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MINERALS YEARBOOK

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DEPARTMENT
OF THE
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OF
MINES

1988

UNITED STATES DEPARTMENT OF THE INTERIOR • Manuel Lujan, Jr., Secretary

BUREAU OF MINES • T S Ary, Director

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

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Foreword

This edition of the Minerals Yearbook discusses the performance of the worldwide minerals industry during 1988 and provides background information to assist in interpreting that performance. Content of the individual Yearbook volumes follows:

Volume I, Metals and Minerals, contains chapters on virtually all metallic and industrial mineral commodities important to the U.S. economy. In addition, it includes a survey methods and statistical summary of nonfuel minerals chapter and a chapter on mining and quarrying trends.

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

Volume III, Area Reports: International, contains the latest available mineral data on more than 150 foreign countries and discusses the importance of minerals to the economies of these nations. A separate chapter reviews the international minerals industry in general and its relationship to the world economy.

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

T S Ary, *Director*

Acknowledgments

The Bureau of Mines, in preparing volume III, utilized extensively statistics and data on mineral production, consumption, and trade provided by various foreign government minerals and statistical agencies through various official publications. The cooperation and assistance of these organizations is gratefully acknowledged. Statistical and informational material was also obtained from reports of the U.S. Department of State, from United Nations publications, and from the domestic and foreign technical and trade press. Of particular assistance were the routine and special reports submitted by 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 Division of International Minerals, Information and Analysis Directorate.

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

George J. Coakley, *Chief, Division of International Minerals*

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MINERALS IN THE

WORLD ECONOMY

By Charles L. Kimbell[1] and William L. Zajac[2]

INTRODUCTION

In overview, 1988 appeared to be the best year for the world's mineral industry since 1980, although the all-important petroleum component suffered severely from low prices. With this notable exception, the traditional statistical measures of mineral industry performance, namely production, trade, and consumption, reflected growth in most elements of the world mineral industry from crude material extraction through the gamut of downstream processing. Moreover, the growth was reasonably well distributed geographically, with many countries sharing in the substantial upturn in activity.

World crude mineral output value was estimated at over $1,272 billion in current dollars ($1,090 billion in constant 1983 dollars). The value added by the processing component of the mineral industry raised the total value of the industry's output to an estimated $3,057 billion in current dollars ($2,620 billion in constant 1983 dollars). Less easily assessed was the value of mineral commodities moving in 1988's international world trade, particularly because of the declines in world crude oil and refinery product prices. It remained to be seen if increased volume and value in nonfuel mineral and coal exports, coupled with an increase in the volume of oil exports, would be adequate to offset the drop in oil prices. Whether or not the value of world mineral commodity trade topped the 1987 level of over $498 billion, an increase in the volume of mineral commodity trade was almost assured. Similarly, although comprehensive statistics were not available on consumption of all mineral commodities in all countries, available data on selected major commodities in selected major countries suggested that not only had output of most mineral commodities advanced, but so too had consumption levels for most commodities.

Mineral industry investment seemed to be increasing, although there was restraint in the petroleum sector. Even here, however, there were increased expenditures for transportation of materials; both tanker building and pipeline construction expenditures seemed to have edged ahead, although comprehensive statistical confirmation was not available. Among the nonfuel sector commodities, comprehensive statistics on 1988 worldwide investment were lacking. However, reports of individual mine and plant development projects, apparently founded on improved prices and forecasts of growing demand, clearly suggested investment upturns.

The prices paid for most nonfuel mineral commodities either held their ground against inflation or advanced. Of major metals, only gold and silver registered significant downturns; price declines among industrial minerals were uncommon. Among fuel commodities, however, lower crude oil prices tended to check growth in competitive fuels.

Although there were many reasons for the generally improved picture of the worldwide mineral industry, and although there were situations that slowed growth in some areas, one force contributing to the brighter outlook, and hence to improved levels of performance, was the significantly improved relationship between the world's market economy countries and the centrally planned states. The U.S.S.R. and China, the most powerful of the centrally planned economy countries and the only ones that have mineral industries of such commodity breadth and vertical integration to be significantly self-sufficient, seemingly were moving toward greater degrees of personal liberty for their populations through 1988. This keystone in improving relations with the world's democracies provided opportunities for interregional mineral industry activities that had been impossible since the end of World War II. Moreover, in the case of the U.S.S.R., there were evidences of at least some foreign policy shifts toward the other members of the Council for Mutual Economic Assistance (CEMA), which would allow for greater independent action by these countries. The Soviet troop withdrawal from Afghanistan neared completion by December, representing an additional reduction in international tension; direct effect on mineral industry operations there, however, seemed minimal.

It was evident that at upper levels of Government in the U.S.S.R. and China there were conflicting views as to the wisdom of both the general nature of and the timetable for doctrinal changes. Such discord obviously could lead to policy reversals. This, in turn, led to apprehensions in market economy countries as to the ultimate outcome. Such apprehensions restrained overly-rapid changes in attitudes toward and relationships with the centrally planned economy countries, within both the mineral industry and other economic sectors.

The end of the Iran-Iraq war was another international political change that tended to improve the situation for mineral industry activity. Although the Near East could hardly be described as tension free, the termination of this long and bloody open warfare not only permited resumption of certain mineral industry activities and also improved the investment climate, if not in the former belligerent states, then certainly in other countries along the Persian Gulf.

No major obstacles to improved mineral industry performance seemed to exist in such key raw material source countries as Australia and Canada, nor in processing and consumption centers such as Japan and the European Communities (EC) countries. Even in the internally troubled Republic of South Africa, mineral industry operations seemed but little affected by international economic sanctions directed at the Republic's apartheid policy, although output of some commodities decreased marginally. In Asia, the Republic of Korea and Taiwan both registered impressive growth in mineral processing industries. These industries, except for cement and nitrogen, were based largely on imported raw materials. Even the politically troubled Philippines showed significant growth in output of some key commodities.

On the negative side, general events affecting world mineral industry activities included the outbreaks of ethnic unrest in the southern U.S.S.R., most notably in Azerbaijan and Armenia. Tragic earthquakes in December in this region assuredly had a negative effect on mineral operations; transportation and communications were disrupted, and many workers were employed in rescue operations.

Among the other CEMA countries, Poland experienced strikes that curtailed coal, steel, and copper production below target levels, and also may have affected sulfur output. In Hungary, rationalization of bauxite operations led to reduced output. Romania outwardly was continuing a drive for greater industrialization, but the economic viability of some mineral industry expansions appeared questionable.

In Latin America, there was another type of problem for expanded mineral industry activities. The dual economic problem of rampant inflation and large external debts checked investment and hence expansion. Perhaps hardest hit were such key mineral producing countries as Mexico, Peru, and Brazil. The problems caused by the narcotics industries in Bolivia, Colombia, and Peru also retarded mineral industry expansion.

Central America continued to suffer from political unrest; much of this centered around the Ortega regime in Nicaragua and the Noriega regime in Panama. Although the area ranks only as a small producer and consumer of mineral products, the difficulties there posed a threat to operations of the vital Panama Canal, which remains a key link in worldwide mineral commodity transport.

PRODUCTION

The estimated value of crude mineral production in 1988 exceeded $1,272 billion in terms of current dollars or $1,090 billion in terms of constant 1983 dollars. The latter figure was almost 3% above the 1987 level, but was considerably below the historic high of $1,207.1 billion set in 1980.

The accompanying tabulation provides the latest available revised time series for the value of world crude mineral production in terms of both constant 1983 dollars and current dollars, and provides one of the two statistical bases for the estimation, this being the data on the value of production of a group of key commodities compiled for and published in the authoritative French language mineral industry periodical, Annales des Mines, for years up to 1983.[3]

It should be stressed that the values just discussed, and those presented in the tabulation are for crude minerals only, and do not adequately depict the role of the entire mineral industry in the world economy. These figures represent only the value of mineral materials as they are extracted from the earth, and do not reflect the value added to these materials through downstream processing, such as beneficiation, smelting, and refining, although such processing takes place within facilities commonly accepted as mineral

Year	Value of 53[1] major crude mineral commodities[2]		Value of all crude mineral commodities[3]	
	Billion current dollars	Billion 1983 constant dollars	Billion current dollars	Billion 1983 constant dollars
1950	25.9	103.5	29.5	117.9
1953	37.0	135.1	42.5	155.3
1958	50.0	173.5	60.1	208.5
1963	59.0	192.0	72.3	235.3
1968	77.9	222.3	94.5	269.8
1973	159.2	357.3	191.6	430.0
1978	477.0	728.5	539.6	824.1
1979	656.5	901.2	733.2	1,006.5
1980	902.9	1,094.6	995.7	1,207.1
1981	912.0	1,008.1	993.2	1,097.9
1982	902.9	938.1	971.2	1,009.1
1983	930.4	930.4	988.7	988.7
1984	999.7	964.4	1,062.3	1,024.8
1985	1,016.4	952.3	1,080.1	1,012.0
1986	1,077.9	984.1	1,145.5	1,045.8
1987	1,125.6	996.2	1,196.1	1,058.6
1988	1,197.5	1,025.8	1,272.4	1,090.0

[1] The list of commodities included has been varied slightly by the authors of the basic source article over the years, and the number 53 may be regarded as debatable. Forty-eight commodities were included in every study, 1950-83 inclusive, and are included in a listing in Table 3 of the 1985 edition of this chapter; this list of 52 entries also includes columbium-tantalum (as a single entry), kyanite, and uranium (each of which has been included in the study from 1958-83 inclusive, and beryl (which was included in the study from 1950-68 inclusive). Additionally, a generic group (natural abrasives), perlite, and vermiculite were incorporated into the 1950 study but dropped thereafter; lithium was included in 1958 only; and asphaltic limestone was included from 1950-68 inclusive. The alterations in the number of commodities had little, if any, significant effect on the totals, with the possible exception of uranium's omission in 1950 and 1953.

[2] Data for 1950, 1953, 1958, 1963, 1968, 1973, 1978, and 1983 are as reported in Annales des Mines, July-Aug.-Sept. 1985, p. 9. Data in constant dollars for 1984-88 inclusive are extrapolated from the 1983 Annales des Mines figures on the basis of the United Nations index of extractive mineral industry production in the United Nations Monthly Bulletin of Statistics, Aug. 1989, p. 236. Data in current dollars for 1984-88 inclusive are derived from the constant dollar estimates using reciprocals of the most recent available U.S. price deflators.

[3] Data extrapolated from values for 53 commodities to compensate for other (additional) mineral commodities. For details on the basis for this extrapolation, see accompanying text under "Value of World Mineral Production."

industry plants. Comprehensive world data on the value added by such processing are not available; however, a total on the order of about $2,620 billion (constant 1983 dollars) would be a conservative estimate of the value of the products produced by world mineral industry plants wholly from primary or newly mined materials. To fully evaluate the worth of the products of these installations would require the addition of a further (and in this case unestimated) increment for the products derived from secondary raw materials, such as scrap and other reclaimed substances. For some commodities, production from secondary materials is nonexistent or inconsequential (such as in the case of sand and gravel and fuels). For other commodities, however, production from secondary materials is very substantial, as is the case for steel, lead, and copper, for example.

It is also important to note that the overall economic impact of mineral materials extends far beyond the materials' worth even in processed form. Mineral products constitute not only the overwhelmingly dominant share of the total raw material supply for all manufacturing operations; mineral fertilizers and other soil treatment products are indispensable for the continuation of high production and productivity by the agricultural-forestry sector of the world economy. Moreover, the mineral industry, through its production of the various fuel materials, provides all but a very small share of the total energy required for the processing of other mineral commodities and of agricultural materials from their crude forms through to the manufactures derived therefrom, and additionally provides the dominant share of the energy required to transport these products and the world's population around this planet. Even the energy derived from the non-mineral industry sources—hydroelectric and geothermal power—could not be produced and distributed without equipment and transmission lines fabricated from mineral commodities.

Year	Index numbers (1980=100)			
	Coal	Crude petroleum and natural gas	Metals	Extractive industry total
Annual averages:				
1978	r93.8	104.4	r98.3	r102.0
1982	r101.9	r80.7	r97.4	85.7
1983	100.7	79.4	97.6	84.9
1984	r99.5	82.5	r104.2	r88.0
1985	r104.0	79.5	r108.4	r86.9
1986	r106.0	82.6	r110.2	r89.8
1987r	106.1	83.1	114.2	90.9
1988	106.3	84.6	124.8	93.6
Quarterly results:				
1987:				
1st quarterr	108.5	79.7	114.2	88.0
2nd quarterr	104.6	79.7	111.8	88.2
3rd quarterr	102.9	85.6	112.6	92.4
4th quarterr	108.6	87.6	118.0	95.2
1988:				
1st quarter	107.6	83.5	119.5	91.9
2nd quarter	103.7	82.1	123.2	91.6
3rd quarter	103.5	85.0	124.6	93.8
4th quarter	110.4	87.6	131.9	97.1

rRevised.

Source: United Nations. Monthly Bulletin of Statistics, V. 43, No. 8, Aug. 1989, p. 236.

Production Index Patterns

The accompanying tabulation summarizes the development pattern of the world's extractive mineral industry output over recent years, as reflected by the United Nations industrial production indices.

This tabulation incorporates a number of revisions from the previous edition of this chapter, but these revisions generally did not alter the direction of change but only its magnitude, at least insofar as the annual world aggregates reproduced here are concerned. Detailed region-by-region figures in the source showed some regional alterations in trend direction. Incorporation of additional data and/or reappraisal of earlier information produced some changes in trend direction in the quarterly results for 1987 in the case of each of the three sectors (coal, crude petroleum, and metals) but not in the aggregate.

The 1988 quarterly results show a slump for fuels between the last quarter of 1987 and the first quarter of 1988. This slump continued in the case of coal through the third quarter of 1988; in the case of oil and gas it reversed after the second quarter. These fuels-sector slumps were sufficient to carry the extractive industry aggregate downward between the last quarter of 1987 and the first quarter of 1988, and downward further in the second quarter of 1988. Growth in the aggregate index was restrained in the third quarter, despite continual gains in the metals extractive index from the fourth quarter of 1987 on through yearend 1988. Only in the fourth quarter of 1988 were gains registered by each of the component indices and by the aggregate as well; the end result was that the index for each sector and for the extractive industry aggregate registered gains across the year, comparing first quarter indices with fourth quarter indices.

Comparison of the growth trends for extractive mineral industry operations in the foregoing tabulation with growth trends registered in the same source for certain mineral processing sectors demonstrates the lack of parallelism between raw material production and mineral processing. These growth trends for processing sectors appear in the following tabulation.

Year	Index numbers (1980 = 100)		
	Non-metallic mineral products	Chemicals, petroleum, coal, rubber products	Base metals
Annual averages:			
1978r	96.5	95.8	100.4
1982	94.6	r99.4	r89.2
1983r	97.0	104.6	91.8
1984r	100.9	111.1	99.2
1985r	101.9	114.7	100.3
1986r	105.3	119.3	99.1
1987	r108.7	125.2	r103.3
1988	114.4	133.2	110.3
Quarterly results:			
1987:			
1st quarterr	100.7	122.1	101.0
2nd quarterr	111.7	125.4	104.1
3rd quarterr	110.7	125.6	100.9
4th quarter	r111.9	127.7	r107.2
1988:			
1st quarter	108.2	130.1	109.9
2nd quarter	116.1	133.4	111.2
3rd quarter	115.9	133.1	108.0
4th quarter	117.4	136.1	112.0

rRevised.

Source: United Nations. Monthly Bulletin of Statistics, V. 43, No. 8, Aug. 1988, p. 237.

As was the case with extractive industry output, there were revisions in the United Nations data that affected the rate of change in each of the listed sectors, but in world aggregate, the direction of change in terms of annual results were unaltered. For the 1987 quarterly results, the changes in the more recent appraisal were only in degree and not in direction.

In the case of the 1988 quarterly returns, nonmetallic mineral products showed a slump between the fourth quarter of 1987 and the first quarter of 1988; the other two sectors registered advances. Thereafter, each of the detailed sectors showed growth in the second quarter with respect to the first, followed by a third quarter slump and renewed growth in the fourth quarter; each ended the year well above the level at the start of the year.

Both of these tabulations of indices reflect the aggregate of results from world areas that individually showed quite varied results, both from area to area and from year to year and quarter to quarter. For these regional details too extensive to be included here, the reader is referred to the source publication for the above tabulations.

Quantitative Commodity Output

Of the 99 distinct mineral commodities and/or subdivisions of mineral commodities for which total world production, as measured by the Bureau of Mines, is presented in table 1 for 1984–88,[4] 82 registered increases in 1988 relative to the 1987 level of production, and 17 registered declines. This compares favorably with results between 1986 and 1987, when only 67 items registered gains (on the basis of revised figures) and 32 logged declines, and was far better than the performance between 1985 and 1986, when only 52 items showed increases and 47 showed declines.

Of the 52 metallic mineral commodities recorded separately in table 1, 40 recorded production gains in 1988 and only 12 showed declines. Of the 40 showing increases, 27 reached new production highs in 1988. Those that had peak historical output in previous years were: primary refined lead and monazite concentrate (both in 1985); secondary smelter zinc (1982 and 1983); secondary magnesium (1981); manganese ore, molybdenum, smelter tin, tungsten, and uranium (all 1980); ferroalloys, selenium, and mine tin (all 1979); and ilmenite (1974). Of the group of 40 metallic commodities logging gains, gold achieved an increase for the eighth consecutive year; four of the group, namely, mine copper, primary smelter copper, primary refined copper, and platinum-group metals, logged growth for six consecutive years. Four others, antimony, iron ore, secondary refined lead, and titaniferous slag were in their fifth consecutive year of growth. Four, namely, bauxite, alumina, secondary smelter lead, and primary magnesium, logged output gains for the third consecutive year. Of the 40, 17 registered gains in both 1988 and 1987 and 10 logged increases in 1988 following declines in 1987.

Of the 12 metallic commodities showing declines in output between 1987 and 1988, 2, vanadium and mine zinc, reached record output levels in 1987. Two more, mine cobalt and refined cobalt, set to-date historic production highs in 1986, and were in a second year of diminishing output in 1988. Primary smelter lead attained its to-date record output high in 1985, decreased slightly in 1986, registered a partial recovery in 1987, and experienced a decline again in 1988. Other metallic commodities recording output declines in 1988 included mine lead and rutile, both of which had recorded an increase in 1987 and both of which remained below their record output levels, set, respectively, in 1973 and 1980. Beryl concentrate output declined in both 1987 and 1988 and remained appreciably below the maximum output level reported back in 1961. Mercury production declined for the third consecutive year, and in 1988 was only slightly greater than half the historic high that was set in 1971. The figures shown on production of bismuth at the mine stage and the metal stage of production are published in this form for the first time by the Bureau of Mines in this chapter. The world total for mine bismuth was lower for the sixth consecutive year, while that for refined bismuth was lower for the third consecutive year (comparison to Bureau statistics for years prior to 1983 are not yet available). World total tellurium output declined for the third consecutive year in 1988, but long-term historical comparison is not valid because U.S. output has not been included in that total since 1975, when it was two-fifths of the total; the U.S. figure is withheld to avoid disclosing individual company proprietary information.

From the viewpoint of the major components of the metals industry, advances were scored in the mining of iron and most of the related ferroalloying metals. These gains served to meet a second year of growth in the world's steel industry, and compensated for evident stock drawdowns in the key ferroalloying ores, chromite and manganese ore, both of which showed reduced output between 1986 and 1987, despite increased steel output at that time. Among the minor ferroalloying ores, only vanadium and the titanium source, rutile, registered downturns in 1988.

Nickel and tin, which have applications in both the steel industry and the nonferrous metal industry, both showed improved output in 1988 for the second consecutive year at both the mine and metal stages of output.

Among the major nonferrous metals, copper showed general gains for 5 years in terms of mine output and primary smelter and refinery products. The recovery of copper from scrap recorded slight downturns within the past 5 years, but has generally become slightly more important each year, and represented over 15% of total 1988 world refinery output. In the case of lead, secondary recovery has become even more important, accounting for over 44% of total world refinery output in 1988. Thus, although mine output peaked in the 1970's and has continued at only slightly reduced levels since then, refined output had moved continually to higher levels. For zinc, secondary recovery plays only a minor role in total supply, and continual growth in mine output has been necessary to meet increasing demand in the production of nonferrous alloys, zinc castings, and the important need for the metal in galvanizing steel. The slight downturn in mine zinc production in 1988, from the 1987 to-date record high, was in contrast to the general trend; the advance in refined zinc output that continued from 1986 cannot be sustained without a change in the trend of mine output.

The newer, light nonferrous metals continued to enjoy growth in terms of world total output of mine product (bauxite), intermediate product (alumina), and refined primary metal. Although the Bureau of Mines does not collect worldwide data on secondary aluminum output, data from those countries for which comparable secondary figures are available suggest growth here, too. The production of magnesium advanced in 1988, and there are indications that titanium output is up, although the Bureau does not collect comprehensive world statistics on titanium metal production.

Of the 36 individual categories of nonmetallic minerals and their products listed under the heading "Industrial Minerals", 31 recorded increases in output in 1988; of these, 21 set new record production highs. This latter group included boron materials, bromine, cement, bentonite, fuller's earth, kaolin, gem diamond, natural industrial diamond, diatomite, feldspar, fluorspar, gypsum, iodine, nitrogen, perlite, phosphate rock, potash, salt, sodium carbonate, strontium minerals, and byproduct sulfur. The 10 others that showed gains in 1988, together with the year in which they set record production levels were: Asbestos, 1976; barite, 1981; natural corundum, 1980; natural graphite, 1963; lime, 1980; Thomas slag, 1979; pumice, 1973; sodium sulfate, 1979; sulfur from pyrites, 1971; and talc and related materials, 1985.

Of the 31 so-called industrial minerals commodities that increased output in 1988, one, hydraulic cement, logged its thirteenth consecutive year of growth. Four, kaolin, gypsum, nitrogen, and byproduct sulfur, recorded output increases for the sixth consecutive year. Two, feldspar and sodium sulfate, registered increases for the fifth consecutive year. Four, boron materials, graphite, perlite, and sodium carbonate, were in the third consecutive year of production increases. Eleven recorded output growth in both 1988 and 1987. The remaining nine recorded an upturn after a slump between 1986 and 1987.

Only five industrial mineral commodities recorded downturns between 1987 and 1988. World output of magnesite, which had a historic high in 1986, slumped for the second year. Mica output dropped slightly from the 1987 level after logging a slight increase in that year, but remained substantially below the 1978 record high. Production of guano, which is a minor world source of phosphate, declined for the second consecutive year and was substantially below the 1980 record level recorded by the Bureau of Mines (data for years prior to 1978 are not available). Elemental sulfur output, primarily Frasch-process sulfur from the United States, Mexico, Poland, and the U.S.S.R., was lower for the third consecutive year, and was at a level barely more that three-quarters of the record output of 1974, as a result of continued increases in competitive byproduct sulfur output. Finally, vermiculite output dropped marginally from its 1987 level after several years of rising output and remained a little below the record level set in 1978.

In terms of major commodity groups, the industrial nonmetallics dedicated primarily to fertilizer applications, namely nitrogen, phosphatic materials, and potash, all showed upturns except for the inconsequential drop in output in the relatively insignificant guano production. Among other chemical materials, fluorspar, sulfur (in total), salt, and sodium carbonate reached new highs in 1988 reflecting the strength of the world's chemical industry. It was notable that the sulfur growth was chiefly the result of increased byproduct recovery, undoubtedly driven in part by environmental concerns rather than by expansion of output of elemental sulfur from Frasch and other sulfur mines.

Expansion of worldwide use of construction materials of mineral origin is mirrored in the data presented in the table for cement production. Other construction materials such as construction sand and gravel, dimension stone, and common brick clays are not included due to the lack of comprehensive world data; statistics that are available for some countries suggest world growth and this evaluation is supported by growth in cement output.

Of the 11 mineral fuel commodities listed in table 1, all logged output increases between 1987 and 1988. Of the primary energy sources, crude oil output increased in 1988 after a very slight drop between 1986 and 1987, but the level remained below the historic high set in 1979; the 1988 figure represented about 93% of that of 1979. Output of marketed natural gas (gross production less that flared, vented, and reinjected into reservoirs for pressure maintenance) reached a new historic high, as increases in output from gasfields were augmented by increases in gas recovery from fields in which gas occurs with oil. The year 1988 was the sixth consecutive year in which marketed natural gas production advanced. The recovery of natural gas liquids, chiefly butane, propane, and natural gasoline obtained as byproducts of natural gas production, also reached a new record high in 1988. It was the third year of such an increase following a very minor decrease between 1984 and 1985. Output of all three listed types of coal reached new highs in 1988. Anthracite recorded an increase for the sixth consecutive year, bituminous coal did so for the seventh consecutive year, and lignite output increased slightly to preserve a 21-year streak of growth. Peat is listed among mineral fuels because of its similar origin and nature to low rank coals; however, about 80% of the total output of peat is used as a soil conditioner or for other nonfuel purposes. Peat showed a very modest increase in output from 1987 to 1988, after a modest decline between 1986 and 1987. In all likelihood, 1986 was the year of the historic to-date record production, although published Bureau of Mines totals in earlier editions of Minerals Yearbooks show higher figures in the late 1970's and early 1980's. These earlier high totals, however, included estimates for Soviet output that have been revised downward very substantially. Although revisions of the time series were not completed in time for inclusion in this review, it seems that 1986 will be proven to be the historic high through 1988.

As for the four fuel-derived products listed in the table, refined oil, although increasing for the third consecutive year, still fell short of the 1979 to-date record high by almost 4% in 1988. Carbon black output, up for the second straight year, reached a new peak in 1988. Metallurgical coke recorded an increase for the second consecutive year, but still fell short of the to-date historic high recorded in 1980; output of other coke increased after a slump in 1986 and 1987, but fell short of the to-date record output set in 1979.

The overall performance of the nonfuel mineral industry can only be summarized in terms of the value of production, and for these commodities, exactitudes for each commodity on a worldwide basis are not available for any year subsequent to 1983 (see "Value of World Mineral Production"). Among fuel commodities, however, the overall pattern of output level changes and their interrelationships can be demonstrated by United Nations data, in which production results for each of the forms of primary energy are adjusted to a common energy equivalent basis. The tabulation summarizes world energy commodity output for 1981-87 as reported by the United Nations, and provides Bureau of Mines estimates for 1988.

Year	Million metric tons of standard coal equivalent					
	Coal	Crude petroleum and natural gas liquids	Natural gas	Primary electricity		Total
				Hydro and geothermal	Nuclear	
1981	2,635	4,250	1,859	220	99	9,063
1982	2,712	4,027	1,844	226	107	8,916
1983	2,719	3,982	1,856	237	124	[1]8,917
1984	[r]2,851	[r]4,032	[r]2,022	245	150	[r]9,300
1985	[r]2,997	[r]3,996	[r]2,098	249	[r]178	[r][1]9,519
1986	[r]3,072	[r]4,191	[r]2,148	[r]252	191	9,854
1987	3,108	4,203	2,276	255	208	10,049
1988[e]	3,161	4,392	2,467	256	225	10,501

[e] Estimated. [r] Revised.

[1] Data do not add to total shown because of independent rounding.

Source: 1981—United Nations. 1984 Energy Statistics Yearbook, New York, 1986, pp. 2, 691; 1982—United Nations. 1985 Energy Statistics Yearbook, New York, 1987, pp. 2, 380; 1983—United Nations. 1986 Energy Statistic Yearbook, New York, 1988, pp. 2, 378; 1984-87—United Nations. 1987 Energy Statistics Yearbook, New York, 1989, pp. 2, 392; 1988—U.S. Bureau of Mines estimates.

It is perhaps noteworthy that the published United Nations results for 1987 in the tabulation were quite close to the Bureau of Mines' estimates included in the previous edition of this chapter, estimates that were made well over 6 months prior to the publication of the United Nations data. Total energy production reported was only 0.5% below the figure that had been estimated by the Bureau. The reported coal figure was 1.6% below the estimate, the reported crude petroleum and natural gas liquids figures were 0.7% below the Bureau estimate, the reported natural gas figure was 0.9% above the Bureau estimate, the reported hydroelectric and geothermal power figure was 0.8% below the estimate, and the reported nuclear power figure was 4% above the Bureau estimate.

For 1988, an increase of nearly 4.5% in total energy output has been estimated, chiefly the result of an 8.4% increase for natural gas and a 4.5% increase for the sum of crude oil and natural gas liquids. An increase in coal output of 1.7% is significant to the total energy output only because it applies to so large a component of the total, whereas the 8% growth in nuclear power output is relatively unimportant in total energy because it affects so small a component of the total. Even less significant is the nominal growth in hydroelectric and geothermal power output.

An examination of electric power output and generating capacity shows phenomenal growth in nuclear power generation. This is significant to world mineral economics because of the importance of electric power to the mining, processing, and transportation of mineral materials. In the absence of comprehensive world statistics for 1988, the tabulation compares actual power generation for 1981 with that in 1987.

The quantity of electricity produced by world nuclear plants increased by nearly 112% in just 7 years, and accounted for over 16% of all electric power produced and for 45% of all primary electricity in 1987. Although the growth in geothermal power was even larger on a percentage basis (119%), this energy source remained relatively unimportant in the world picture.

Source plant type	1981 Production (billion kilowatt hours)	1981 Share of total (percent)	1987 Production (billion kilowatt hours)	1987 Share of total (percent)
Primary electricity:				
Hydroelectric	1,776	21.2	2,038	19.5
Geothermal	16	.2	35	.3
Nuclear	801	9.6	1,396	16.2
Subtotal	[1]2,592	[1]30.9	3,768	36.0
Secondary electricity:				
Thermal	5,792	69.1	1	64.0
Total	**8,384**	**100.0**	**10,467**	**100.0**

[1] Data do not add to total shown because of independent rounding.

Sources: 1981—United Nations. 1984 Energy Statistics Yearbook. New York, 1986, p. 384; 1987—United Nations. 1987 Energy Statistics Yearbook. New York, 1989, p. 392.

A similar trend in growth of generating capacity, although not precisely parallel, can be seen in the tabulation.

Plant type	1981 Capacity (million kilowatts)	1981 Share of total (percent)	1987 Capacity (million kilowatts)	1987 Share of total (percent)
Primary plants:				
Hydroelectric	488	23.1	585	22.9
Geothermal	3	.1	7	.3
Nuclear	161	7.6	306	12.0
Subtotal	652	30.8	898	[1]35.2
Secondary plants:				
Thermal	1,462	69.2	1,657	64.8
Total	**2,114**	**100.0**	**[2]2,556**	**100.0**

[1] Percentage shown does not calculate precisely from capacity data because it is calculated from unrounded capacity data.
[2] Data do not add to total shown because of independent rounding.

Sources: 1981—United Nations. 1984 Energy Statistics Yearbook. New York, 1986. p. 328; 1987—United Nations. 1987 Energy Statistics Yearbook. New York, 1989, p. 332.

Nuclear generating capacity increased by over 90% between 1981 and 1987; the much less sizable geothermal capacity advanced by 133%, compared with a hydroelectric capacity growth of only 20% and a thermal plant capacity expansion of only 13%. Nuclear plants accounted for over 34% of primary electricity capacity in 1987 compared with only 25% in 1981.

The figures on actual production and capacity show a 3% increase in capacity utilization for all powerplants in aggregate between 1981 and 1987, but the improvement was not universal among the various types of plants. There was a 23% drop in geothermal plant capacity utilization over the 7 year period and a 4.2% drop in capacity utilization of hydroelectric plants. Conventional thermal plants logged a 2% increase in utilization, and nuclear plants recorded an 11.6% increase in capacity utilization.

These shifting patterns, and their implications to such electric power demanding industries as aluminum production, copper recovery and refining, and ferroalloy production cannot be ignored.

Another noteworthy point regarding electric power generation is the proportion accounted for by public utilities as opposed to so-called self producers, that is, plants with capacities essentially dedicated to specific industries. During the 7 years from 1981 to 1987, there was a very small downward shift in the share of output provided by self-producers; this principally was a result of a drop, both quantitatively and in share of total in hydropower output, by such firms. In terms of power actually produced, self-producers accounted for a slightly larger share of thermal power output in 1987 than in 1981, both quantitatively and in share of total. The role of such self-producers can be significant in some mineral producing countries, where such power generation is dedicated primarily to the industry that produces the power. Mineral industry firms that acquire power from public utilities are forced into a competitive position with other sectors of the economy and may well suffer in times of shortage. Specific data on mineral industry control over power facilities for their own use are not available on a comprehensive global basis. For some selected major mineral producing and processing countries, the proportion of total electric power produced by the self-producers in aggregate differs quite widely. In 1987, such plants generated 5.2% of the U.S.S.R.'s total output, 2.3% of total U.S. output, 10.1% of total Japanese output, 16.6% of output in the Federal Republic of Germany, 8.8% in Canada, 7.3% in Australia, 7.1% in India, 20.5% in Chile, 20% in Norway, and 66.9% in Zaire. Contrasting with the relatively high Chilean and Zairian figures is the 2.3% level in Zambia, the other major copper exporter.

Value of World Mineral Production

The value of world crude mineral production in 1988 was estimated at $1,090 billion in constant 1983 dollars, or $1,272.4 billion current (1988) dollars. Details on the basic methodology employed to prepare this estimate are summarized in the 1985 edition of this chapter, to which the reader is referred.

Geographic Distribution of World Mineral Output Value

Available information is inadequate to reliably extrapolate to 1988 the 1983 data on geographic distribution of world crude mineral output value published in the July–September 1985 edition of Annales des Mines, and reproduced in summary form in the 1985 edition of this Minerals Yearbook chapter. These data for 1983 appear in the 1985 "Minerals in the World Economy" chapter (table 2) together with corresponding figures for 1950 and 1978, and with some textual comments on this material. The reader is referred to this publication, as well as to its original source, for further information.

Commodity Distribution of World Mineral Output Value

As is the case with geographic distribution of world mineral output value, the inadequacy of data precludes any reliable extrapolation to 1988 of the various commodities' shares of the totals shown for 1983 in the 1985 edition of this chapter. Clearly, some major shifts in percentage shares, if not in ranking, will have occurred as a result of unit price changes such as in the cases of crude oil and gold, to cite but two of the more notable commodities. For details on the 1983 distribution of the total, the reader is referred to the 1985 edition of this chapter, particularly to table 3, and to the source publication for that table.

TRADE

In 1987, the aggregate value of total world international trade in mineral commodities was estimated at $498 billion, about 8.5% above the revised 1986 level but still 29.8% below the record high set in 1980. Comparable data for 1988 were not available in time for inclusion in this chapter, but incomplete returns suggest an advance over the 1987 level. The tabulation provides a data series for the estimated value of world export trade in all mineral commodities from 1979 through 1987; also shown are the subdivision of those data between nonfuel and fuel commodities, and the percent change from year to year in the total and that total's share of world merchandise trade.

The tabulation shows that 1987 was a

Year	Value of mineral commodity export trade (million current dollars)			Change in total from previous year (percent)	Mineral commodities' share of all commodities exported (percent)
	Mineral fuels	Nonfuel minerals[1]	Total[2]		
1979	333,031	188,416	521,447	41.3	31.9
1980	483,033	226,848	709,881	36.1	35.4
1981	474,266	199,328	673,594	-5.1	34.3
1982	430,384	180,950	611,334	-9.2	33.1
1983	384,188	174,724	558,912	-8.6	30.8
1984	378,398	184,701	563,099	.7	29.5
1985	360,642	186,605	547,247	-2.8	28.4
1986	263,504	195,392	458,896	-1.5	21.7
1987	277,727	220,395	498,122	8.5	20.0

[1] In part estimated, based on data presented in table 2 of this chapter.
[2] All figures are substantially revised downward from those appearing in the 1987 edition of this chapter, as well as other previous editions, as a result of a revision in the method of estimating nonfuel minerals not included in the reported data in table 2 of this chapter.

watershed year for total mineral commodity trade; the downtrend in value that extended back to 1981 with only a minuscule upturn in 1984, was substantially reversed. Despite this reversal, the growth in value of other merchandise exports was so substantial that the mineral commodity share of total merchandise exports declined for the seventh consecutive year. The tabulation also demonstrates that the decline in value of total mineral commodity exports between 1980 and 1986 was chiefly the result of declines in the fuels commodities. The aggregate estimated value of nonfuel mineral commodities has increased regularly, although not steadily, since 1984, and was only 2.8% below the 1980 to-date record high in 1987.

The tabulation, however, does not show that in terms of constant dollars, the decline in trade value is worse than shown in current dollars. Adjusted for inflation, using the implicit price deflators for exports, the 1987 value of mineral commodity exports was only $448,409 million in terms of 1980 dollars, or only 63% of the record high of 1980.

The role of individual major mineral commodity groups in world export trade for 1982–87 is evident in table 2, as is the contribution of these groups to total merchandise export trade. This table is the basis for the estimates of the total value of all mineral commodity export trade that was presented in the tabulation. Table 3 demonstrates the relative importance of each of these major groups of mineral commodities in the aggregate of export trade in major mineral commodities, and reflects the constantly lower share of the total accounted for by the mineral fuel commodities in each year between 1982 and 1987. Table 4 shows the change in each of the major mineral commodity groups across the same time period in terms of percent change from the previous year.

Information on the geographic pattern of trade by major geographic and political country groups of the major mineral commodity groups shown in table 2 is available in the source publication for these data.

CONSUMPTION

Nonfuel Mineral Commodities

Available statistics on 1988 worldwide consumption of selected major nonfuel minerals shown in table 5 indicate increases over the 1987 levels. This was the second consecutive year in which all listed nonfuel commodities registered an upturn. Although the 1988 results incorporate a number of estimates for countries that theoretically might change with the receipt of final, more complete results, it is strongly believed that the pattern of rising consumption of these major materials will be preserved when the more complete results become available; however, the growth rates calculable from the data may vary somewhat.

Consumption of the two ferrous metal raw materials listed advanced as functions of increased output of pig iron and crude steel. In the case of iron ore, available figures suggested a slight increase in world inventories as the growth rate for production exceeded that for consumption. The estimated upturn in scrap consumption was slightly less than the increase in steel output on a percentage basis, but it is believed that there was little change in the ratio of iron ore to scrap as iron and steel plant feed on a global basis.

Before summarizing the nonferrous metal use situation, it is essential to comment on the nature of some of the data published. Examination of table 5 shows that separate statistics have been provided for market economy countries and centrally planned economy countries. This had been done for two reasons. First, the consumption trends from year to year for these two groups of countries often differ, in that the trends in market economy countries are influenced to a significant extent by variations in the economies of the countries included, whereas the trends in centrally planned economy countries are generally the result of rigid economic planning. Second, however, and perhaps more importantly, the consumption figures for the centrally planned economy countries are universally apparent consumption figures—that is, they represent the sum of production (often estimated) and imports minus exports, plus or minus variations in stocks (where such information is available). As such, any change in the level of any of these component figures will result in a change in the calculated apparent consumption, and for several commodities in this group there are differences between production estimates by the Bureau of Mines and those of Metallgesellschaft AG, the source of these consumption figures. Hence, the consumption numbers provided here would differ if Bureau production numbers were substituted in the formula. For instance, substitution of the Bureau's estimates for refined copper output for 1988 would lower the centrally planned economy countries consumption by 438,000 tons. Similar but smaller reductions would result for lead and zinc, but results for aluminum, cadmium, magnesium, nickel, and tin would be but little altered.

Bearing the foregoing in mind, and thus considering the consumption data for the centrally planned economy countries to be a measure more of year-to-year trends rather than of precise quantities of materials consumed, one can examine consumption changes and the relationship to production changes. Of the eight nonferrous metals reported, five registered greater percentage increases in production than in consumption in 1988, suggesting the possibility of stock growth. These were aluminum, copper, lead, nickel, and tin. Of these, aluminum and lead had also demonstrated a greater increase in production than in consumption in 1987 as well, whereas for copper, nickel, and tin, the percentage growth in consumption had exceeded that for production in 1987. Of the remaining three metals—cadmium, magnesium, and zinc—the growth in consumption exceeded that in production between 1987 and 1988. For cadmium and magnesium, the relationship between production and consumption had been similar between 1986 and 1987, with a more substantial percentage increase in the latter, whereas in the case of zinc, the growth in production exceeded that in consumption between 1986 and 1987, in contrast to the 1987 to 1988 pattern.

Examining the differences in performance between the market economy nations and the centrally planned economy states, it is evident that the former group accounted for the entirety of the world increase in use of aluminum, cadmium, copper, magnesium, nickel, and tin, for the centrally planned country consumption of each of these either declined or at least failed to increase. Moreover, growth in world consumption of lead and zinc was dominated by gains in the market economy countries; percentage growth in these two commodities in the market economy states exceeded those logged for the centrally planned economy states. This strong market economy growth was in distinct contrast to the pattern of the early and mid-1980's when growth in consumption in the centrally planned states exceeded that in the market economy states for a number of the metals in a number of years.

Among the fertilizer minerals and sulfur, all showed higher consumption levels for the second consecutive year; all had logged downturns between 1985 and 1986.

Mineral Fuel Commodities

Mineral fuel and primary electric power consumption, shown in table 5 in terms of standard coal equivalent (SCE) to facilitate interfuel comparisons, advanced again in 1988 to a new record high. Indeed, the growth of over 3.4% in the aggregate was the largest registered since that between 1983 and 1984. Considering the relative share of total energy provided by each listed source, solid fuels lost a small share between 1987 and 1988 as did hydroelectric and geothermal power; liquid fuels (including natural gas liquids), natural gas, and nuclear power each showed slight increases. With the gain registered for liquid fuels, 1988 was the first time that the previous record level of 3,947 million metric tons SCE, set in 1979, was topped.

INVESTMENT

Comprehensive world mineral industry investment data do not exist, but limited material published on aggregates of investment in some elements of the world mineral industry suggest an upturn in the investment level, at least in market economy countries in 1988. Steel industry investments in Organization for Economic Cooperation and Development (OECD) countries are not yet available for 1988 but, as shown in table 6, increased somewhat for 1987, assuming level investment for Australia and Canada. The pattern of investment ups and downs varied during 1987 within country blocs and economic alliances showing no particular trends. Although investment in the steel industry by the United States increased by 34.6% between 1986 and 1987, it was still the second lowest amount invested during the 1983–87 period and was 63% less than the amount invested in 1983. Investment in the steel industries of the European Coal and Steel Community (ECSC) dropped somewhat in 1987 after 4 years of steady growth. This drop was the result of lower investments by the Federal Republic of Germany and the Netherlands; investments grew or remained level in the other 10 members of the EC between 1986 and 1987. Decreases in investment in the Japanese (-13%) and Turkish (-32.9%) steel industries were offset by increases registered by the members of the European Free Trade Association (EFTA) of 23.3%, and of the nations of Latin America of 27.6%. The increased investment in the steel industries of Latin America in 1987 reversed the general trend in this area of lower investments but nevertheless were, in toto, only 56% of the amount invested only 4 years earlier, in 1983. If data for the world steel industry as a whole, including those of the centrally planned economy countries, were available, the same pattern presumably would be shown as that reported; that is, it would remain fairly stable, with increases in some countries being offset by decreases in others. However, the lack of comprehensive information on the centrally planned economy countries makes it impossible to determine whether the overall trend was up or down despite recorded increases or decreases in production of the materials involved. Preliminary data show that investment levels in industries dealing with the production and/or processing of mineral commodities for 1988 will probably increase over those of 1987, in some cases substantially.

Market economy petroleum industry investment as reported by the Global Energy Component of the Chase Manhattan Bank has been summarized in table 7 of this chapter but only presents information through 1987. However, the information for 1987 shows that the trend of lower and lower investment in the petroleum industry around the world continued in 1987, with an increase only in Western Europe. The total increase of 13.3% in this area did not offset the decreases in total investment in the United States (-17.8%), other countries of North America (-11.1%), the Far East and Oceania (-18.5%), as well as those in other areas listed. Although the total amount of money invested dropped by 9.2% in 1987 for the areas listed, the amount invested in the construction and maintenance of processing plants and crude oil tankers increased by 9.7%; this partly offset the drop of 13.7% in investment for the exploration and development of oil and gas reserves. Investment in the construction and maintenance of refineries and natural gas liquids plants increased in all areas listed except the countries of the Western Hemisphere, excluding the United States. Between 1986 and 1987, investment in refineries in Western Europe increased by 84.5% and in liquified natural gas plants in the Far East and Oceania by 12.2%. Although investment in production and processing areas of the industry may have dropped somewhat again, investment in the transportation of the materials probably has been increasing and will result in the expansion of the transportation network. That will, in turn, create a favorable atmosphere for more investment in exploration as well as production facilities. As with the nonfuels sector, decreased investments by some countries will be countered by increased investments by others, such as Iran and Iraq, which probably will modernize and upgrade petroleum industry facilities now that a truce has been declared in their war. Iran, which was forced to begin importing petroleum refinery products in 1988 because of war damage to its refineries, is expected to invest heavily in this sector to help repair its economy. As with the steel industry, the petroleum industry investment rate in centrally planned economy countries was almost assuredly not very much different from that of the rest of the world, although there are indications that investment in production and processing facilities in the U.S.S.R. have been growing at a faster rate than is the case for market economy countries. General information indicates that investment by the Soviets in production has increased almost fivefold between 1970 and 1988, although production of oil and natural gas has increased during the 1980's only slightly.

Data on U.S. foreign investment in mineral industry activity are updated to 1988 in table 8 of this chapter. These data show that U.S. direct foreign investment in the petroleum industry declined somewhat in 1988, while U.S. direct foreign investment in the mining, smelting, and refining industries continued to increase (+12.4% between 1987 and 1988). Reinvested earnings of foreign affiliates showed the same pattern. The reinvested earnings in the smelting and fabricated metals industries again showed a dramatic increase (+32.8%) over the previous year, while those for the petroleum industry reversed from 1987 to a dramatic 97.5% decrease. Income showed the same divergent paths; income from mining, smelting, and refining increasing by 59% in 1988 but there was a decrease of 8.5% in income from the petroleum industry.

TRANSPORTATION

Marine Transport

Bulk carriers, freighters, and tankers are the three classes of marine vessels engaged in transporting mineral commodities. However, vessels in each of these categories are not devoted wholly to mineral commodity transport. Bulk carriers move agricultural products as well as crude minerals and mineral fertilizers. Freighters, owing to their great variety, can be devoted wholly to hauling mineral products or wholly to moving nonmineral goods, as well as carrying mixed mineral and nonmineral cargoes. Tankers, although largely engaged in moving crude oil and refinery products, also transport liquid chemicals, molasses, wine, and other fluids.

Although physical characteristics of vessels, such as size, draft, crew requirements, and type of propulsion system, as well as fuel costs have an undeniable influence on shipping industry performance, problems of and changes in the quantity and quality and types of material moved also significantly affect the shipping sector of the world economy. Unfortunately, comprehensive data in this regard are not available.

Bulk Carriers.—During 1988, the world's bulk carrier fleet increased by 30 vessels compared with decreases of 412 vessels in 1987 and 302 vessels in 1986. This was the first increase in 3 years; 227 vessels were added to this fleet in 1985. During 1988, the total deadweight tonnage of bulk carriers increased by 1.5% compared with decreases of 1.3% and 3.6% in 1987 and 1986, respectively. The average deadweight tonnage of bulk carriers increased slightly in 1988 to 42,670 tons from 42,306 tons in 1987. The tabulation shows the distribution of the bulk carrier fleet of the world as of December 31, 1988.

Country of registry	Number of vessels	Deadweight tonnage (thousand long tons)
Panama	895	32,191
Liberia	505	27,900
Japan	316	19,703
Greece	470	18,539
Cyprus	423	15,938
Philippines	272	12,230
British Dependencies	183	10,235
Korea, Republic of	148	7,858
China	224	7,429
U.S.S.R.	240	6,386
Norway (NIS)[1]	96	6,157
Brazil	99	5,311
India	114	4,927
Bahamas	104	4,550
Italy	69	4,242
Singapore	72	3,650
Taiwan	55	3,585
Yugoslavia	82	2,859
Romania	68	2,706
Poland	95	2,609
Turkey	57	2,152
Belgium	22	2,103
Australia	33	2,028
Spain	57	1,952
Malta	63	1,836
Iran	51	1,767
Other	519	16,672
Total	**5,332**	**227,515**

[1] Established during 1988.

Freighters.—The world's freighter fleet decreased in 1988 by 54 vessels compared with a decrease in 1987 of 214 vessels and a decrease in 1986 of 1,151 vessels. Despite the decrease in the number of vessels during 1988, the total deadweight tonnage of the freighter fleet increased by 1.14 million tons or 1.0% compared with decreases in 1987 of 6.1% and in 1986 of 6.1%. Thus, there was a nominal increase in the average tonnage of freighters. The tabulation shows the distribution of the world's freighter fleet at the end of 1988.

Country of registry	Number of vessels	Deadweight tonnage (thousand long tons)
Panama	1,742	17,583
U.S.S.R.	1,716	11,747
China	833	8,241
United States	381	7,427
Cyprus	587	3,576
Japan	473	4,278
Liberia	285	4,157
Greece	266	3,130
Germany, Federal Republic of	321	3,123
Singapore	218	2,941
Taiwan	150	2,701
British Dependencies	246	2,263
Netherlands	283	2,168
Yugoslavia	167	1,987
Korea, Republic of	221	1,818
Philippines	239	1,811
India	122	1,770
United Kingdom	107	1,644
Romania	219	1,561
Poland	156	1,514
Bahamas	167	1,476
Denmark (DIS)[1]	97	1,458
Italy	194	1,369
Brazil	134	1,280
Turkey	228	1,231
Other	2,966	25,823
Total	**12,518**	**118,077**

[1] Established during 1988.

Tankers.—The world's tanker fleet increased by 160 vessels in 1988, the second straight year of an increase (+91 in 1987) as opposed to decreases of 457 vessels in 1986 and 26 vessels in 1985. Despite the increase of total deadweight tonnage in 1988 of 3.6%, the average deadweight tonnage in 1988 increased only by 0.5%, continuing the trend of the past several years to the use of medium-size tankers. The tabulation presents the distribution of the tanker fleet of the world at the end of 1988.

Country of registry	Number of vessels	Deadweight tonnage (thousand long tons)
Liberia	602	57,065
Panama	628	22,974
United States	247	16,708
Japan	314	15,664
Greece	205	15,358
Norway (NIS)[1]	176	12,289
British Dependencies	110	11,674
Cyprus	125	10,516
Bahamas	133	10,415
U.S.S.R.	444	7,270
Singapore	127	5,161
Italy	223	5,036
Iran	33	4,938
France	59	4,107
Brazil	95	3,995
Denmark (DIS)[1]	48	3,890
Spain	87	3,614
India	70	3,329
China	166	2,700
United Kingdom	88	2,654
Saudia Arabia	47	2,617
Isle of Man[1]	58	2,483
Malta	52	1,895
Korea, Republic of	65	1,707
Iraq	21	1,520
Other	1,027	25,217
Total	**5,250**	**254,796**

[1] Established during 1988.

Information gleaned from articles and reports concerning the world's tanker fleet indicated that the total deadweight tonnage of tankers and combined tankers (which can carry liquid or bulk cargo) that was being dismantled and melted down to scrap or was lost during 1988 fell to 3.0 million deadweight tons, a 60% drop from the tonnage scrapped or lost during 1987 and 80% and 90% less than the tonnages scrapped or lost during 1986 and 1985, respectively. This dramatic drop in the deadweight tonnage scrapped or lost can, at least in part, be attributed to the end of hostilities between Iran and Iraq and the consequent end of the "tanker war" in the Persian Gulf. According to industry sources, the war in the Persian Gulf, between April 1984 and August 1988, caused 62 vessels totalling almost 11 million deadweight tons to be declared complete losses. The expected post-war increase in oil production from both Iran and Iraq, intended to provide funds to help pay for repairing their respective infrastructures, will probably lower the price of crude oil on the international market. This lower price in turn could cause marginal- or higher-cost producers to stop pumping, and, as a result, more of the international supply would come from the Middle East. Under these conditions, tanker demand would rise owing to the increased long-haul shipping involved. Increased imports of crude oil by countries such as the United States also require larger tankers that carry oil on longer routes for the imports to be as economical as possible. The resale value of large tankers also remained above scrap metal value in 1988, which helped prevent scrapping.

Information furnished by the Maritime Administration, an agency of the U.S. Department of Transportation, shows that the average deadweight tonnage of new tankers delivered during 1988 was 59,187 long tons, which continued the trend of the past few years to the use of tankers in the small to medium range. This, however, was an increase of 15% over the average deadweight tonnage of the tankers delivered during the previous year. Tankers under construction at the end of 1988 demonstrated the same trend, with the average deadweight tonnage at 56,507 long tons. The tabulation shows, by country of construction, the number of tankers being built or on order at the end of 1988.

Country	Number of vessels	Deadweight tonnage (long tons)
Korea, Republic of	37	3,995,100
Japan	45	3,043,700
Yugoslavia	18	1,171,100
Spain	13	951,600
Romania	9	699,500
Poland	8	389,100
China	7	283,600
Denmark	7	245,800
Brazil	5	162,500
Taiwan	1	150,200
Germany, Federal Republic of	13	138,400
United Kingdom	4	102,400
Portugal	1	87,500
Italy	11	87,200
Belgium	3	85,500
Bulgaria	3	85,500
Norway	3	72,800
Argentina	2	34,900
U.S.S.R.	1	28,300
Netherlands	9	23,000
Finland	8	20,600
Philippines	1	4,700
Malaysia	1	3,400
Total	**210**	**11,866,400**

Ocean Freight Rates

Data on ocean freight rates that, in the past, had been published by the United Nations are no longer available. Other sources, however, provide information that is indicative of this broad area. Considering ocean shipping rates for iron ore as representative of dry cargo in general, these average rates increased during 1988 from a low of 16% for iron ore shipped from Australia to Europe to a high of 51% for iron ore shipped from Brazil to Japan. This was a greater spread of increases than during 1987 when comparable rates increased from 22% to 46% from Australia and Canada, respectively, to Europe. The yearly average rate for shipping iron ore from Canada to Europe doubled between 1986 and 1988, although there was an increase of only about 15% in the value of the material itself during the same period. In addition to the value of the material being shipped, other factors determine the variance of these rates. These factors include the size of the ship, the availability of different size ships, the cost of marine fuel, and the general economic conditions in the importing countries.

Tanker rates, as usual, generally followed the same trend as for dry cargo, and ended 1988 somewhat higher than at the beginning of the year. The end of the Iran-Iraq war caused investors to reconsider stocks in companies involved in oil shipping, and by the end of the year, some of these stocks were being sold at an increase of 60% over their price at the beginning of the year. Increased demand for internationally shipped crude oil coupled with increased investment in tankers by owners are resulting in increased tanker rates. According to industry sources, rates for large tankers in 1985 averaged about $5,000 a day but by late 1988 the rates had reached an average of $16,000 a day.

Panama and Suez Canals

Data on fiscal year 1988 shipments through the Panama Canal showed a drop in mineral commodity movements, but this decline was miniscule in comparison to the decline registered between 1986 and 1987, as is shown in the tabulation.

In fiscal year 1988, mineral commodities accounted for 43.8% of all commercial ocean traffic through the Panama Canal, a figure lower than the 46.1% in 1987 and only 62.4% of the amount of mineral commodities that were moved through the canal in 1982. Table 10 shows mineral commodity movements through this canal during 1986–88 by major mineral groups.

In terms of major mineral commodity groups, fuels remained dominant in 1988 but dropped again both in terms of quantity and share, registering a 1.2% decline on a tonnage basis to account for only 48.6% of the total mineral commodities transiting the canal compared with 49.4% in 1987 and 56.3% in 1986. Industrial minerals remained in second place in 1988 with a 1.3% increase in tonnage, to account for 26.3% of total mineral commodities compared with 25.9% and 21.1% in 1987 and 1986, respectively. Total metals remained in third place in 1988 with a 1.3% increase in tonnage to account for 25.1% of total mineral commodities, up from 24.7% in 1987

	Fiscal year[1]				
	1984	1985	1986	1987	1988
Number of transits:					
Commercial ocean traffic	11,230	11,515	11,925	12,230	12,234
Other traffic	1,293	1,251	1,353	1,214	1,207
Total	**12,523**	**12,766**	**13,278**	**13,444**	**13,441**
Cargo moved (thousand metric tons):					
Commercial ocean traffic:					
Mineral commodities	72,210	74,128	74,139	69,797	69,586
Other commodities	70,515	66,740	68,052	81,280	89,408
Subtotal	142,725	140,868	142,191	151,077	158,994
Other traffic	336	265	184	212	303
Total	**143,061**	**141,133**	**142,375**	**151,289**	**159,297**

[1] Year ending Sept. 30 of that stated.

and 22.6% in 1986.

Iron and steel ingots and semimanufactures remained the dominant single metals class; fertilizer materials were again the overwhelmingly dominant industrial minerals class; refined petroleum products were again for the fifth year the dominant fuel commodity although they dropped back to less than one-half of the mineral fuels moved through the canal during 1988. The amount of mineral commodities moved through the Panama Canal continued to decrease despite increases in various materials over the years, such as movements of bauxite, alumina, and unspecified ores and concentrates from the Pacific to the Atlantic. Even though the Panama Canal is still being operated on a break-even basis by the United States, increased fees and charges associated with various services are making alternate transportation methods more attractive to shippers. Two of these alternatives are the Trans-Isthmus pipeline, which carries about 600,000 barrels of oil per day from tankers in the Pacific Ocean to the Caribbean Sea, and a growing network of container ships and railroad lines that are carrying U.S. imports originating in countries on the Pacific Ocean from the U.S. west coast to the east coast, thereby bypassing the canal.

Information on mineral commodity shipments through the Suez Canal during 1988 was not available to the Bureau of Mines in time to be included in this edition of this chapter.

Overland Transport

The paucity of detailed information available has prevented a comprehensive study of the overland international transport of mineral commodities. Large-scale international rail shipments of mineral commodities were confined chiefly to movements between the United States and Canada and Mexico and to transfers within Europe south of the Baltic Sea. Notable exceptions continued to be the shipment of large quantities of iron ore from Sweden to Narvik, Norway, for loading onto vessels for export through that port, and to the flow of a variety of minerals from several southern African nations through the Republic of South Africa for export through that country's ports. During 1988, efforts were continued to restore regular service on rail lines in Mozambique and Zaire to lessen the dependence on the railroads and ports of the Republic of South Africa by the nations in that area, but economic conditions and continuing guerrilla activity prevented this from becoming a reality. Although not on an international railway, a rail tunnel through Canada's western Selkirk Mountains was on the verge of completion at the end of 1988. When this tunnel is completed, it will mean that Canada's transcontinental main line for the first time will be able to carry raw materials such as coal, potash, and sulfur from the Canadian interior smoothly and without interruption to the west coast for shipment to countries on the Pacific Rim. The tunnel, which will be 9.1 miles long when completed, will increase by 60% the railroad's capacity to move material through the mountains and thus for export.

Major international pipeline movements of crude petroleum and natural gas in 1988 were, in general, confined to the same area cited as the centers of rail movements of mineral commodities. Noteworthy here, however, was the continuing operation of the pipelines for both oil and natural gas from the U.S.S.R. to the other centrally planned economy countries and on to some market economy countries of Europe. The end of overt military activity between Iran and Iraq during 1988 lessened the urgency of completing pipelines that would divert oil movements in the area away from the shipping lanes but the fact remains that these pipelines had become operational and provide an alternative to tankers in moving crude petroleum from the producing areas of the Middle East to the consuming areas of Europe.

Information on rail and pipeline transport of mineral commodities within certain individual countries is provided in the appropriate country chapter.

PRICES

Comprehensive data on market prices for crude minerals and mineral products for the world as a whole do not exist, and even the data that are available and published are not compatible between countries, particularly between the market economy countries and the centrally planned economy countries. However, the regularly published prices for selected major commodities in key market areas can be regarded as indicative of general world price trends. Tables 11, 12, and 13 summarize prices for selected metals in the United States, the United Kingdom, and Canada, respectively, for 1984–88 inclusive, with monthly data provided for 1988. In broadest overview, of the 20 prices listed in the tables, all except four showed advances, many quite substantial, between 1987 and 1988. Only the silver price in each market area, and the gold price listed for the United Kingdom alone recorded drops. The drop in the annual average gold price was only 2.1%, but the generally downward trend across the year and high levels of production did not bode well for the outlook for 1989. The drops in the three annual average silver prices ranged from the 7% decrease in the London price, through the 6.8% drop in the U.S. price, to the 6.3% decline in the Canadian price; as with gold, the general downturn after midyear in each of these markets suggested a somewhat less than bright outlook.

In contrast to these downturns were the increases for most metals listed. The U.S. price for aluminum advanced by nearly 53%, and this was a smaller increase than that reported for the United Kingdom market. A 46.8%

growth in the U.S. copper price was only fractionally greater than the growth recorded for the United Kingdom price, and was substantially below the 66% increase in the reported Canadian price. The recorded Canadian nickel price soared, topping the 1987 level by 168%, a markedly greater upturn than the 8% increase recorded for its companion metal, cobalt, on the U.S. market. The 43% growth in the quoted U.S. zinc price topped the increase on the Canadian market but fell short of the increase recorded for the cited United Kingdom price. Clearly most prominent from the viewpoint of the percentage growth among the prices recorded in the three tables was the 282% increase for cadmium on the U.S. market. Increases of about 3% in the annual average lead price on the U.S. and Canadian markets hardly accommodated the inflation rate, but the 9.9% increase in the United Kingdom price was noteworthy. Advances of around 5% in the tin price in both the United States and the United Kingdom undoubtedly were somewhat heartening to tin producers, although they were not as substantial as those logged between 1986 and 1987.

Among the industrial minerals and their chemical derivatives, contract prices for exported sulfur on an f.o.b. basis were slightly higher in the first half of 1988 than in the latter half of 1987 in the U.S. gulf coast market and in the Middle East market, and slightly lower on the Canadian and Polish markets. In the second half of 1988, the reported U.S. gulf coast export price advanced from the \$99–\$105 per ton f.o.b. range of the first half to a \$105–\$110 range; the Middle East market price rose from the \$97–\$100 per ton, f.o.b. Persian Gulf, range of the first half to \$100–\$104; the Canadian market export price increased from \$90–\$98 per ton, f.o.b. Vancouver, range of the first half to \$98–\$105 for the second half; and the Polish market export price moved up from the \$96–\$99 per ton, f.o.b. Gdansk, range of the first half to \$98–\$105 for the second half. Thus, in 1988, Polish sulfur, which was more costly than that from the other listed markets through 1987, moved downward relatively to a price level below that of the U.S. gulf coast, but remained more expensive than that from Canada and the Middle East.

Urea export prices ranged from a low of about \$102 per ton, f.o.b. East Europe, for bulk material to about \$115 per ton, f.o.b. Middle East ports, for bagged product at the start of the year. Thereafter, a series of step-like increases set in, with the f.o.b. East Europe bulk price peaking around \$130–\$135 per ton and the f.o.b. Middle East bagged price at about \$152 per ton in July. Thereafter, the f.o.b. East Europe bulk price declined to a low of about \$120 per ton in November, edged upward to \$125 in December, and dropped again to about \$120 at yearend. In contrast, the f.o.b. Middle East bagged price dropped slightly under \$150 per ton by August, edged back to \$150 by September, fell to about \$138 by October, advanced marginally by November, moved sharply to \$150 by December, and fell slightly thereafter, ending the year at about \$145 per ton.

In the case of ammonia, the c&f price in northwest Europe remained quite close to \$125 per ton from January through August, slumped slightly to about \$120 per ton in September and then moved upward to about \$135 per ton for December and even more sharply to over \$160 per ton by yearend. The f.o.b. price in the Caribbean started the year at nearly \$100 per ton, suffered a slight drop in March and recovered to about \$100 by May, held that level until October, advanced to about \$110 by December, and leapt to almost \$135 by yearend.

Ammonium sulfate prices in the U.S. gulf area began the year at about \$50 per ton, f.o.b., for bulk material; the West Europe f.o.b. bulk price was about \$2 per ton higher. The U.S. gulf price advanced to about \$56 per ton by February and then fluctuated at or just below that level until September, when it advanced to about \$61 per ton. Thereafter, there was a brief and small advance followed by a drop to around \$59 per ton which held through yearend. The West Europe price advanced to about \$62 per ton by March, held that level until May, slumped to about \$57 per ton by July, rose to about \$61 by September, held that level until November, rose to about \$63 by December and declined to about \$61 per ton again by yearend.

Prices for various phosphatic materials showed rather divergent patterns in 1988. Phosphoric acid began the year at about \$290 per ton of P_2O_5, f.o.b. U.S. gulf ports, and in a series of upward steps with a minor slump between September and November, reached \$380 per ton by December, a price that held until yearend. In contrast, diammonium phosphate, bulk basis, started the year at \$210 per ton, f.o.b. U.S. gulf ports, fell sharply to \$175 per ton by April, advanced to \$200 per ton by July, and thereafter fluctuated slightly around the \$200 level through yearend, when it was about \$195 per ton. The triple superphosphate price, f.o.b. U.S. gulf ports for bulk material, began the year at about \$152, remained at or near that level until May, advanced in steps to about \$163 per ton for October, and held that level to yearend.

Potash prices, as measured by the potassium chloride price, f.o.b. Vancouver, Canada moved upward in steps throughout 1988, starting at about \$76 per ton in January, reaching \$80 per ton by April, \$90 per ton by August, and about \$99 per ton by yearend.

The price of cement in the United States, as expressed in terms of the average value at mills, was equivalent to \$54.12 per metric ton for 1988, or \$0.21 below the 1987 level. This made it one of the few industrial mineral commodities logging even a fractional decline between 1987 and 1988. Space does not permit further detailed recitation of specific prices, but suffice it to say that for most commodities, either stability or an increase between 1987 and 1988 was more common than declines.

The topic of energy material prices on a global basis is so complex, both from the viewpoint of monetary equivalency and that of the exceedingly variable nature of the materials involved, that the following summary can only touch on broadest generalities and lacks reliable information on much of the material produced and consumed within the centrally planned economy nations. The U.S. Department of Energy's compilation of average world crude oil prices shows a decrease of 18% between January 1, 1988, and January 1, 1989, from $16.57 per barrel to $13.58 per barrel, but these global year-start-to-yearend results are a tremendous oversimplification of the actual changes across the year. For details, either by area or in terms of a time series within the year, the reader is referred to the Energy Information Administration's publication "Weekly Petroleum Status Report." In broadest terms, the global average fluctuated widely across the year, dropping to a low of about $10.10 per barrel in early October and after several sharp up and down variations, was on a rising trend through the month of December. Summarizing only end-of-year figures for major areas, crude oil from OPEC countries showed a decline even greater than that for the world as a whole—20% from $16.77 per barrel on January 1, 1988, to $13.36 per barrel on January 1, 1989. The corresponding figures for all non-OPEC countries were a 13.3% decline from $16.21 per barrel to $14.06 per barrel. The latter figure, however, included many quite different components, with January 1, 1988, prices ranging from $11.10 to $18.50 per barrel, January 1, 1989, prices ranging from $9.97 to $16.00 per barrel, and percent declines ranging from 2% to 35%. Similarly, OPEC crude oils were also quite variable; January 1, 1988, prices ranged from $12.20 to $18.92 per barrel, January 1, 1989, prices ranged from $10.00 to $16.10 per barrel, and percent declines varied between 7.6% and 30.4%. Prices for the variety of refinery products varied appreciably from market area to market area, from product to product, and from month to month, but overall there were evidently downturns related to drops in the price of crude.

Price data for coal were even less comprehensive than for oil and its products, but for the countries for which data were readily available—Australia, Canada, France, the Federal Republic of Germany, Italy, Japan, Sweden, the United Kingdom, and the United States—increases of $1.00 to $3.00 per ton were evident for metallurgical coal and industrial steam coal (including that for electric power generation), and even larger increases were reported for residential steam coal, some of more than $20.00 per ton. Illustrative of individual country-to-country variations, the metallurgical coal price (including taxes) was reported at the equivalent of $22.94 per metric ton in Australia, $58.26 in the Federal Republic of Germany, $44.49 in Sweden, and $52.59 in the United States; Australia and Sweden recorded small drops in price of this grade in 1988 with respect to the 1987 levels. The metric ton price (including taxes) of steam coal for electricity generation was reported for Australia as $24.12, for France as $41.12, for the Federal Republic of Germany as $123.13, for Italy as $50.63, for Japan as $95.15, for Sweden as $49.11, and for the United States as $33.83. Prices for steam coal (including taxes) for use in private residences, in terms of dollars per metric ton, were given as follows: France, $442; the Federal Republic of Germany, $381; Sweden, $224; and the United Kingdom, $176.

Reporting on natural gas prices is also far from comprehensive. For most areas for which figures were available, modest increases were reported, both for industrial and residential users. However, in some instances, the industrial price increased while the residential price declined, and in other areas the reverse was true, thus further complicating the picture.

STATISTICAL SUMMARY OF WORLD PRODUCTION AND TRADE OF MAJOR MINERAL COMMODITIES

The final 26 tables of this chapter, tables 14–39, extend and expand the statistical series on production that was started in the 1963 edition of the "Area Reports: International" volume of the "Minerals Yearbook" and that was subsequently updated and expanded in the 1965 and 1967–87 editions. This year, tables showing the leading world producers of mine silver and uranium oxide have been added to this series principally in recognition of contribution these two materials make to the computed value of crude mineral production worldwide. Based on the information presented in table 3 of the 1985 edition of this chapter, mine silver ranked ninth and uranium ranked tenth in value of production in 1983. Their inclusion now leaves no gaps in showing the leading world producers of the principal (based on value) crude minerals produced. These 26 tables are primarily a supplement to other statistical data within this chapter but also serve as a summary of international production data for major mineral commodities covered in greater detail on a commodity basis in volume I of the 1988 "Minerals Yearbook" and on a country basis in volume III.

In this edition, the data presented in these tables, in most instances, correspond with the data in the individual commodity world production tables appearing in volume I and may differ somewhat from a total that might be obtained by adding figures presented for any single commodity in each of the country chapters of volume III. This apparent disparity results from the problems of scheduling the compilation of tables in the numerous commodity and country chapters in the separate volumes. In an effort to provide the user with the most up-to-date information possible, data received after completion of worldwide commodity production tables (volume I) have been included in many of the individual country production tables (volume III). Limitations of time, however, often prevent the incorporation of these revisions in the abbreviated versions of the world commodity tables included here. Thus, a more precise figure for total world production of any commodity could possibly be obtained by adding figures presented in the individual country chapters. For summary purposes, however, the tables of this chapter are sufficiently correct without the inclusion of all of these revisions.

The series of data on world trade in major mineral commodities that appeared in earlier editions of this chapter (tables 57-69 in the 1967 edition) could not be included because of scheduling problems.

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[1] Senior Foreign Mineral Specialist, Division of International Minerals.

[2] Chief, Branch of Geographic Data, Division of International Minerals.

[3] Callot, F. Production et consommation mondiales de minerals en 1983. Annales des Mines. Nos. 7, 8, 9, July-Aug.-Sept. 1985, pp. 3-123.

[4] Table 1 contains 100 data lines, but 3 of these are totals of others; these total lines are not included in the total of 97 distinct commodities or forms of commodities counted here.

TABLE 1

WORLD PRODUCTION OF MAJOR MINERAL COMMODITIES[1]

Commodity		1984	1985	1986	1987[p]	1988[e]
METALS						
Aluminum:						
Bauxite, gross weight[2]	thousand metric tons	88,266	85,286	88,867	95,094	99,990
Alumina, gross weight	do.	33,712	32,230	32,935	34,794	37,372
Unalloyed ingot metal	do.	15,705	15,398	15,354	16,378	17,304
Antimony, mine output, Sb content	metric tons	54,683	56,235	57,550	68,809	71,196
Arsenic, trioxide[3]	do.	47,070	53,201	53,147	53,696	55,103
Beryl concentrate, gross weight[3]	do.	8,975	8,141	8,946	8,434	8,289
Bismuth[4]:						
Mine output, Bi content	do.	3,451	4,406	3,457	2,886	2,767
Smelter	do.	3,189	4,325	4,295	4,222	3,513
Cadmium, smelter	do.	19,617	19,063	19,064	18,996	19,773
Chromite, gross weight[3]	thousand metric tons	9,776	10,516	11,094	10,917	11,666
Cobalt:						
Mine output, Co content	metric tons	40,972	46,781	50,243	45,742	43,904
Metal, refined	do.	23,703	27,717	31,076	26,840	25,254
Columbium-tantalum concentrate, gross weight[3 5]	do.	33,307	35,503	34,835	22,256	38,935
Copper:						
Mine output, Cu content	thousand metric tons	7,879	7,969	8,001	8,328	8,453
Metal:						
Smelter:						
Primary[6]	do.	7,647	7,698	7,868	8,002	8,022
Secondary[7]	do.	808	957	949	912	1,001
Refined:						
Primary[6]	do.	7,913	8,018	8,244	8,340	8,538
Secondary[7]	do.	1,235	1,456	1,418	1,475	1,534
Gold, mine output, Au content	thousand troy ounces	46,929	49,284	51,534	53,034	58,454
Iron and steel:						
Iron ore, iron ore concentrates, iron ore agglomerates, gross weight	thousand metric tons	829,349	862,158	868,360	890,137	916,431
Metal:						
Pig iron	do.	495,016	504,919	501,486	503,014	538,518
Ferroalloys	do.	14,946	14,937	14,873	14,962	15,783
Steel, crude	do.	711,174	717,886	711,254	733,199	777,784
Lead:						
Mine output, Pb content	do.	3,269	3,430	3,354	3,429	3,381
Metal:						
Smelter:						
Primary	do.	3,176	3,391	3,220	3,313	3,293
Secondary	do.	2,249	2,207	2,302	2,373	2,424
Refined:						
Primary	do.	3,172	3,368	3,206	3,215	3,254
Secondary	do.	2,296	2,301	2,370	2,512	2,601

See footnotes at end of table.

TABLE 1—Continued

WORLD PRODUCTION OF MAJOR MINERAL COMMODITIES[1]

Commodity		1984	1985	1986	1987[p]	1988[e]
METALS—Continued						
Magnesium metal, smelter:						
Primary	metric tons	327,783	319,633	320,839	327,677	338,167
Secondary	do.	68,525	73,098	66,989	65,825	70,727
Manganese ore, gross weight	thousand metric tons	25,035	25,384	24,982	23,726	23,927
Mercury, mine output, Hg content	76-pound flasks	195,380	198,340	174,890	172,090	166,520
Molybdenum, mine output, Mo content	metric tons	97,695	98,424	92,819	89,178	94,750
Monazite concentrate (source of rare-earth metals and thorium)[4]	do.	30,313	32,305	29,548	23,240	25,404
Nickel:						
Mine output, Ni content	do.	773,540	804,661	770,313	811,568	835,138
Metal, plant output	do.	730,890	753,547	735,557	761,887	806,169
Platinum-group metals, mine output, metals content	thousand troy ounces	7,653	7,941	8,314	8,593	8,668
Selenium, smelter[3 5]	metric tons	1,494	[4]1,325	[4]1,224	[4]1,229	1,503
Silver, mine output, Ag content	thousand troy ounces	418,761	422,642	418,987	442,855	445,270
Tellurium, smelter[3 4 5]	metric tons	100	100	85	74	73
Tin:						
Mine output, Sn content	do.	188,183	180,759	172,899	177,205	200,798
Metal, smelter	do.	192,979	193,703	181,381	187,373	204,340
Titanium concentrate, gross weight:						
Ilmenite[4 8]	thousand metric tons	3,481	3,536	3,424	3,884	3,942
Rutile[3 4]	do.	341	373	394	439	435
Titaniferous slag	do.	1,143	1,280	1,285	1,575	1,725
Tungsten, mine output, W content	metric tons	46,162	46,583	42,799	42,174	[4]43,236
Uranium, mine output, U_3O_8 content[3 5]	do.	43,574	40,224	41,540	40,246	41,105
Vanadium, mine output, V content	do.	33,290	33,352	32,418	37,471	34,270
Zinc:						
Mine output, Zn content	thousand metric tons	6,524	6,799	6,936	7,242	3,977
Metal, smelter:						
Primary[6]	do.	6,189	6,466	6,400	6,692	6,760
Secondary[7]	do.	338	332	299	322	349
Zirconium concentrate	do.	[4]736	[4]815	[4]741	[4]754	923
INDUSTRIAL MINERALS						
Asbestos	do.	4,314	4,274	4,057	4,256	4,361
Barite	do.	5,815	6,066	4,707	4,714	5,305
Boron materials	do.	2,519	2,505	2,511	2,701	2,781
Bromine[3]	do.	397	381	374	389	405
Cement, hydraulic	do.	940,608	959,367	1,000,743	1,045,508	1,100,539
Clays:[3]						
Bentonite	do.	8,822	8,856	8,895	8,831	9,087
Fuller's earth[5]	do.	2,235	2,384	2,271	2,411	2,568
Kaolin	do.	20,633	22,325	23,383	24,012	25,748

See footnotes at end of table.

TABLE 1—Continued

WORLD PRODUCTION OF MAJOR MINERAL COMMODITIES[1]

Commodity		1984	1985	1986	1987[p]	1988[e]
INDUSTRIAL MINERALS—Continued						
Corundum, natural	metric tons	9,213	9,248	9,717	9,214	9,217
Diamond, natural:						
Gem[e]	thousand carats	26,093	26,233	39,045	37,995	43,606
Industrial[e]	do.	37,359	39,785	52,672	49,620	50,393
Total	**do.**	**63,452**	**66,018**	**91,717**	**87,615**	**93,999**
Diatomite[3]	thousand metric tons	1,750	1,836	1,842	1,817	1,847
Feldspar[3]	do.	3,798	4,042	4,121	4,277	4,294
Fluorspar	do.	4,797	4,923	5,010	4,965	5,181
Graphite[4]	metric tons	624,916	608,345	659,384	661,011	672,657
Gypsum	thousand metric tons	85,779	86,986	89,175	89,650	95,209
Iodine	metric tons	[4]12,488	[4]12,784	[4]12,971	[4]12,637	14,608
Lime[3]	thousand metric tons	117,072	116,076	113,831	113,162	118,997
Magnesite[4]	do.	11,823	12,172	12,313	12,139	12,132
Mica[3]	do.	276	255	289	290	271
Nitrogen: N content of ammonia	do.	88,630	91,135	91,403	94,274	98,948
Perlite[3]	do.	1,634	1,628	1,656	1,750	1,848
Phosphate, gross weight:						
Phosphate rock	thousand metric tons	151,855	148,842	138,870	144,228	163,673
Thomas slag	do.	2,637	2,515	2,037	2,095	2,119
Guano	do.	9	9	14	13	11
Potash, marketable, K_2O equivalent	do.	29,334	29,151	28,694	30,470	31,429
Pumice[3 5]	do.	11,622	10,774	10,245	10,781	10,833
Salt	do.	172,312	172,869	175,101	178,636	183,986
Sodium compounds, n.e.s.:[3]						
Carbonate	do.	29,238	29,137	29,358	30,230	31,081
Sulfate	do.	4,300	4,392	44,334	4,502	4,604
Strontium materials[3 5]	metric tons	139,874	162,572	149,843	181,364	191,600
Sulfur, elemental basis:						
Elemental[9]	thousand metric tons	14,137	15,322	14,708	14,297	13,874
From pyrites	do.	8,737	9,021	8,914	9,855	10,187
Byproduct[10]	do.	29,625	30,318	31,032	32,788	34,335
Total	**do.**	**52,499**	**54,661**	**54,654**	**56,940**	**58,396**
Talc, soapstone, pyrophyllite	do.	7,572	7,666	7,492	7,599	7,657
Vermiculite[3 5]	metric tons	494,022	504,406	525,532	541,679	539,531
MINERAL FUELS AND RELATED MATERIALS						
Carbon black[3 5]	thousand metric tons	4,399	4,487	4,434	4,548	4,760
Coal:						
Anthracite	million metric tons	314	326	337	353	363
Bituminous	do.	2,801	2,955	3,027	3,120	3,181
Lignite	do.	1,110	1,160	1,179	1,203	1,212
Total	**do.**	**4,225**	**4,441**	**4,543**	**4,676**	**4,756**

See footnotes at end of table.

TABLE 1—Continued

WORLD PRODUCTION OF MAJOR MINERAL COMMODITIES[1]

Commodity		1984	1985	1986	1987[p]	1988[e]
MINERAL FUELS AND RELATED MATERIALS—Continued						
Coke:[11]						
Metallurgical	thousand metric tons	338,552	345,813	340,646	343,168	353,610
Other	do.	10,043	11,053	11,042	10,428	10,961
Gas, natural, marketed	billion cubic feet	59,627	61,875	63,420	66,058	67,976
Natural gas liquids[3]	million 42-gallon barrels	1,523	1,517	1,586	1,643	1,687
Peat	thousand metric tons	187,629	181,809	190,039	185,199	185,225
Petroleum:						
Crude	million 42-gallon barrels	19,974	19,535	20,635	20,458	21,405
Refined	do.	21,113	21,054	21,825	21,860	22,459

[e] Estimated. [p] Preliminary.
[1] Incorporates numerous revisions from the corresponding table in previous editions of this chapter. Figures generally conform to those published in appropriate commodity chapters of volume I of the "Minerals Yearbook," 1988 edition.
[2] Includes bauxite equivalent of nepheline syenite concentrate and alunite ore produced in the U.S.S.R., the only producer on record of such materials as a source of aluminum metal.
[3] Excludes data for China (no adequate basis for estimation available).
[4] Excludes data for the United States (withheld to avoid disclosing company proprietary data).
[5] Excludes data for the U.S.S.R. (no adequate basis for estimation available).
[6] Includes all metal clearly identified as primary as well as all metal that cannot be subdivided clearly between primary and secondary (see footnote 7).
[7] Includes only that metal that is clearly identified as secondary. Some countries do not distinguish between primary and secondary, and for some of these, no basis is available for estimating the breakdown of total production. For such countries, the total has been included under Primary (see footnote 6).
[8] Includes leucoxene.
[9] Comprises sulfur produced by the Frasch process plus sulfur mined in the elemental state from ores.
[10] 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.
[11] Production of coke other than metallurgical by China and the U.S.S.R. is included with "Coke: Metallurgical."

TABLE 2

VALUE OF EXPORT TRADE IN MAJOR MINERAL COMMODITY GROUPS[1]

(Million U.S. dollars)

Commodity group	1982	1983	1984[r]	1985[r]	1986[r]	1987
Metals:						
All ores, concentrates, scrap	24,481	23,247	25,753	24,854	24,251	27,110
Iron and steel	68,732	61,322	66,126	69,731	74,482	81,595
Nonferrous metals	31,967	36,575	36,185	34,809	36,522	44,669
Total	**125,180**	**121,144**	**128,064**	**129,394**	**135,255**	**153,374**
Nonmetals, crude only	9,938	9,325	9,855	9,947	10,647	11,198
Mineral fuels	430,384	384,188	378,398	360,642	263,504	277,727
Grand total	**565,502**	**514,657**	**516,317**	**499,983**	**409,406**	**442,299**
All commodities	1,848,930	1,812,944	1,909,303	1,928,399	2,117,135	2,491,466

[r] Revised.
[1] Data presented are for selected major commodity groups of the Standard International Trade Classification, Revision 2 (SITC-R2) and as such exclude some mineral commodities classified in that data array together with other (nonmineral) commodities. SITC-R2 categories included are as follows: All ores, concentrates, scrap-Div. 28; iron and steel-Div. 67; nonferrous metals-Div. 68; nonmetals (crude only)-Div. 27; and mineral fuels-Div. 3. Major items not included are the metals, metalloids, and metal oxides of Group 513; mineral tar and other coal-, petroleum-, and gas-derived crude chemicals of Div. 52; manufactured fertilizers of Div. 56; and nonmetallic mineral manufactures of Groups 661, 662, 663, and 667. Data include special category exports, ship stores and bunkers, and other exports of minor importance, and exclude the trade of the centrally planned economy countries of Asia and trade between the Federal Republic of Germany and the German Democratic Republic.

Sources: 1984-87 data: United Nations. Monthly Bulletin of Statistics. V. 43, May 1989, pp. 274-301; 1983 data: United Nations. Monthly Bulletin of Statistics. V. 42, May 1988, pp. 274-301; 1982 data: United Nations. Monthly Bulletin of Statistics. V. 41, May 1987, pp. 274-301.

TABLE 3

DISTRIBUTION OF VALUE OF WORLD EXPORT TRADE IN MAJOR MINERAL COMMODITY GROUPS

(Percent)

Commodity group	1982	1983	1984	1985	1986	1987
Metals:						
All ores, concentrates, scrap	4.3	4.5	5.0	5.0	5.9	6.1
Iron and steel	12.1	11.9	12.8	13.9	[r]18.2	18.5
Nonferrous metals	5.7	7.1	7.0	[r]7.0	8.9	10.1
Total	**22.1**	**23.5**	**24.8**	**[r]25.9**	**[r]33.0**	**34.7**
Nonmetals, crude only	1.8	1.8	1.9	2.0	2.6	2.5
Mineral fuels	76.1	74.6	73.3	[r]72.1	[r]64.4	62.8

[r] Revised.
[1] For detailed definition of groups, see footnote 1, table 2.

TABLE 4

GROWTH OF VALUE OF WORLD EXPORT TRADE IN MAJOR MINERAL COMMODITY GROUPS[1]

(Percent change from that of previous year)

Commodity group	1982	1983	1984[r]	1985[r]	1986	1987
Metals:						
All ores, concentrates, scrap	-13.1	-5.0	+10.8	-3.4	-2.4	+11.8
Iron and steel	-6.4	-10.8	+7.8	+5.4	+6.8	+9.5
Nonferrous metals	-11.9	+14.0	-1.1	-3.8	+4.9	+22.3
All metals	-9.2	-3.2	+5.7	+1.0	+4.5	+13.4
Nonmetals, crude only	-9.3	-6.2	+5.7	+0.9	+7.0	+5.2
Mineral fuels	-9.3	-10.7	-1.5	-4.7	-26.9	+5.4
All major mineral commodity groups	-9.2	-9.1	+0.3	-3.2	-18.1	+8.0
All commodities	-5.9	-1.9	+5.3	+1.0	+9.8	+17.7

[r] Revised.
[1] For detailed definition of groups, see footnote 1, table 2.

TABLE 5

WORLD CONSUMPTION OF SELECTED MINERAL COMMODITIES

(Thousand metric tons unless otherwise specified)

Commodity		1984[r]	1985[r]	1986[r]	1987	1988[p]
Ferrous metals: World:						
Iron ore, gross weight[e]	million metric tons	817	850	855	[r]880	905
Iron and steel scrap, gross weight	do.	312	306	297	301	[e]318
Nonferrous metals:						
Market economy countries:						
Aluminum, refined		12,302	12,540	12,788	13,654	14,462
Cadmium		14	13	15	16	17
Copper, refined		7,668	7,348	7,718	8,068	8,302
Lead, refined		4,050	3,971	4,069	4,157	4,213
Magnesium, primary		194	192	188	210	229
Nickel[1]		582	569	572	632	666
Tin, refined		161	157	165	172	177
Zinc, slab		4,616	4,706	4,854	5,018	5,174
Centrally planned economy countries:						
Aluminum, refined		3,273	3,288	3,252	3,333	3,323
Cadmium		4	4	4	4	4
Copper, refined		2,269	2,356	2,372	2,395	2,373
Lead, refined		1,447	1,470	1,436	1,449	1,453
Magnesium, primary		94	102	105	108	112
Nickel[1]		200	206	206	206	206
Tin, refined		61	58	58	59	58
Zinc, slab		1,837	1,811	1,845	1,906	1,940
World total:						
Aluminum, refined		15,575	15,828	16,040	16,987	17,785
Cadmium		18	17	19	20	21
Copper, refined		9,937	9,704	10,090	10,463	10,675
Lead, refined		5,497	5,441	5,505	5,606	5,666
Magnesium, primary		288	294	293	318	341
Nickel[1]		782	775	778	838	872
Tin, refined		222	215	223	231	235
Zinc, slab		6,453	6,517	6,699	6,924	7,114
Industrial minerals: World:						
Fertilizers:[2]						
Nitrogenous, contained N		87,740	88,162	87,667	93,827	98,259
Phosphatic, contained P_2O_5		32,718	34,158	32,961	34,749	36,598
Potassic, K_2O equivalent		25,493	25,947	25,543	26,010	27,280
Sulfur, elemental S equivalent		58,282	57,916	56,938	59,536	63,245
Mineral fuels: World:						
Solid fuels	million metric tons of standard coal equivalent	2,874	3,037	3,075	3,127	[e]3,170
Liquid fuels	do.	3,657	3,631	3,717	3,784	[e]3,950
Natural gas	do.	2,006	2,103	2,127	2,278	[e]2,385
Primary electricity:						
Hydro and geothermal	do.	245	249	252	255	[e]256
Nuclear	do.	150	178	191	208	[e]225
Total[3]	**do.**	**8,932**	**9,198**	**9,364**	**9,654**	**[e]9,986**

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

[1]Nickel content of refined nickel, ferronickel, and nickel oxide.

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

[3]Data may not add to totals shown because of independent rounding.

Sources: Based on data provided by the World Bureau of Metal Statistics (market economy countries, nonferrous metals except magnesium); Metallgesellschaft AG (centrally planned economy countries, nonferrous metals and all magnesium consumption); British Sulphur Corp. Ltd. (nonmetals); and 1987 United Nations Energy Statistics Yearbook (all mineral fuels for 1984-87). Data on iron ore and iron and steel scrap for all years and on mineral fuels for 1988 compiled from a variety of sources by the U.S. Bureau of Mines.

TABLE 6

ANNUAL INVESTMENT IN THE STEEL INDUSTRY FOR SELECTED COUNTRIES

(Million dollars)

Country or country group	1983	1984	1985	1986	1987
Organization for Economic Cooperation and Development (OECD):					
European Communities:					
Belgium	281	179	229	308	321
France	420	544	504	420	494
Germany, Federal Republic of	618	733	1,268	914	851
Ireland and Denmark	6	7	8	6	6
Italy	550	368	583	978	821
Luxembourg	32	34	50	71	85
Netherlands	132	131	239	348	278
Portugal	([1])	([1])	([1])	1	8
Spain	([2])	([2])	([2])	650	696
United Kingdom	225	297	263	365	479
Subtotal[3]	[r]2,295	[r]2,345	[r]3,159	[r]4,081	4,045
EFTA[4]	198	274	372	[r]457	598
Other:[5]					
Australia	64	96	134	485	NA
Canada	156	176	310	476	NA
Japan	3,744	2,669	2,892	[r]4,011	3,488
Spain[6]	131	290	395	XX	XX
Turkey	232	217	210	146	98
United States	3,137	1,203	1,641	[r]862	1,160
Total[7]	**[r]7,662**	**[r]4,925**	**[r]5,954**	**[r]1,107**	**9,389**
Latin America:					
Argentina	164	147	184	191	262
Brazil	1,248	809	472	413	540
Chile	2	11	1	4	1
Colombia	24	8	13	[r]10	11
Ecuador	NA	NA	2	NA	NA
Mexico	410	526	491	119	171
Peru	5	1	4	2	1
Uruguay	9	1	1	1	—
Venezuela	90	25	25	121	111
Central America	6	([8])	NA	NA	1
Total[9]	**[10]1,959**	**1,528**	**1,193**	**851**	**[8]1,099**
Grand total	**[r]11,916**	**[r]8,798**	**[r]10,306**	**[r]11,379**	**9,389**

[r] Revised. NA Not available. XX Not applicable; included with EC figures.

[1] 1983-85 figures included with EFTA total; joined EC in 1986.

[2] 1983-85 figures listed separately; joined EC in 1986.

[3] Source: EUROSTAT Iron and Steel Statistical Yearbook 1988. Luxembourg 1989. Source reports in million European Currency Units (ECU). For this tabulation the units in the source have been converted to U.S. dollars using the following factors supplied by the International Monetary Fund: U.S. dollars per ECU, average for the period: 1983—0.89128; 1984—0.78899; 1985—0.76219; 1986—0.98119; and 1987—1.15432.

[4] European Free Trade Association (EFTA) figures exclude data for Switzerland.

[5] Data for New Zealand have not been available since 1979.

[6] Portugal and Spain became members of the EC effective Jan. 1, 1986.

[7] Sources for OECD other than EC: The Iron and Steel Industry in 1984. Paris, 1986, p. 32; The Iron and Steel Industry in 1985. Paris, 1987, p. 32; The Iron and Steel Industry in 1986. Paris, 1987, p. 32; The Iron and Steel Industry in 1987. Paris, 1988, p. 32.

[8] Less than 1/2 unit.

[9] Source for Latin America: Instituto Latinamericano del Fierro y el Acero. Statistical Yearbook of Steelmaking and Iron ore Mining in Latin America 1988. Santiago, p. 189.

[10] Data do not add to total shown because of rounding.

TABLE 7

MARKET ECONOMY COUNTRY PETROLEUM INDUSTRY CAPITAL AND EXPLORATION EXPENDITURES, BY GEOGRAPHIC AREA

(Million dollars)

Area and type of expenditure	1983	1984	1985	1986	1987
United States:					
Capital	4,400	3,710	3,710	2,800	2,960
Exploration	46,260	48,060	43,640	24,830	19,760
Total	**50,660**	**51,770**	**47,350**	**27,630**	**22,720**
Other North America:					
Capital	1,720	2,760	3,330	2,100	1,610
Exploration	6,810	9,490	8,790	6,380	5,930
Total	**8,530**	**12,250**	**12,120**	**8,480**	**7,540**
Central and South America:					
Capital	1,220	980	850	820	800
Exploration	6,920	4,750	4,910	4,870	4,430
Total	**8,140**	**5,730**	**5,760**	**5,690**	**5,230**
Western Europe:					
Capital	2,050	1,720	1,650	1,480	2,730
Exploration	11,960	12,100	11,620	11,550	12,030
Total	**14,010**	**13,820**	**13,270**	**13,030**	**14,760**
Africa and Middle East:					
Capital	1,880	1,750	990	940	1,020
Exploration	5,970	4,530	4,010	3,160	2,770
Total	**7,850**	**6,280**	**5,000**	**4,100**	**3,790**
Far East and Oceania:					
Capital	2,130	1,630	2,110	3,090	3,420
Exploration	5,240	4,970	4,400	3,680	2,100
Total	**7,370**	**6,600**	**6,510**	**6,770**	**5,520**
Tankers	4,300	2,050	990	1,580	1,510
World:					
Capital (including tankers)	17,700	14,600	13,630	12,810	14,050
Exploration	83,160	83,900	77,370	54,470	47,020
Grand total	**100,860**	**98,500**	**91,000**	**67,280**	**61,070**

Source: Chase Manhattan Bank, Global Energy Component. Capital Investments of the World Petroleum Industry 1987. New York.

TABLE 8

SALIENT STATISTICS ON U.S. FOREIGN INVESTMENT IN MINERAL INDUSTRY ACTIVITIES

(Million dollars)

	1985	r1986	r1987	1988
Direct foreign investment:				
Mining, smelting, refining	7,345	7,923	8,135	9,446
Petroleum	57,695	58,497	61,800	59,658
Reinvested earnings of foreign affiliates:				
Smelting and fabricated metals	198	476	862	1,145
Petroleum	2,594	27	1,822	45
Equity and intercompany account flows:				
Smelting and fabricated metals	-136	243	-276	126
Petroleum	-4,026	3,331	1,523	-1,797
Income:				
Mining, smelting, refining	r263	413	593	943
Petroleum	9,306	8,477	8,667	7,932

r Revised.

Source: U.S. Department of Commerce. Survey of Current Business, v. 69, No. 8, Aug. 1989.

TABLE 9

WORLD MERCHANT FLEET DISTRIBUTION, BY TYPE[1]

		1984	1985	1986	1987	1988
Number of vessels:						
Bulk carriers		5,560	5,787	5,481	5,302	5,332
Freighters[2]		14,019	13,937	12,786	12,572	12,518
Tankers		5,482	5,456	4,999	5,090	5,250
Other[3]		363	375	352	343	368
Total		**25,424**	**25,555**	**23,618**	**23,307**	**23,468**
Gross tonnage:						
Bulk carriers	thousand long tons	129,274	135,366	130,654	128,468	130,225
Freighters[2]	do.	94,549	97,284	93,157	93,966	95,932
Tankers	do.	164,451	158,508	134,660	135,010	140,833
Other[3]	do.	3,705	3,898	3,798	3,688	4,367
Total	**do.**	**391,979**	**395,056**	**362,179**	**361,132**	**371,357**
Deadweight tonnage:						
Bulk carriers	do.	225,496	235,833	227,325	224,309	227,515
Freighters[2]	do.	124,758	126,542	118,845	116,937	118,077
Tankers	do.	304,589	292,345	245,584	245,906	254,796
Other[3]	do.	1,579	1,604	1,476	1,405	1,531
Total	**do.**	**656,422**	**[4]656,323**	**[4]593,229**	**588,557**	**601,919**

[1] Maritime Administration classification. Tankers include whaling tankers. Vessels shown here as "Other" include combination passenger and cargo and combination passenger and refrigerated cargo. Data are as of Dec. 31 of the year indicated.

[2] Includes refrigerated freighters.

[3] Excludes refrigerated freighters.

[4] Data do not add to total shown because of independent rounding.

Source: U.S. Department of Transportation, Maritime Administration. Merchant Fleets of the World. Annual issues for 1984-88.

TABLE 10

MOVEMENT OF MINERAL COMMODITIES THROUGH THE PANAMA CANAL

(Thousand metric tons)

	1986			1987			1988		
	Atlantic to Pacific	Pacific to Atlantic	Total	Atlantic to Pacific	Pacific to Atlantic	Total	Atlantic to Pacific	Pacific to Atlantic	Total
METALS									
Ore and concentrate:									
Bauxite and alumina	103	898	1,001	116	744	860	181	1,404	1,585
Chromite	7	31	38	7	23	30	7	25	32
Copper	41	672	713	36	737	773	40	871	911
Iron	57	187	244	62	534	596	135	776	911
Lead	5	150	155	—	192	192	2	212	214
Manganese	47	195	242	36	193	229	72	198	270
Tin	—	30	30	—	15	15	—	9	9
Zinc	69	575	644	106	1,684	1,790	43	670	713
Other and unspecified	282	1,391	1,673	367	1,157	1,524	268	1,660	1,928
Subtotal	611	4,129	4,740	730	5,279	6,009	748	5,825	6,573
Ingots and semimanufactures:									
Aluminum	215	92	307	371	52	423	422	39	461
Copper	10	926	936	15	840	855	14	785	799
Iron and steel[1 2]	6,076	4,272	10,348	5,859	3,733	9,592	5,042	4,187	9,229
Lead	5	82	87	3	51	54	7	62	69
Tin[1]	21	19	40	14	11	25	13	10	23
Zinc	47	176	223	14	152	166	15	171	186
Other	31	41	72	19	80	99	37	73	110
Subtotal	6,405	5,608	12,013	6,295	4,919	11,214	5,550	5,327	10,877
Total	**7,016**	**9,737**	**16,753**	**7,025**	**10,198**	**17,223**	**6,298**	**11,152**	**17,450**
INDUSTRIAL MINERALS									
Borax	1	406	407	3	385	388	1	438	439
Cement	196	23	219	253	3	256	152	1	153
Clays, fire and china	363	15	378	447	27	474	480	25	505
Fertilizer materials	7,694	2,414	10,108	10,047	2,148	12,195	10,454	1,878	12,332
Salt	103	760	863	120	1,128	1,248	42	813	855
Sulfur	24	3,419	3,443	8	3,278	3,286	9	3,641	3,650
Other[3]	199	21	220	185	39	224	187	191	378
Total	**8,580**	**7,058**	**15,638**	**11,063**	**7,008**	**18,071**	**11,325**	**6,987**	**18,312**
MINERAL FUELS									
Carbon black	22	1	23	6	85	91	40	1	41
Coal and coke	7,655	2,715	10,370	5,997	2,052	8,049	5,477	3,237	8,714
Petroleum:									
Crude	2,980	10,164	13,144	3,447	5,655	9,102	2,865	6,063	8,928
Refined	9,148	9,063	18,211	9,863	7,398	17,261	9,183	6,958	16,141
Subtotal	12,128	19,227	31,355	13,310	13,053	26,363	12,048	13,021	25,069
Total	**19,805**	**21,943**	**41,748**	**19,313**	**15,190**	**34,503**	**17,565**	**16,259**	**33,824**
Grand total	**35,401**	**38,738**	**74,139**	**37,401**	**32,396**	**69,797**	**35,188**	**34,398**	**69,586**

[1] Tinplate is included under "Tin" as in the source publication rather than under "Iron and steel."
[2] Includes a category identified simply as "Scrap" in source publication, which may include scrap other than iron and steel scrap.
[3] Comprises asbestos, bricks and tile, clinkers, diatomite, dross, marble and other stone, slag, and soda and other sodium compounds.

Source: Panama Canal Commission Annual Report 1988.

TABLE 11

NONFERROUS METAL PRICES IN THE UNITED STATES

(Average cents per pound unless otherwise specified)

Year and month	Aluminum[1]	Copper[2]	Lead[3]	Zinc[4]	Tin[5]	Silver[6]	Cadmium[7]	Cobalt[8]
1984	81.000	66.757	25.548	48.601	5.680	8.140	1.693	10.40
1985	81.000	65.566	19.067	40.366	5.259	6.142	1.208	11.43
1986	55.869	64.652	22.047	37.995	2.941	5.470	1.248	7.49
1987	72.295	81.096	35.943	41.923	3.156	7.009	1.988	6.56
1988:								
January	89.711	131.096	38.000	44.439	3.182	6.733	3.283	7.04
February	96.275	106.117	34.845	45.439	3.154	6.325	4.725	6.98
March	107.087	108.320	34.000	47.901	3.191	6.413	8.591	6.85
April	107.119	102.241	34.000	51.501	3.191	6.478	9.550	7.02
May	114.476	102.973	34.571	56.036	3.216	6.543	9.479	7.03
June	126.273	112.875	36.295	62.550	3.309	7.037	9.300	7.00
July	122.250	103.448	36.500	65.644	3.355	7.147	9.300	7.03
August	124.391	100.051	36.522	66.463	3.427	6.708	9.300	7.04
September	111.381	114.720	38.405	68.255	3.449	6.365	6.974	7.10
October	104.725	136.648	39.149	69.446	3.391	6.285	5.925	7.12
November	107.350	150.920	41.375	71.248	3.421	6.275	7.010	7.37
December	110.000	159.870	42.018	73.440	3.428	6.108	7.743	7.49
Average	110.087	119.107	37.140	60.197	3.310	6.535	7.598	7.09

[1] For 1984–85 inclusive: U.S. list price, North American producer; for 1986–88: Metals Week U.S. market price.
[2] Electrolytic, f.o.b. refinery, producer.
[3] Refined lead, 1984–Sept. 1986 inclusive: U.S. producer price; Oct.1986–87; North America producer price.
[4] Prime Western, f.o.b. East St. Louis.
[5] U.S. dollars per pound, New York dealer.
[6] U.S. dollars per troy ounce, 0.99 fine, New York.
[7] U.S. dollars per pound, producer.
[8] U.S. dollars per pound, average annual spot for cathodes.

Source: American Bureau of Metal Statistics Inc. except Cobalt, which is compiled by the U.S. Bureau of Mines.

TABLE 12

NONFERROUS METAL PRICES IN THE UNITED KINGDOM[1]

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

Year and month	Aluminum[2]	Copper[3]	Gold[4]	Lead[5]	Silver[6]	Tin[7]	Zinc[8]
1984	56.526	62.562	360.438	20.117	8.140	5.566	40.459
1985	47.850	64.904	317.265	17.842	6.132	5.567	36.233
1986	52.179	62.314	367.512	18.429	5.465	2.723	34.194
1987	71.004	80.847	446.470	27.041	7.024	3.035	36.197
1988:							
January	91.260	120.799	476.580	30.206	6.732	3.088	39.810
February	98.260	105.698	442.074	29.706	6.342	3.035	39.722
March	114.580	107.018	443.607	29.390	6.411	3.072	44.501
April	113.850	103.706	451.547	29.414	6.452	3.063	48.462
May	137.050	111.039	451.068	30.267	6.542	3.074	53.332
June	164.870	115.225	451.332	30.678	7.016	3.191	61.867
July	122.640	100.403	437.629	28.057	7.098	3.243	56.081
August	125.240	99.821	431.277	27.254	6.708	3.322	59.345
September	109.790	110.474	413.455	27.629	6.372	3.360	60.298
October	106.530	133.334	406.781	29.683	6.283	3.290	68.851
November	110.420	149.897	420.168	31.327	6.294	3.317	70.634
December	113.520	158.708	419.047	33.117	6.122	3.328	72.236
Average	117.334	118.010	437.047	29.727	6.531	3.199	56.262

[1] London Metal Exchange.
[2] Unalloyed ingot, 99.5%.
[3] For 1984-85, electrolytic wirebars, monthly average settlement price; for 1986-88, Grade A settlement price.
[4] U.S. dollars per troy ounce, final price.
[5] Refined lead, monthly average cash price.
[6] U.S. dollars per troy ounce, 0.999 fine, spot price.
[7] U.S. dollars per pound, for 1984-87 Straits tin; beginning 1988 Kuala Lumpur tin market price. (1986 and 1987 average prices were the same on both markets.)
[8] Monthly average cash price: 1983-Aug. 1984 inclusive, slab; Sept. 1984-Dec. 1988, high grade.

Source: American Bureau of Metal Statistics Inc.

TABLE 13

NONFERROUS METAL PRICES IN CANADA

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

Year and month	Copper[1]	Lead[2]	Nickel[3]	Silver[4]	Zinc[5]
1984	63.365	25.805	3.200	8.140	49.006
1985	64.071	19.205	3.200	6.145	41.731
1986	64.222	22.245	3.200	5.474	40.403
1987	73.150	35.948	2.277	6.988	43.910
1988:					
January	135.310	38.000	3.789	6.739	45.600
February	114.919	34.905	3.888	6.329	46.095
March	104.403	34.000	6.161	6.415	48.522
April	110.605	34.000	7.864	6.482	53.500
May	103.790	34.545	7.724	6.550	57.318
June	117.034	36.000	7.000	7.057	63.136
July	96.472	36.000	6.638	7.181	66.000
August	97.393	36.087	6.554	6.726	66.000
September	118.131	38.000	5.207	6.385	68.864
October	129.964	38.857	5.125	6.299	70.571
November	167.158	42.000	5.720	6.295	72.000
December	163.016	42.000	7.421	6.144	74.864
Average	121.516	37.033	6.091	6.550	61.039

[1] Hudson Bay Mining & Smelting Co. Ltd. delivered price for cathode.
[2] Producers' price, carload quantities, pig lead, Cominco Ltd.
[3] U.S. dollars per pound 1984-86 inclusive: Canadian producer price. Beginning Jan. 1987: New York dealers, cathode.
[4] U.S. dollars per troy ounce.
[5] Producers' price, carload quantities, regular high grade, Cominco, Ltd.

Source: American Bureau of Metal Statistics Inc.

TABLE 14

LEADING WORLD PRODUCERS OF BAUXITE[1]

(Thousand metric tons, gross weight)

Country	1984	1985	1986	1987[p]	1988[e]
Australia	31,537	31,839	32,384	34,102	[2]36,192
Guinea	[r]12,740	[r]11,790	13,300	[r e]13,500	15,600
Brazil	6,433	5,846	6,544	[r e]8,750	8,750
Jamaica	[r]8,735	[r]6,239	6,944	7,660	7,408
U.S.S.R.[e 3]	[r]5,690	[r]5,695	[r]5,710	[r]5,715	5,730
India	2,093	2,281	2,322	2,736	[2]3,829
Suriname	3,454	3,738	3,731	2,581	[2]3,434
China[e]	1,600	1,600	1,650	2,400	3,200
Yugoslavia	3,347	3,538	3,459	3,394	[2]3,034
Hungary	2,994	2,815	3,022	3,101	[2]2,906
Greece	2,296	2,453	2,230	2,472	2,400
Guyana	1,333	[e]1,675	2,074	2,785	[2]1,774
Sierra Leone	1,040	1,185	1,246	1,390	1,400
Total	**[r]83,292**	**[r]80,694**	**84,616**	**90,586**	**95,657**
Other	[r]4,974	[r]4,592	4,251	4,508	4,333
Grand total	**[r]88,266**	**[r]85,286**	**88,867**	**95,094**	**99,990**

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

[1]Table includes data available through July 5, 1989.

[2]Reported figure.

[3]Includes bauxite equivalent of nepheline syenite concentrate and alunite ore, which are produced in the U.S.S.R. only.

TABLE 15

LEADING WORLD PRODUCERS OF ALUMINUM[1]

(Thousand metric tons)

Country	1984	1985	1986	1987[p]	1988[e]
United States	4,099	3,500	3,037	3,343	[2]3,944
U.S.S.R.[e]	2,100	2,200	2,300	2,400	2,400
Canada	[r]1,222	1,282	1,355	1,540	[2]1,535
Australia	758	851	882	1,004	[2]1,150
Brazil	455	549	757	843	874
Norway	765	[r]743	726	806	840
China[e]	400	410	410	[r]615	800
Germany, Federal Republic of	777	745	765	738	744
Venezuela	386	396	423	440	417
Spain	381	370	350	341	[2]323
France	342	293	322	323	322
United Kingdom	288	275	276	294	[2]300
India	269	260	257	245	298
Netherlands	249	251	266	276	[2]278
Romania	244	247	269	260	260
Yugoslavia[e]	270	280	282	244	250
Italy	230	[r]224	243	233	227
New Zealand	243	241	173	249	200
Indonesia	199	217	219	216	180
Total	**[r]13,677**	**[r]13,334**	**13,312**	**14,410**	**15,342**
Other	[r]2,028	[r]2,064	2,042	1,968	1,962
Grand total	**[r]15,705**	**[r]15,398**	**15,354**	**16,378**	**17,304**

[e]Estimated. [p]Preliminary. [r]Revised.
[1]Table includes data available through May 31, 1989.
[2]Reported figure.

TABLE 16

LEADING WORLD PRODUCERS OF CHROMITE[1]

(Thousand metric tons, gross weight)

Country	1984	1985	1986	1987[p]	1988[e]
South Africa, Republic of	3,407	3,699	3,907	3,789	4,200
U.S.S.R.[e]	2,940	2,940	[r]3,185	3,150	3,240
Albania[e]	720	825	850	830	750
Finland	446	506	678	543	700
India	423	560	630	624	700
Turkey	487	[r]589	543	[e]600	625
Zimbabwe	477	536	533	[r e]570	600
Brazil	260	190	223	[e]225	230
Philippines	261	272	174	188	190
Total	**9,421**	**[r]10,117**	**10,723**	**10,519**	**11,235**
Other	355	[r]399	371	398	431
Grand total	**9,776**	**[r]10,516**	**11,094**	**10,917**	**11,666**

[e] Estimated. [p] Preliminary. [r] Revised.
[1] Table includes data available through May 3, 1989.

TABLE 17

LEADING WORLD PRODUCERS OF MINE COPPER[1]

(Thousand metric tons, Cu content of ore)

Country	1984	1985	1986	1987[p]	1988[e]
Chile[2]	1,308	1,360	1,399	1,413	[3]1,472
United States[2]	1,103	[r]1,103	1,144	1,244	[3]1,420
Canada[2]	722	739	698	794	756
U.S.S.R.[e 2]	590	600	620	630	640
Zaire	562	558	532	[r e]525	530
Poland	431	431	434	438	440
Zambia	533	459	462	463	400
China[e]	180	185	185	[r]250	300
Peru[2]	354	391	397	406	298
Mexico	[r]190	[r]177	189	254	280
Australia	236	260	248	233	246
Papua New Guinea	164	175	178	218	[3]219
Philippines	233	222	223	216	[3]218
South Africa, Republic of	198	195	184	188	[3]170
Total	**[r]6,804**	**[r]6,855**	**6,893**	**7,272**	**7,389**
Other	[r]1,075	[r]1,114	1,108	1,056	1,064
Grand total	**[r]7,879**	**[r]7,969**	**8,001**	**8,328**	**8,453**

[e] Estimated. [p] Preliminary. [r] Revised.
[1] Table includes data available through July 5, 1989.
[2] Recoverable.
[3] Reported figure.

TABLE 18

LEADING WORLD PRODUCERS OF GOLD[1]

(Thousand troy ounces)

Country	1984	1985	1986	1987[p]	1988[e]
South Africa, Republic of	21,861	21,565	20,514	19,177	[2]19,881
U.S.S.R.[e]	8,650	8,700	8,850	8,850	9,000
United States	2,085	2,427	3,739	4,947	[2]6,460
Australia	1,296	1,881	2,414	3,559	4,887
Canada	2,683	2,815	[e]3,365	3,724	[2]4,110
Brazil[e]	[r]1,980	[r]2,320	[r]2,170	[r]2,690	3,220
China[e]	1,900	1,950	2,100	2,300	2,500
Papua New Guinea	[r]835	1,187	1,128	1,069	[2]1,226
Philippines	827	1,063	1,296	1,048	[2]1,134
Colombia	731	1,142	1,286	854	[2]933
Chile	541	554	577	548	640
Zimbabwe	478	472	478	473	475
Total	**[r]43,867**	**[r]46,076**	**47,917**	**49,239**	**54,466**
Other	[r]3,062	[r]3,208	3,617	3,795	3,988
Grand total	**[r]46,929**	**[r]49,284**	**51,534**	**53,034**	**58,454**

[e]Estimated. [p]Preliminary. [r]Revised.
[1] Table includes data available through June 7, 1989.
[2] Reported figure.

TABLE 19

LEADING WORLD PRODUCERS OF IRON ORE, IRON ORE CONCENTRATES, AND IRON ORE AGGLOMERATES[1]

(Thousand metric tons, gross weight)

Country	1984	1985	1986	1987[p]	1988[e]
U.S.S.R.	247,104	247,639	249,959	250,874	251,000
Brazil	112,132	128,251	132,288	134,105	[2]145,040
China[e]	75,000	80,000	90,000	100,000	105,000
Australia	[r]89,046	[r]97,447	94,015	101,748	[2]96,084
United States	52,092	49,533	39,486	47,648	[2]57,515
India	41,026	42,545	47,800	51,018	[2]52,322
Canada	[r]39,930	39,502	36,167	37,702	[2]38,742
South Africa, Republic of	24,647	24,414	24,483	22,008	[2]25,248
Sweden	18,123	20,454	20,489	19,627	20,440
Venezuela	13,054	16,228	19,125	17,782	[2]18,789
Liberia	15,100	15,318	15,295	13,742	[2]12,767
France	14,839	14,447	12,436	10,852	10,650
Mauritania	9,527	9,333	8,929	9,002	[2]10,004
Korea, North[e]	8,000	8,000	8,000	8,000	9,000
Mexico	8,317	7,820	7,298	7,522	[2]8,431
Chile	6,685	6,534	6,981	6,637	[2]7,866
Turkey	4,037	3,994	5,249	5,366	[2]5,693
Yugoslavia	5,321	5,478	6,618	5,983	5,545
Spain	7,261	6,463	6,089	4,700	4,200
Total	**[r]791,241**	**[r]823,400**	**830,707**	**854,316**	**884,336**
Other	38,108	[r]38,758	37,653	35,821	32,095
Grand total	**[r]829,349**	**[r]862,158**	**868,360**	**890,137**	**916,431**

[e] Estimated. [p] Preliminary. [r] Revised.
[1] Table includes data available through July 19, 1989.
[2] Reported figure.

TABLE 20

LEADING WORLD PRODUCERS OF CRUDE STEEL[1]

(Thousand metric tons)

Country	1984	1985	1986	1987[p]	1988[e]
U.S.S.R.	154,238	154,668	160,550	161,887	163,000
Japan	105,586	105,279	98,275	98,513	[2]105,681
United States	83,940	80,067	74,032	80,877	[2]90,650
China[e]	[2]43,370	46,700	52,100	56,000	59,000
Germany, Federal Republic of	39,389	40,497	37,134	36,248	[2]41,023
Brazil	18,386	20,456	21,234	22,231	[2]24,536
Italy	24,026	23,744	22,872	22,847	[2]23,668
Korea, Republic of	13,033	13,539	14,554	16,782	[2]19,113
United Kingdom	15,121	15,722	14,811	17,425	[2]19,013
France	[r]19,008	18,832	17,624	17,726	[2]19,003
Poland	16,533	16,126	17,144	17,148	17,000
Canada	14,715	[r]14,600	14,100	14,700	[2]15,175
Czechoslovakia	14,831	15,036	15,112	15,415	15,000
India	10,344	11,054	11,427	12,883	[2]14,198
Romania	14,437	13,795	14,276	13,885	14,000
Spain	13,484	14,235	11,976	11,691	12,000
Belgium	11,303	10,683	9,744	9,787	[2]11,196
South Africa, Republic of	7,827	8,582	[e]8,800	8,400	[2]8,600
German Democratic Republic	7,573	7,853	7,967	8,243	8,400
Korea, North[e]	6,500	6,500	6,500	6,500	8,000
Mexico	7,560	7,367	7,170	7,571	[2]7,794
Total	**[r]641,204**	**[r]645,335**	**637,402**	**656,759**	**696,050**
Other	[r]69,970	[r]72,551	73,852	76,440	81,734
Grand total	**[r]711,174**	**[r]717,886**	**711,254**	**733,199**	**777,784**

[e] Estimated. [p] Preliminary. [r] Revised.
[1] Steel ingots and castings. Table includes data available through June 12, 1989.
[2] Reported figure.

TABLE 21

LEADING WORLD PRODUCERS OF MINE LEAD[1]

(Thousand metric tons, Pb content of ore)

Country	1984	1985	1986	1987[p]	1988[e]
Australia	441	498	448	489	475
U.S.S.R.[e]	440	440	440	440	440
United States[2]	335	424	353	319	[3]394
Canada	264	268	349	414	[3]368
China[e]	180	200	[3]227	[3]252	300
Mexico	203	198	195	177	[3]170
Peru	194	202	194	204	[3]149
Korea, North[e]	110	110	110	110	110
Yugoslavia	114	115	115	107	100
Total	**2,281**	**2,455**	**2,431**	**2,512**	**1,425**
Other	[r]988	[r]975	923	917	2,001
Grand total	**[r]3,269**	**[r]3,430**	**3,354**	**3,429**	**3,426**

[e]Estimated. [p]Preliminary. [r]Revised.
[1]Table includes data available through June 19, 1989.
[2]Recoverable.
[3]Reported figure.

TABLE 22

LEADING WORLD PRODUCERS OF MANGANESE ORE[1]

(Thousand metric tons, gross weight)

Country	1984	1985	1986	1987[p]	1988[e]
U.S.S.R.	10,089	9,900	9,300	9,400	9,200
South Africa, Republic of	3,049	3,601	3,719	2,892	[2]3,440
China	2,869	2,611	2,723	2,750	2,750
Gabon	2,119	2,340	2,510	2,403	[2]2,250
Australia	1,849	2,003	1,649	1,853	[2]1,985
Brazil	2,693	2,523	2,697	[r e]2,070	1,900
India	1,130	1,240	1,213	1,303	[2]1,324
Mexico[e]	476	396	459	385	439
Ghana	269	[r]357	340	295	252
Hungary	67	63	63	78	75
Romania	66	[r]68	67	[e]65	65
Total	**[r]24,676**	**[r]25,102**	**24,740**	**23,494**	**23,680**
Other	[r]359	[r]282	242	232	247
Grand total	**[r]25,035**	**[r]25,384**	**24,982**	**23,726**	**23,927**

[e]Estimated. [p]Preliminary. [r]Revised.
[1]Table includes data available through June 9, 1989.
[2]Reported figure.

TABLE 23

LEADING WORLD PRODUCERS OF MINE NICKEL[1]

(Thousand metric tons, Ni content)

Country	1984	1985	1986	1987[p]	1988[e]
Canada	174	170	164	189	[2]199
U.S.S.R.[e]	175	180	185	185	190
New Caledonia[e]	[2]58	72	62	[r]57	68
Australia	77	86	77	75	[2]62
Indonesia	48	40	54	58	53
Cuba	32	32	[e]33	[r e]36	44
South Africa, Republic of[e]	25	25	32	34	35
Dominican Republic	24	25	22	32	29
Total	**613**	**630**	**629**	**666**	**680**
Other	[r]161	[r]175	141	146	155
Grand total	**[r]774**	**[r]805**	**770**	**812**	**835**

[e] Estimated. [p] Preliminary. [r] Revised.
[1] Table includes data available through May 4, 1989.
[2] Reported figure.

TABLE 24

LEADING WORLD PRODUCERS OF MINE SILVER[1]

(Thousand troy ounces, Ag content)

Country	1984	1985	1986	1987[p]	1988[e]
Mexico	75,340	73,167	75,200	77,643	[2]75,841
United States	44,592	39,433	34,524	39,793	[2]53,416
Peru	53,080	58,230	61,916	66,052	[2]49,885
U.S.S.R.[e] (refinery)	47,400	47,900	48,200	48,200	48,000
Canada	42,655	38,484	34,979	44,207	[2]44,094
Australia	31,260	34,914	32,882	35,986	35,848
Poland	23,920	26,717	26,653	26,717	[2]34,176
Chile	15,766	16,633	16,078	16,068	16,700
Spain	9,311	11,797	10,513	11,253	10,000
Japan (refinery)	10,403	10,915	11,294	9,035	[2]8,085
Sweden	7,676	7,442	7,555	6,912	6,800
South Africa, Republic of	6,997	6,700	7,145	6,691	[2]5,759
Yugoslavia (refinery)	4,051	5,015	5,690	4,859	4,850
Morocco	2,410	2,733	1,566	5,208	[2]4,197
Papua New Guinea	1,427	1,483	1,787	1,963	2,264
Namibia	3,255	3,404	3,472	2,411	[2]2,186
Total	**379,543**	**384,967**	**379,454**	**402,998**	**402,101**
Other	39,218	37,675	39,533	39,857	43,169
Grand total	**418,761**	**422,642**	**418,987**	**442,855**	**445,270**

[e] Estimated. [p] Preliminary.
[1] Table includes data available through June 27, 1989.
[2] Reported figure.

TABLE 25

LEADING WORLD PRODUCERS OF MINE TIN[1]

(Metric tons, Sn content of ore)

Country	1984	1985	1986	1987[p]	1988[e]
Brazil	19,957	26,514	26,246	27,364	[2]43,700
Indonesia	23,223	21,759	24,910	26,217	[2]30,590
Malaysia	41,307	36,884	29,135	30,388	[2]28,866
China[e]	15,000	15,000	15,000	[r]20,000	25,000
U.S.S.R.[e]	[r]12,000	[r]13,500	[r]14,500	[r]16,000	16,000
Thailand	21,960	16,864	17,066	15,006	[2]14,225
Bolivia	19,911	16,136	10,479	8,128	[2]10,504
Australia	7,923	[r]6,363	8,508	7,691	[2]7,247
Peru	3,314	[r]3,807	4,817	5,263	[2]4,378
United Kingdom	5,216	5,204	4,276	4,084	3,450
Canada	217	120	2,485	3,397	3,300
Zaire	2,708	3,100	2,650	2,378	2,200
South Africa, Republic of	2,301	2,153	2,054	1,438	[2]1,362
Total	**[r]175,037**	**[r]167,404**	**162,126**	**167,354**	**190,822**
Other	[r]13,146	[r]13,355	10,773	9,899	8,926
Grand total	**[r]188,183**	**[r]180,759**	**172,899**	**177,253**	**199,748**

[e] Estimated. [p] Preliminary. [r] Revised.
[1] Table includes data available through June 13, 1989.
[2] Reported figure.

TABLE 26

LEADING WORLD PRODUCERS OF MINE URANIUM[1]

(Metric tons, U_3O_8 content)

Country[2]	1984	1985	1986	1987[p]	1988[p]
Canada	13,171	12,814	13,824	14,664	14,347
South Africa, Republic of	6,762	5,751	5,460	4,735	4,583
United States	4,535	3,900	3,765	2,722	4,309
Australia	5,099	3,781	4,899	4,422	4,165
Namibia[e]	4,400	4,400	3,990	4,175	4,100
France	3,725	3,752	3,804	3,981	4,009
Niger	3,863	3,751	3,671	3,501	3,491
Gabon	1,079	1,105	1,059	934	1,094
Total	**42,634**	**39,254**	**40,472**	**39,134**	**40,098**
Others	940	970	1,068	1,112	1,007
Grand total	**43,574**	**40,224**	**41,540**	**40,246**	**41,105**

[e] Estimated. [p] Preliminary.
[1] Table includes data available through Oct. 31, 1989.
[2] Known market-economy producing countries; centrally planned economy countries excluded.

TABLE 27

LEADING WORLD PRODUCERS OF MINE ZINC[1]

(Thousand metric tons, Zn content of ore)

Country	1984	1985	1986	1987[p]	1988[e]
Canada	1,207	1,172	1,291	1,504	[2]1,352
U.S.S.R.[e]	810	810	810	810	810
Australia	677	759	712	778	766
China[e]	160	300	[2]396	[2]458	[2]527
Peru	466	523	598	613	[2]489
Mexico	304	292	278	272	[2]262
Spain	230	235	223	266	[2]256
United States	278	252	221	233	[2]256
Korea, North[e]	140	180	[r]225	[r]220	225
Sweden	210	216	220	219	[2]187
Poland	191	[r]188	185	184	184
Ireland	206	192	182	177	[2]177
Japan	253	253	222	166	[2]147
Brazil	114	124	124	133	[2]135
South Africa, Republic of	106	97	102	113	89
Yugoslavia	86	89	95	81	80
Thailand	41	78	97	89	[2]78
Greenland	71	70	62	69	78
Germany, Federal Republic of	113	118	104	99	75
Zaire	75	78	81	75	74
Total	**5,738**	**[r]6,026**	**5,607**	**6,559**	**6,247**
Other	786	[r]773	1,329	683	730
Grand total	**6,524**	**[r]6,799**	**6,936**	**7,242**	**6,977**

[e]Estiimated. [p]Preliminary. [r]Revised.
[1]Table includes data available through July 10, 1989.
[2]Reported figure.

TABLE 28

LEADING WORLD PRODUCERS OF HYDRAULIC CEMENT[1]

(Thousand metric tons)

Country	1984	1985	1986	1987[p]	1988[e]
China[e]	[2]121,080	142,500	161,500	180,000	203,000
U.S.S.R.	129,866	130,722	135,119	137,404	139,000
Japan	78,860	[r]72,847	71,264	71,551	[2]77,554
United States (including Puerto Rico)	71,395	71,540	72,499	72,122	[2]70,989
India	29,030	33,030	36,400	36,980	[2]40,700
Italy	37,782	36,677	35,340	[e]36,200	[2]37,257
Germany, Federal Republic of	28,909	25,758	26,580	25,268	31,010
Korea, Republic of	20,413	20,424	23,403	25,662	[2]28,995
Brazil	19,741	20,612	25,297	25,470	[2]25,328
France	22,724	23,546	[e]23,500	23,560	24,000
Spain (including Canary Islands)	25,435	24,197	[e]24,000	[e]23,400	24,000
Mexico	18,436	20,680	19,751	22,749	[2]22,872
Turkey	15,738	17,581	20,004	21,980	[2]22,675
Taiwan	14,234	14,418	14,806	15,663	[2]17,281
Poland	16,700	15,000	15,800	16,100	15,000
Romania	14,016	12,238	14,216	[e]14,300	14,000
United Kingdom	13,481	13,339	13,413	[e]13,400	13,500
Greece	13,521	13,669	13,341	13,168	13,000
Canada	8,609	10,192	10,602	12,603	[2]12,611
Iran	11,803	12,646	12,273	12,729	12,500
German Democratic Republic	11,555	11,608	11,988	12,430	12,500
Indonesia	8,858	10,081	10,941	11,844	[2]12,472
Total	**[r]732,186**	**[r]753,305**	**792,037**	**824,583**	**870,244**
Other	[r]208,422	[r]206,062	208,706	220,307	230,295
Grand total	**[r]940,608**	**[r]959,367**	**1,000,743**	**1,044,890**	**1,100,539**

[e]Estimated. [p]Preliminary. [r]Revised.
[1]Table includes data available through July 5, 1989.
[2]Reported figure.

TABLE 29

LEADING WORLD PRODUCERS OF NATURAL DIAMOND[1]

(Thousand carats)

Country	1984	1985	1986	1987[p]	1988[e]
Australia	5,692	7,070	29,211	30,333	[2]35,034
Zaire	18,459	20,159	23,304	19,425	19,000
Botswana	12,914	12,635	13,110	13,207	[2]15,229
U.S.S.R.[e]	10,700	10,800	10,800	[r]10,800	11,000
South Africa, Republic of	10,143	10,200	10,228	9,053	8,382
China[e]	1,000	1,000	1,000	1,000	1,000
Angola	902	714	[e]250	[e]190	1,000
Namibia	930	910	1,010	1,037	[2]938
Brazil	750	450	625	522	610
Total	**[r]61,490**	**[r]63,938**	**89,538**	**85,567**	**92,193**
Other	[r]1,962	[r]2,080	2,179	2,048	1,806
Grand total	**63,452**	**[r]66,018**	**91,717**	**87,615**	**93,999**

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

[1] Gem and industrial grades undifferentiated. Table includes data available through May 31, 1989.

[2] Reported figure.

TABLE 30

LEADING WORLD PRODUCERS OF NITROGEN IN AMMONIA[1]

(Thousand metric tons, N content)

Country	1984	1985	1986	1987[p]	1988[e]
U.S.S.R.	17,700	[r]18,300	19,600	20,000	20,500
China[e]	14,000	15,000	15,500	14,500	16,200
United States	[r]12,454	[r]12,915	10,804	12,002	12,637
India[3]	[r]3,832	[r]4,270	7,933	5,300	6,205
Canada	[r]2,871	[r]2,976	2,910	2,887	[2]3,297
Netherlands	[r]2,382	[r]2,516	2,692	2,828	[2]2,956
Romania	2,861	2,880	3,040	2,788	2,800
Indonesia	1,658	2,057	2,299	2,364	[2]2,367
Poland	[r]1,822	1,812	2,124	2,177	2,200
Mexico	1,773	1,859	1,602	1,744	2,067
France	2,342	2,012	2,022	2,029	1,832
Germany, Federal Republic of	1,963	1,908	1,570	1,932	[2]1,750
Italy	[r]1,460	[r]1,471	1,536	1,494	[2]1,560
Japan	[r]1,675	[r]1,646	1,508	1,556	[2]1,524
Trinidad and Tobago	1,080	[r]1,085	1,141	1,128	[2]1,386
German Democratic Republic	1,203	1,206	1,193	1,315	1,350
Pakistan	1,128	1,107	1,154	1,179	[2]1,202
United Kingdom	1,836	1,767	1,388	1,415	[2]1,105
Bulgaria	1,138	1,138	1,091	1,070	1,050
Total	**[r]75,178**	**[r]77,925**	**81,107**	**79,708**	**83,988**
Other	[r]13,452	[r]13,210	10,296	14,566	14,960
Grand total	**[r]88,630**	**[r]91,135**	**91,403**	**94,274**	**98,948**

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

[1] Table includes data available through May 17, 1989.

[2] Reported figure.

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

TABLE 31

LEADING WORLD PRODUCERS OF PHOSPHATE ROCK[1]

(Thousand metric tons, gross weight)

Country	1984	1985	1986	1987[p]	1988[e]
United States	49,197	50,835	38,710	40,954	[2]45,389
U.S.S.R.[e]	33,300	33,750	33,900	34,100	38,820
Morocco[3]	21,245	20,737	21,178	[r e]20,000	24,783
China[e]	11,800	6,970	6,700	9,000	15,000
Tunisia	5,346	4,530	5,951	[e]6,390	[2]6,103
Jordan	6,263	6,067	6,249	6,800	5,666
Brazil	3,855	4,214	4,509	4,777	4,672
Israel	3,312	4,076	3,673	3,798	[2]3,479
Togo	2,696	2,452	2,314	2,644	[2]3,464
South Africa, Republic of	2,585	2,433	2,920	2,623	2,850
Total	**139,599**	**136,064**	**126,104**	**131,086**	**150,226**
Other	[r]16,256	[r]12,778	12,766	13,142	13,447
Grand total	**[r]155,855**	**[r]148,842**	**138,870**	**144,228**	**163,673**

[e] Estimated. [p] Preliminary. [r] Revised.
[1] Includes only phosphate rock; Thomas slag and guano are excluded. Table includes data available through May 10, 1989.
[2] Reported figure.
[3] Includes output from Western Sahara.

TABLE 32

LEADING WORLD PRODUCERS OF MARKETABLE POTASH[1]

(Thousand metric tons, K_2O equivalent)

Country	1984	1985	1986	1987[p]	1988[e]
U.S.S.R.	9,776	10,367	10,228	10,888	11,000
Canada	7,527	6,661	6,452	7,668	[2]8,070
German Democratic Republic	3,465	3,465	3,485	3,500	[2]3,510
Germany, Federal Republic of	2,645	2,583	2,161	2,199	[2]2,290
United States	1,564	1,296	1,202	1,262	[2]1,521
France	1,739	1,750	1,617	1,539	[2]1,502
Israel	1,100	1,200	1,255	1,253	[2]1,244
Total	**27,816**	**27,322**	**26,400**	**28,309**	**29,137**
Other	1,518	1,829	2,294	2,161	2,292
Grand total	**29,334**	**29,151**	**28,694**	**30,470**	**31,429**

[e] Estimated. [p] Preliminary.
[1] Table includes data available through Apr. 26, 1989.
[2] Reported figure.

TABLE 33

LEADING WORLD PRODUCERS OF SALT[1]

(Thousand metric tons)

Country	1984	1985	1986	1987[p]	1988 [e]
United States (including Puerto Rico)	[r]35,615	35,441	33,296	33,142	[2]34,506
China[e]	16,286	14,446	17,300	18,000	22,000
U.S.S.R.	16,500	16,100	15,300	15,400	15,500
Germany, Federal Republic of	12,212	13,080	13,102	13,466	13,605
Canada	10,235	10,085	10,332	10,129	10,647
India[e]	7,728	9,879	10,118	[r]9,902	8,402
France	7,149	7,113	7,084	[r]7,840	7,925
United Kingdom	7,126	7,145	6,855	7,081	7,000
Mexico	6,167	6,467	6,205	6,199	[2]6,965
Australia	5,695	5,835	6,130	6,486	6,500
Poland	4,441	4,865	5,421	6,168	5,700
Romania	4,874	5,019	5,355	5,395	5,400
Brazil	4,527	[r]2,689	2,200	4,550	4,600
Italy	3,978	3,746	[r e]4,233	[r e]4,494	4,500
Netherlands	3,674	4,154	3,763	3,979	[2]3,693
Spain	[r]3,388	3,240	[e]3,100	[e]3,100	3,100
German Democratic Republic[e]	3,133	3,138	3,134	[r]3,134	3,059
Japan	955	[e]1,200	1,370	1,397	1,400
Turkey	1,290	1,189	1,172	1,218	1,350
Total	**[r]154,973**	**[r]154,831**	**155,470**	**161,080**	**165,852**
Other	[r]17,339	[r]18,038	19,631	17,556	18,134
Grand total	**[r]172,312**	**[r]172,869**	**175,101**	**178,636**	**183,986**

[e] Estimated. [p] Preliminary. [r] Revised.
[1] Table includes data available through July 5, 1989.
[2] Reported figure.

TABLE 34

LEADING WORLD PRODUCERS OF ELEMENTAL SULFUR[1]

(Thousand metric tons)

Country	1985				1986			
	Native	From pyrites	Byproduct	Total	Native	From pyrites	Byproduct	Total
United States	[2]5,011	W	6,598	11,609	[2]4,043	W	7,044	11,087
U.S.S.R.[e]	[r][4]2,760	[r]2,421	[r]4,024	[r]9,205	[r][4]3,000	[r]2,090	[r]4,100	[r]9,190
Canada[e]	—	—	[r]6,694	[r]6,694	—	—	6,543	6,543
Poland[e]	[4]4,990	—	220	[r]5,203	[r][4]4,987	—	220	[r]5,207
China[e]	300	2,200	400	2,900	300	2,500	300	3,100
Japan	—	253	2,245	2,498	—	158	2,213	2,371
Mexico	[2]1,551	—	[e]629	[e]2,180	[2]1,588	—	[e]632	[e]2,220
Germany, Federal Republic of[e]	—	—	[r]1,769	[r]1,769	—	—	[r]1,773	[r]1,773
Saudi Arabia	—	—	1,100	1,100	—	—	1,446	1,446
Spain	—	1,231	[r][e]224	[r][e]1,455	—	1,195	[r][e]220	[r][e]1,415
France	—	—	1,723	1,723	—	—	1,306	1,306
Iraq[e]	[2]500	—	70	570	[2]600	—	200	800
South Africa, Republic of	—	562	[e]185	[e]747	—	499	218	717
Italy	1	280	[r][e]350	[r][e]631	—	309	[r][e]385	[r][e]694
Finland	—	248	302	550	—	275	[e]302	[e]577
Yugoslavia	—	[r]221	[e]173	[r][e]394	—	327	[e]178	[r][e]505
Sweden	—	210	146	356	—	227	174	401
Kuwait	—	—	238	238	—	—	[e]260	[e]260
Brazil	[2]4	91	134	229	[2]6	92	174	272
Iran[e]	30	—	150	180	30	—	250	280
German Democratic Republic[e]	—	—	330	330	—	—	315	315
Belgium[e]	—	—	[r]260	[r]260	—	—	[r]300	[r]300
Philippines	—	108	100	208	—	113	[e]120	[e]233
Total	**[r]15,147**	**[r]7,825**	**[r]28,064**	**[r]51,029**	**14,554**	**7,785**	**28,673**	**51,012**
Other	[r]175	[r]1,196	[r]2,255	[r]3,633	155	1,128	2,359	3,643
Grand total	**[r]15,322**	**[r]9,021**	**[r]30,319**	**[r]54,662**	**14,709**	**8,913**	**31,032**	**54,655**

See footnotes at end of table.

TABLE 34—Continued

LEADING WORLD PRODUCERS OF ELEMENTAL SULFUR[1]

(Thousand metric tons)

Country	1987[p]				1988[e]			
	Native	From pyrites	Byproduct	Total	Native	From pyrites	Byproduct	Total
United States	[2]3,202	W	7,336	10,538	[2,3]3,174	W	[3]7,572	[3]10,746
U.S.S.R.[e]	[r,4]3,000	[r]2,150	[r]4,950	[r]10,100	3,000	2,150	5,550	10,700
Canada[e]	—	—	[r]6,588	[r]6,588	—	—	6,907	6,907
Poland[e]	[r,4]5,104	—	220	[r]5,324	[4]4,900	—	190	5,090
China[e]	300	[r]3,700	[r]500	[r]4,500	300	3,900	550	4,750
Japan	—	79	2,237	2,316	—	[3]70	2,377	2,447
Mexico	[2]1,806	—	[e]678	[r,e]2,484	[2,3]1,629	—	764	2,393
Germany, Federal Republic of[e]	—	—	[r]1,825	[r]1,825	—	—	1,795	1,795
Saudi Arabia	—	—	1,432	1,432	—	—	1,450	1,450
Spain	—	960	[r,e]235	[r,e]1,195	—	1,100	240	1,340
France	—	—	[e]1,252	[e]1,252	—	—	1,142	1,142
Iraq[e]	[r,2]707	—	250	[3]957	[2]700	—	350	1,050
South Africa, Republic of	—	468	[r,e]215	[r,e]683	—	470	230	700
Italy	—	[r,e]330	[r,e]370	[r,e]700	—	320	375	695
Finland	—	311	[e]260	[e]571	—	300	281	581
Yugoslavia	—	264	[e]178	[r,e]442	—	258	173	431
Sweden	—	[e]220	[e]175	[e]395	—	224	174	398
Kuwait	—	—	[e]310	[e]310	—	—	360	360
Brazil	[2]6	77	230	313	[2]6	105	240	351
Iran[e]	30	—	300	330	30	—	300	330
German Democratic Republic[e]	—	—	315	315	—	—	315	315
Belgium[e]	—	—	[r]300	[r]300	—	—	310	310
Philippines	—	158	[e]140	[e]298	—	160	150	310
Total	**14,155**	**8,717**	**30,296**	**53,168**	**13,739**	**9,057**	**31,795**	**54,591**
Other	143	1,137	2,492	3,772	136	1,130	2,541	3,807
Grand total	**14,298**	**9,854**	**32,788**	**56,940**	**13,875**	**10,187**	**34,336**	**58,398**

[e]Estimated. [p]Preliminary. [r]Revised. W Withheld to avoid disclosing company proprietary data; included with "Byproduct."

[1]Includes all recorded production of sulfur, regardless of 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 (1) elemental sulfur and the S content of compounds such as H_2S, SO_2, and H_2SO_4 recovered as a principal product of pyrite mining and as a byproduct of the recovery of crude oil and natural gas and as a byproduct of petroleum refining, coal treatment, and metal smelting and/or refining, and (2) sulfur recovered from tar sands, spent oxides, and other miscellaneous sources. Table includes data available through May 31, 1989.

[2]Entirely Frasch process sulfur.

[3]Reported figure.

[4]Includes Frasch process sulfur as follows, in thousand metric tons: Poland (estimated): 1985—4,326 (revised), 1986—4,437 (revised), 1987—4,410 (revised), and 1988—4,400; the U.S.S.R. (estimated): 1985—960 (revised), 1986—1,100 (revised), 1987—1,100 (revised), and 1988—1,100; and total of individually listed countries and grand total: 1985—12,352 (revised), 1986—11,774, 1987—11,231, and 1988—11,009.

TABLE 35

LEADING WORLD PRODUCERS OF COAL (ALL GRADES)[1]

(Million metric tons)

Country	1985			1986			1987[p]			1988[e]		
	Lignite	Bituminous and anthracite	Total	Lignite	Bituminous and anthracite	Total	Lignite	Bituminous and anthracite	Total	Lignite	Bituminous and anthracite	Total
China[e]	([2])	850	850	([2])	870	870	([2])	920	920	([2])	946	946
United States	66	736	802	69	738	808	71	762	833	[3]70	[3]813	[3]883
U.S.S.R.	157	569	726	163	588	751	165	595	760	170	602	772
German Democratic Republic	312	—	312	311	—	311	309	—	309	305	—	305
Poland	58	192	250	67	192	259	73	193	266	[3]74	[3]193	[3]267
Australia	37	158	195	38	170	208	44	179	223	40	[3]174	214
India	8	149	157	8	163	171	8	177	186	8	189	197
Germany, Federal Republic of	121	82	203	114	81	195	109	76	185	[3]109	[3]73	182
South Africa, Republic of	—	174	174	—	177	177	—	177	177	—	182	182
Czechoslovakia	102	26	129	103	26	129	101	26	127	102	26	128
United Kingdom	([4])	94	94	([4])	108	108	([4])	104	104	([3] [4])	[3]104	[3]104
Canada	10	60	70	8	58	66	9	61	70	[3]10	[3]71	[3]81
Korea, North	[r]13	[r]44	[r]57	[r]14	[r]48	[r]62	15	55	70	18	62	80
Yugoslavia	69	([4])	70	70	([4])	70	72	([4])	72	[3]72	([3] [4])	[3]72
Romania	[r]39	[r]10	[r]49	40	11	51	44	12	56	45	12	57
Greece	36	—	36	38	—	38	43	—	43	[3]47	—	[3]47
Turkey	36	9	45	36	9	45	46	8	54	38	7	45
Spain	24	16	40	22	16	38	16	19	35	20	17	37
Bulgaria	[r]32	([4])	[r]32	35	([4])	35	35	([4])	35	35	([4])	35
Korea, Republic of	—	25	25	—	24	24	—	24	24	—	24	24
Hungary	21	3	24	21	2	23	21	2	23	[3]19	[3]2	[3]21
Total	**1,141**	**[r]3,197**	**[r]4,340**	**1,157**	**3,281**	**4,439**	**1,181**	**3,390**	**4,572**	**1,187**	**3,497**	**4,684**
Other	[r]19	[r]84	[r]101	22	83	103	22	84	104	25	46	71
Grand total	**[r]1,160**	**[r]3,281**	**[r]4,441**	**1,179**	**3,364**	**4,542**	**1,203**	**3,474**	**4,676**	**1,212**	**3,543**	**4,755**

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

[1] Table includes data available through Oct. 31, 1989. Data may not add to totals shown because of independent rounding.

[2] Output small; included under "Bituminous and anthracite."

[3] Reported figure.

[4] Less than 1/2 unit.

TABLE 36

LEADING WORLD PRODUCERS OF MARKETED NATURAL GAS[1]

(Billion cubic feet)

Country	1984	1985	1986	1987[p]	1988[e]
U.S.S.R.	20,700	22,700	24,200	25,670	27,200
United States	17,392	16,382	15,991	16,536	[2]16,630
Canada	2,506	2,831	2,696	2,845	[2]3,144
Netherlands (gross)	2,728	2,851	2,615	2,622	[2]2,317
United Kingdom	[r]1,263	[r]1,403	1,474	1,470	[2]1,299
Algeria	[r]1,360	[r]1,360	1,330	1,525	1,585
Mexico	1,243	1,197	1,175	1,194	[2]1,219
Indonesia	1,386	1,149	1,113	1,188	[2]1,312
Romania[e]	[r]1,379	[r]1,374	[r]1,390	[r]1,320	1,165
Norway	[r]997	[r]943	992	1,055	[2]1,053
Saudi Arabia	253	716	848	708	800
Iran	[r]477	[r]516	537	565	710
Italy	489	503	564	576	[2]587
Germany, Federal Republic of (gross)	563	511	490	560	412
Australia	446	475	519	531	[2]543
Argentina	[r]486	[r]517	562	583	625
United Arab Emirates	[r]344	[r]460	530	682	660
China[e]	438	455	485	495	505
Venezuela	518	498	576	465	450
German Democratic Republic[e]	459	459	459	459	425
Malaysia (Sarawak)	325	437	528	547	580
Total	**[r]55,752**	**[r]57,737**	**59,074**	**61,596**	**63,221**
Other	[r]3,875	[r]4,138	4,346	4,462	4,756
Grand total	**[r]59,627**	**[r]61,875**	**63,420**	**66,058**	**67,977**

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

[1] Comprises all gas collected and utilized as a fuel of a chemical industry raw material as well as that used for gas lift in fields, including gas used in oilfields and/or gasfields as a fuel by producers even though it is not actually sold. Excludes gas produced and subsequently vented to the atmosphere, flared, and/or reinjected to reservoirs. Table includes data available through Oct. 31, 1989.

[2] Reported figure.

TABLE 37

LEADING WORLD PRODUCERS OF NATURAL GAS PLANT LIQUIDS[1]

(Million 42-gallon barrels)

Country[2]	1984	1985	1986	1987[p]	1988[e]
United States	597	587	566	582	[3]595
U.S.S.R.[e]	[r]229	[r]250	[r]290	[r]321	318
Mexico	[r]94	99	128	123	135
Saudi Arabia	130	115	111	126	150
Canada	139	125	120	117	121
United Kingdom	55	60	67	66	[3]58
United Arab Emirates[e]	[r]48	[r]58	[r]68	[r]53	55
Algeria	[r]30	[r]33	41	46	35
Total	**[r]1,292**	**[r]1,294**	**1,350**	**1,388**	**1,432**
Other	[r]231	[r]223	236	255	255
Grand total	**[r]1,523**	**[r]1,517**	**1,586**	**1,643**	**1,687**

[e]Estimated. [p]Preliminary. [r]Revised.
[1] Every effort has been made to include 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 oil output 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 may include field output. Table includes data available through Oct. 31, 1989.
[2] In addition to the countries listed, China, Czechoslovakia, and the German Democratic Republic may also produce natural gas plant liquids in substantial quantities, but available information is inadequate to make reliable estimates of output levels.
[3] Reported figure.

TABLE 38

LEADING WORLD PRODUCERS OF CRUDE OIL[1]

(Million 42-gallon barrels)

Country	1984	1985	1986	1987[p]	1988[e]
U.S.S.R.	[r]4,503	[r]4,373	4,520	4,588	4,586
United States	3,250	3,274	3,168	3,047	[2]2,979
Saudi Arabia[3]	1,702	1,237	1,841	1,354	1,850
China[e]	836	874	954	978	999
Iraq	438	521	617	792	[2]981
Mexico	[r]982	960	886	927	[2]917
Iran	[r]806	[r]811	696	836	829
United Kingdom	[r]906	[r]914	905	878	[2]817
Venezuela	[r]658	614	657	667	[2]637
Kuwait[3]	424	374	519	497	[2]590
Canada	526	538	538	560	[2]584
United Arab Emirates	[r]427	[r]408	521	542	567
Nigeria	508	[r]540	535	472	[2]511
Indonesia	517	484	507	479	[2]491
Libya	406	392	389	368	374
Total	**[r]16,889**	**[r]16,314**	**17,253**	**16,985**	**17,712**
Other	[r]3,085	[r]3,220	3,382	3,473	3,693
Grand total	**[r]19,974**	**[r]19,534**	**20,635**	**20,458**	**21,405**

[e]Estimated. [p]Preliminary. [r]Revised.
[1] Table includes data available through Oct. 31, 1989.
[2] Reported figure.
[3] Includes the country's share of production from the Kuwait-Saudi Arabia Divided Zone.

TABLE 39

LEADING WORLD PRODUCERS OF REFINED OIL[1]

(Million 42-gallon barrels)

Country	1984	1985	1986	1987[p]	1988[e]
United States (including Puerto Rico and Virgin Islands)	5,223	5,179	5,301	5,339	[2]5,498
U.S.S.R.[e]	[r]3,223	[r]3,136	3,229	3,255	3,290
Japan	1,399	1,304	1,272	1,237	[2]1,274
China[e]	550	655	700	710	725
United Kingdom	[r]615	[r]611	624	625	[2]669
Germany, Federal Republic of	683	665	649	622	671
Italy	629	595	660	656	670
France	570	603	584	539	550
Canada	560	569	594	560	573
Mexico	502	519	505	520	522
Brazil	450	[r]449	476	453	430
Netherlands	407	364	430	436	[2]476
Venezuela	325	379	391	364	[2]368
Saudi Arabia[e 3]	[r]320	[r]363	[r]495	[r]503	520
India	252	306	335	357	368
Spain (including Canary Islands)	[r]345	[r]369	416	398	405
Singapore[e]	[2]293	394	287	282	285
Total	**[r]16,346**	**[r]16,460**	**16,948**	**16,856**	**17,294**
Other	[r]4,767	[r]4,594	4,877	5,004	5,165
Grand total	**[r]21,113**	**[r]21,054**	**21,825**	**21,860**	**22,459**

[e]Estimated. [p]Preliminary. [r]Revised.
[1]Table includes data available through Oct. 31, 1989.
[2]Reported figure.
[3]Includes country's share of production from the Kuwait-Saudi Arabia Divided Zone.

THE MINERAL INDUSTRIES OF

CENTRAL AFRICA

By Thomas P. Dolley, George A. Morgan, Hendrik G. van Oss, John G. Panulas, and George A. Rabchevsky

BURUNDI[1]

Building stone, cassiterite, kaolin, gold, lime, and peat were the only commodities mined. The country's main economy was in agriculture, primarily in coffee exports. Tribal violence occurred again, between the Hutu and Tutsi tribes, causing an estimated 50,000 deaths, mainly in rural and mining areas. The inflation and a large deficit continued. The country continued to import cement, fertilizers, oil, and petroleum products.

Burundi possessed numerous small gold deposits. The northwest and northeast were the country's two most important gold-bearing regions. A large kaolin deposit was found at Ngozi, and its mining was specified in the fifth 5-year development plan for 1988-1992. In the area of Rugombo, limestone was being explored with the intention of opening a cement plant.

Peat was mined in the central area at Gitanga and Ijenda, and in the north at Buyongwe and Kanyaru. Peat deposits in Akanyaru and Buyongwe were reported to be of relatively high energy value. Peat was used domestically as a substitute for firewood. Only about 2% of the population had access to electricity, most of which was imported from Zaire.

Of all the known mineral deposits in the country, the most important was the nickel deposit at Buhinda, northeast of Musongati. The deposit has an average content of more than 1.6% nickel, and also contains cobalt, copper, palladium, and platinum. All exploration and mining activities were at a virtual standstill.

Potentially minable deposits were also reported for iron-titanium-vanadium at Mukanda, in the central region, and for rare earths such as bastnasite-monazite in the west at Gakara. The latter deposits contained 0.3% europium. A relatively large phosphate deposit, with an average content of 11% P_2O_5, was found at Matongo in the northwest. Trial production was expected to start in 1989.

TABLE 1

BURUNDI: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1984	1985	1986	1987[p]	1988[e]
Clays: Kaolin		1,990	4,360	5,113	5,290	[3]4,021
Gold	troy ounces	1,115	829	980	836	[3]433
Lime		42	1,100	160	137	[3]96
Peat		14,000	10,313	12,455	17,000	[3]17,589
Tin, mine output, ore (60% SnO_2)		—	—	—	1,000	[e]1,000

[e]Estimated. [p]Preliminary.
[1]Includes data available through Feb. 20, 1990.
[2]In addition to the commodities listed, modest quantities of unlisted varieties of crude construction materials (clays, sand and gravel, stone) presumably are produced, but output is not reported quantitatively, and information is inadequate to make reliable estimates of output levels.
[3]Reported figure.

CAMEROON[2]

Export revenues from crude petroleum and agricultural products continued to dominate Cameroon's economy in 1988. External debt at yearend amounted to $4 billion.[3] Compared to the previous year, crude petroleum production declined marginally from approximately 174,000 to 172,000 barrels per day. Petroleum production had stabilized in the past 2 years since the 1986 decrease in worldwide oil prices. At yearend, recoverable oil reserves amounted to approximately 520 million barrels. In an effort to increase its reserve base, Cameroon offered new territory for exploration. France's Société Nationale Elf Aquitaine remained the primary foreign investor in Cameroon's petroleum sector. Elf's offshore multifield complex at Rio del Rey accounted for approximately 98% of Cameroon's oil production.

Nonfuel mineral production was limited to cement and tin. Cameroon possessed a variety of mineral deposits, but few were exploited. France's Bureau de Recherches Géologiques et Minières (BRGM) withdrew from a project to redevelop a cassiterite mine at Mayo-Darle due to the fall of the world price of tin. However, BRGM was still interested in development of titanium from a rutile deposit in alluvial soils of the Akonolinga region. BRGM began this assessment project in March with a target completion date of August 1989.

The Government wished to continue investigations in mineral development on such projects as a bauxite deposit with 75 million tons grading 37% aluminum hydroxide; chalk deposits for the cement industry; a diamond project at Mobilon also containing gold, rutile, and monazite (containing cerium and thorium); nepheline syenite, a possible bauxite source, at Kribi; and clays from Yaounde and Douala. The aluminum smelter at Edea operated at 96% of its output capacity in 1988. Total capacity was 85,000 tons per year. The smelter was a joint venture between Pechiney of France (58%) and the Government of Cameroon (42%), and was operated by Société Camerounaise d'Aluminium (Alucan). Guinea provided bauxite for the smelter.

In July, the United Kingdom office of GECO Geophysical Co. of Norway, in cooperation with the Government of Cameroon, conducted seismic surveys in the offshore Douala Basin. The Douala Basin covered 18,000 square kilometers of which 11,000 square kilometers was offshore acreage. The

1,200 kilometers of seismics shot were built on older seismic surveys of poor definition. Preliminary examination of the data by GECO indicated greater potential for oil reservoirs than had been previously thought. The data indicated that, geologically, the basin developed during Mesozoic time with the rifting of the South Atlantic Ocean and the deposition of a thick sequence of nonmarine clastic sediments from Late Jurassic to Late Cretaceous time. At the end of this period, the southern half of the basin developed massive evaporites. The beginning of Upper Cretaceous time to the present featured, in the area, open marine conditions that deposited a sedimentary prism of shales and sandstones prograding seaward.

Hydrocarbon reservoir rocks occur in the Lower Cretaceous pre-evaporite sequence as fluvial and alluvial deposits and in the Upper Cretaceous and Tertiary as channel fills and submarine fans with sandstone porosities of 16% to 25%. Possible petroleum traps might be found in Lower Cretaceous sands sealed by salt or by the base of the Upper Cretaceous unconformity that exists in the basin. Additional petroleum traps were postulated to exist in association with Upper Cretaceous sandstones and salt structures or in channel fill stratigraphic traps. The Government planned to invite bids to interested oil companies to explore offshore and onshore blocks in the Douala Basin in 1989. Most of the territory had not been under license in the past.

CENTRAL AFRICAN REPUBLIC[4]

Primarily an agrarian nation, the Central African Republic (CAR) remained one of the world's poorest and least monetized countries in 1988. Alluvial diamonds and gold were the primary minerals exploited in the landlocked country. Diamond production levels have increased since 1980 and were the principal export of the CAR in 1988.

The gross domestic product (GDP) was approximately $1.2 billion[5] in 1988. The country's annual per capita income was estimated at $393. The CAR's trade deficit was approximately $147 million, and the estimated foreign debt was $49 million. In December 1988, the Paris Club rescheduled the country's debt, which was the fourth rescheduling since 1981. Mining, manufacturing, and construction represented 14.5% of the GDP. Slow advancement toward economic development had typified the CAR's efforts since the nation's independence from France 27 years ago. Internal economic problems complicated by external factors resulted in a decline of per capita GDP between 1965 and 1986. Despite economic aid from France, the International Monetary Fund (IMF), the World Bank, and other international donors, coupled with economic reform programs, the CAR had not achieved the desired economic stability. The CAR remained heavily dependent on foreign assistance.

Early 1988 featured phase II of the Government's economic reform program. The phase concentrated on budgetary cutbacks and reforms in the civil service and public administration and planned initiatives in agriculture, mining, and other sectors. In May, the CAR initiated a new investment code that provided incentives and guarantees to domestic and foreign investors. The new investment code was hindered in August by the passage of a new law restricting the right of foreigners to purchase improved real estate. The new law was likely to inhibit some types of foreign investment.

Approximately 75% of the diamonds exported from CAR were gem quality, primarily mined from alluvial deposits in Carnot and Bria. Much of the production was from small-scale mining operations. Diamond and gold production had shown increases since the early 1980's. However, officially reported gem-quality and industrial diamond production figures had stabilized or decreased slightly over the past year, primarily due to suspected substantial smuggling and the consequent inaccuracies of reported figures. It was hoped that recent improved surveillance procedures at the mine sites and a lowered export tax would encourage full reporting of exports and attract large producers.

The National Diamond Agency (NDA), a joint venture between the Government and a United States firm, operated the country's only diamond cutting facility, which was capable of processing about 4,900 carats per year. Belgium rivaled France as the principal outlet for CAR diamond production, primarily due to Belgium's importance as a diamond cutter and distributor.

Osborne & Chappel Goldfields of Malaysia and Société d'Enterprise et d'Investissements (Sibeka) of Belgium participated in a joint venture exploration program to determine potential for alluvial diamonds along a 170-kilometer section of the Mamber River. Reconnaissance drilling in 1988 confirmed the presence of basal gravels containing an above average proportion of heavy minerals in two areas that were previously investigated in 1987. Further development of the prospects awaited the results of more detailed analysis. Gold production increased substantially over the 1987 value. This increase was due to figures in statistical surveys that were revised upward to include production that was channeled through jewelers and for which figures had been omitted in past years.

An estimated 80% of the CAR's energy needs were supplied by wood fires. Petroleum products were the largest commodity among imports to the CAR. Despite a recent decline in world prices for crude oil and consequent lower import costs, savings had not been passed on to consumers. Retail sales of petroleum products were controlled by the parastatal PETROCA, managed by its private partner, Compagnie Francaise Des Petroles (Total). Esso's exploratory drilling in 1985 revealed oil deposits, which were currently uneconomic to develop, in northern CAR.

Unconfirmed reports from the Government indicate that mining of CAR uranium deposits by Japanese investors could take place by 1990-91. Geographic location, poor transportation infrastructure, and depressed global markets continue to hinder mineral resource development in the CAR.

CHAD[6]

The landlocked nation of Chad had no significant mineral industry in 1988. Poor infrastructure, lack of significant foreign investment, and recent military conflict with Libya had hindered development of a viable mineral industry. In October, a cease-fire and reestablishment of diplomatic relations between Chad and Libya ended active conflict and allowed Chad to proceed with economic recovery. Economic recovery had mixed results in 1988. Foreign aid will be necessary in the foreseeable future for economic recovery or to assist long-term investments in mineral projects. This need for foreign assistance was exemplified by Chad's 1988 budget deficit of $23.8 million,[7] which was predicted to increase to $49 million by 1989. However, positive economic developments included increased foreign investment and $95 million of World Bank support for economic restructuring, educational support, telecommunications, and transportation infrastructure improvements.

In December 1988, Esso Chad of the United States, a consortium of Shell, Chevron, and Exxon, agreed to renew its exploration concession with two 5-year leases. Exploration would take place in the Sedigi oilfields near Lake Chad. Pending the discovery of sufficient oil reserves for domestic production, Esso Chad will participate in a World Bank-financed project for the construction and operation of a microrefinery in the capital city of N'Djamena. The Hunt International Petroleum Co. of the United States signed an agreement in December with the Government to conduct oil exploration in central Chad.

Chad and Libya continued to lay historical claim over the disputed Aouzou strip north of the Tibesti mountain region. Following military victories over Libya in 1987, Chad was able to recover all occupied territories except the Aouzou strip. The 116,550-square-kilometer area was known to contain tin, uranium, and other mineral deposits.

Significant rainfall caused agricultural production to soar in 1988, despite a poor transportation infrastructure for distribution of products. Chad possessed no railroad or river port facilities. The inadequate infrastructure also negatively affected exploration and exploitation of mineral resources. The Government and international donors made the establishment of an internal transportation network a high priority to aid development of the economy.

Chad remained one of the poorest countries in the world. Most of the daily energy needs in Chad continued to be generated from traditional fuels such as wood and charcoal. The modern segment of the Chadian economy utilized predominantly imported petroleum products, the bulk of which came from Nigeria and Cameroon. Shell, Mobil, and Total were the top three oil importers in Chad. These companies were the only ones with important storage facilities and distribution networks. The sales volume of these three companies in Chad was approximately 456,000 barrels of petroleum products. At yearend 1988, Chad expressed interest in outside financing for the acquisition of solar energy products. The Government intended to reduce demands on N'Djamena's powerplants through the installation of solar power equipment in Government buildings, private homes, and local industry.

CONGO[8]

Depressed world oil prices and the depreciation of the dollar thwarted development and created an economic crisis for the People's Republic of the Congo in 1988. This was the third consecutive year that the Government had to adopt austere budgetary measures due to the economic downturn. The petroleum sector improved during the year, and exploration and development activities were predicted to reach record levels in the early 1990's.

The Congo was a major oil producer in sub-Saharan Africa. Crude petroleum represented 80% of the Congo's export earnings for 1988. The oil export revenues amounted to $540 million, and industry experts predicted that oil revenue would climb to $630 million[9] by 1989. Petroleum production increased 4.4 million barrels over the 1987 figure. Production for 1989 should exceed 156,000 barrels per day. With continued exploration and development, Congo's total annual oil production could exceed 73 million barrels by 1992. The United States continued to be the main export market for Congolese petroleum.

The petroleum industry was the exception, and the remainder of the Congolese economy performed poorly during the year. The economy of the Congo remained heavily dependent on trade, notwithstanding attempts at diversification. The official policy of the Government favored diversification and encouraged private sector companies to stimulate growth. Industries such as forestry and agriculture were given special tax incentives and customs waivers.

The IMF program for Congo expired in April and a new agreement had not been negotiated by yearend 1988. The Government's decreased operating budget, civil servant salary reductions, and the privatization of parastatals and Government-run companies had been initiated to reduce the national deficit. The deficit amounted to approximately $600 million in 1988, and the total foreign debt was an estimated $4 billion.

Crude petroleum reserves in the Congo were estimated at 720 million barrels at yearend 1988. The Government hoped that incentives would attract increased foreign exploration and thus increase the nation's oil reserves. Hydro-Congo was the state-owned petroleum company. France's state-owned Société Nationale Elf Aquitaine (Elf) was the primary petroleum exploration force in west-central Africa, and the Congo was no exception. Elf Aquitane accounted for 83.1% of oil production from the Congo in 1988. The production was from Elf's offshore fields, primarily Sendji, Yanga, Emeraude, and Tchibouela. Experimentation at the Emeraude Field showed 450 million barrels of heavy,

TABLE 2

CAMEROON, CENTRAL AFRICAN REPUBLIC, AND CONGO: PRODUCTION OF MINERAL COMMODITIES[1]

Country[2] and commodity[3]		1984	1985	1986	1987[p]	1988[e]
CAMEROON						
Aluminum metal, primary	metric tons	73,100	90,296	83,810	79,008	[4]86,513
Cement, hydraulic[r]	do.	694,000	748,858	783,368	[e]734,000	734,000
Gold, mine output, Au content	troy ounces	[e]250	249	246	[e]250	250
Petroleum, crude[e]	thousand 42-gallon barrels	56,000	49,000	53,000	63,500	[4]62,780
Pozzolana	metric tons	NA	105,634	168,425	128,574	[4]130,490
Stone:						
Limestone	do.	NA	96,961	78,260	42,443	[4]57,369
Marble	do.	251,600	1,432	331	209	200
Tin ore and concentrate:						
Gross weight	do.	14	13	NA	8	7
Sn content	do.	10	10	9	6	6
CENTRAL AFRICAN REPUBLIC						
Diamond:						
Gem	carats	235,589	189,545	258,701	303,769	[4]284,130
Industrial	do.	101,562	87,452	98,677	108,455	[4]59,278
Total	**do.**	**337,151**	**276,997**	**357,378**	**412,224**	**[4]343,408**
Gold	troy ounces	6,953	6,033	7,041	7,181	[4]12,269
CONGO						
Cement, hydraulic	metric tons	[e]45,000	57,700	[e]58,000	[6]38,449	58,000
Copper, mine output, Cu content	do.	[e]135	253	[e]250	726	726
Gas natural:[e]						
Gross	million cubic feet	13,000	13,000	13,000	13,000	13,000
Marketed	do.	350	350	350	350	350
Gold, mine output, Au content[e]	troy ounces	101	515	168	150	150
Lead, mine output, Pb content	metric tons	1,740	1,460	[e]1,400	[e]1,400	1,750
Lime[e]	do.	[5]7,061	7,000	7,000	7,000	7,000
Petroleum, crude	thousand 42-gallon barrels	44,911	43,564	43,435	44,895	[4]49,275
Zinc, mine output, Zn content[e]	metric tons	2,780	2,336	2,300	2,300	1,750

[e]Estimated. [p]Preliminary. [r]Revised. NA not available.

[1]Includes data available through July 8, 1989.

[2]In addition to the countries listed, Equatorial Guinea and Sao Tomé e Principe, covered textually in this chapter, presumably produce modest quantities of a variety of crude construction materials (clays, stone, 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 make reliable estimates of output levels.

[3]In addition to the commodities listed, modest quantities of unlisted varieties of crude construction materials (clays, stone, sand, and gravel) presumably are produced, but output is not reported quantitatively and available information is inadequate to make reliable estimates of output levels.

[4]Reported figure.

[5]Includes imported clinker.

[6]Production includes July–Dec. 1987 only.

viscous oil, which could be exploited with steam injection recovery techniques. This process was deemed too costly and uneconomic at current market prices. Elf and British Petroleum were engaged in preliminary airborne and seismic surveys of onshore coastal tracts around Pointe-Noire. Additionally, the United Kingdom office of GECO Geophysical Co. of Norway, as part of the West African Salt Basin Project, conducted a series of test seismic profiles in an area offshore in early 1988. Further surveys were planned.

Hydro-Congo confirmed Amoco's oil discovery at its Yombo Marine II Field. The Kuwait Foreign Petroleum Exploration Co. was also associated with the project. Production was to be an estimated 3,350 barrels per day. The Yombo Marine II Field, which had a water depth of 115 meters, was situated approximately 87 kilometers offshore of Pointe Noire. Hydro-Congo had explored the area since 1979; Amoco joined the project in 1984. Production at the Zatchi offshore oilfield commenced in September 1988. This field, along with the offshore Loango Field, was owned and developed by Italy's Azienda Generali Italiana Petroli S.p.A. (Agip) Research Congo Oil Co. Construction of three offshore platforms was planned, in addition to the drilling of eight wells. Agip's total production from the Congo was 7.8 million barrels for 1988. Following initial development, planned production from the Zatchi Field was to be approximately 2,170,000 barrels in 1989.

With equity ownership by Elf at 65% and Agip at 35%, the offshore Tchibouela Oilfield should undergo full production in 1989. Situated off Pointe Noire, the field was expected to produce in excess of 140,000 barrels a day by 1989. On September 30, 1988, a U.S. oil company consortium involving Chevron, Amoco, and Shell signed an agreement with the Government of Congo to explore the onshore prospect identified as Kayes Tract C. Hydro-Congo had a 50% share of each permit. Additionally, Conoco of the United States had both onshore and offshore acreage. Congo's oil industry also should benefit from additional petroleum discoveries in neighboring Gabon and Angola's Cabinda sector.

The sole oil refinery in the Congo, at Pointe Noire, was operated by Congolaise de Raffinage (Coraf); equity ownership was by Elf (40%) and Hydro-Congo (60%). The Government was under pressure from international lenders to sell its share of Coraf and to end Hydro-Congo's monopoly on retail sales of petroleum products.

The Congolese nonfuels mineral sector remained underexploited in 1988. Primary reasons for the underdevelopment were the lack of financial support from commercial interests and glutted international markets in mineral commodities that the Congo possessed. During the year, the only mineral production was limited to a single Government-operated polymetallic mine and minor artisanal production of alluvial gold and diamonds at Kelle, near the Gabonese border. The Congolese Government had expressed interest in developing these alluvial gold deposits. Exploration was being conducted by RIDA Mining Corp., a subsidiary of the RLG Group in Houston, Texas, United States, to determine the extent of gold mineralization. Exports of lead-zinc concentrates amounted to 3,500 tons in 1988. The only significant mining effort in the Congo was a potash mine near Holle where sylvinite (KCl) was exploited. The mine commenced operations in 1969, but closed in 1977 when the mine flooded. Reopening of the mine awaited commercial interest. Additionally, the Congo possessed 30,000 tons of reserves of potash, near Holle, in the form of carnallite. Congo had estimated offshore phosphate deposits totaling 4.5 million tons. The High Ivingo region had approximately 1 billion tons of iron ore reserves.

The principal form of transportation in the Congo was the railroad, which had a record total of freight traffic at 465 million tons per kilometer. The opening of the Owendo mineral port and the Transgabonese railway in Gabon will sharply curtail Gabonese manganese export transshipments utilizing Congolese railroads. Prior traffic had amounted to 170 to 190 tons per month.

EQUATORIAL GUINEA[10]

The Republic of Equatorial Guinea is a small, tropical west-central African nation that has a total land area of 28,050 square kilometers and is slightly larger than the State of Maryland. The Republic consisted of two main provinces: the volcanic island of Bioko in the Gulf of Guinea and Rio Muni on the African mainland. Equatorial Guinea also included the smaller volcanic islands of Pagalu, Corisco, and the Elobeies that are within the national territory. Malabo, the capital of the country, was on Bioko.

In 1988, Equatorial Guinea had no significant mineral industry. The economy was based on agriculture, forestry, and fishing. These commodities accounted for 60% of the GDP and nearly all exports. Undeveloped mineral resources include alluvial gold, uranium, manganese, iron ore, and titanium.

At yearend, the nation's external debt was $189 million.[11] Population was approximately 347,000, and the average annual growth rate was 1.9%. Financial assistance from France, Spain, and the World Bank were forthcoming in 1988–89. The French were scheduled to complete a new hydroelectric plant, and a World Bank rehabilitation loan was to be utilized for municipal improvements.

Petroleum exploration and development in Equatorial Guinea, both onshore and offshore, continued to be delayed by lowered global oil prices and an unresolved maritime boundary dispute with neighboring Gabon. Seismic work and exploratory drilling were scheduled to begin, in 1988, on the 2,230-square-kilometer permit in Rio

Muni. The permit was shared by the principal operator, France's Société Nationale Elf Aquitaine Equatorial Guinea, Azienda Generali Italiana Petroli S.p.A. Africa Ltd. of Italy, and Britoil Co. Ltd. of the United Kingdom; each had a 25% interest. Murphy Equatorial Guinea Oil Co. and Rimrock Offshore Ltd. of the United States combined with Ultramar Exploration Co. Ltd. of the United Kingdom for an equity share of 25% in the venture. For 1989, GECO Geophysical Co. of Norway planned to conduct 1,250 kilometers of offshore seismic survey and evaluation, in cooperation with Equatorial Guinea's Ministerio de Minas e Hidrocarburos as part of the West African Salt Basin Project.

The Spanish-Equatorial Guinea Oil Co. (GEPSA) was owned 50% by Hispanoil of Spain and 50% by the Government of Equatorial Guinea. In 1985, GEPSA reported that the company had discovered substantial natural gas reserves north of the island of Bioko. With the decline of petroleum product prices worldwide, the lease was never developed, and Hispanoil's contract will expire in March 1990. During the year, GEPSA was planning to decide the fate of the natural gas reserve, which included forfeiture of the exploration costs and the reserve itself, or development and installation of a system to produce a gas concentrate; Hispanoil planned to sell its share to another partner.

GABON[12]

Gabon's economy in 1988 continued to be dominated by the export of petroleum and other minerals, notably manganese and uranium. Because world petroleum prices were even lower than in 1987, revenues from petroleum fell almost 20%, despite a modest increase in production. The decrease in oil revenues was the principal cause of the continued decline of the economy, as revealed by most economic indicators.

Interest in oil exploration remained very high as additional reserves were announced for the recently discovered Rabi-Kounga Oilfield. Work to complete the pipelines from the Rabi-Kounga Field to the exporting terminals progressed rapidly, and production from the field was predicted to start in January 1989, well ahead of schedule. Full production from the field, slated for 1990, was expected to almost double the country's total oil output. Record-high bids were received by the Government for several onshore petroleum exploration concession blocks.

The minerals port at Owendo was completed toward yearend, and the first shipment of manganese ore from the mine at Moanda to the port was made in early December. The port would allow Gabon, for the first time, to internally export at least one-half its manganese ore production, rather than exporting all of it through the Congolese port of Pointe Noire.

Studies conducted during the year of the Mabounié carbonatite, discovered in 1987, showed that the columbium and rare-earth resources therein were probably not economic, but that the phosphate resources would likely be.

Production and Trade

Mineral exports, chiefly of petroleum, manganese, and uranium, dominated the economy of Gabon in 1988. Revenues from mineral exports declined 15.4% to $910 million[13] as a result of low world prices for petroleum and uranium, but, nevertheless, were 75% of Gabon's total export income. Petroleum export revenues declined almost 19% to $710 million. Uranium export revenues were $79 million, a 5% decline. Manganese export revenues, however, increased slightly in value to $121 million. Gabon's largest nonmineral export was timber, for which export revenues were $180 million. France was again Gabon's largest trading partner, taking about 50% of Gabon's exports and supplying about one-third of the country's imports. Gabon's exports to the United States, mostly petroleum and manganese, were worth $199 million (16.4% of total exports) and imports from the United States totaled $54 million, or 7.7% of total imports. Total U.S. investment in Gabon at yearend was approximately $600 million.

Petroleum production increased slightly, but production of refined petroleum products was virtually unchanged. Gabon was the smallest oil-producing member of the Organization of Petroleum Exporting Countries (OPEC), and oil production during the year was just within the country's quota of 159,000 barrels per day. Gabon expected to have to renegotiate its OPEC quota, however, in light of the anticipated production from the new Rabi-Kounga Field, which alone was expected to produce about 120,000 barrels per day by 1990.

Uranium production increased 17%. Total manganese ore production decreased slightly, but was expected to increase in 1989 because of the increase in export capacity represented by the new minerals port at Owendo. Officially reported gold production almost doubled, but did not include artisanal production smuggled out of the country. No reliable estimates exist for the latter. It is likely that there was minor, undocumented artisanal production of alluvial diamonds during the year.

Commodity Review

Metals.—**Columbium.**—Exploration of the Mabounié carbonatite continued in 1988 and confirmed early suspicions that the bulk of the columbium-bearing pyrochlore mineralization was in weathered residuum above the carbonatite, rather than in the carbonatite itself.[14] Columbium resources were variously estimated as 15 million tons grading 2% columbium oxide, or 42 million tons grading 1.78% columbium oxide.

Tests were conducted in late 1987 and in 1988 to discover an economic recovery method for the pyrochlore.[15] Standard

TABLE 3

GABON: PRODUCTION OF MINERAL COMMODITIES[1]

Commodity[2]		1984	1985	1986	1987^{p}	1988^{p}
Cement, hydraulic	metric tons	207,916	244,768	210,858	137,400	[3]131,260
Diamond, gem and industrial^{e}	carats	550	550	500	—	—
Gas, natural:						
Gross	million cubic feet	74,484	^{e}75,000	70,000	62,500	67,235
Marketed	do.	4,800	^{e}4,000	3,000	4,000	^{e}4,500
Gold, mine output, Au content	troy ounces[4]	1,325	1,608	2,000	2,529	4,428
Manganese:						
Ore, gross weight (50% to 53% Mn)	metric tons	2,037,760	2,281,000	2,440,000	2,216,039	2,186,158
Pellets, battery- and chemical-grade, gross weight (89% to 85% MnO_2)	do.	81,102	59,000	70,000	187,000	67,977
Total	**do.**	**2,118,862**	**2,340,000**	**2,510,000**	**2,403,039**	**2,254,135**
Petroleum:						
Crude	thousand 42-gallon barrels	61,582	62,307	60,000	56,243	^{e}58,000
Refinery products:						
Gasoline	do.	490	523	480	447	459
Jet fuel and kerosene	do.	703	776	530	485	499
Distillate fuel oil	do.	1,465	1,690	1,380	1,121	1,153
Residual fuel oil	do.	1,285	2,912	1,130	1,100	1,080
Other^{e}	do.	[5]129	135	100	100	100
Refinery fuel and losses^{e}	do.	[5]148	200	130	150	150
Total^{e}	**do.**	**[5]4,220**	**6,236**	**3,750**	**3,403**	**3,441**
Uranium oxide (U_3O_8), content of concentrate	metric tons	^{r}1,079	^{r}1,105	1,059	934	1,094

^{e}Estimated. ^{p}Preliminary. ^{r}Revised.

[1] Table includes data available through Oct. 25, 1989.

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

[3] Of the cement produced, 104,000 tons was from domestic clinker.

[4] Gold production figures likely do not include production smuggled out of the country, for which there are no reliable data.

[5] Reported figure.

gravity separation tests were unsuccessful because of insufficient density contrast between the pyrochlore and several gangue minerals. Low-intensity magnetic separation experiments failed to give adequate separation of pyrochlore from magnetite because a significant proportion of the pyrochlore is iron bearing. Initial flotation tests also failed to yield a satisfactory pyrochlore concentrate, owing to the difficulty of separating the pyrochlore from its clay and iron oxide mineral gangue. Although it was planned to conduct further, selective, flotation tests in 1989, the consensus at yearend was that the columbium resource was likely uneconomic, except possibly as a byproduct of phosphate mining.

Gold.—Gold was produced by one small French-operated dredging operation at Lekita, near Lambaréné, and by numerous artisanal miners. Most of the production from the latter was smuggled out of the country. Despite the dearth of gold mines, the country contains numerous gold prospects. In October, the Government published two reports on gold in Gabon, the first of which was an annotated index describing 72 gold occurences,[16] and the second of which contained a geologic summary of gold mineralization and a detailed bibliography.[17]

Manganese.—The manganese ore shipping facilities at the port of Owendo were completed in December after 16 months of construction; the $45 million port was inaugurated December 30. With Owendo's completion, Gabon was able to export manganese ore via the recently completed Trans-Gabon Railroad, in addition to using the traditional aerial cableway and rail route to the Congolese port of Pointe Noire. The first manganese ore shipment to Owendo, consisting of about 5,600 tons loaded into 70 railcars, was made in early December. When all of the railcar-dumpers at Owendo become operational, normal ore shipment would be by 96-railcar trains.

The minerals port of Owendo can accept ships of 30,000- to 40,000-ton capacity, having a maximum draft of about 11 meters. The loading facilities at Owendo were reported to have a design capacity of at least 2.5 million tons of manganese ore per year, enough to handle all of Gabon's 1988 output. However, it was expected that at this output level, about one-half the production would continue to be exported through the Congo. It was estimated that about 1.35 million tons of ore would be shipped through Owendo in 1989. Any increase in manganese ore production over 1988 levels would be shipped through Owendo as well.

Industrial Minerals.—**Phosphates.**—Studies in 1987 and 1988 of the Mabounié carbonatite[18] showed the presence of a significant phosphate (apatite) resource in a weathering horizon immediately overlying the carbonatite itself. The phosphate horizon underlies the potentially economic columbium-rich horizon. However, following largely unsuccessful tests of the viability of the columbium deposit, attention was turned to the phosphate resource. The phosphate horizon varies in thickness from 5 to 41 meters and averages 16 meters. It has an average grade of 24% P_2O_5. Potential reserves were thought to be about 85 million tons at this grade. France's BRGM conducted a pilot study of phosphate recovery from this deposit, with emphasis on recovering a concentrate that was low in aluminum and iron. It was felt that it might be possible to economically recover columbium and rare earths, the latter in florencite, as a byproduct of phosphate mining. Investigations were to continue in 1989.

Mineral Fuels.—**Petroleum.**—The largest operators in Gabon were the Elf Group (67%), made up of France's Société Nationale Elf Aquitaine (SNEA) and its subsidiary Elf-Gabon; Shell-Gabon Oil Co. (13%); Amoco (11%); and Tenneco (9%). In July, Tenneco sold its assets in Gabon to British Gas Corp.

Interest in onshore petroleum exploration continued to be high, as a result of the discovery of the massive Rabi-Kounga Field in 1985 and the periodic announcements of increases in the field's reserves. Several onshore concessions were put up for bid by the Government; the encouraging news about Rabi-Kounga caused bid prices to be extraordinarily high.

The Rabi-Kounga Field was a partnership between Shell-Gabon (50%) and the Elf Group. Work on completing Shell's 135-kilometer pipeline from the field to the shipping port of Gamba was completed during the year, and work on Elf's 238-kilometer pipeline to Cape Lopez progressed rapidly. It was expected that the field would begin producing in late January 1989, almost 4 months ahead of schedule.

Published reserves for the field were increased during the year and at yearend stood at about 1.2 billion barrels, of which 450 million barrels were recoverable. However, it was widely felt that these reserves were conservative, and that the true reserves were perhaps twice as large. In addition, several smaller satellite deposits were proven to be economic, and these indicated that Rabi-Kounga was likely a part of a much larger field. The oil from the Rabi-Kounga Field has a low sulfur content and was expected to fetch about $1.20 per barrel more than oil from other Gabonese fields. Planned production from Rabi-Kounga was to be 15,000 barrels per day initially, rising to an estimated 80,000 barrels per day by yearend 1989, and to 120,000 barrels per day by mid-1990 and thereafter for the life of the field.

Elsewhere, Elf-Gabon reported that it held a 40% share of, and was operator for, the onshore Mabora permit in northern Gabon. Elf's partners were EXXON Corp., 25%; Britoil of the United Kingdom, 20%; and SNEA, 15%. Two exploration wells drilled on Elf's onshore Ogooué Sette-Cama and Ogooué Dianongo concessions intersected oil-impregnated sandstone; the Dianongo well had a flow of about 660 barrels per day.

In April, Tenneco and Winterschaft Oil A.G. of the Federal Republic of Germany signed a contract for exploration and production-sharing in the 4,000-square-kilometer Ananga block in L'Estuaire and Moyen-Ogooué Provinces. Tenneco would be the operator.

Sun International Exploration and Production Co., in partnership with Kerr-McGee Gabon Ltd., acquired the 908-square-kilometer Mahok Block along the coast, 10 to 50 miles south of Libreville. A group led by Petrofina Exploratie Gabon BV acquired the 914-square-kilometer Alombie block about 38 kilometers north of the Rabi-Kounga Field.

In April, Conoco was awarded two large, predominantly onshore blocks, its first onshore concessions. The first block was acquired in partnership with Esso and Phillips Petroleum and amounted to 2,200 square miles between Kango and Cocobeach. The second block was in partnership with Phillips Petroleum and amounted to a 1,000-square-mile area south of Lambaréné. It was expected that it would take 4 to 5 years to explore these blocks. The offshore portion of the Kango-Cocobeach concession diagonally overlapped a portion of Corisco Bay, which was an area of dispute between Gabon and Equatorial Guinea.

Total Exploration Gabon signed a production-sharing agreement for the 1,370-square-kilometer Migoumbi permit, its first as operator in Gabon. It was expected that the company would shoot 300 line kilometers of seismic survey and drill two wells during an initial 2-year exploration period.

RWANDA[19]

During 1988, Rwanda continued to endure economic hardships that were largely a result of the sharp decline in coffee prices that began in 1986. This, in tandem with the continued appreciation in Rwanda's currency value, caused Rwanda's economy to contract. Relative to 1987, GDP declined 2%, from $2.4 billion, while the country's trade deficit expanded about 6%, to over $160 million.[20] In order to finance imports, foreign exchange holdings were down, and, in turn, fell about 30%.

The Rwandan Government established and assumed a 51% controlling interest in Regie d'Exploitation et de Développement des Mines (REDM). This organization had the task of restarting and managing 20 tungsten and tin mines that closed with the 1985 bankruptcy of Rwanda's sole mineral agency, Société des Mines du Rwanda. Prior to that time, Rwanda exported annually about 1,500 tons of tin concentrate and 500 tons of tungsten concentrate. The two commodities combined generated roughly 20% of Rwanda's foreign exchange earnings and provided employment for 1,500 workers. It was expected that the success of REDM would depend on its ability to win long-term contracts for its output.

TABLE 4

RWANDA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]	1984	1985	1986	1987[p]	1988[e]
Beryllium: Beryl concentrate, gross weight	44	27	—	—	—
Columbite-tantalite, ores and concentrate, gross weight	52	28	—	—	—
Gold, mine output, Au content troy ounces	240	238	193	293	300
Tin:					
Mine output, Sn content	1,093	813	29	—	—
Smelter output, Sn content	1,000	800	—	—	—
Tungsten, mine output, W content	260	167	13	—	—

[e] Estimated [p] Preliminary

[1] Includes data available through Feb. 20, 1990.

[2] In addition to the commodities listed, modest quantities of unlisted varieties of crude construction materials (clays, sand and gravel, and stone) presumably are produced, but output is not reported quantitatively, and available information is inadequate to make reliable estimates of output levels.

SAO TOME E PRINCIPE[21]

Sao Tomé e Principe was a former Portuguese colony, which gained independence in 1975. Volcanic and mountainous, the dual island nation was south of Nigeria and west of Gabon on the Equator in the North Atlantic Ocean. The population, which had an average annual growth of 3%, was approximately 117,000 in 1988. The main industries were light construction, textiles, and fishing. The country had no mineral industry, with the exception of some small clay and stone open pit mines for local construction operations.

The small republic was in the midst of a 5-year plan for 1986–90. The plan called for the restructuring of the economy and rescheduling of external debt service payments with the cooperation of the International Development Association and other Western lenders.[22]

A barter trade agreement was signed between Sao Tomé e Principe and Angola in September. The agreement called for Sao Tomé to supply beer and other products through the Angolan port of Cabinda in exchange for petroleum and agricultural development assistance. In July, cooperation accords were signed between Portugal and Sao Tomé covering telecommunications, transportation, and banking.

ZAIRE[23]

In 1988, the mining industry accounted for about 25% of the GDP, and mineral export sales were about two-thirds of total exports. La Générale des Carrières et des Mines du Zaire (Gécamines), the largest and most important mining group in the country, contributed about 15% of the GDP, 57% of total export receipts, and 23% of total Government receipts.

Gécamines reported record receipts in 1988, primarily owing to higher world prices for its most important commodity, copper. Total sales of all products were $1.4 billion[24] compared with $1 billion in 1987. Copper accounted for $1.1 billion; cobalt, $223.2 million; zinc, $61.3 million; and all others, about $8 million. A $20 million credit was proposed by the International Development Agency (IDA) for a joint $30 million program with Gécamines. The program was intended to restructure the company's purchasing and management operations, to improve maintenance and rehabilitation functions and personnel management, and to introduce additional cost-accounting systems. Gécamines costs of production have risen relative to other world producers owing to modernization plans undertaken by the latter. High average copper ore grades of more than 4%, despite difficult recovery, had made Zaire's copper industry very competitive in the past. This advantage was offset by several inefficient procedures, which the Gécamines project with the IDA sought to rectify.

Gécamines employed a total labor force of 37,000, of whom about 33,000 were unskilled and semiskilled. In addition to a basic wage, workers are supplied with housing, health facilities, and food supplements.

Asea Brown Boveri of Sweden took over operation and maintenance of the Inga-Shaba powerline following the departure of Morrison-Knudsen. Contract terms were $20 million payable over 2.5 years. Asea proceeded with removal of vegetation along the route of the powerline and the replenishing of parts inventory. Communications remained to be reestablished between the power stations at Inga and the converter station at Kolwezi. Lack of foreign exchange has delayed some payments to Asea. The Société Nationale d'Electricité (SNEL) sought to obtain payment from Gécamines, the largest user of electricity in Shaba with more than 60% of total energy consumption.

A cooperation agreement was signed between SNEL and the Electricity Supply Commission of the Republic of South Africa for the transfer of technology and the training of staff. The agreement was part of an effort to establish a power grid covering southern Africa.

Government Policies and Programs

Zaire maintained a program of preshipment inspection to oversee exports and imports of merchandise. This was to reduce fraud, abusive trade practices, and price discrimination, as well as to prevent the importation of dangerous or substandard products.

Production and Trade

Belgium accounted for 30% of Zaire's exports. Zaire owed about $1.2 billion of its total external debt of $5.5 billion to Belgium.

Zaire broke with the IMF's fiscal regime in mid-1987, and has subsequently devalued its currency three times. Inflation was rampant in the first half of 1988 and averaged about 100% for the year. The margin between official and free market exchange rates was between 35% and 40%. An excess of 10% more than the official rate has generally led to the reemergence of the parallel market and to cross-border smuggling of diamonds to Brazzaville, Congo, and Bujumbura, Burundi.

Because of the great distances from the Zairian copper-cobalt production region to the coast, shipments for export are heavily dependent upon the railroads. About 50% of Gécamines exports was through the port of Matadi on the Atlantic Ocean via the Voie Nationale, 40% was via the southern route through Zambia and Zimbabwe to South Africa, and 10% was via the Tazara railroad through Zambia and the eastern route to Dar es Salaam. The Benguela railroad through Angola remained closed, although it would be the cheapest and fastest route if it were opened and operated efficiently. The Shaba Region was dependent upon imports of equipment, machinery, fuel, and food via these same routes, particularly the southern route. About 60,000 tons of coal and 70,000 tons of coke were imported from Zimbabwe and the Republic of South Africa. Shipping costs were highest to Matadi and lowest to Dar es Salaam.

The port of Ilebo on the Kasai River was a critical transshipment point for materials moving east and west on the Voie National, the only export-import route completely within Zaire. Rail transport was by the Société National Chemin de Fer Zairois, and the tariff schedule was indexed to the price of copper. Containers were used extensively to prevent pilfering of cargo. Traffic shipped from west to east through the port in the first 5 months of 1988 was 125,681 tons, of which 40,640 tons was reported to be fuel, and 23,682 tons was cargo shipped in containers. East-to-west traffic through Ilebo in the same period was 118,936 tons, of which 103,518 tons was minerals. Of 20,765 tons shipped via Kalemi on Lake Tanganyika in the same period, 17,609 tons was mineral related. Imports via Kalemi were only 751 tons, including 7 tons of fuel. Sakania, on the border with Zambia, remained the principal rail-transport route for material coming into Zaire. Of 202,028 tons imported in the first 5 months of 1988, 72,015 tons was coal and coke and 30,455 tons was liquid fuels. Exports via Sakania were 81,837 tons, of which 81,441 tons was minerals.

The Office National des Transports (Onatra) raised its fares 65% to help meet criteria proposed by the World Bank for modernizing the Voie National. A $280 million program to upgrade 300 kilometers of the Voie National was underway. Financing for the program was provided by the Arab Development Bank, Belgium, the European Community, France, and the Federal Republic of Germany. Onatra also commenced river transportation to private shippers in order to help reduce shipping delays on the Kasai River.

Commodity Review

***Metals.*—Cobalt.**—Zaire was the world's largest producer and exporter of cobalt. Cobalt sales were 15,707 tons in 1988, which were valued at $223.2 million, compared with 10,700 tons and $147 million in 1987. Production capacity was 18,000 tons per year, with the potential for further increase. On November 4, Zaire and Zambia, the world's two leading producers of cobalt, agreed to increase the producer price for cobalt from $7.50 per pound to $8.40 per pound. A joint group of representatives of Gécamines and Zambia Consolidated Copper Mines Ltd. has also proposed a quality grading program for cobalt. Initially set between buyer and seller, the proposal will provide for input by users as to the quality of cobalt required, particularly in aerospace applications. Also, the proposal set standards for sampling flake cobalt cathode, methods of anal-

TABLE 5

ZAIRE: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987[p]	1988[e]
METALS						
Cadmium, smelter		318	296	364	299	[2]281
Cobalt:						
Concentrate, Co content		25,943	29,200	33,373	[e]29,000	[e]25,400
Refined		9,075	10,791	14,518	11,871	[2]10,139
Columbite-tantalite concentrate:						
Gross weight	kilograms	100,000	147,000	[e]50,000	[e]50,000	[2]30,000
Cb content[e]	do.	27,000	40,000	13,000	13,000	7,800
Ta content[e]	do.	28,000	41,200	14,000	14,000	8,400
Copper:						
Concentrate, Cu content		562,000	557,900	566,030	[re]525,000	[e]530,000
Blister and leach cathodes		480,600	486,800	498,100	487,400	[2]466,779
Refined		224,774	221,400	218,000	210,100	[2]202,604
Gold	troy ounces	117,115	63,022	167,827	140,561	[2]114,553
Monazite concentrate, gross weight		2	—	7	97	[2]168
Silver	thousand troy ounces	1,225	1,516	[e]1,500	[e]1,400	[2]752
Tin:						
Mine output, Sn content		2,708	3,100	2,650	2,378	[2]2,688
Smelter, primary		170	85	56	[e]—	[2]120
Tungsten, mine output, W content		30	18	27	21	[2]20
Zinc:						
Mine output, Zn content		101,900	105,600	126,700	134,000	[e]130,000
Concentrate, Zn content		74,836	77,457	81,286	74,700	[e]80,000
Metal, primary, electrolytic		66,087	64,046	63,928	54,878	[2]61,086
INDUSTRIAL MINERALS						
Cement, hydraulic	thousand tons	[r]534	444	[e]400	[e]400	[e]400
Diamond:						
Gem[e]	thousand carats	5,169	4,032	4,661	3,885	2,734
Industrial[e]	do.	13,290	16,127	18,643	15,540	15,493
Total	**do.**	**18,459**	**20,159**	**23,304**	**19,425**	**[2]18,227**
Lime		109,856	115,365	136,400	98,500	[e]100,000
Stone, crushed	thousand tons	348	[e]350	[e]350	350	[e]400
Sulfur:						
Byproduct of metallurgy, S content of sulfuric acid from sphalerite[e]		37,000	36,000	38,500	34,500	35,000
Sulfuric acid, gross weight[3]		152,800	169,000	146,400	140,300	140,000
MINERAL FUELS AND RELATED MATERIALS						
Coal, bituminous	thousand tons	121	121	96	107	100
Petroleum:						
Crude	thousand 42-gallon barrels	11,698	12,226	11,857	11,420	11,400
Refinery products:						
Gasoline	do.	258	18	—	[e]250	250
Kerosene and jet fuel	do.	240	—	—	[e]250	250
Distillate fuel oil	do.	422	—	—	[e]450	450
Residual fuel oil	do.	364	—	—	[e]370	370
Refinery fuel and losses	do.	67	19	—	[e]80	80
Total	**do.**	**1,351**	**37**	**—**	**1,400**	**1,400**

[e] Estimated. [p] Preliminary. [r] Revised.
[1] Table includes data available through July 14, 1989.
[2] Reported figure.
[3] Includes acid produced from imported sulfur.

TABLE 6

ZAIRE: APPARENT EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Destinations, 1987 United States	Destinations, 1987 Other (principal)
METALS					
Antimony: Metal including alloys, all forms		—	13	—	Belgium-Luxembourg 8; Netherlands 5.
Cadmium: Metal including alloys, all forms		r [2]300	183	—	Belgium-Luxembourg 82; United Kingdom 51.
Chromium: Ore and concentrate		—	5	—	All to United Kingdom.
Cobalt:					
Oxides and hydroxides		583	337	337	
Metal including alloys, all forms		r [2]13,800	[2]9,367	4,246	NA.
Columbium and tantalum: Ore and concentrate		39	25	25	
Copper:					
Ore and concentrate[2]		32,140	38,884	—	NA.
Metal including alloys, all forms		[2]452,200	[2]505,108	24,492	NA.
Gold:					
Waste and sweepings	value, thousands	—	$45	$45	
Metal including alloys, unwrought and partly wrought	troy ounces	[2]62,758	[2]107,769	—	Belgium-Luxembourg 32,150.
Iron and steel: Metal:					
Pig iron, cast iron, related materials	value, thousands	—	$1	—	All to Turkey.
Ferroalloys:					
Ferromanganese		43	—		
Ferrosilicon		20	—		
Unspecified		20	—		
Semimanufactures: Universals, plates, sheets		25	—		
Lead:					
Ash and residue containing lead		21	—		
Metal including alloys:					
Unwrought		—	415	—	All to Belgium-Luxembourg.
Semimanufactures		—	5	—	Do.
Manganese:					
Ore and concentrate, metallurgical-grade		797	NA		
Metal including alloys, all forms		—	1	—	All to Belgium-Luxembourg.
Nickel: Metal including alloys:					
Unwrought		71	70	—	All to Italy.
Semimanufactures		190	NA		
Silver:					
Ore and concentrate[3]	value, thousands	$124	NA		
Metal including alloys, unwrought and partly wrought	do.	$1	—		

See footnotes at end of table.

TABLE 6—Continued

ZAIRE: APPARENT EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
METALS—Continued				
Tin:				
Ore and concentrate	r 2 4,545	2 3,328	—	Spain 934.
Oxides	—	56	56	
Metal including alloys:				
Unwrought	1,034	36	—	All to Belgium-Luxembourg.
Semimanufactures	10	—		
Tungsten:				
Ore and concentrate	r 2 60	2 53	—	
Metal including alloys, semimanufactures	10	—		
Zinc: Metal including alloys:				
Unwrought	r 2 70,100	2 46,115	17,338	NA.
Semimanufactures	—	1	—	All to Belgium-Luxembourg.
Other:				
Ores and concentrates	—	4	—	All to Italy.
Ashes and residues	106	NA		
Base metals including alloys, all forms	r 438,502	282	143	Taiwan 74; Belgium-Luxembourg 53.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc value, thousands	$20	NA		
Dust and powder of precious and semiprecious stones including diamond do.	$134	$312	—	All to Turkey.
Clays, crude: Kaolin	—	10	—	All to Belgium-Luxembourg.
Diamond:				
Gem, not set or strung value, thousands	$168,148	$221,700	$45,438	Belgium-Luxembourg $175,200.
Industrial stones do.	$14,843	$1,841	$7	Belgium-Luxembourg $1,196; Switzerland $7.
Dust and powder do.	$2,101	$3,837	$3,828	Spain $9.
Precious and semiprecious stones other than diamond: Natural value, thousands	$882	$1,126	$269	Hong Kong $792.
Stone, sand and gravel: Dimension stone:				
Crude and partly worked	195	NA		
Worked value, thousands	—	$3	—	All to French Guiana.
MINERAL FUELS AND RELATED MATERIALS				
Carbon black	—	1	—	All to Belgium-Luxembourg.
Petroleum:				
Crude thousand 42-gallon barrels	r 2 11,725	133,644	130,849	Belgium-Luxembourg 1,326; Italy 746.
Refinery products:				
Gasoline do.	—	283	—	All to Greece.
Residual fuel oil do.	r 97	NA		

r Revised. NA Not available.

[1] Table prepared by Virginia A. Woodson. Owing to a lack of available official trade data published by Zaire, this table should not be taken as a complete presentation of this country's mineral exports. These data have been compiled from trade statistics of individual trading partners unless otherwise specified.

[2] Conjoncture Economique (printed in Belgium).

[3] May include waste and sweepings and other precious metals.

TABLE 7

ZAIRE: APPARENT IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS				
Aluminum:				
Oxides and hydroxides	143	106	—	United Kingdom 105.
Metal including alloys, semimanufactures	984	599	—	Netherlands 291; Hong Kong 235.
Copper: Metal including alloys:				
Unwrought	—	1	—	All from Belgium-Luxembourg.
Semimanufactures	261	77	6	Belgium-Luxembourg 56; Italy 12.
Gold: Metal including alloys, unwrought and partly wrought value, thousands	$4	—		
Iron and steel: Metal:				
Scrap	—	2	—	All from Belgium-Luxembourg.
Pig iron, cast iron, related materials	2	2	—	Do.
Ferroalloys:				
Ferromanganese	1	—		
Ferrosilicon	5	—		
Unspecified	42	1	—	All from Belgium-Luxembourg.
Steel, primary forms	—	267	—	All from Italy.
Semimanufactures:				
Bars, rods, angles, shapes, sections	7,435	6,516	24	Belgium-Luxembourg 5,218; Italy 1,163.
Universals, plates, sheets	13,807	5,915	34	Belgium-Luxembourg 5,126; Italy 447.
Hoop and strip	1,228	327	—	All from Belgium-Luxembourg.
Rails and accessories	10,491	229	—	Do.
Wire	570	194	—	Belgium-Luxembourg 145; Italy 30.
Tubes, pipes, fittings	5,018	2,328	294	Belgium-Luxembourg 986; Italy 951.
Castings and forgings, rough	1,182	138	—	Italy 113; Belgium-Luxembourg 21.
Lead:				
Ore and concentrate	—	1	—	All from Belgium-Luxembourg.
Oxides	18	25	—	Do.
Metal including alloys:				
Scrap	—	12	—	Do.
Unwrought	118	1	—	All from Italy.
Semimanufactures	5	—		
Magnesium: Metal including alloys, scrap	—	70	—	All from Belgium-Luxembourg.
Nickel: Metal including alloys, semimanufactures	3	2	—	All from Switzerland.
Platinum-group metals: Metals including alloys, unwrought and partly wrought value, thousands	$13	$4	—	All from Belgium-Luxembourg.
Silver: Metal including alloys, unwrought and partly wrought do.	$542	$147	—	Switzerland $128; Belgium-Luxembourg $19.

See footnotes at end of table.

TABLE 7—Continued

ZAIRE: APPARENT IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS—Continued				
Tin:				
Ore and concentrate	—	1,332	—	All from Netherlands.
Metal including alloys:				
Unwrought	5	—		
Semimanufactures	2	—		
Titanium:				
Ore and concentrate	20	—		
Oxides	48	56	17	Belgium-Luxembourg 39.
Zinc:				
Oxides	8	25	—	Belgium-Luxembourg 21; Italy 4.
Metal including alloys, semimanufactures	12	—		
Other: Ores and concentrates	25	—		
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	7	2	—	Belgium-Luxembourg 1; Italy 1.
Artificial:				
Corundum	—	1	—	All from Switzerland.
Silicon carbide	—	11	—	All from Hong Kong.
Grinding and polishing wheels and stones	81	46	([2])	Belgium-Luxembourg 23; Italy 23.
Asbestos, crude	198	569	—	All from Canada.
Barite and witherite	400	5	—	All from Belgium-Luxembourg.
Boron materials: Crude natural borates	—	3	—	Do.
Cement	1,222	1,080	—	Belgium-Luxembourg 880; Portugal 169.
Chalk	60	138	—	Belgium-Luxembourg 128; Italy 10.
Clays, crude:				
Bentonite	23	11	—	All from Netherlands.
Chamotte earth	180	NA		
Kaolin	18	9	—	All from Italy.
Unspecified	208	NA		
Diamond: Gem, not set or strung carats	14,841	NA		
Diatomite and other infusorial earth	355	61	3	Belgium-Luxembourg 58.
Feldspar, fluorspar, related materials	—	10	—	All from Netherlands.
Fertilizer materials:				
Crude, n.e.s.	13	11	—	All from Belgium-Luxembourg.
Manufactured:				
Ammonia	89	72	34	Netherlands 22; Belgium-Luxembourg 16.
Nitrogenous	r3 12,202	r3 14,424	—	Belgium-Luxembourg 1,904; Netherlands 1,628.
Phosphatic	r3 6,541	r3 2,873	—	NA.

See footnotes at end of table.

TABLE 7—Continued

ZAIRE: APPARENT IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
INDUSTRIAL MINERALS—Continued				
Fertilizer materials—Continued				
Manufactured—Continued				
Potassic	812	200	—	All from Belgium-Luxembourg.
Unspecified and mixed	8,517	3,037	—	Do.
Graphite, natural	3	—		
Gypsum and plaster	5,902	13,313	—	Spain 13,287.
Lime	1,817	1,234	—	Belgium-Luxembourg 1,195.
Magnesium compounds:				
Magnesite, crude	8	2	—	All from Belgium-Luxembourg.
Oxides and hydroxides	137	NA		
Mica: Crude including splittings and waste	3	21	—	Italy 20.
Phosphates, crude	4	—		
Pigments, mineral: Iron oxides and hydroxides, processed	8	4	—	Belgium-Luxembourg 3; Italy 1.
Precious and semiprecious stones other than diamond: Natural value, thousands	$3	$4	$4	
Salt and brine	r 3 61,094	3 40,048	—	NA.
Sodium compounds, n.e.s.:				
Carbonate, manufactured	2,208	NA		
Sulfate, manufactured	r 3 12,251	3 11,954	—	NA.
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked	83	51	—	All from Italy.
Worked	442	1,170	—	Italy 629; Belgium-Luxembourg 254.
Gravel and crushed rock	28	—		
Quartz and quartzite	27	17	—	All from Hong Kong.
Sand other than metal-bearing	35	25	—	Belgium-Luxembourg 15; Netherlands 10.
Sulfur:				
Elemental: Crude including native and byproduct	117	47	—	All from Belgium-Luxembourg.
Sulfuric acid	346	462	—	Netherlands 282; Belgium-Luxembourg 113.
Talc, steatite, soapstone, pyrophyllite	289	163	—	Belgium-Luxembourg 140; Netherlands 20.
Other:				
Crude	140	17	—	All from Belgium-Luxembourg.
Slag and dross, not metal-bearing	180	52	—	Do.
MINERAL FUELS AND RELATED MATERIALS				
Asphalt and bitumen, natural	180	34	34	
Carbon:				
Carbon black	23	6	1	Italy 4.
Gas carbon	—	5	—	All from United Kingdom.

See footnotes at end of table.

TABLE 7—Continued

ZAIRE: APPARENT IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987	
				United States	Other (principal)
MINERAL FUELS AND RELATED MATERIALS—Continued					
Coal: Briquets of anthracite and bituminous coal		—	125	—	All from Belgium-Luxembourg.
Coke and semicoke		2	1,002	—	Do.
Peat including briquets and litter		24	5	—	Do.
Petroleum refinery products:					
Liquefied petroleum gas	thousand 42-gallon barrels	(2)	(2)	(2)	
Gasoline	do.	13	2 1	—	NA.
Mineral jelly and wax	do.	4	3	—	Hong Kong 1; Netherlands 1.
Kerosene and jet fuel	do.	r 3 867	3 758	—	NA.
Distillate fuel oil	do.	r 3 2,369	3 1,700	—	NA.
Lubricants	do.	20	60	(2)	Portugal 51; Spain 7.
Residual fuel oil	do.	r 3 332	3 67	—	NA.
Bitumen and other residues	do.	6	9	—	Spain 8; Belgium-Luxembourg 1.
Bituminous mixtures	do.	4	(2)	—	All from Belgium-Luxembourg.

r Revised. NA Not available.

[1] Table prepared by Virginia A. Woodson. Owing to a lack of available official trade data published by Zaire, this table should not be taken as a complete presentation of this country's mineral imports. These data have been compiled from trade statistics of individual trading partners unless otherwise specified.

[2] Less than 1/2 unit.

[3] Conjoncture Economique (printed in Belgium).

ysis, and trace-element levels.

Copper.—Sales of copper by Gécamines in the first quarter of 1988 were 106,676 tons. Prices averaged 107.49 cents per pound compared with a projected 72.03 cents per pound. Total revenue in that period for copper alone was $252.8 million. Gécamines export services operated normally until late in the year, when shortages of railcars, poor track conditions, and inadequate river loading facilities delayed some export shipments of copper. Preference was given to copper shipments over zinc because of the higher prices for red metal on the world market. Movement of ore and concentrates between mines and processing plants continued to be inadequate, resulting in shortages at some facilities. About 15 million tons of ore was processed annually by the washing plant and the concentrators. Gécamines used a $110 million World Bank loan for equipment purchases and modernization plans at its existing mines. It commenced exploration for new ore bodies in its southern concession area, although the Société de Développement Industriel et Minière du Zaire (Sodimiza), whose concession reverted to Gécamines in 1987, had made some discoveries earlier in the region. Exploration was underway for economic prospects in the upper and lower Roan Group in the vicinity of Mbaya, Kimpe, Kisaby, Kamibuka, and Lubembe.

Klockner AG of the Federal Republic of Germany proposed the construction of an electrorefinery in the Kolwezi area to produce high-grade copper cathode in lieu of the wirebar currently produced. The refinery would be built at the site of the uncompleted refinery near Luilu. Work on that facility was terminated in the late 1970's owing to financing problems and two rebel invasions. Only the foundation for the flash smelter was completed at that time. Planned capacity was 100,000 tons of copper per year.

Gécamines' SKM open pit mine had a waste-to-ore ratio of about 3 and produced about 13 million cubic meters of ore grading 4.5% copper. The SKM Mine represented a western expansion of the Musonoi open pit mine into the new open pit Kov Mine. Overburden and ore removal was projected to be about 400 million cubic meters over a 20-year period. About 65 trucks with haulage capacities of 100 to 150 tons were employed in this work. In the pit, 15 shovels stripped overburden and 5 mined ore. A portion of the Kov deposit exposed in the SKM pit graded 7% copper. By 1992, an in-pit crusher and conveyor system was planned for output of about 17 million cubic meters of waste per year. Bench dimensions were 12 meters high and 10 meters wide. Blasting consumed about 900 tons per year of ammonium nitrate-fuel oil mix.

Output from the Kamoto underground mine was 3.4 million tons of ore grading 4.2% copper, and ore reserves were about 70 million tons. The Kamoto concentrator, part of the Dima-Kamoto complex, produced four concentrates: a sulfide-rich concentrate grading 55% copper, a sulfide-poor concentrate grading 42% copper, a dolomitic concentrate grading 22% copper, and a siliceous oxide concentrate grading 22% copper.

Most output from the Dima-Kamoto concentrator continued to be shipped 5 kilometers by pipeline to the refinery at Luilu, which had a capacity of 175,000 tons per year of cathode copper. Output also was also shipped on demand to the Lubumbashi smelter.

Because of lack of smelter or refining capability, Sodimiza continued to ship copper concentrates to the Mufulira smelter and refinery in Zambia for processing. About 35,000 tons was shipped. Mine capacity of the Musoshi Mine was reported at 90,000 tons per month and at the Kinsenda Mine 25,000 tons per month. In situ grade at Musoshi was 3%, and head grade was 2.5%, with chalcopyrite as the primary mineral. At Kinsenda the in situ grade was 6% and the head grade, 4.5%. Proved reserves in Musoshi to the 450-meter level were 9 million tons and at Kinsenda to the 485-meter level were 12 million tons. Output was 28,295 tons of copper in concentrate. Production at the Kinsenda Mine, which began after 2 months of inactivity, was adversely affected by flooding at yearend. Reduced output was expected for several months. The sole concentrator for the two mines was at the Musoshi Mine, with a capacity of about 5,000 tons of ore throughput per day. A mixture of 30% Kinsenda ore and 70% Musoshi ore yielded a 3% copper in ore feed to the concentrator. Separate sulfide and oxide circuits reportedly yielded concentrates grading 48% and 34% copper, respectively. Total aboveground storage for ore was about 50,000 tons and for concentrate was 8,000 tons. Sales were to Marc Rich and Co.

Gold.—Development of the D7 Kanga deposit was delayed because of insufficient investor funding. The Office des Mines d'Or Kilo-Moto (Okimo) secured interest in financing equipment for the mine from the Brazilian export-import bank, but total funding was inadequate. Belgian companies expressed interest in modernizing and expanding Okimo's mines and plants, including leasing of the D7 Kanga deposit. Zaframines, a Kinshasa-based company, obtained exclusive exploration rights for an area previously worked by the Société Internationale Forestière et Minière du Congo, a Belgian company. A deposit at Adumbi by BRGM and grading between 0.185 and 0.817 troy ounce of gold per ton was slated for development. Zaframines sought to develop the deposit through joint ventures.

The Société Minière du Kivu (Sominki) negotiated with an unnamed European company for the development of gold mineralization near Twangiza. Sominki reported that reserves were 4 million tons grading 0.167 troy ounce of gold per ton.

Monazite.—Output increased because infrastructure improved somewhat in the Kivu Region, enabling Sominki to improve the efficiency of its numerous operations. Monazite remained primarily a byproduct of tin production.

Tin.—Sominki was the largest tin producer in Zaire, operating in the Kivu area of eastern Zaire. About 80% of Sominki's production was via sluicing of ore slurries. Production was highly dependent upon the company's wood mill for the manufacture of sluice boxes, as well as a large labor force estimated at 10,000. Sluicing is an effective and appropriate technology for the conditions existing in the region. Output from the northern area in the vicinity of Kalima was shipped by truck to Kindu, then transported via the Lualaba River to Kisagani for further shipment on the Zaire River. The purchases of cassiterite from artisanal miners were estimated at about 1,500 tons per year.

Zinc.—Output was adversely affected by problems with the Kipushi concentrator. Sales in the first quarter were 8,429 tons compared with a projected 16,750 tons; the decline was due in part to preference given to shipment of copper, which yields a higher price.

***Industrial Minerals.*—Diamond.**—Total diamond exports were 18.2 million carats in 1989, valued at $278.6 million. The Société Minière de Bakwanga (MIBA) accounted for 8 million carats, and licensed buyers-counters for 10.1 million carats. Stricter monitoring of exports in the last half of 1988 was largely responsible for the increase in value from the 1987 total of $197.3 million. Licensing procedures for buyers and counters of diamonds were changed to reduce the number of licensed individuals or companies in the industry. The license fee was doubled to $100,000 per year, and a minimum of $10 million of diamond was to be exported annually. This would reduce the number of licensed buyers-counters to about 9 from the current 15.

An increase in parallel market operations reportedly resulted in the loss of several million dollars a year through the illegal export of diamond to neighboring countries. Such operations were generally sensitive to the value of the Zaire, indicating higher inflation or depreciation of the currency and were usually by small unlicensed miners or illegal miners on MIBA's concession. MIBA increased output through further mechanization, improved operational efficiency, and the use increased availability of electric power. Production by MIBA reportedly may reach 10 million carats in 1989. MIBA extended its influence over artisanal diggers who were legally allowed to prospect for and exploit diamond on its concession. MIBA created two affiliates at Mbuji-Mayi and Anvers for the purchase and sale of diamonds from artisanal workers. MIBA had previously been given responsibility for the opening of offices for buyers-counters and for controlling the artisanal diggers activities.

Mineral Fuels.—Total installed capacity of the Inga 1 and Inga 2 hydroelectric plants on the Zaire River southwest of Kinshasa was 1,296 megawatts, of which 560 megawatts was available for transmission via the 1,800-kilometer Inga-Shaba direct current powerline.

Morrison Knudsen, constructor and operator of the 1,800-kilometer Inga-Shaba direct current powerline to the Shaba region, withdrew from the project. The company cited nonreceipt of fees and operating costs for its maintenance contract as reasons for the termination. Asea Brown Boveri was contracted to maintain the line for the SNEL. The line supplied about 45% of the power requirements of the Shaba Region, mainly for Gécamines' copper-cobalt operations. The remaining 55% was from hydroelectric plants in the Shaba Region that were undergoing refurbishing. Gécamines accounted for 90% of all power consumption in the region.

Construction was underway on a dam across the Ubangi River near Mobayi. A hydroelectric plant, also under construction, was rated at 27 megawatts, and was expected to provide power to the town of Gbadolite, about 10 miles away.

Coal.—About 2,000 tons per year of coal was used in sugar refining in Bas Zaire Region.

Peat.—Peat deposits are known to exist west and southwest of Bukavu in eastern Zaire. The bog deposits vary in size from 100 acres to about 2,000 acres and vary in depth from 1 meter to 15 meters. They are in volcanic craters in the Virungua mountain range at 1,600- to 2,200-meter altitudes. The relatively small size, lack of reliable infrastructure, and lack of adequate labor precluded full-scale commercial development.

Petroleum.—Fundamental data base studies made on two drill holes completed in the 1950's and two deep-drill holes completed in 1981 by Exxon Corp., along with more recent seismic reflection and geophysical data, identified potential host rock and structural traps for petroleum and natural gas in the Congo Basin. In particular, the Upper Zaire Sequence of the early to middle Paleozoic Era had reservoir potential and had the most favorable maturity history for crude petroleum. No current prospecting license existed, although a round of licensing was planned for 1989.

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[1] Prepared by George A. Rabchevsky and Lloyd Antonides, physical scientists, Division of International Minerals.

[2] Prepared by Thomas P. Dolley, physical scientist, Division of International Minerals.

[3] Where necessary, values have been converted from Communauté Financiere Africaine francs (CFAF) to U.S. dollars at the rate of CFAF301.0 = US$1.00.

[4] Prepared by Thomas P. Dolley, physical scientist, Division of International Minerals.

[5] Where necessary, values have been converted from Communauté Financière Africaine francs (CFAF) to U.S. dollars at the rate of CFAF301.0 = US$1.00.

[6] Prepared by Thomas P. Dolley, physical scientist, Division of International Minerals.

[7] Where necessary, values have been converted from Communauté Financière Africaine francs (CFAF) to U.S. dollars at the rate of CFAF301.0 = US$1.00.

[8] Prepared by Thomas P. Dolley, physical scientist, Division of International Minerals.

[9] Where necessary, values have been converted from Communauté Financière Africaine francs (CFAF) to U.S. dollars at the rate of CFAF301.0 = US$1.00.

[10] Prepared by Thomas P. Dolley, physical scientist, Division of International Minerals.

[11] Where necessary, values have been converted from Communauté Financière Africaine francs (CFAF) to U.S. dollars at the rate of CFAF301.0 = US$1.00.

[12] Prepared by Hendrik G. van Oss, physical scientist, Division of International Minerals.

[13] Where necessary, values have been converted from Communauté Financière Africaine francs (CFAF) to U.S. dollars at the rate of CFAF299 = US$1.00.

[14] Laval M., V. Johan, and B. Tourlière. La Carbonatite de Mabounié: Example de Formation d'un Gite Résiduel à Pyrochlore (The Mabonié Carbonatite: an Example of the Formation of a Residual Deposit with Pyrochlore), Chron. de la Recherche Minière, No. 491, 1988, pp. 125-136.

[15] Republique Gabonaise, Direction Générale des Mines et de la Géologie. Le Gisement de Mabounié (The Mabounié Mineral Deposit), 1989, 31 pp.

[16] ———. Fichier des Indices d'Or du Gabon (Index File of Gold Occurrences in Gabon), 1988, 73 pp.

[17] ———. L'Or au Gabon (Gold in Gabon), 1988, 45 pp.

[18] Work cited in footnote 15.

[19] Prepared by John G. Panulas and Lloyd Antonides, physical scientists, Division of International Minerals.

[20] Where necessary, values have been converted from Rwanda francs (F) to U.S. dollars at the rate of F76.45 = US$1.00.

[21] Prepared by Thomas P. Dolley, physical scientist, Division of International Minerals.

[22] Where necessary, values have been converted from Sao Toméan dobras (STD) to U.S. dollars at the rate of STD86.34 = US$1.00.

[23] Prepared by George A. Morgan, physical scientist, Division of International Minerals.

[24] Where necessary, values have been converted from zaires (Z) to U.S. dollars at the rate of Z131.5 = US$1.00 for 1987 and Z274.0 = US$1.00 for 1988.

THE MINERAL INDUSTRIES OF

EAST AFRICA AND THE INDIAN OCEAN

By Lloyd E. Antonides, Thomas P. Dolley, Harold R. Newman, John G. Panulas, George A. Rabchevsky, and Walter G. Steblez

COMOROS[1]

Comoros is made up of several islands with poor transportation links, increasing population, and few natural resources. Agriculture, including fishing and forestry, the leading sector of the economy, contributed about 40% to the gross domestic product (GDP), employed about 80% of the labor force, and provided most of the exports. Despite major investments in the tourist industry, which accounted for about 25% of GDP, economic growth has stagnated since 1983. Commercially exploitable mineral deposits on the islands of the Comoros archipelago were limited to small sand and gravel quarries, which were operated for local construction needs.

DJIBOUTI[2]

Saudi Arabia and France continued the financial assistance that had started upon the country's independence from France in June 1977. Saudi Arabia funded the construction of the country's first roadway between the capital city, Djibouti, and Tajoura in the north. There has been almost no foreign private investment and little domestic private investment since independence. The largest manufacturing enterprises were state-owned: a dairy, a mineral water bottler, and a livestock feed processor. All petroleum product requirements were also imported. Live animals were Djibouti's largest export, primarily to Saudi Arabia and the Yemens.

Mineral production was limited to the exploitation of small sand and gravel deposits for domestic construction, evaporated salt, and a small amount of lime. A salt evaporation pan was operated in the salt marshes of Todoura. Limestone was mined in Mangadafo, supplying a lime kiln in the town of Dorale. Most of the country's electricity was generated by the diesel-run electric powerplant. Electricité du Djibouti, state-owned, continued working on a geothermal research center to assess the feasibility of incorporating geothermal power into its grid, thereby cutting oil imports.

ETHIOPIA[3]

The 1988 economy declined, largely caused by another drought, military setbacks, decline in coffee prices, and Government policies. Real GDP decreased by 2%, while the population grew by 3%. The small, but important, mining and quarrying sector grew by 20%. Agriculture continued to be the main factor in the economy, contributing 40% of GDP, 85% of exports, and about 80% of employment. The United States and the Federal Republic of Germany continued to be Ethiopia's largest export markets. Coffee accounted for about 71% of total Ethiopian exports to the United States.

Small amounts of gold, gypsum, kaolin clay, limestone, marble, platinum, and salt were mined. Mining of cesium and columbium also was planned. Gold was the major mineral export in terms of value. The placer gold deposits of the Adola area, in the Sidamo region, about 470 kilometers south-southeast of Addis Ababa, were mined at the production rate of about 400 kilograms per year. The construction of facilities for the Lega Dembi gold mine near Shakiso in Jemjem Province, in the Sidamo region, about 500 kilometers south of Addis Ababa, was 50% completed. The project was expected to start production in 1989. Reportedly, the roads linking the mine to the nearby towns were constructed. The capacity of the mine was to be 96,000 troy ounces of gold per year. The facilities included a 3,000-ton-per-day cyanide leach section and associated processing plant. The project was jointly financed by the African Development Bank, the European Investment Bank, and the Ethiopian Government.

An iron ore deposit, estimated at 18 million tons, was discussed in the Welega Province, western Ethiopia. A tantalum deposit was discovered near Shakiso. Ethiopia had large deposits of bentonite, reserves of 31 million tons of diatomite, and large quantities of soda ash. Smaller deposits included copper, feldspar, graphite, lignite coal, mica, nickel, potash, pyrite, sulfur, talc, and a variety of gem stones. Potash, mostly sylvinite, occurred in the Danakil Depression in Tigre Province and was reportedly being redeveloped as an open pit, with Libyan help. There were also substantial resources of carnallite.

The Assab Oil Refinery, the only petroleum refinery in Ethiopia, used imported crude as feedstock. A gas discovery was made in the arid Ogaden region bordering Somalia.

Loans were made by the Czechoslovakian Government in October for the development of Ethiopian mining and energy resources, among other projects. A 2-year protocol agreement on economic, scientific, and technical cooperation was signed with Cuba on October 28. An agreement was signed with Italy on October 17 to alleviate the shortage of foreign exchange aid to purchase the products needed for various economic development sectors. The funds from the Italian Government will be used for buying raw materials and chemicals for industry, construction, transportation, and other economic sectors. A joint-venture company was reportedly set up with Libya to begin the construction of a marble, granite, and limestone plant. The plant will be located about 225 kilometers east of Addis Ababa.

TABLE 1

ETHIOPIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2 3]		1984	1985	1986	1987[p]	1988[e]
Cement, hydraulic[e]		240,000	250,000	250,000	250,000	250,000
Gold, mine output, Au content	troy ounces	[e]20,000	[e]25,000	29,675	20,649	[4]23,414
Gypsum and anhydrite, crude		[r]700	[r]700	850	1,400	[4]1,900
Lime		[e]2,000	[e]2,100	2,200	2,300	[4]3,000
Petroleum refinery products:						
Gasoline	thousand 42-gallon barrels	[e r]800	[r]852	913	1,436	1,173
Jet fuel	do.	380	403	418	531	482
Kerosene	do.	20	22	64	130	117
Distillate fuel oil	do.	[e]1,500	2,149	1,484	1,913	1,535
Residual fuel oil	do.	[e]2,000	[r]1,365	2,051	2,381	2,157
Liquefied petroleum gas	do.	50	58	69	138	103
Other[5]	do.	[r]700	[r]660	526	612	379
Total including refinery fuel and losses	**do.**	**5,450**	**[r]5,509**	**5,525**	**7,141**	**5,946**
Platinum, mine output, Pt content	troy ounces	[e r]50	[e r]50	77	33	[3]48
Pumice		[e]6,000	15,000	35,481	26,042	[4]143,442
Salt:[e]						
Rock		15,000	15,000	15,000	15,000	15,000
Marine		120,000	120,000	120,000	120,000	120,000
Stone, sand and gravel:						
Limestone[e]	thousand tons	100	100	100	75	[4]145
Sand[e]	do.	520	530	550	680	[4]990
Other[e]	do.	1,100	1,100	1,030	1,150	[4]1,320

[e]Estimated. [p]Preliminary. [r]Revised.
[1]Includes data available through Feb. 20, 1990.
[2]In addition to the commodities listed, modest quantities of unlisted varieties of crude construction materials (clays, sand and gravel, and stone) presumably are produced, but output is not reported quantitatively, and available information is inadequate to make reliable estimates of output levels.
[3]Data are for year ending June 30 of year stated.
[4]Reported figure.
[5]Includes refinery fuel and losses through 1985. Starting with 1986, refinery fuel and losses are included in output of individual products.

KENYA[4]

Major activity in Kenya's mining sector occurred predominantly in its cement and soda ash industries. Kenya's two major cement producers were Bamburi Portland Cement Co. and East African Portland Cement Co., producing 970,000 tons per year and 330,000 tons per year, respectively. A third cement works was scheduled for construction over a 3-year period at West Pokot in the Rift Valley Province. The $98 million facility was to have a capacity of 300,000 tons per year of cement; the bulk of that tonnage was slated for export to Uganda.

Kenya's economic performance in 1988 was markedly better than in 1987, primarily as a result of higher coffee and tea prices, trade liberalization, and effective monetary management policies. The real GDP grew by 5.2% in 1988, compared with 4.8% in 1987, and 5.5% in 1986. New job creation increased by 5.4% over 1987.

Magadi Soda Co. produced about 220,000 tons of soda ash at its Lake Magadi trona operation. Owned by ICI Chemical and Polymeers Ltd. of the United Kingdom, the company also produced just over 40% of the country's crude salt, with an output of nearly 40,000 metric tons.

Production of blue sapphire continued at the Garba-Tula Mine. Sapphire extracted from a new deposit north of Lodner and west of Lake Turkana was determined to contain an unspecified amount of heat-treatable geuda, and cabochon material that produced sharp 6-ray or 12-ray stars.

Ruby prospecting was undertaken near Amboseli National Park in the Kajiado district. Preliminary samples

TABLE 2

KENYA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1984	1985	1986	1987[p]	1988[e]
Barite		210	255	420	50	[3]48
Carbon dioxide, natural gas		3,161	3,151	4,093	4,386	[3]5,182
Cement, hydraulic	thousand tons	1,164	847	1,312	1,321	[3]1,239
Clays, kaolin		295	320	2,000	40	[3]42
Diatomite		1,512	3,082	1,450	616	[3]712
Feldspar		685	692	—	—	[3]—
Fluorspar (acid grade)		46,578	58,174	50,851	60,190	[3]99,000
Gem stones, precious and semiprecious:						
Amethyst	kilograms	17	10	([4])	([4])	([4])
Aquamarine	do.	7	7	([4])	([4])	[3]97
Garnet	do.	107	87	44	408	[3]835
Iolite	do.	23	24	20	20	20
Ruby	do.	187	92	66	70	[3]1,420
Tourmaline	do.	13	31	5	11	[3]23
Gold, mine output, Au content	troy ounces	600	442	2,339	8,939	[3]546
Gypsum and anhydrite		[e]1,500	[e]1,500	11,060	38,819	[3]37,965
Iron and steel: Steel, crude[e]		10,000	10,000	10,000	10,000	10,000
Kyanite[e]		1	1	1	1	1
Lime		20,855	27,860	12,300	26,482	[3]27,326
Magnesium compounds: Magnesite[e]		[3]311,254	300,000	300,000	[r]—	[3]—
Petroleum refinery products:						
Liquefied petroleum gas	thousand 42-gallon barrels	267	253	303	304	300
Gasoline	do.	2,594	2,722	2,832	2,869	2,900
Jet fuel and kerosene	do.	2,822	2,775	3,095	3,261	3,300
Distillate fuel oil	do.	3,496	3,719	3,916	4,333	4,400
Residual fuel oil	do.	5,064	4,310	4,234	4,178	4,200
Other[5]	do.	680	687	721	844	900
Total including refinery fuel and losses	**do.**	**14,923**	**14,466**	**15,101**	**15,789**	**16,000**
Phosphatic materials: Guano		6	6	—	—	[3]—
Salt:						
Crude, rock		72,885	66,330	[r][e]91,000	[r]72,000	[3]94,682
Refined		28,000	25,800	35,379	[r][e]28,000	37,000
Sodium compounds, n.e.s.:						
Soda ash (sodium carbonate)		226,050	227,760	237,650	228,650	[3]220,000
Soda, crushed, raw		5,288	5,441	5,882	1,557	[3]—
Stone, sand and gravel:						
Calcareous:						
Coral[e]	thousand tons	[r]1,186	[r]1,200	[r]1,200	[r]1,331	[3]1,352
Limestone	do.	1,444	1,333	2,069	400	[3]416
Sand, glass		[r]95	[r]100	255	[e]250	250
Shale		789,484	750,000	750,000	142,428	143,000
Vermiculite		872	1,515	2,544	3,887	[3]3,707
Wollastonite		—	—	298	—	[3]—

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

[1] Includes data available through Feb. 20, 1990.

[2] In addition to the commodities listed, modest quantities of unlisted varieties of crude construction materials (clays, sand and gravel, and stone) presumably are produced, but output is not reported quantitatively, and available information is inadequate to make reliable estimates of output levels.

[3] Reported figure.

[4] Less than 1/2 unit.

[5] Includes refinery fuel and losses through 1985. Starting in 1986, refinery fuel and losses are included in output of individual products.

collected included small rubies of high quality. Ruby and tsavorite mining within the boundaries of the national game park was suspended by the Government in October after it was discovered that poachers, hunting rhinoceros and elephants, were disguising themselves as miners to escape detection. Tsavorite is a green gem variety of grossular garnet found only in Kenya.

MADAGASCAR[5]

Mineral industry production in Madagascar showed only slight improvement in 1988. Total revenues from all exports were $284 million of which mineral commodities contributed only 3%. Economic problems included inflation and the devaluation of the Madagascar franc (FMG) relative to the United States dollar, with the exchange rate more than doubled since 1986. The major mineral commodities produced were chromite, graphite, mica, and precious and semiprecious stones. Development of Madagascar's titanium-bearing ilmenite sands continued to show potential for becoming the nation's single largest foreign exchange earner. Proposed levels of investment for this mining project were approximately $250 million[6] for mining operations and $150 million for the necessary infrastructure development. Infrastructure needed for the project included roads, a 20-megawatt electricity generating plant and an ore bulk-loading terminal. Funding for the titanium mining project would be subsidized by the World Bank with other potential backers being the African Development Bank and the European Development Bank.

Government Policies and Programs

A World Bank credit worth $100 million allowed the Government of Madagascar to agree to an introduction of an open general license (OGL), or flexible exchange rate system in mid-1988. The OGL economic reform plan allowed open market forces to determine for the first time in Madagascar the value of the FMG. World Bank support would be reinforced by additional credits from France and the United States. These actions were planned to stimulate economic development following the Government's 71% overall devaluation of the FMG in 1987. This provided impetus to the export sector, bringing the overvalued FMG closer to a realistic rate of exchange. On December 26, 1988, France and Madagascar signed two agreements worth $14.2 million and $1.1 million, respectively. The first agreement was for the rehabilitation of Malagasy banks and the second was for the supply of telecommunications equipment. Additionally, the Federal Republic of Germany cancelled Madagascar's debts to it amounting to approximately $710,000.

Madagascar's Office Militaire National pour les Industries Strategiques (OMNIS) was the state company for the minerals sector. During 1988, OMNIS requested financing for a feasibility study from the U.S. Trade and Development Program (USTDP) for a ferrochrome project. Subsequently, the USTDP approved a $500,000 grant for the ferrochrome project feasibility study.

Production and Trade

Chromite production in Madagascar, modest by world standards, came principally from an open pit mining operation in Andriamena, operated by the Malagasy parastatal Kraomita. An additional open pit chromite mine was owned by Kraomita and was in Ranomena. Total production output of chromite ore was 107,307 metric tons yielding 64,177 metric tons of marketable concentrate. Chromite ore production capacity for Madagascar was estimated at between 300,000 and 500,000 metric tons per year. Madagascar exported an estimated 90% of its chromite to France and Japan.

Small-scale mining of precious and semiprecious stones yielded approximately 490,000 kilograms. Piezoelectric quartz, used in the electronics industry, yielded 153 kilograms.

In July, Madagascar received the last shipment of approximately 350,000 barrels of crude oil from the U.S.S.R. The Government's contract with the U.S.S.R. for shipments of crude oil was suspended due to payment arrears. According to officials of Solima, the parastatal that managed petroleum importation, refining, and distribution, the World Bank financed Madagascar's crude oil purchased in November and December. The total shipment for both months was approximately 700,000 barrels of oil. In September, Madagascar imported approximately 350,000 barrels of crude oil from Iran. At yearend, the Government was searching for additional sources to finance the roughly 350,000 barrels of imported crude oil needed to forestall shortages into 1989.

Mica production yielded approximately 617 metric tons, more than 215 metric tons greater than 1987 production figures but less than one-half the amount mined in 1986. Malagasy mica was generally found as very large sheets in pegmatites and was valuable because of its use as an electrical insulator.

Total export revenues declined by approximately $26.6 million from the 1987 total of $310.7 million. The drop in export revenue in 1988 was mainly attributed to the falling prices of Madagascar's important export crops, cloves and coffee.

Commodity Review

Metals.—**Gold.**—Gold mining in Madagascar at the turn of the 19th century approached 64,000 troy ounces per year. By comparison, production increased by over 44% to 2,894 troy ounces of gold in 1988, primarily due to contract work by the French agency Bureau de Recherches Géologiques et Minières (BRGM) and OMNIS. Production was augmented by BRGM operating a lightweight gold dredge in

TABLE 3

MADAGASCAR: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1984	1985	1986[e]	1987[p]	1988
METALS						
Beryllium: Beryl in quartz concentrates, industrial and ornamental	kilograms	[3]46	50	50	[3]35	3
Chromium: Chromite concentrate, gross weight		59,765	127,415	[3]82,910	[3]106,600	64,177
Gold, mine output, Au content[e]	troy ounces	130	130	130	[3]1,289	2,894
Rare-earth minerals: Bastnasite[e]	kilograms	25,000	9,000	10,000	10,000	10,000
INDUSTRIAL MINERALS						
Abrasives, natural: (industrial only)[e]	kilograms	10,000	10,000	10,000	10,000	10,000
Cement, hydraulic[e]		35,000	35,000	35,000	35,000	35,000
Clay, kaolin		[e]2,500	6,367	6,000	[3]1,427	365
Feldspar[e]	kilograms	1,800	[3]5,195	5,000	5,000	5,000
Gem stones:						
Amazonite	do.	6,162	5,519	5,500	[3]3,783	525
Amethyst:						
Gem	do.	10	11	10	[3]11	1,700
Geodes[e]	do.	[3]4,300	[3]8,550	9,000	9,000	9,000
Citrine	do.	46	372	400	[3]6	112
Cordierite	do.	10	762	800	[3]387	886
Garnet	do.	2,603	1,201	1,500	1,500	6
Tourmaline	do.	2,000	2,000	2,000	2,000	2,367
Graphite, all grades		13,973	13,971	[3]16,187	[3]13,169	14,106
Mica, phlogopite:						
Block		26	25	100	[3]25	5
Scrap		623	500	1,300	[3]300	605
Splittings and sheet		71	64	194	[3]77	8
Total		**720**	**589**	**[3]1,594**	**[3]402**	**618**
Ornamental stones:						
Agate	kilograms	9,300	8,042	8,000	[3]14,034	13,886
Apatite	do.	3,500	3,500	3,500	[3]1,948	2,090
Aragonite		809	991	1,000	[3]500	[e]500
Calcite		1,584	1,160	1,000	[3]2,934	12
Celestite	kilograms	30,000	29,974	30,000	[3]4,365	34,511
Jasper	do.	16,425	16,300	16,000	[3]19,730	21,030
Labradorite	do.	2,740	14,821	15,000	[3]24,320	27,748
Other gem and ornamental[e]		150	200	250	250	[e]250
Quartz:						
Crystal	kilograms	32,467	32,500	32,500	32,500	22,136
Geodes	do.	2,970	3,000	3,000	[e]3,000	2,700
Hematoid	do.	14,964	15,000	15,000	[3]6,825	9,089
Other ornamental	do.	6,397	6,500	6,500	[3]4,925	[e]5,000
Rose quartz	do.	139,645	10,500	50,000	[3]77,980	360,290
Smelting	do.	1,058,000	1,334,000	1,000,000	[e]1,000,000	[e]1,000,000

See footnotes at end of table.

TABLE 3—Continued

MADAGASCAR: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1984	1985	1986[e]	1987[p]	1988
INDUSTRIAL MINERALS—Continued						
Ornamental stones—Continued						
Tourmaline	kilograms	26,558	1,100	1,000	[3]276	520
Quartz, piezoelectric	do.	145	150	150	[e]150	153
Salt, marine[e]		30,000	30,000	30,000	30,000	30,000
Stone:						
Calcite, industrial[e]		2,000	2,000	2,000	2,000	2,000
Dimension, marble, other[e]		2,500	3,000	3,000	3,000	3,000
Marble, cipoline		113	35	110	[3]5	4
MINERAL FUELS AND RELATED MATERIALS						
Petroleum refinery products:						
Distillate fuel oil	thousand 42-gallon barrels	129	598	600	[e]600	[e]600
Gasoline	do.	87	454	450	[e]450	[e]450
Kerosene and jet fuel	do.	49	304	300	[e]300	[e]300
Other	do.	2	30	30	[e]30	[e]30
Residual fuel oil	do.	142	729	730	[e]730	[e]730
Total	**do.**	**409**	**2,115**	**2,110**	**[e]2,110**	**[e]2,110**

[e]Estimated. [p]Preliminary.
[1]Table includes data available through June 29, 1989.
[2]In addition to the commodities listed, modest quantitites of unlisted varieties of crude construction materials (clays, sand and gravel, stone) presumably are produced, but output is not reported and available information is inadequate to make reliable estimates of output levels.
[3]Reported figure.

shallow-water alluvial gold prospects in northeastern Madagascar.

Additionally, BRGM signed a contract with OMNIS in September 1988 for the exploration, mining, and sales of platinum-group metals, chromite, and sulfide minerals in the gold-bearing Andriamena district. After review of the exploration data, the deposits appeared to be too low grade and might not be economically minable.

Titanium.—The Canadian firm QIT-Fer et Titane Inc., a subsidiary of RTZ's BP Minerals and OMNIS, had formed the joint-venture company QIT-Madagascar Minerals to exploit the ilmenite sands near Toalagnaro (formerly Fort Dauphin). The scheme was owned 49% by QIT and 51% by OMNIS. Reserves at yearend were estimated at 75 million metric tons. The deposit represented one of the largest ilmenite sources in the world, considerably greater than the estimated reserve base of 45.4 million metric tons in Australia, the world's largest titanium producer. The project had the potential to be the greatest revenue-generating mining venture in Malagasy history. The ilmenite sands were to be dredged from a coastal lagoon 8 kilometers east of Toalagnaro with the ilmenite being separated from the other minerals by an electrostatic and electromagnetic process. QIT planned for production to commence in 1992 or 1993 with the mine eventually producing 625,000 metric tons per year to supply its Sorel, Quebec, smelter. The smelter operation planned to use the concentrate to produce a 90% titanium dioxide slag for use in the manufacture of pigments. QIT was aiming at eventually supplying approximately 15% of the world market for titanium from this deposit. Pilot plant work on wet gravity concentration of the sands produced bulk samples of heavy mineral concentrates. Equipment for the pilot plant was supplied by Mineral Deposits Ltd. of Australia.

Industrial Minerals.—Madagascar remained an important producer of graphite. Although production was small by world standards, the graphite produced was a special high quality, crystalline flake product. Total mined graphite production for 1988, in both flakes and fines, was 14,106 metric tons, from five private operators: Etablissements Gallois, Societe Miniere de la Grande Ile, Izouard, Rostaing, and A. Louys.

Mineral Fuels.—Discovery of do-

TABLE 4

MADAGASCAR: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1985	1986	Destinations, 1986: United States	Destinations, 1986: Other (principal)
METALS				
Chromium:				
Ore and concentrate	27,277	35,096	—	India 18,596; China 16,500.
Oxides and hydroxides	2	—		
Copper: Metal including alloys:				
Scrap	13	56	—	Belgium-Luxembourg 37; West Germany 19.
Unwrought	272	—		
Semimanufactures	(2)	19	—	All to Spain.
Iron and steel: Metal:				
Ferroalloys, ferromanganese value, thousands	—	$1	—	All to France.
Steel, primary forms do.	$1 *	—		
Semimanufactures:				
Bars, rods, angles, shapes, sections	1	1	—	Mainly to Switzerland.
Universals, plates, sheets	126	1	—	Mainly to Mauritius.
Hoop and strip	14	2	—	Mainly to West Germany.
Wire value, thousands	$1	$1	NA	NA.
Tubes, pipes, fittings	(2)	4	—	Reunion 3.
Lead: Metal including alloys, scrap	10	—		
Tungsten: Metal including alloys, all forms	2	1	—	All to Japan.
Zinc: Metal including alloys, semimanufactures	(3)	12	12	
Other: Ores and concentrates	76,211	95,152	—	Japan 95,148.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.: Grinding and polishing wheels and stones value, thousands	—	$1	—	All to Reunion.
Cement	13	31	—	All to Mauritius.
Fertilizer materials: Manufactured, ammonia value, thousands	—	$1	NA	NA.
Graphite, natural	16,060	13,771	2,371	United Kingdom 5,979; West Germany 2,176.
Lime	26	—		
Mica:				
Crude including splittings and waste	471	1,209	—	Belgium-Luxembourg 1,053; France 156.
Worked including agglomerated splittings	1	2	—	Mainly to West Germany.
Precious and semiprecious stones other than diamond: Natural value, thousands	$1,002	$1,267	$30	West Germany $829; Japan $162.
Salt and brine	11,216	9,254	—	Greece 2,793; France 2,727; Spain 1,453.
Sodium compounds, n.e.s.: Carbonate, manufactured	4	—		
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked	9	—		

See footnotes at end of table.

TABLE 4—Continued

MADAGASCAR: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1985	1986	Destinations, 1986 United States	Destinations, 1986 Other (principal)
INDUSTRIAL MINERALS—Continued					
Stone, sand and gravel—Continued					
Dimension stone—Continued					
Worked		—	1	—	All to Reunion.
Quartz and quartzite		523	136	—	West Germany 133.
Sand other than metal-bearing		110	36	—	All to Australia.
Sulfur: Sulfuric acid	value, thousands	$8	$3	—	All to France.
Other: Crude		—	665	—	Mainly to Japan.
MINERAL FUELS AND RELATED MATERIALS					
Petroleum refinery products:					
Gasoline, motor	42-gallon barrels	5,542	230	—	Comoros 77; unspecified 102.
Kerosene and jet fuel	do.	11,749	35,929	—	France 9,617; U.S.S.R. 6,541; Reunion 3,681.
Distillate fuel oil	do.	71,004	23,081	—	Yugoslavia 1,156; unspecified 21,380.
Lubricants	do.	213,423	3,850	—	Mainly for bunkers.
Residual fuel oil	do.	81,265	201,398	—	Singapore 186,227; France 8,205.

NA Not available.
[1] Table prepared by Virginia A. Woodson.
[2] Unreported quantity valued at $2,000.
[3] Unreported quantity valued at $1,594,000.

mestic sources of petroleum were becoming critical for Madagascar during 1988. Payment arrears by the Government caused suspension of an oil importation contract with the U.S.S.R. Madagascar was therefore forced to accept World Bank aid to purchase the remaining oil imports for 1988. Without domestic production of oil, the Government could be faced with fuel shortages in 1989.

OMNIS opened all remaining petroleum tracts for bidding in 1988 with contracts that covered onshore tracts of an average of 10,000 square kilometers and offshore tracts of an average of 15,000 square kilometers. OMNIS offered two types of contracts for the petroleum acreage. The first type of contract was based on the Petroleum Regulations of 1980 and covered all concessions to date. It provided for equity ventures between the foreign oil company (49%) and OMNIS (51%) to cover cost and production sharing with income tax payments and royalties based on achieved rates of return. The second type of contract was a risk service contract in which the foreign oil company assumed all exploration and exploitation costs and would recoup costs through a royalty on production of 10% to 20% for a crude oil discovery and 5% to 20% for a natural gas discovery. During the year, Shell Oil was the first foreign company to respond to the call for exploration under three risk service contracts. Total acreage for the contracts was approximately 54,000 square kilometers. Shell Oil was to spend $42 million to explore the acreage.

Petro-Canada International Assistance Corp. (PCIAC) announced Madagascar's first potentially commercial hydrocarbon find in January 1988. Drilling was in cooperation with OMNIS on tracts abandoned by AMOCO in the onshore Morondava Basin. Located approximately 320 kilometers west of Antananarivo, the West Manambolo-1 well tested gas at a depth of 5,399 feet with production of 9.5 million cubic feet per day, and at a depth of 5,824 feet with production of 6.3 million cubic feet per day. Petro-Canada capped the well as a potential producer. Furthermore, Petro-Canada stated that the majority of the 65 exploratory wells drilled in the Morondava Basin and adjacent basin structures sought hydrocarbon evidence from deeper Carboniferous and Jurassic sediments than the Cretaceous strata of the West Manambolo-1 discovery. This would be a positive sign for additional prospects in the 100,000-square-kilometer onshore area.

Madagascar's only refinery, the Tamatave Solima Petroleum Refinery, produced an estimated 2.1 million barrels of

TABLE 5

MADAGASCAR: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1985	1986	Sources, 1986: United States	Sources, 1986: Other (principal)
METALS				
Alkali and alkaline-earth metals	—	2	—	All from France.
Aluminum:				
Ore and concentrate	9	—		
Oxides and hydroxides	—	12	—	All from France.
Metal including alloys:				
Scrap	9	—		
Semimanufactures	311	196	4	France 55; Austria 53; Italy 38.
Chromium: Oxides and hydroxides	24	—		
Cobalt: Oxides and hydroxides value, thousands	—	$1	—	All from West Germany.
Copper: Metal including alloys, semimanufactures	54	31	([2])	France 24; Japan 3.
Iron and steel: Metal:				
Pig iron, cast iron, related materials value, thousands	$472	$567	—	All from France.
Ferroalloys, ferromanganese	95	90	—	West Germany 70; France 20.
Steel, primary forms value, thousands	—	$3	—	All from Belgium-Luxembourg.
Semimanufactures:				
Bars, rods, angles, shapes, sections	4,754	6,612	6	France 4,028; Mozambique 524.
Universals, plates, sheets	9,952	6,072	19	France 4,656; Japan 671.
Hoop and strip	81	77	—	Italy 49; France 24.
Rails and accessories	2	1,202	—	France 1,199.
Wire	2,014	777	22	France 402; Mauritius 234.
Tubes, pipes, fittings	970	2,797	1,734	France 734.
Lead:				
Oxides	10	62	—	France 57; United Kingdom 5.
Metal including alloys:				
Scrap	2	—		
Unwrought	257	1	—	All from France.
Semimanufactures value, thousands	$21	$85	—	Do.
Magnesium: Metal including alloys:				
Scrap do.	—	$4	$4	
Semimanufactures	—	1	—	All from France.
Manganese:				
Ore and concentrate, metallurgical-grade	2	145	—	Gabon 144.
Oxides	90	30	—	All from West Germany.
Mercury value, thousands	$7	$2	—	West Germany $1; Norway $1.
Nickel: Metal including alloys, semimanufactures do.	$6	$9	—	Japan $7.
Platinum-group metals: Metals including alloys, unwrought and partly wrought do.	$1	$3	—	All from Italy.
Silver: Metal including alloys, unwrought and partly wrought do.	$1	$2	—	Mainly from Italy.

See footnotes at end of table.

TABLE 5—Continued

MADAGASCAR: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1985	1986	Sources, 1986: United States	Sources, 1986: Other (principal)
METALS—Continued					
Tin: Metal including alloys:					
Scrap	value, thousands	—	$2	—	All from Japan.
Semimanufactures		1	1	—	Do.
Titanium: Oxides		3	19	—	France 17; West Germany 2.
Zinc:					
Ore and concentrate		445	99	—	All from China.
Oxides		—	5	—	West Germany 4; France 1.
Metal including alloys:					
Scrap		—	1	—	All from France.
Semimanufactures		25	10	—	France 9.
Other:					
Oxides and hydroxides		130	504	—	France 503.
Base metals including alloys, all forms		—	2	—	All from France.
INDUSTRIAL MINERALS					
Abrasives, n.e.s.:					
Natural: Corundum, emery, pumice, etc.	value, thousands	$27	$125	$125	
Artificial: Corundum		88	—		
Dust and powder of precious and semiprecious stones including diamond	value, thousands	$4	$1	NA	NA.
Grinding and polishing wheels and stones		147	24	—	France 10; Italy 6.
Asbestos, crude		2,099	348	NA	NA.
Boron materials: Crude natural borates	value, thousands	$39	$11	—	All from France.
Cement		67,111	29,221	1,613	U.S.S.R. 9,915; Republic of South Africa 4,531.
Chalk		—	793	793	
Clays, crude		10	136	—	All from France.
Diatomite and other infusorial earth		44	1	—	Do.
Feldspar, fluorspar, related materials		72	—		
Fertilizer materials:					
Crude, n.e.s.	value, thousands	$1	—		
Manufactured:					
Ammonia		29	28	—	Belgium-Luxembourg 25; West Germany 3.
Nitrogenous		10,063	2,475	—	Netherlands 2,000; France 320.
Phosphatic		4,204	2,520	—	Spain 2,000; Belgium-Luxembourg 520.
Potassic		2,529	1,216	—	France 784; Belgium-Luxembourg 431.
Unspecified and mixed		4,396	8,558	—	Norway 8,550.
Graphite, natural		—	3	—	All from France.
Gypsum and plaster		5,491	4,001	—	Do.

See footnotes at end of table.

TABLE 5—Continued

MADAGASCAR: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1985	1986	Sources, 1986: United States	Sources, 1986: Other (principal)
INDUSTRIAL MINERALS—Continued				
Lime	258	2	NA	NA.
Magnesium compounds	—	7	5	West Germany 2.
Mica:				
Crude including splittings and waste	7	—		
Worked including agglomerated splittings	1	3	—	Japan 2; United Kingdom 1.
Pigments, mineral: Iron oxides and hydroxides, processed	18	—		
Precious and semiprecious stones other than diamond: Natural value, thousands	$1	$1	—	All from Japan.
Salt and brine	(2)	12	—	France 10.
Sodium compounds, n.e.s.:				
Carbonate, manufactured	513	133	—	West Germany 130.
Sulfate, manufactured	2,705	1,385	—	Spain 599; France 457.
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked	1	—		
Worked value, thousands	—	$1	NA	NA.
Gravel and crushed rock	—	2	—	Mainly from France.
Quartz and quartzite	3	11	—	All from France.
Sand other than metal-bearing	3	1	—	All from Netherlands.
Sulfur:				
Elemental: Crude including native and byproduct	—	120	—	All from West Germany.
Sulfuric acid	173	122	15	France 74; Netherlands 31.
Talc, steatite, soapstone, pyrophyllite	14	15	—	All from United Kingdom.
Other: Crude	319	—		
MINERAL FUELS AND RELATED MINERALS				
Asphalt and bitumen, natural	—	1,900	—	All from Singapore.
Carbon black	137	50	—	West Germany 48.
Coal	—	2,884	—	All from Mozambique.
Coke and semicoke	—	11,239	NA	Mozambique 2,000; unspecified 9,105.
Peat including briquets and litter	4,303	—		
Petroleum:				
Crude thousand 42-gallon barrels	1,443	7	—	All from France.
Refinery products:				
Liquefied petroleum gas do.	10	29	NA	Greece 6; Malaysia 4; unspecified 19.
Gasoline, motor do.	617	1,488	—	U.S.S.R. 980; unspecified 263.
Mineral jelly and wax do.	40	4	—	Hong Kong 3; Netherlands 1.
Kerosene and jet fuel do.	154	414	—	Bahrain 97; Yemen (Aden) 71; unspecified 163.
Distillate fuel oil do.	392	1,074	4	U.S.S.R. 331; United Arab Emirates 157; Bahrain 155.
Lubricants do.	53	39	1	France 2; unspecified 35.
Residual fuel oil do.	5	310	NA	Singapore 116; unspecified 194.
Bitumen and other residues do.	1	(2)	—	Mainly from France.

NA Not available.
[1] Table prepared by Virginia A. Woodson.
[2] Less than 1/2 unit.

refined gasoline and fuel oils during the year. Total production capacity for the refinery was 2.5 million barrels.

MAURITIUS[7]

Mauritius remained a modest producer of salt and quarry products including limestone and basalt. The country's economy continued to show robust growth as the GDP rose by 7.8% in 1988 over that of 1987. Mauritius's balance of payments became positive in 1985 and posted surpluses of $217 million in 1987 and $95 million in 1988.[8] The country's debt-service ratio declined from 27% in 1985 to 12.4% in 1988. The country's manufacturing sector continued to grow, comprising 25% of the GDP in 1988. Exports of sugar, consumer durables, and textiles were the country's mainstays in foreign trade. Needed mineral fuels and raw materials were imported. The Government planned an environmental protection project that would entail the creation of an industrial park, which would concentrate all of the island's polluting industries. A sewage and water treatment facility would treat the water from the park and the country's hotels.

REUNION[9]

Mineral activities in Réunion centered primarily on the operation of a 200,000-ton-per-year cement clinker grinding plant at Saint-Deins, which manufactured cement mix from imported materials. In addition, there were a number of small sand and gravel operations that supported local construction.

SEYCHELLES[10]

The only mineral-related operations on the islands of Seychelles continued to be small sand and gravel pits for local construction, and the collection and processing of guano for fertilizer.

SOMALIA[11]

Sepiolite (meerschaum) continued to be the only mineral produced for export. A major sepiolite deposit was evaluated by the United Nations Development Program (UNPD). Reserves were estimated to be 10 million tons. The decision to undertake production was expected in 1989. Other mineral production in 1988 included cement from the plant at Berbera that used limestone from local quarries, solar salt

TABLE 6

MAURITIUS: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]	1984	1985	1986	1987[p]	1988[e]
Lime[e]	7,000	7,000	7,000	7,000	7,000
Salt[e]	6,000	6,000	6,000	6,000	6,000
Stone: Basalt, not further described[e]	1,100,000	1,100,000	1,100,000	1,100,000	1,100,000

[e] Estimated. [p] Preliminary.
[1] Includes data available through Feb. 20, 1990.
[2] In addition to the commodities listed, modest quantities of unlisted varieties of crude construction materials (clays, sand and gravel, and stone) presumably are produced, but output is not reported quantitatively, and available information is inadequate to make reliable estimates of output levels.

TABLE 7

SEYCHELLES: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]	1984	1985	1986	1987[p]	1988[e]
Phosphate minerals, guano[e]	4,500	4,500	4,500	4,500	4,500

[e] Estimated. [p] Preliminary.
[1] Includes data available through Feb. 20, 1990.
[2] In addition to the commodities listed, modest quantities of unlisted varieties of crude construction materials (clays, sand and gravel, and stone) presumably are produced, but output is not reported quantitatively, and available information is inadequate to make reliable estimates of output levels.

produced from the evaporation of sea water, and a small amount of tin.

The New India Mining Corp. of India signed a 1-year agreement to prospect for minerals in the Togdheer region and in the Shaykh, Berbera, and Gabiey districts in the northwest.

International oil companies, including Amoco, Chevron, Conoco, and Shell, continued their activities in petroleum exploration in 1988. Chevron's first test well southeast of Zeila, in the northwest corner of Somalia began in early 1988. Shell was drilling at its site near Bardera in southwest Somalia. Amoco Somalia Petroleum Co. commenced exploration on 1.4 million hectares near the capital of Mogadishu. The Government also continued to operate the Iraqsoma petroleum refinery near Mogadishu.

Somalia is one of the world's least developed countries and has few known resources. Agriculture was the most important sector of the economy and accounted for about 50% of GDP. The small industrial sector was based on the processing of agricultural products and accounted for less than 10% of GDP. Attempts by the Government to diversify the agriculture economy have met with limited success. Somalia was well positioned geographically for international trade with the deep-water ports Berbera, Kismayo, and Mogadishu. However, economic progress was expected to be slow, considering the country's marginally developed infrastructure and high debt levels. Also, domestic problems with insurgents and border conflicts with Ethiopia were expected to further slow economic development.

SUDAN[12]

Sudan's metallic mining operations extracted modest amounts of chromite, gold, and manganese. The country also produced small amounts of industrial minerals. Gold continued to be the most lucrative aspect of the mineral industry. Sudan's Gebeit gold mine, jointly owned and operated by Minex Minerals Ltd., a subsidiary of Greenwich Resources Ltd. of the United Kingdom and the Sudanese Government, expected to produce about 36,000 troy ounces of gold in 1988. However, during the year, Gebeit's rich Wadi deposit was determined to be discontinuous, which resulted in a significant grade and output reduction. The operation was to have supplemented its reduced output by processing mine tailings, and, reportedly, the actual output at yearend was about 7,500 troy ounces. New exploratory studies were to be conducted to determine the true scope of the reserves.

The nearby Aberketeib Mine, closed for 20 years, was reopened by Kenmare Resources PLC of Dublin, Ireland. Kenmare reached an agreement with Sudan's Central Desert Mining Co. to acquire a 49% share in the mine and a surrounding 2-square-kilometer mining lease. The operation was incorporated in the Sudan as the Bashken Mining Co. Ltd. In 1988, having taken tailings volume measurements and samples for testing, Kenmare found the amalgamation and cyanidation tailings resources to total 28,130 tons with an average grade of 0.24 troy ounce of gold per metric ton. The company anticipated a

TABLE 8

SOMALIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1984	1985	1986	1987[p]	1988[e]
Nitrogen: Ammonia, N content		26	26	15	10	—
Petroleum refinery products:						
Gasoline, motor	thousand 42-gallon barrels	247	665	682	725	700
Jet fuel	do.	200	160	152	168	160
Kerosene	do.	93	93	77	70	80
Distillate fuel oil	do.	522	522	537	612	600
Residual fuel oil	do.	107	100	107	93	100
Other[3]	do.	182	189	301	259	260
Total, includes refinery fuel and losses	**do.**	**1,351**	**1,729**	**1,856**	**1,927**	**1,900**
Salt, marine[e]		30,000	30,000	30,000	30,000	30,000
Sepiolite, meerschaum[e]		10	10	10	10	10

[e]Estimated. [p]Preliminary.

[1]Includes data available through Feb. 20, 1990.

[2]In addition to the commodities listed, modest quantities of unlisted varieties of crude construction materials (clays, sand and gravel, and stone) presumably are produced, but output is not reported quantitatively, and available information is inadequate to make reliable estimates of output levels.

[3]Includes refinery fuel and losses through 1985. Starting with 1986, refinery fuel and losses are included in output of individual products.

TABLE 9

SUDAN: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1984	1985	1986	1987[p]	1988[e]
Cement, hydraulic	thousand tons	176	193	200	122	175
Chromium: Chromite ore and concentrate, gross weight		20,000	8,799	8,500	13,015	[3]8,000
Gold, mine output, Au content[e]	troy ounces	1,500	1,500	1,600	2,734	[3]16,075
Gypsum and anhydrite, crude[e]		8,000	6,400	7,000	7,000	[3]5,000
Mica, all grades[e]		10	10	10	10	10
Petroleum refinery products:[e]						
Liquefied petroleum gas	thousand 42-gallon barrels	NA	NA	NA	NA	[3]101
Gasoline	do.	772	1,000	1,000	1,000	[3]1,275
Jet fuel	do.	334	300	300	300	[3]669
Kerosene	do.	NA	NA	NA	NA	[3]128
Distillate fuel oil	do.	1,438	1,500	1,500	1,500	[3]2,026
Residual fuel oil	do.	1,690	1,500	1,500	1,500	[3]1,573
Other[4]	do.	260	300	300	300	[3]208
Total including refinery fuel and loss[e]	**do.**	**4,394**	**4,600**	**4,600**	**4,600**	**5,980**
Salt		75,000	38,467	40,000	51,662	[3]150,000

[e] Estimated. [p] Preliminary.
[1] Includes data available through Feb. 20, 1990.
[2] In addition to the commodities listed, modest quantities of unlisted varieties of crude construction materials (clays, sand and grave, and stone) presumably are produced, but output is not reported quantitatively, and available information is inadequate to make reliable estimates of output levels.
[3] Reported figure.
[4] Includes refinery fuel and losses through 1985. Starting in 1986, refinery fuel and losses are included in output of individual products.

recovery rate of 75%, utilizing a Kenmare-designed vat leaching process and a Merill Crowe gold precipitating system. Thus, over 5,000 troy ounces would be recovered. Kenmare would initially recover the gold from the old tailings heaps while simultaneously conducting exploration on the surrounding property.

After the exhaustion of the tailings, underground mining would be resumed with the addition of a primary crusher. Preliminary test results indicated that the mine would yield an ore grade of about 0.45 troy ounce of gold per metric ton.

BRGM of France reported the production of about 32,000 troy ounces of gold at the Hassai pilot plant in the Nubian Desert. The pilot plant reportedly reached its design capacity during the year. Gold reserves at the Hassai were estimated to be 200,000 troy ounces. Under the provisions of an agreement with the Sudanese Government, BRGM was to have 100% ownership of the mine and be responsible for its operation.

At yearend, Sudan reported the discovery of copper, chromite, manganese, phosphate, and uranium resources in the Nuba mountains. Exploration work was done by Sudan's Public Corp. of Geological Studies in collaboration with the Federal Republic of Germany. In November, the Chevron Petroleum Corp. announced the resumption of oil drilling operations, for which security was provided by Sudan's military forces, in the Muglad area.

TANZANIA[13]

The Tanzanian economy was heavily dependent upon agriculture, which accounted for about 40% of GDP, provided 85% of exports and employed 90% of the workforce. Recurring drought deterred economic performance by reducing food production and increasing the amount of imports. However, real economic activity rose for the third straight year and most sectors experienced growth in 1988. Industry accounted for about 10% of GDP and was limited to processing farm products and light consumer goods. The 3-year economic recovery program announced in mid-1986 had produced some positive results. Most notable were a currency devaluation of 4.8% in June 1988 and a further devaluation of 21% in November 1988, incentives for private investment, reduction in the inflation rate, and a willingness of the World Bank and the International Monetary Fund to provide credits. The total cost of the 3-year program was estimated to be $3 billion.[14]

Tanzania has varied mineral resources; however, lack of capital, a skilled workforce, and equipment hinders the Government's ability to exploit these resources. Mineral and petroleum exploration were two areas the Government had targeted for foreign investment. On the local level, miners were encouraged to create co-operatives to enable them to obtain loans for the purchase of small-scale mining equipment.

Gold was mostly mined by small operators and often was smuggled out of the country. The Kahama district was believed to contain significant gold mineralization owing to its location within a known gold belt that extended

TABLE 10

TANZANIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1984	1985	1986	1987[p]	1988[e]
Cement, hydraulic		370,000	301,000	300,000	300,000	[3]189,390
Clays:						
Bentonite[e]		[3]75	75	75	75	75
Kaolin		1,885	1,636	1,600	1,446	[3]528
Coal, bituminous		9,722	20,000	20,000	2,860	[3]3,349
Diamond[4]	carats	277,352	236,000	190,000	150,000	150,000
Gem stones, precious and semiprecious excluding diamond[e 5]	kilograms	650	[3]646	650	4,400	9,400
Gold, refined	troy ounces	2,680	1,776	2,735	6,466	[3]1,672
Gypsum and anhydrite, crude		[e]12,000	14,411	[e]14,000	24,648	[3]19,570
Lime, calcined and hydrated[e]		3,000	[3]2,472	3,000	3,000	3,000
Limestone, crushed		NA	NA	NA	680,701	792,454
Mica, sheet		([6])	([6])	([6])	([6])	([6])
Petroleum refinery products:						
Liquefied petroleum gas	thousand 42-gallon barrels	63	80	80	44	73
Gasoline	do.	892	800	800	909	784
Kerosene	do.	259	220	220	330	325
Jet fuel	do.	213	300	300	220	232
Distillate fuel oil	do.	1,062	1,050	1,050	1,069	1,088
Residual fuel oil	do.	1,904	1,750	1,750	525	1,771
Other	do.	330	300	300	540	320
Total including refinery fuel and losses[e]	**do.**	**[3]4,723**	**4,500**	**4,500**	**3,600**	**4,600**
Phosphate minerals: Apatite		14,536	15,000	10,000	18,386	[3]4,466
Salt, all types		21,659	21,108	21,868	41,123	[3]19,777
Salt, glass		NA	NA	NA	6,071	[3]12,043
Soda ash[e]		298	300	300	300	300
Tin, mine output, Sn content[e]		4	2	2	2	2

[e]Estimated. [p]Preliminary. NA Not available.
[1]Includes data available through Feb. 20, 1990.
[2]In addition to the commodities listed, modest quantities of unlisted varieties of crude construction materials (clays, sand and gravel, and stone) presumably are produced, but output is not reported quantitatively, and available information is inadequate to make reliable estimates of output levels.
[3]Reported figure.
[4]Diamond figures are estimated to represent 70% gem-quality or semigem-quality and 30% industrial-quality stones.
[5]Exports.

westerly from northeastern Tanzania to the western side of Lake Victoria. The Kahama Gold Mining Co., a joint venture owned by the Government and three Finnish firms, prospected this area in 1988. It was reported that drilling indicated estimated reserves of more than 4 million tons of ore averaging 0.03 troy ounce of gold per ton. The Buckreef gold mine in the Geita district was undergoing a technical evaluation that consisted of ore reserve determination, exploration drilling requirements, and a review of mining operations. If the evaluation showed the mine to be economically viable, then a detailed study of overall technical and financial viability would be performed. Exploration was also underway in the northwestern Siga Hills where preliminary investigations had indicated a potential for gold mineralization.

The Government of Tanzania was seeking financial and technical assistance for exploration and development of the Linganga iron ore deposits in the Kipengere mountains of the Iringa region. The Linganga deposits were estimated to contain 45 million tons of ore with an average grade of 51% iron, 13% titanium, and 0.6% vanadium. The country's iron and steel requirement was around 500,000 tons per year with only 30,000 tons per year produced in the country, at steel mills in Tanga and Dar-es-Salaam. The Government's planned development of a mining complex would meet the domestic demand and provide material for export. However, the estimated cost of $350 million to develop the complex and required infrastructure was likely to require foreign investment.

Tanzania's first major coal mine commenced operations at yearend. The Kiwira Mine is at Songe-Kiwira in the southern region of Mbeya. It will be operated by Kiwira Coal Mining Co., a subsidiary of State Mining Co. (STAMICO). The initial output of 93,000 tons per year would be used mostly to satisfy local demands. This would significantly reduce the country's oil imports. The project's estimated cost was almost $50 million and was estimated to have 65 years of reserves.

The Williamson Diamond Mines Co.'s Mwadui Mine was to undergo a modernization program to rehabilitate the treatment plant, at a cost of $5 million. The company was jointly owned by STAMINCO and Willcroft Ltd. (Canada). Diamond reserves at the Williamson Mine have been estimated at almost 3.9 million carats. This was considered sufficient for 10 years of operation at current production rates. Gulf Exploration and Mining Co. was exploring for gem stones at Umba in the Tenga region, and Mayote Ltd., Thailand, had gem stone exploration underway at Ifakari-Matombo in the Morogoro region. The Minjingu deposit remained the only active phosphate mine in 1988. The open pit mine was operated by STAMINCO with Kone Corp. of Finland being responsible for engineering and design.

American and other foreign firms continued exploration for natural gas reserves in addition to the Songa Songa Gasfield off the southern coast of Tanzania, although results obtained were not promising. However, Tanzania was considered to be geologically favorable for large deposits of natural gas.

UGANDA[15]

Uganda's economy showed some signs of recovery in 1988, and the steel industry registered impressive results, increasing production by 82% over that of 1987. The growth in the steel industry was attributed largely to the startup of a new rolling mill at Jinja, as well as the resumption of output by plants producing roofing materials and iron sheets.

The reconstruction of the second line of Uganda's cement plant at Hima

TABLE 11

UGANDA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]	1984	1985	1986	1987[p]	1988[e]
Cement, hydraulic[e]	20,000	20,000	20,000	20,000	20,000
Lime, hydrated and quick[e]	500	500	500	500	500
Phosphate minerals: Apatite[e]	100	100	100	100	100
Salt, evaporated[e]	5,000	5,000	5,000	5,000	5,000
Tin, mine output, Sn content[e]	18	18	18	10	10
Tungsten, mine output, W content[e]	[3]4	4	4	4	4

[e]Estimated. [p]Preliminary.
[1]Includes data available through Feb. 20, 1990.
[2]In addition to the commodities listed, modest quantities of unlisted varieties of crude construction materials (clays, sand and gravel, and stone) presumably are produced, but output is not reported quantitatively, and available information is inadequate to make reliable estimates of output levels.
[3]Reported figure.

began in November with assistance from the Federal Republic of Germany. The installation work was to be done largely by Ugandan engineers; upon completion, the plant would produce about 600 tons of cement per day. The Kilembe copper mine remained on a care-and-maintenance basis throughout the year.

In September, France and Uganda discussed plans to assess the possibility of processing slags stockpiled at Kasese, the partial rehabilitation of the Kilembe Mine, and the exploration for gold in Uganda.

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[1] Prepared by Harold R. Newman and Lloyd E. Antonides, physical scientists, Division of International Minerals.

[2] Prepared by George A. Rabchevsky and Lloyd E. Antonides, physical scientists, Division of International Minerals.

[3] Prepared by George A. Rabchevsky and Lloyd E. Antonides, physical scientists, Division of International Minerals.

[4] Prepared by John G. Panulas and Lloyd E. Antonides, physical scientists, Division of International Minerals.

[5] Prepared by Thomas P. Dolley, physical scientist, Division of International Minerals.

[6] Where necessary, values have been converted from Madagascar francs (FMG) to U.S. dollars at the rate of FMG1,407.1 = US$1.00.

[7] Prepared by Walter G. Steblez, foreign mineral specialist, and Lloyd E. Antonides, physical scientist, Division of International Minerals.

[8] Where necessary, values have been converted from rupees(R) to U.S. dollars at the rate of R12.878 = US$1.00 for 1987, and R13.438 = US$1.00 for 1988.

[9] Prepared by John G. Panulas and Lloyd E. Antonides, physical scientists, Division of International Minerals.

[10] Prepared by John G. Panulas and Lloyd E. Antonides, physical scientists, Division of International Minerals.

[11] Prepared by Harold R. Newman and Lloyd E. Antonides, physical scientists, Division of International Minerals.

[12] Prepared by Walter G. Steblez, foreign mineral specialist, and Lloyd E. Antonides, physical scientist, Division of International Minerals.

[13] Prepared by Harold R. Newman and Lloyd E. Antonides, physical scientists, Division of International Minerals.

[14] Where necessary, values have been converted from Tanzania shillings (s) to U.S. dollars at the rate of S99.292 = US$1.00.

[15] Prepared by Walter G. Steblez, foreign mineral specialist, and Lloyd E. Antonides, physical scientist, Division of International Minerals.

THE MINERAL INDUSTRIES OF

NORTH AFRICA

By Thomas P. Dolley and Bernadette Michalski

ALGERIA[1]

Algeria's economic recovery program was based largely on reducing imports, curbing demand, and increasing economic efficiency. The program met with some measure of success as the nation shifted from a trade deficit of $1.2 billion[2] in 1986, when petroleum prices were low, to a positive trade balance estimated at $1.7 billion in 1988. The nation's external debt was estimated at $21.5 billion. To help reduce the debt service ratio, the Government has launched an aggressive policy to develop and market hydrocarbons, particularly natural gas.

Reduced production from Algeria's depleting oilfields made investments in hydrocarbon exploration, production, and processing imperative. The 1986 Hydrocarbons Law was a step in attracting foreign investors and resulted in at least three exploration agreements through 1988. The agreements were between foreign companies and the Government's hydrocarbon agency, Société Nationale pour la Recherche, la Production, le Transport, la Transformation, et la Commercialisation des Hydrocarbures (SONATRACH).

The Government's investment spending budget was projected at $7.8 billion. Included in the Government's priority list was the development of the Hamra Gasfield, construction of the Tebessa fertilizer plant, and the construction of the Bellara steel complex.

Production and Trade

Algeria led the members of the Organization of Petroleum Exporting Countries (OPEC) cartel in natural gas production and exports and ranked sixth among the world's producers. Although petroleum production remains significant, the nation's older wells required gas reinjection to maintain pressures. Algeria's dwindling oil reserves prompted the Government to focus on marketing natural gas, condensates, and refined products. Hydrocarbon export sales consisted of refined products, $2.1 billion; condensates, $1.9 billion; natural gas, $1.8 billion; and crude oil, $1.4 billion. All other exports earned only $0.4 billion.

Revenues from natural gas exports are expected to increase appreciably as traditional and new export markets respond to Algeria's introduction of a realistic market-based pricing formula. By 1994, exports are expected to reach 1.4 billion cubic feet compared with 0.9 billion cubic feet in 1988.

Commodity Review

Metals.—**Iron Ore.**—The bulk of Algeria's iron ore output was extracted from the mine at Ouenza. Mining operations spread over 17 square kilometers with the main seam 2 kilometers long and 500 meters wide. Production totaled 2.8 million tons of hematite ranging from 53% to 60% iron content requiring removal of 5.6 million tons of overburden.

Iron ore was also mined at Boukadra and shipped with Ouenza ore by rail to

TABLE 1

ALGERIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1984	1985	1986	1987[p]	1988[e]
METALS						
Cadmium, refined[e]		80	128	124	125	125
Copper concentrate:						
Gross weight		820	—	—	—	—
Cu content		115	—	—	—	—
Iron and steel:						
Iron ore, gross weight	thousand tons	3,664	3,776	3,360	3,380	3,400
Metal:						
Pig iron[e]	do.	1,100	1,100	1,100	1,100	1,700
Steel, crude[e]	do.	700	750	750	750	750
Lead, concentrate, Pb content[e]		4,000	3,800	3,600	3,600	3,500
Mercury	76-pound flasks	17,000	23,000	22,000	22,000	20,000
Silver[e]	thousand troy ounces	120	120	120	120	120
Zinc:						
Concentrate, Zn content		14,600	13,500	16,500	13,000	12,000
Metal, smelter output		35,000	35,700	29,000	19,000	18,000

See footnotes at end of table.

TABLE 1—Continued

ALGERIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1984	1985	1986	1987[p]	1988[e]
INDUSTRIAL MINERALS						
Barite, crude		15,200	60,000	60,300	60,000	60,000
Cement, hydraulic[e]	thousand tons	5,500	[3]6,096	[3]6,460	6,500	6,500
Clays:						
Bentonite		31,000	32,000	30,000	30,000	30,000
Fuller's earth[e]		3,500	3,500	3,500	3,500	3,500
Kaolin		14,400	13,000	14,200	14,000	14,000
Diatomite		1,600	2,600	4,000	4,000	4,000
Gypsum[e 4]	thousand tons	250	250	275	275	275
Lime, hydraulic[e]	do.	40	40	40	40	40
Nitrogen: N content of ammonia		146,300	150,000	150,000	150,000	150,000
Phosphate rock	thousand tons	1,000	1,207	1,203	1,073	[3]1,332
Salt	do.	175	168	190	200	200
Sodium compounds: Caustic soda[e]		700	700	700	700	700
Strontium minerals: Celestite, gross weight[e]		5,400	5,400	5,400	5,400	5,400
Sulfur, elemental[e]		20,000	20,000	20,000	20,000	20,000
MINERAL FUELS AND RELATED MATERIALS						
Gas, natural:						
Gross	billion cubic feet	3,223	3,543	3,440	3,350	3,500
Dry[5]	do.	1,360	1,360	1,330	1,525	1,585
Natural gas plant liquids	thousand 42-gallon barrels	30,000	33,100	40,550	45,750	35,000
Petroleum:						
Crude	do.	233,508	234,095	248,675	239,200	236,800
Condensate from oil and gas fields	do.	145,000	150,000	160,000	170,000	175,000
Refinery products:						
Gasoline	thousand 42-gallon barrels	52,925	59,500	51,500	52,000	52,000
Kerosene and jet fuel	do.	12,045	15,300	14,600	14,600	14,600
Distillate fuel oil	do.	4,745	5,100	5,100	5,500	5,500
Residual fuel oil	do.	730	700	700	700	700
Lubricants	do.	52,560	42,700	48,500	49,000	49,000
Refinery fuel and losses	do.	6,205	6,200	6,200	6,300	6,300
Other	do.	35,040	34,700	40,500	40,500	40,500
Total	**do.**	**164,250**	**164,200**	**167,100**	**168,000**	**168,600**

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

[1]Table includes data available through June 29, 1989.

[2]In addition to the commodities listed, secondary aluminum, secondary lead, and secondary copper may be produced in small quantities and and crude construction materials presumably are produced for local consumption, but output is not reported, and available information is inadequate to make reliable estimates of output levels.

[3]Reported figure.

[4]Includes approximately 50,000 tons of plaster each year.

[5]Excludes gas used in reinjection, flaring, venting, transmission losses, and natural gas liquids extraction.

TABLE 2

ALGERIA: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
METALS					
Aluminum: Metal including alloys, scrap		203	177	—	France 142; West Germany 35.
Copper: Metal including alloys:					
Scrap		5,290	1,760	—	France 712; West Germany 518; Italy 451.
Semimanufactures		717	—		
Iron and steel:					
Iron ore and concentrate excluding roasted pyrite		—	60,591	—	Czechoslavakia 42,113; Albania 18,448.
Metal:					
Scrap		148,415	150,637	2,416	Spain 91,370; Italy 44,541.
Pig iron, cast iron, related materials		66,841	72,656	—	Italy 46,590; Denmark 11,247; Bulgaria 9,941.
Steel, primary forms		38,628	73,241	94	Italy 38,957; Thailand 11,636; United Kingdom 7,589.
Semimanufactures:					
Bars, rods, angles, shapes, sections		5,420	1,979	—	All to Italy.
Universals, plates, sheets		28,638	35,391	7,495	Italy 9,285; United Kingdom 6,005.
Tubes, pipes, fittings		12,216	14,649	7,755	United Arab Emirates 2,903; Belgium-Luxembourg 2,113.
Lead:					
Ore and concentrate		3,153	3,471	—	Sweden 2,512; France 959.
Metal including alloys, scrap		—	2,000	—	All to Italy.
Magnesium: Metal including alloys, scrap		—	2	—	All to France.
Mercury	76-pound flasks	16,535	17,637	—	East Germany 9,718; Romania 2,002; Netherlands 1,508.
Nickel: Metal including alloys, scrap		—	1	—	All to France.
Zinc: Metal including alloys:					
Scrap		923	656	—	All to Italy.
Unwrought		28,772	3,236	—	All to Hungary.
Other:					
Ashes and residues		720	942	—	All to France.
Base metals including alloys, all forms		225	224	—	All to Netherlands.
INDUSTRIAL MINERALS					
Abrasives, n.e.s.: Grinding and polishing wheels and stones	value, thousands	$4	$1	—	All to Tunisia.
Barite and witherite		1,000	1,000	—	All to Albania.
Cement		—	150	—	All to Senegal.
Clays, crude		3,117	5,495	—	Tunisia 4,490; Iraq 1,000.
Diatomite and other infusorial earth		40	380	—	All to Tunisia.
Fertilizer materials: Manufactured:					
Ammonia		75,181	63,101	—	Greece 41,118; Spain 21,983.
Nitrogenous		4,066	83,366	—	France 80,023.
Graphite, natural		132	67	—	All to France.

See footnotes at end of table.

TABLE 2—Continued

ALGERIA: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
INDUSTRIAL MINERALS—Continued					
Phosphates, crude		785,363	855,520	—	United Kingdom 117,597; Romania 101,633; Poland 91,239.
Salt and brine		13,938	4,942	—	Benin 4,440; Niger 502.
Stone, sand and gravel: Dimension stone, worked		24	6	—	All to France.
Sulfur: Sulfuric acid		37,645	—		
Other: Crude		1,167	—		
MINERAL FUELS AND RELATED MATERIALS					
Gas, natural: Gaseous and liquefied	billion cubic feet	728	880	—	Italy 365; France 330.
Coke and semicoke		34,184	36,219	—	All to Tunisia.
Petroleum:					
Crude	thousand 42-gallon barrels	180,727	183,996	42,236	Italy 28,397; Netherlands 22,982.
Refinery products:					
Liquefied petroleum gas	do.	(2)	27,945	1,763	France 11,822; Italy 6,704; Belgium-Luxembourg 3,022.
Gasoline, motor	do.	38,119	30,132	1,452	Netherlands 15,163; Japan 2,161.
Kerosene and jet fuel	do.	1,670	1,715	—	United Kingdom 483; Canada 297; Iran 155.
Distillate fuel oil	do.	36,370	29,778	700	Netherlands 17,238; France 6,149; Italy 2,450.
Lubricants	do.	9	10	—	Mainly to Tunisia.
Residual fuel oil	do.	39,975	32,577	26,291	Netherlands 2,920; France 2,437.

[1] Table prepared by Virginia A. Woodson.
[2] Unreported quantity valued at $2,632,481,000.

a processing plant at El Hadjar, a distance of 170 kilometers. Both mines are operated by Entreprise Nationale de Fer et de Phosphates.

Iron and Steel.—At yearend, site preparation for the 2-million-ton-per-year-capacity Bellara steel complex, east of Algiers, was near completion by Algerian firms. Bids for the complex were invited in three lots: direct-reduction process plant, scrap yard, and harbor installations; electric arc furnace with continuous casting, water treatment plant, and electrical distribution network; and maintenance shop, stockyard, and repair area. Final decision on technical bids was anticipated in 1989. Possible bidders included Voest-Alpine Anlagenbail AG (Austria), Merlin Gerin (France), Danieli Engineering (Italy), and C. Itoh Co. Ltd. (Japan).

Raw steel output, estimated at 750,000 tons annually, was produced at the Entreprise Nationale de Siderurgie's El Hadjar steel complex, the nation's sole steelworks. France's Concessionary Credit Agency, Caisse Centrale de Cooperation Economique, increased loans to Algeria in 1988 including $22.3 million for a project designed to reduce coke consumption at El Hadjar.

Mercury.—Algeria was a significant world producer of mercury, supplying about 10% of the world's total output. Only the U.S.S.R. and Spain reported higher production. Entreprise Nationale des Nonferreur et Substances Utiles reported the average production cost of mercury in Algeria at $300 per flask. The price of mercury on the New York market in 1988 ranged from $233 to $370 per flask. A factor that contributed to the price improvement was the curtailment of U.S.S.R. exports to Europe at prices well below market levels. The reduced shipments were prompted by an antidumping claim filed with the European Commission by Spain against the U.S.S.R.

***Industrial Minerals.*—Phosphate Rock.**—Production was derived from the Djebel Onk open pit mine 330 kilometers south of Annaba. Operated by Entreprise Nationale de Fer et de Phosphates, the deposit site covers 2,100 square kilometers and produced 1.3 million tons of processed phosphate. To

TABLE 3

ALGERIA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS				
Alkali and alkaline-earth metals	2	27	(2)	France 16; West Germany 7.
Aluminum:				
Oxides and hydroxides	796	187	(2)	France 126; West Germany 60.
Metal including alloys:				
Scrap	82	20	—	All from West Germany.
Unwrought	6,636	7,665	—	West Germany 2,994; Norway 1,801; Netherlands 1,005.
Semimanufactures	16,777	13,812	1	France 5,037; Italy 2,531; Eqypt 1,496.
Beryllium: Metal including alloys, all forms value, thousands	$6	—		
Chromium: Oxides and hydroxides	61	44	—	Netherlands 40; France 4.
Copper: Metal including alloys:				
Unwrought	1,182	418	—	France 307; West Germany 103.
Semimanufactures	16,947	24,496	7	Turkey 8,200; Saudi Arabia 5,650; France 4,605.
Iron and steel:				
Iron ore and concentrate excluding roasted pyrite	—	387	—	Netherlands 200; Canada 140.
Metal:				
Scrap	20	3	—	All from West Germany.
Pig iron, cast iron, related materials	23,167	10,472	—	West Germany 6,281; Belgium-Luxembourg 2,840; France 759.
Ferroalloys:				
Ferromanganese	4,495	2,170	—	France 1,370; West Germany 759.
Unspecified	4,824	3,458	—	Norway 2,607; Brazil 440.
Steel, primary forms	18,593	22,014	—	West Germany 10,218; Netherlands 6,890; France 3,364.
Semimanufactures:				
Bars, rods, angles, shapes, sections	789,266	662,162	5	Brazil 159,766; Spain 118,649; Austria 98,065.
Universals, plates, sheets	154,408	76,917	—	West Germany 27,243; Belgium-Luxembourg 24,830; France 12,770.
Hoop and strip	10,279	6,856	3	France 2,705; West Germany 2,458; Belgium-Luxembourg 1,208.
Rails and accessories	38,870	24,745	6	France 17,863; United Kingdom 3,469.
Wire	42,354	33,914	1	Italy 14,566; West Germany 6,122; Belgium-Luxembourg 4,927.
Tubes, pipes, fittings	121,528	66,331	599	France 22,002; Tunisia 17,748; Italy 11,587.
Lead:				
Ore and concentrate	6	6	—	All from France.
Oxides	2,731	2,481	—	Switzerland 1,200; China 875; Italy 356.
Metal including alloys:				
Unwrought	17,025	16,214	643	Belgium-Luxembourg 5,198; Italy 3,960; Sweden 3,677.
Semimanufactures	393	55	(2)	France 49; Canada 5.

See footnotes at end of table.

TABLE 3—Continued

ALGERIA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS—Continued					
Magnesium: Metal including alloys:					
Unwrought		—	14	—	All from Norway.
Semimanufactures		36	21	—	United Kingdom 13; Japan 8.
Manganese:					
Ore and concentrate, metallurgical-grade	value, thousands	$2	—		
Oxides		1,822	1,799	—	Belgium-Luxembourg 720; West Germany 690; France 300.
Mercury	value, thousands	$22	$3	—	West Germany $2; France $1.
Molybdenum: Metal including alloys, all forms	do.	$68	$32	—	Austria $26; France $6.
Nickel:					
Matte and speiss		—	3	—	Netherlands 2; France 1.
Metal including alloys:					
Unwrought		7	1	—	Mainly from France.
Semimanufactures		93	266	—	Canada 175; West Germany 29.
Platinum-group metals: Metals including alloys, unwrought and partly wrought	value, thousands	$1,523	$24	—	France $9; Spain $8; Switzerland $4.
Silver: Metal including alloys, unwrought and partly wrought	do.	$4,411	$2,025	—	Belgium-Luxembourg $1,169; France $664.
Tin: Metal including alloys:					
Scrap	do.	$2	—		
Unwrought		161	310	—	Malaysia 270; Belgium-Luxembourg 22.
Semimanufactures		130	55	—	West Germany 27; Italy 21.
Titanium: Oxides		15,251	9,791	228	West Germany 3,220; France 2,837; Belgium-Luxembourg 1,643.
Tungsten: Metal including alloys, all forms		5	—		
Zinc:					
Ore and concentrate		83,859	100,820	—	Canada 47,689; Sweden 41,326; West Germany 7,396.
Oxides		426	578	—	China 395; Netherlands 120.
Metal including alloys, semimanufactures		502	587	—	France 327; West Germany 122.
Other:					
Ores and concentrates		24	—		
Oxides and hydroxides		150	341	88	France 109; West Germany 106.
Base metals including alloys, all forms		58	156	—	Belgium-Luxembourg 75; China 40; Italy 37.
INDUSTRIAL MINERALS					
Abrasives, n.e.s.:					
Natural: Corundum, emery, pumice, etc.		156,205	29,217	2	Greece 28,695.
Artificial: Corundum		1,502	382	—	Austria 150; West Germany 80; France 32.
Dust and powder of precious and semiprecious stones including diamond	value, thousands	$4	$68	—	Ireland $42; France $16.
Grinding and polishing wheels and stones		635	218	([3])	West Germany 79; Italy 56; France 40.

See footnotes at end of table.

TABLE 3—Continued

ALGERIA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
INDUSTRIAL MINERALS—Continued					
Asbestos, crude		11,125	18,260	502	Canada 15,500; Republic of South Africa 2,218.
Barite and witherite		50	—		
Boron materials:					
Crude natural borates		64	—		
Oxides and acids		103	36	—	China 20; Italy 13.
Cement	thousand tons	2,920	1,663	34	Greece 593; Spain 341; Tunisia 309.
Chalk		37,917	35,069	—	France 31,779; Spain 2,345.
Clays, crude		10,492	13,713	—	United Kingdom 9,433; France 4,255.
Cryolite and chiolite	value, thousands	$50	$10	—	All from France.
Diamond: Industrial stones	do.	$345	$247	—	Zaire $227; Ireland $20.
Diatomite and other infusorial earth		79	54	—	All from West Germany.
Feldspar, fluorspar, related materials		4,900	1,653	—	Norway 900; Turkey 360; Italy 350.
Fertilizer materials:					
Crude, n.e.s.	value, thousands	$846	$1	—	All from Italy.
Manufactured:					
Ammonia		15	2	—	France 1; United Kingdom 1.
Nitrogenous		7,612	18,227	812	Romania 7,500; France 6,150; Jordan 3,000.
Phosphatic		118,983	172,239	—	Tunisia 88,970; Turkey 54,839; Iraq 15,730.
Potassic		71,588	102,681	—	Belgium-Luxembourg 41,656; Spain 41,372; East Germany 16,647.
Unspecified and mixed		52,888	53,790	—	Spain 30,025; Greece 18,300.
Graphite, natural		161	25	—	United Kingdom 18; France 4.
Gypsum and plaster		1,927	—		
Magnesium compounds, unspecified		697	1,229	—	Austria 1,100; France 104.
Mica:					
Crude including splittings and waste		149	88	—	All from France.
Worked including agglomerated splittings		2	1	—	Mainly from France.
Phosphates, crude		3	—		
Pigments, mineral: Iron oxides and hydroxides, processed		1,990	3,084	153	China 2,519; Italy 268.
Precious and semiprecious stones other than diamond:					
Natural	value, thousands	$4	—		
Synthetic	do.	$2,702	$2	—	All from Ireland.
Pyrite, unroasted		60	35	—	All from West Germany.
Salt and brine		105	283	—	United Kingdom 251; France 16.
Sodium compounds, n.e.s.:					
Carbonate, manufactured		23,972	32,178	—	Italy 23,023; France 5,067.
Sulfate, manufactured		20,392	15,069	—	Italy 8,349; Belgium-Luxembourg 2,946; Libya 2,000.

See footnotes at end of table.

TABLE 3—Continued

ALGERIA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987 United States	Sources, 1987 Other (principal)
INDUSTRIAL MINERALS—Continued					
Stone, sand and gravel:					
Dimension stone:					
Crude and partly worked		14	50	—	All from France.
Worked		2,464	1	—	All from Canada.
Dolomite, chiefly refractory-grade		1,817	510	—	France 248; West Germany 161; Austria 61.
Gravel and crushed rock		153,209	103,010	—	Italy 98,782; France 4,228.
Quartz and quartzite		2,286	18	(4)	Austria 12; France 6.
Sand other than metal-bearing		291	33	—	All from France.
Sulfur:					
Elemental:					
Crude including native and byproduct		77,978	126,888	—	France 85,184; Poland 25,708.
Colloidal, precipitated, sublimed		5	4,104	—	All from France.
Sulfuric acid		40	2,317	—	Spain 2,299.
Talc, steatite, soapstone, pyrophyllite		1,584	957	—	Spain 500; France 394.
Other: Crude		233	40	—	France 35; Belgium-Luxembourg 5.
MINERAL FUELS AND RELATED MATERIALS					
Carbon black		3,907	2,226	11	Italy 804; West Germany 692; Spain 387.
Coal:					
Anthracite and bituminous	thousands tons	1,009	1,371	880	Australia 341; Poland 150.
Briquets of anthracite and bituminous coal		—	59	—	All from France.
Coke and semicoke		—	53,000	—	Japan 40,000; Yugoslavia 13,000.
Peat including briquets and litter	value, thousands	$1	$130	—	Sweden $116; Netherlands $14.
Petroleum refinery products:					
Liquefied petroleum gas	42-gallon barrels	12	35	—	Mainly from Belgium-Luxembourg.
Gasoline, motor	value, thousands	$168	$222	—	Belgium-Luxembourg $219.
Mineral jelly and wax	42-gallon barrels	74,175	32,834	—	Spain 31,937; France 527.
Kerosene and jet fuel	value, thousands	$20,475	$1,000	—	Belgium-Luxembourg $867; France $114.
Lubricants	42-gallon barrels	609,644	294,861	70	France 158,088; Belgium-Luxembourg 96,593; Italy 24,115.
Residual fuel oil	do.	4,995	—		
Bitumen and other residues	do.	614,860	415,801	—	Spain 393,900; Austria 21,228.
Bituminous mixtures	do.	42,069	95,269	424	France 45,650; Italy 25,834; Austria 21,974.
Petroleum coke	do.	407	—		

[1] Table prepared by Virginia A. Woodson.
[2] Less than 1/2 unit.
[3] Unreported quantity valued at $13,000.
[4] Unreported quantity valued at $35,000.

produce this amount, the mine handles 3 million tons of overburden and 3 million tons of phosphate-bearing material. The latter is processed by either wet or dry methods following crushing and screening. Water is supplied to the plant at a rate of 300 cubic meters per hour through a 90-kilometer-long pipeline. Both mine and plant were in virtually continuous operation. About one-third of the output was utilized at the Annaba fertilizer complex, and the remainder was exported principally to European markets.

Mineral Fuels.—**Natural Gas.**—Gross production of natural gas was 3.5 trillion cubic feet, less than 7% was flared, and nearly 50% was reinjected to maintain petroleum reservoir pressure. Export activities increased when Algeria made gas prices more flexible. As a result, Distrigas Corp. and Panhandle Eastern Corp. resumed contracts to import Algerian liquefied natural gas into the United States. The contracts had been suspended following disputes over prices in 1983 and 1985, respectively. At the close of 1987, Algeria shipped the first of 17 cargoes to Distrigas of Boston, Massachusetts, priced at $2.60 per million British thermal units. A longstanding price dispute with Gaz de France was also resolved in 1988. A price structure for a 4-year period was agreed to, and the old pricing formula based on the official selling price of eight OPEC crude oils was abandoned.

The magnitude of investment necessary to develop natural gas liquefaction-shipment-regasification networks and the rigidity of the distribution patterns requires the signing of long-term purchase and sales contracts to ensure investment viability. Table 4 lists Algerian export contracts in effect during 1988.

Algeria exported nearly 900 billion cubic feet of natural gas to Europe in 1988 and provided 9% of Europe's natural gas requirements. More than one-half of this amount was shipped as liquefied natural gas. Algeria will supply 11% of the European natural gas requirement when annual capacity of the Transmed pipeline is increased from its present 425 billion cubic feet to 580 billion cubic feet and when natural gas delivery contracts to Belgium and Spain reach full delivery rate.

TABLE 4

ALGERIA: LIQUEFIED NATURAL GAS EXPORT CONTRACTS IN EFFECT OR PLANNED

Country	Volume[1] (billion cubic feet per year)	Liquefaction terminal	Regasification terminal	Contract duration
Belgium	100	Arzew	Zeebrugge	1982–2002
France	20	do.	Le Havre	1965–90
Do.	120	Skikda	Fos-Sur-Mer	1973–98
Do.	180	Arzew	Montoir de Bretagne	1982–2002
Greece	20	Skikda	Athens	1991–2011
Spain	135	do.	Barcelona	1975–2004
Turkey	70	do.	Ereglisi	1992
United Kingdom	7	Arzew	Canvey Island	1988
United States	160	do.	Lake Charles, LA	1987–2003
Do.	45	do.	Everett, MA	1988–2004

[1] Most contracts offer some volume flexibility.

After a 14-year breach, diplomatic relations were resumed between Algeria and Morocco with the signing of an agreement to ship natural gas to Spain through a second Transmed pipeline. This pipeline will originate at the Hassi R'Mel Field and extend to the border with Morocco at Oujda, through Fez to Tangier. It is scheduled for completion in 1995.

A protocol was signed in the early months of 1988 by Algeria, Libya, and Tunisia to construct a 415-kilometer natural gas pipeline from the junction of the Transmed pipeline at the Tunisian border, through Tunisia to Zuwara, on the Libyan coast. The construction cost was estimated at $400 million. The line will deliver Algerian gas to fuel an 800,000-kilowatt power station at Zuwara and may provide a basis for future petrochemical and fertilizer plants at Zuwara.

Petroleum.—Exploration.—Exploration agreements based on the amended 1986 Hydrocarbons Code have been finalized with Azienda Generali Italiana Petroli S.p.A. (AGIP), Compania Espanola de Petroleos (Cepsa), and the Broken Hill Pty. Ltd. (BHP). Agreement terms call for a 50-50 split in development cost. Production is to be shared on a 35-65 basis in SONATRACH'S favor for production up to 15,000 barrels per day (bbl/d). SONATRACH's share gradually rises to 87.5% for production in excess of 75,000 bbl/d.

AGIP activity was centered in Block 403 about 725 kilometers south of the Mediterranean coast and 208 kilometers west of Tunisia where development work on the Rom discovery will include construction of a pipeline from the field to the coast. Production startup was expected by late 1990 and was expected to reach an optimum production level of 30,000 bbl/d.

The Cepsa concession covered a 1,500-square-kilometer area in the eastern Erg region near Rhourde Yakoub.

BHP conducted exploration in the Rhourde-el-Lough and Sif Fatima blocks of the Ghadones Basin.

SONATRACH'S exploration in the Erg region resulted in a discovery at Rhourde-El-Rouni about 350 miles east of Hassi Messaoud. An appraisal of the discovery was underway in 1988.

CFP-Total, working outside the new exploration terms, contracted for an 18-month seismic survey for SONATRACH. It included shooting two surveys in the Hassi Messaoud area, one in the northern Sahara, and a fourth in the southern region of Algeria.

Production.—Crude oil production averaged 650,000 bbl/d, well below the 667,000-bbl/d quota assigned by OPEC. Most of the production was derived from Hassi Messaoud-Haoud el Hamra Oilfields in the Algerian Sahara and the Zarzaitine-Edjeleh Field near Ohanet and in Amenas near the Libyan border. Field condensate production not limited by OPEC quotas averaged 470,000 bbl/d from petroleum and natural gasfields.

Refining.—SONATRACH operated four refineries with a combined distillation capacity of 465,000 bbl/d and a 56,000-bbl/d catalytic reforming capacity. Refined product output averaged 460,000 bbl/d.

EGYPT[3]

Major sources of wealth for the Egyptian economy, petroleum and natural gas production, declined in 1988. This coincided with a drop in oil prices and a rise in wheat prices. Oil export revenues dropped, and wheat and flour imports rose during 1988. However, the Egyptian Government's new approach to mineral exploration and revenue-sharing concepts began to pay dividends during the year. Petroleum production had apparently peaked in 1987; however, the production of natural gas could be expected to rise owing to new Government steps to induce exploration. The Government approved several dozen new oil exploration concession agreements with foreign companies to extend and enhance oil and natural gas production in Egypt.

Foreign exchange revenues rose in 1988 but remained less than the amount needed to finance a level of imports that would stimulate economic growth and meet the nation's large debt service obligations. The gross domestic product (GDP) for Egypt in 1988 was approximately $43 billion.[4] Real growth in GDP for 1988 was about 2.7% compared with 4.2% in 1987.

Negotiations with the International Monetary Fund (IMF) continued throughout 1988 with no substantive agreement reached. A rescheduling of debt by the IMF may not be forthcoming until at least 1989, owing to the ineffectiveness of the Egyptian 1987 Economic

FIGURE 1

1988 EGYPTIAN EXPORTS

(Value: $3 billion)

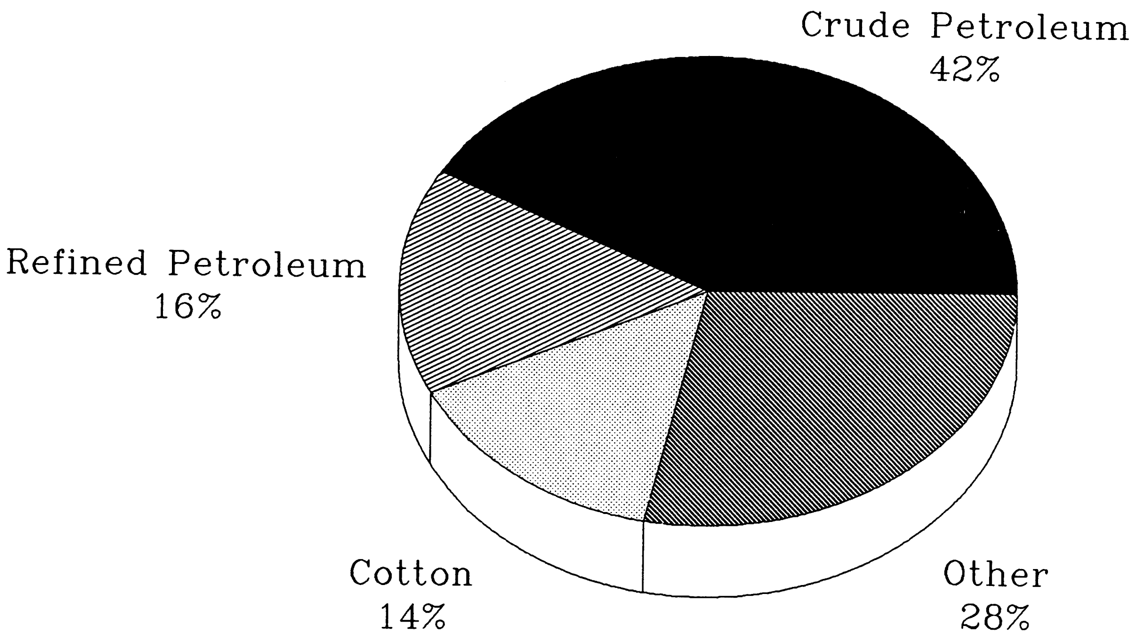


TABLE 5

EGYPT: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987[p]	1988[e]
METALS						
Aluminum metal		170,000	208,587	175,000	[r]178,850	173,460
Copper, refined, secondary[e]		2,600	2,600	2,500	2,500	25,000
Iron and steel:						
Iron ore and concentrate	thousand tons	2,500	87	2,135	[r]1,700	[2]2,000
Pig iron	do.	225	225	121	46	[2]132
Crude steel	do.	200	533	281	[r]347	347
Semimanufactures	do.	500	500	NA	NA	NA
Ferroalloys: Ferrosilicon[e]		7,500	7,500	[2]7,221	[2]7,702	[2]7,806
INDUSTRIAL MINERALS						
Asbestos		325	229	476	209	[2]166
Barite		3,500	4,426	3,385	4,116	[2]5,651
Cement: Hydraulic	thousand tons	6,500	5,749	7,612	8,746	[2]9,787
Clays:						
Bentonite		3,000	3,000	5,126	3,827	[2]3,166
Fire clay		250,000	250,000	364,300	148,727	150,000
Kaolin		120,000	108,378	127,784	125,256	[2]24,122
Feldspar, crude		7,281	19,073	19,287	15,963	[2]6,131
Fluorspar		[r]810	85	80	776	[2]1,849
Gypsum and anhydrite, crude		750,000	841,467	905,688	1,088,472	1,100,000
Lime[e]		97,500	97,000	95,000	95,000	95,000
Nitrogen: Ammonia, N content	thousand tons	686	684	680	788	[2]485
Phosphate: Phosphate rock	do.	1,043	1,074	1,271	1,167	[2]1,146
Salt, marine	do.	1,000	1,061	976	1,012	[2]922
Sodium compounds:						
Sodium carbonate		40,000	49,108	[e]50,000	[e]45,000	[2]47,711
Sodium sulfate		[e]30,000	66,830	18,940	42,484	42,484
Stone, sand and gravel:						
Basalt	thousand cubic meters	100	720	899	1,044	1,050
Dolomite[e]	thousand tons	500	500	500	500	500
Graphite, dimension	cubic meters	4,000	4,000	2,938	2,000	2,000
Gravel	thousand cubic meters	7,500	10,736	11,214	11,200	11,000
Limestone and other calcareous n.e.s.	do.	10,000	12,059	13,476	14,785	5,000
Marble blocks (including alabaster)	cubic meters	17,500	43,312	40,000	27,814	[2]13,000
Quartz		7,500	7,500	NA	NA	NA
Sand including glass sand	thousand cubic meters	1,500	12,677	13,122	246	252
Sandstone	do.	710	486	475	417	400
Sulfur:						
Elemental, byproduct[e]		4,000	3,000	7,300	7,600	7,600
Sulfuric acid		45,000	46,452	55,000	575,301	[2]31,274
Talc, steatite, soapstone, pyrophyllite		12,213	7,700	8,800	[e]7,500	[2]7,268
Vermiculite		325	488	495	[e]500	[2]236

See footnotes at end of table.

TABLE 5—Continued

EGYPT: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987[p]	1988[e]
MINERAL FUELS AND RELATED MATERIALS						
Coke: Oven and beehive	thousand tons	950	895	908	[e]900	[2]936
Gas, natural:						
Gross production	million cubic feet	140,000	172,000	180,000	[r]195,200	195,000
Marketed	do.	110,000	134,000	155,000	[e]155,000	155,000
Petroleum and refinery products:						
Crude	thousand 42-gallon barrels	302,000	319,000	[r]296,745	[r]327,040	[2]309,520
Refinery products:						
Gasoline and naphtha	do.	25,000	25,000	27,000	[e]27,000	27,000
Kerosene and jet fuel	do.	20,000	20,000	20,000	[e]20,000	20,000
Distillate fuel oil	do.	25,000	25,000	30,000	[e]30,000	30,000
Residual fuel oil	do.	75,000	65,000	60,000	[e]60,000	60,000
Lubricants	do.	1,000	1,000	1,000	[e]1,000	1,000
Liquefied petroleum gas	do.	2,500	2,000	5,000	[e]5,000	5,000
Asphalt	do.	2,500	2,500	2,000	[e]2,000	2,000
Unspecified	do.	1,000	1,000	4,500	[e]4,500	4,500
Refinery fuel and losses	do.	6,500	6,500	6,500	[e]6,500	6,500
Total	**do.**	**158,500**	**148,000**	**156,000**	**[e]156,000**	**156,000**

[e]Estimated. [p]Preliminary. [r]Revised. NA Not available.
[1]Table includes data available through July 15, 1988.
[2]Reported figure.

Stabilisation Programme with the IMF and the May 1987 Paris Club agreement to reschedule $6.5 million in debt payments. In the absence of a renegotiated agreement coupled with a 25% inflation rate, Egypt could face severe payment problems into the 1990's. The Government also took action during 1988 to regulate Islamic investment companies that lost tens of thousands of Egyptians' personal monetary savings. It was hoped that these companies could be converted to joint stock entities within 1 year, pending the necessary legislation.

However, positive gains were seen in non-oil exports, tourism, and diplomacy during the year. Egypt made impressive political moves as a nation from a nonaligned status to more positive ties with Arab neighbors. These developments were expected to yield more positive opportunities for economic advancement in the future.

Production and Trade

Total remittance from exports was approximately $3 billion for 1988. Of this total, crude petroleum represented 41.7%, refined petroleum represented 15.7%, and cotton represented 14.4%. Imports were valued at about $8 billion for 1988. The trade balance as a percentage of GDP for 1988 was −18.8% with a current account balance of −$554 million. These figures were the result of increased international commodity prices, decreased remittances from Egyptian workers in the Persian Gulf and elsewhere (Egypt's major source of foreign exchange earnings), and sagging oil revenues. To offset these deficit accounts, Egypt sought to stimulate foreign investment in the petroleum industry. It was hoped that these efforts would generate revenue for 1989.

Principal nonpetroleum minerals in Egypt are phosphates, iron ore, coal, clays, and cement. All of these commodities are utilized domestically and were not significant in international trade. In the mid-1980's, the Government tried to stimulate the development of Egypt's mineral resources in the face of an investment capital shortage. It extended to potential foreign investors a production-sharing concept utilized in the petroleum industry. This adaptation to the exploitation of mineral resources met with only modest results. Another problem was the relative lack of knowledge of Egypt's geology and commercial mineral deposits. Positive results were shown in 1988 with the addition of a project sponsored by the United States Agency for International Development (USAID) to train Egyptian Government staff and upgrade equipment. Continental Oil Co. sponsored a project to survey and

TABLE 6

EGYPT: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
METALS				
Aluminum: Metal including alloys:				
Unwrought	24	—		
Semimanufactures	101,555	107,307	—	Netherlands 56,552; Italy 23,952; Belgium-Luxembourg 6,596.
Copper: Metal including alloys:				
Scrap	421	—		
Unwrought	—	1,138	—	All to Italy.
Semimanufactures	745	383	—	Italy 360; Sudan 16.
Iron and steel:				
Iron ore and concentrate including roasted pyrite	30	—		
Metal:				
Scrap	—	547	—	Italy 310; Netherlands 238.
Ferroalloys	—	8,853	3,500	West Germany 3,053; Japan 1,200.
Steel, primary forms	13,682	26,390	4,400	Italy 9,963; United Kingdom 6,170.
Semimanufactures:				
Bars, rods, angles, shapes, sections	—	144	—	All to Sudan.
Universals, plates, sheets	19,686	13,254	—	United Kingdom 4,892; Italy 3,070; Sudan 2,966.
Hoop and strip	—	4,912	—	Italy 2,500; United Kingdom 922; Portugal 920.
Wire	3	13	—	All to Sudan.
Tubes, pipes, fittings	342	598	—	Do.
Castings and forgings, rough	37	116	—	Sudan 113.
Nickel: Metal including alloys, scrap	—	17	—	All to Saudi Arabia.
Zinc:				
Oxides value, thousands	—	$1	—	All to Bahrain.
Metal including alloys:				
Unwrought	1,262	200	—	All to India.
Semimanufactures	—	404	—	Do.
Other: Ashes and residues	601	699	—	Do.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.: Grinding and polishing wheels and stones	—	3	—	All to Sudan.
Cement	1,052	2,000	—	Do.
Fertilizer materials: Manufactured:				
Nitrogenous	13,104	5,362	—	Greece 2,342; Jordan 1,500; Morocco 1,020.
Unspecified and mixed	—	20	—	All to Australia.
Phosphates, crude	71,770	68,650	—	Albania 44,750; Romania 13,500.
Pigments, mineral: Iron oxides and hydroxides, processed	137	256	—	Sudan 206; Lebanon 50.
Precious and semiprecious stones other than diamond: Natural value, thousands	$5	—		

See footnotes at end of table.

TABLE 6—Continued

EGYPT: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Destinations, 1987	
				United States	Other (principal)
INDUSTRIAL MINERALS—Continued					
Salt and brine		13,013	180,276	—	Italy 84,350; Yugoslavia 21,500; United Kingdom 20,500.
Sodium compounds, n.e.s.: Carbonate, manufactured		—	1,550	—	All to Sudan.
Stone, sand and gravel:					
Dimension stone:					
Crude and partly worked	value, thousands	$43	$175	—	West Germany $109; Jordan $57.
Worked		—	915	(2)	West Germany 896.
Gravel and crushed rock	value, thousands	$92	$148	—	All to Israel.
Sand other than metal-bearing		—	4,937	—	Kuwait 4,712; Cyprus 225.
Sulfur: Sulfuric acid		—	100	—	All to Sudan.
Talc, steatite, soapstone, pyrophyllite		843	345	—	East Germany 157; West Germany 154.
MINERAL FUELS AND RELATED MATERIALS					
Asphalt and bitumen, natural		—	30	—	All to Sudan.
Coal: Anthracite and bituminous		—	9	—	All to Israel.
Coke and semicoke		71,816	63,635	—	Romania 59,621; Tunisia 4,014.
Petroleum:					
Crude	thousand 42-gallon barrels	52,191	72,166	10,861	Israel 18,705; Italy 15,554.
Refinery products:					
Liquefied petroleum gas	do.	—	124	—	All to Yemen (Sanaa).
Gasoline, motor	do.	33	88	—	India 65; West Germany 23.
Mineral jelly and wax	do.	127	146	24	West Germany 121.
Kerosene and jet fuel	do.	3,797	5,566	—	France 2,131; Italy 2,103.
Distillate fuel oil	do.	965	925	—	All for bunkers.
Lubricants	do.	35	—		
Residual fuel oil	do.	12,115	11,066	—	Italy 2,935; France 1,620; bunkers 5,814.
Bitumen and other residues	do.	—	12	—	All to Greece.

[1] Table prepared by Virginia A. Woodson.
[2] Unreported quantity valued at $2,000.

publish a 1:500,000 scale geological map, to be made available through the state oil company Egyptian General Petroleum Co. (EGPC). Additionally, the Government revised its bureaucratic structure to transfer new mineral exploration and exploitation from the Ministry of Industry to the Ministry of Petroleum (renamed the Ministry of Petroleum and Mineral Wealth). This restructuring will enable foreign investors to deal solely with EGPC instead of multiple ministries.

During 1988, the volume of shipping in the Suez Canal generated $1.27 billion. Shipping traffic was expected to decline in 1989.

Commodity Review

Metals.—**Gold.**—Commercial development of Egypt's gold resources continued during the year. The United Kingdom's Minex, a subsidiary of Greenwich Resources, conducted exploration and development of gold prospects in the Eastern Desert near the Port of Safaga. Drilling was carried out over Minex' 5,000-square-kilometer El Sid Prospect in the Red Sea Hills (including El Sid South and Hammaa) and at old surface workings at Abu Marawat. At Abu Marawat the company isolated two disseminated gold and silver mineralized veins. They were the "Fin" vein, with a width of 5.8 meters at grades of 6.2 grams per ton (g/t) gold and 84 g/t silver; and the "C" vein, at a depth of 60 meters, with a width of 6.5 meters at grades of 4.4 g/t gold and 51.8 g/t of

TABLE 7

EGYPT: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS				
Alkali and alkaline-earth metals	31	1	—	Mainly from France.
Aluminum:				
Ore and concentrate	1,060	—		
Oxides and hydroxides	27,401	1,659	84	West Germany 1,193; India 200.
Metal including alloys: Semimanufactures	3,085	2,704	11	Italy 744; West Germany 608; France 441.
Chromium: Oxides and hydroxides	—	10	—	Romania 6; West Germany 2.
Cobalt: Oxides and hydroxides	10	1	—	All from United Kingdom.
Columbium and tantalum: Metal including alloys, all forms, tantalum	([2])	8	—	West Germany 5; France 3.
Copper:				
Matte and speiss including cement copper	1,030	—		
Metal including alloys:				
Scrap	23	11	—	All from ship stores.
Unwrought	697	5	—	All from United Kingdom.
Semimanufactures	9,248	11,755	445	Turkey 4,096; Greece 1,524; West Germany 1,095.
Iron and steel:				
Iron ore and concentrate excluding roasted pyrite	67,425	538,931	67,657	Brazil 349,278; United Kingdom 121,996.
Metal:				
Scrap	1,539	1,992	—	NA.
Pig iron, cast iron, related materials	29,196	983	—	Italy 387; Spain 216; Brazil 100.
Ferroalloys:				
Ferromanganese	5,371	16,415	—	France 8,707; United Kingdom 6,999.
Unspecified	93	64	—	West Germany 32; Yugoslavia 20.
Steel, primary forms value, thousands	$33,698	$25,513	—	United Kingdom $8,461; West Germany $5,338; Sweden $4,369.
Semimanufactures:				
Bars, rods, angles, shapes, sections	1,674,958	824,333	8,590	Czechoslavakia 209,347; Yugoslavia 133,238; Romania 125,971.
Universals, plates, sheets	79,810	195,857	27,751	West Germany 31,725; France 16,144; Italy 14,696.
Hoop and strip	3,183	965	11	West Germany 365; East Germany 175; Belgium-Luxembourg 156.
Rails and accessories	2,785	15,012	—	Poland 6,498; Austria 6,072; Republic of Korea 1,143.
Wire	15,316	18,112	2	China 4,750; Poland 3,067; West Germany 2,293.
Tubes, pipes, fittings value, thousands	$131,291	$115,437	$10,947	Switzerland $15,822; Italy $12,977; West Germany $11,704.
Castings and forgings, rough	24,066	22,643	664	Romania 5,160; West Germany 3,867; Republic of Korea 3,243.

See footnotes at end of table.

TABLE 7—Continued

EGYPT: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987	
				United States	Other (principal)
METALS—Continued					
Lead:					
Oxides		2,507	1,790	54	East Germany 725; West Germany 451; Bulgaria 368.
Metal including alloys:					
Scrap		375	561	—	Sudan 315; United Kingdom 246.
Unwrought		7,710	15,807	—	Switzerland 4,701; Morocco 2,253; Spain 1,876.
Semimanufactures		5	71	7	West Germany 57; Republic of Korea 5.
Magnesium: Metal including alloys:					
Scrap	value, thousands	—	$7	—	All from West Germany.
Unwrought		9	50	—	Yugoslavia 47.
Semimanufactures		—	4	—	United Kingdom 3; West Germany 1.
Manganese:					
Ore and concentrate: Metallurgical-grade		263	408	—	All from Belgium-Luxembourg.
Oxides		769	505	180	Belgium-Luxembourg 307.
Mercury	76-pound flasks	551	522	—	Spain 493; Netherlands 1.
Molybdenum: Metal including alloys, all forms	value, thousands	—	$46	—	All from Netherlands.
Nickel:					
Matte and speiss		—	40	—	All from United Kingdom.
Metal including alloys:					
Scrap		—	21	—	Do.
Unwrought		88	56	—	United Kingdom 31; France 10.
Semimanufactures		105	110	—	West Germany 45; Canada 21.
Platinum-group metals: Metals including alloys, unwrought and partly wrought	value, thousands	$35	$354	—	All from West Germany.
Silver: Metal including alloys, unwrought and partly wrought	do.	$162	$1,677	$20	Switzerland $866; West Germany $775.
Tin: Metal including alloys:					
Scrap		3	4	—	All from Sudan.
Unwrought		262	186	—	Malaysia 120; Spain 30; Belgium-Luxembourg 29.
Semimanufactures		16	24	—	Singapore 8; Republic of Korea 6.
Titanium: Oxides		424	1,085	205	Czechoslovakia 213; West Germany 197.
Tungsten: Metal including alloys, all forms		2	9	—	All from Netherlands.
Zinc:					
Oxides		623	295	69	Yugoslavia 103; Belgium-Luxembourg 50.
Metal including alloys:					
Unwrought		11,412	7,158	—	Zaire 4,403; France 1,475; Somalia 1,001.
Semimanufactures		92	19	—	NA.

See footnotes at end of table.

TABLE 7—Continued

EGYPT: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS—Continued				
Other:				
Oxides and hydroxides	35	2,189	—	Republic of Korea 2,007; Netherlands 62.
Base metals including alloys, all forms	2,521	1,781	—	Switzerland 1,107; West Germany 351.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	51	434	69	Greece 188; Italy 153.
Artificial: Corundum	79	52	—	All from West Germany.
Dust and powder of precious and semiprecious stones including diamond value, thousands	—	$17	—	All from United Kingdom.
Grinding and polishing wheels and stones	1,996	3,170	—	Italy 1,446; Yugoslavia 511; China 292.
Asbestos, crude	1,949	9,300	—	Canada 4,337; Cyprus 2,080; Republic of South Africa 2,006.
Barite and witherite	7,281	—		
Boron materials: Oxides and acids	428	352	—	Italy 171; Turkey 100; West Germany 75.
Cement value, thousands	6,702	3,823	—	Greece 1,362; Romania 978; Jordan 519.
Chalk	265	427	—	France 254; United Kingdom 160.
Clays, crude	34,593	31,317	289	United Kingdom 23,973; Cyprus 2,238.
Cryolite and chiolite	—	11	—	West Germany 10; Switzerland 1.
Diamond: Industrial stones value, thousands	$103	—		
Diatomite and other infusorial earth	322	747	—	West Germany 472; Spain 270.
Feldspar, fluorspar, related materials	8,331	9,079	—	Turkey 8,101; Italy 400.
Fertilizer materials:				
Crude, n.e.s.	8	—		
Manufactured:				
Ammonia	91	141	—	Netherlands 140.
Nitrogenous	175,630	122,165	—	U.S.S.R. 90,675; Romania 31,472.
Potassic	35,394	31,713	—	Switzerland 31,663.
Unspecified and mixed	442	756	121	West Germany 298; Switzerland 215.
Graphite, natural	165	1,365	—	China 924; Italy 207.
Lime	9	—		
Magnesium compounds, unspecified	2,289	8,484	2	Turkey 5,000; Japan 1,904.
Mica:				
Crude including splittings and waste	28	14	—	All from India.
Worked including agglomerated splittings	4	3	—	Mainly from Belgium-Luxembourg.
Pigments, mineral: Iron oxides and hydroxides, processed	5,461	5,324	20	China 2,852; India 741; West Germany 739.
Precious and semiprecious stones other than diamond:				
Natural value, thousands	—	$111	$12	Belgium-Luxembourg $94.
Synthetic do.	$3,596	$149	$97	West Germany $51.

See footnotes at end of table.

TABLE 7—Continued

EGYPT: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987 United States	Sources, 1987 Other (principal)
INDUSTRIAL MINERALS—Continued				
Pyrite, unroasted	203	4	—	All from West Germany.
Salt and brine	623	812	—	Netherlands 662; West Germany 150.
Sodium compounds, n.e.s.:				
Carbonate, manufactured	1,023	8,556	—	Poland 3,012; Romania 2,778; Bulgaria 1,546.
Sulfate, manufactured	27,240	48,140	—	Belgium-Luxembourg 22,705; Italy 10,900; Romania 6,431.
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked value, thousands	$8,704	$1,697	—	Italy $806; Belgium-Luxembourg $666.
Worked	1,003	698	—	Jordan 476; Italy 131.
Dolomite, chiefly refractory-grade	380	241	—	France 205.
Gravel and crushed rock	1,798	1,521	3	Italy 600; Czechoslovakia 470; France 391.
Quartz and quartzite	33	435	—	Italy 422.
Sand other than metal-bearing	337	487	—	Belgium-Luxembourg 327; West Germany 117.
Sulfur:				
Elemental:				
Crude including native and byproduct	69,921	110,312	20,000	Iraq 36,795; Saudi Arabia 19,375; Romania 19,041.
Colloidal, precipitated, sublimed	9,060	38	—	All from West Germany.
Sulfuric acid	85	4	([3])	West Germany 2; Sweden 1.
Talc, steatite, soapstone, pyrophyllite	975	1,570	—	Finland 1,122; Norway 301.
Other: Crude	447	731	252	Italy 240; Cyprus 173.
MINERAL FUELS AND RELATED MATERIALS				
Carbon black	3,722	4,490	1,140	Italy 970; France 960.
Coal:				
Anthracite and bituminous thousands tons	1,185	1,310	492	U.S.S.R. 478; Australia 340.
Lignite including briquets	—	1	—	All from Jordan.
Coke and semicoke	5,019	42	—	All from United Kingdom.
Peat including briquets and litter	3,212	618	19	West Germany 268; Belgium-Luxembourg 143.
Petroleum refinery products:				
Liquefied petroleum gas thousand 42-gallon barrels	927	1,774	—	Greece 838; Italy 723.
Gasoline do.	3	—		
Mineral jelly and wax do.	16	2	([3])	West Germany 1.
Kerosene and jet fuel do.	([4])	147	23	Kuwait 51; Israel 35.
Distillate fuel oil do.	5,125	4,106	—	Kuwait 2,305; Israel 1,445.
Lubricants do.	679	295	38	Spain 63; United Kingdom 51.
Bitumen and other residues do.	—	([3])	—	All from West Germany.
Bituminous mixtures do.	1	1	—	Mainly from France.

NA Not available.
[1] Table prepared by Virginia A. Woodson.
[2] Unreported quantity valued at $32,000.
[3] Less than 1/2 unit.
[4] Unreported quantity valued at $24,258,000.

silver (maximum average grade of 2.8 g/t gold and 70.9 g/t silver over a width of 16 meters). Geologically, the area was a 100-meter wide hydrothermal gold-rich mineralized zone on the western side of the Fawakhir granite body. Gold metal content was estimated at 10 tons. With more detailed work, it is expected to define about 1 million tons of material suitable for open pit mining.

Iron and Steel.—Iron ore was mined at the sedimentary deposits in the Bahraiya Oasis of the Western Desert. Production was about 2 million tons per year with the ore transported by rail 350 kilometers to the Helwan iron and steel complex south of Cairo. It was operated by the state-owned Iron and Steel Co. Capacity at the Helwan plant will be raised from 900,000 tons per year to 1.5 million tons per year by 1995. Financing was to originate from $250 million in loans from the World Bank and a loan of $120 million from the Soviet Union. The Soviet loan was to be used to modernize the high-blast furnaces and to supply an oxygen plant to improve the quality of steel from the Helwan complex. Additionally, the Soviet Union had agreed to upgrade production to 3 million tons per year by 1997. The Soviet Union was also financing the construction of a major iron and steel complex, on the Red Sea, with a capacity of 4 million tons per year at a cost of $1.4 billion.

Egypt's largest private sector venture was the construction of the El Dikheila steel complex, near Alexandria, which was completed in 1986. Production was 1.15 million tons per year, about 900,000 tons short of demand.

Other Metals.—The Egyptian Government's latest technical and economic feasibility study on vanadium and titanium ore was conducted during 1973–75. The study revealed proven ore reserves of approximately 41 million tons with about 8.5 million tons of the ore outcropping on the surface. The study also showed that vanadium was within the economically feasible amount to be invested together with titanium.

The Egyptian Geological Survey and Mining Authority (EGSMA) had a project underway in 1988 to extract tin from cassiterite along the Red Sea coast. When fully developed, the project is expected to eliminate about 20% of Egypt's tin imports.

***Industrial Minerals.*—Cement.**—Egyptian cement production continued its strong growth during the year. Cement production for the fiscal year ending September 1988, was 12.1 million tons, about 19% more than the 10.2 million tons in 1987. Cement production goals for 1988–89 were 13.8 million tons. Because of increased production, cement imports have dropped from 5.4 million tons to 3.3 million tons for 1988. The Federal Republic of Germany's Kloeckner-Humboldt-Deutz, France's Fives-Cail Babcock S.A., Japan's consortium of Kobe Steel Co. and Mitsubishi Corp., and Romania's Uzinexportimport bid on contracts to build 3 cement plants in Upper Egypt. Only 2 of these cement projects were still being considered, one plant at El Minya and the other at Beni Suef II. Each plant had a projected output of 3,300 metric tons per day. The third project was shelved owing to a lack of bids. Additionally, two new 3,700-metric-ton-per-day clinker cement production lines were still under construction at Helwan Portland Cement Co.'s Asyut plant. National Cement Co.'s Tabbin plant was in the process of commissioning a 4,500-metric-ton-per-day kiln line during 1988.

Fertilizer Materials.—Egypt's only phosphoric acid plant had a capacity of 66,000 tons per year and was operated by Abu Zaabal Fertilizer and Chemicals Co. at Abu Zaabal, northeast of Cairo.

Italy's Technipetrol submitted a bid of $66 million for a natural gas-driven ammonia plant to replace an existing facility at Suez. It will have a design capacity of 400 tons per day of ammonia.

Work started on an ammonium nitrate plant in Alexandria during the year with a production capacity of 1,000 tons per day of ammonia, 1,800 tons per day of nitric acid, and 2,300 tons per day of ammonium nitrate. The builder of the $215 million plant was the Abu Qir Co. for Fertilizers and Chemicals Industries.

Phosphate Rock.—Phosphate rock production increased approximately 4% in 1988 to 1.14 million tons from 1.1 million tons in 1987. Average P_2O_5 content of the mined rock was 25% and was obtained principally from mines near the Red Sea ports of Quseir and Safaga and at Sebaiya on the River Nile, south of Luxor.

The Misr Phosphate mine and plant in Hamrawein was undergoing a feasibility study to expand capacity from 198,000 to 1.3 million tons per year of phosphoric oxide. Additionally, the Red Sea Phosphate in Abu Tartour was undergoing construction to increase capacity from 2.2 million to 3.8 million tons per year by the 1990's.

Most of the mined output of phosphate rock was utilized domestically for fertilizer production. Total exports of phosphate rock was approximately 267,000 tons, chiefly to East Europe and Asia.

The Government conducted an economic feasibility study during the year on constructing a plant for producing uranium. The proposed plant would be built in the Abu Zaabal industrial region, northeast of Cairo, at an estimated cost of $9 million. Uranium would be recovered from phosphate rock that was mined at the West Sebaiya mine, which was processed at the phosphoric acid operations of Abu Zaabal Fertilizer and Chemical Co.

Sulfur.—The northern Sinai was the site of a sulfur discovery in 1987 by the Freeport Egyptian Sulfur Co., a wholly owned subsidiary of Freeport-McMoran Inc. of the United States. The sulfur body was a 38-meter-thick bed with a length of 3 kilometers and a depth of 360 to 400 meters. The concession was in the

North Sinai Desert near the town of El Arish on the Mediterranean Sea and covers approximately 1,217 square kilometers. Sulfur mining was to begin within 2 years at an initial rate of 250,000 tons per year with production increasing to 1 million tons per year. This amount would be sufficient to meet the needs of the nation's chemical and phosphate industries. The concession agreement was based on revenue sharing and included a royalty payment with Freeport-McMoran marketing the product for themselves and the state-owned component of the enterprise. Additionally, Freeport-McMoran signed a second sulfur concession in the Eastern Desert region along the Gulf of Suez in 1988.

***Mineral Fuels.*—Coal.**—Coal mining remained marginal in 1988 but efforts were undertaken to develop additional coal reserves. Egypt's Sinai Coal Co. along with the United Kingdom's British Mining Consultants and Babcock Contractors Ltd. started ground work during the year to develop the Maghara coal mine discovered in the Egyptian controlled north Sinai Peninsula. The coal mine was originally abandoned during the 1967 Egyptian-Israeli conflict. Coal reserves were estimated at about 27 million tons, and the proposed operation had a startup date of 1991 at an annual capacity of approximately 125,000 tons per year and rising to 750,000 tons per year in 5 years. This operation could save the Government $42 million per year in coal imports.

Natural Gas and Petroleum.—Average oil production was approximately 848,000 bbl/d for 1988. Total Egyptian oil production in 1988 was about 309.5 million barrels. Production for the year declined when compared to the 1987 production figure of approximately 327 million barrels. Petroleum exports generated $850 million in revenue. Analysts believe that the best Egyptian oilfields were relatively mature and that the new fields in the Western Desert were less productive. They predicted a decline in petroleum production and a lower contribution to the GDP over the next 4 years.

Accessible natural gas reserves were estimated at 10 trillion cubic feet but exploitation costs were uncertain owing to the gas being trapped in relatively small pockets. During the year, the Government sought to encourage the exploration and development of natural gas by adopting a production sharing concept for the gas sector. Prior to this, all natural gas was owned by the Government.

EGPC revitalized the Ras al-Gharib Oilfield using computer analysis and water injection processes to generate needed export revenues. The formerly unreachable reserves (depth 1,200 meters) were being extracted by drilling several new wells about 14 kilometers from the central field in the Eastern Desert and injecting water to upgrade oil removal capacity from 7% to 14%. The field was near export centers of the gulf coast and was currently producing 20,000 bbl/d with a projected lifetime of 10 to 20 years. Expected production was 400 million barrels or 14% of all Egyptian petroleum.

Egypt awarded contracts to Amoco in the 194-square-kilometer North October area in the Gulf of Suez with a $16 million development cost for three wells in 3 years. The British Petroleum Co. was awarded a Gulf of Suez 169-square-kilometer tract at Abu Zeneima at a cost of $25 million for four wells in 5 years.

LIBYA[5]

The declining world petroleum market had further negative effects on the Libyan economy in 1988. However, petroleum continued to be Libya's major industry. During the year, Libya began to show a more conciliatory and open economic attitude toward neighboring North African nations and toward Italy, Libya's biggest trading partner. The United States trade, financial, and other sanctions against Libya continued in 1988. Libya maintained 2d place among African oil producers and 16th place among petroleum producers worldwide. Nigeria continued to be the top African oil producer. Libya had estimated reserves of 22 billion barrels by yearend, mostly high-quality light crudes. Libyan natural gas reserves were estimated at 25.7 trillion cubic feet.

Libya's balance of payments worsened significantly in 1988 owing to low world oil prices. The current-account deficit for 1988 was approximately $1.3 billion compared with $800 million for 1987. The oil exports for 1988 were valued at $5.2 billion,[6] a drop of nearly 50% from the 1985 value.

Due to slumping oil revenues and foreign exchange losses, Libya continued to diversify its petroleum revenues by seeking to acquire new refining capacity overseas and by increasing output of value-added petrochemicals and refinery products. The Government created a new downstream petroleum investment vehicle to oversee Libyan foreign investments in energy, the Oil International Investment Co. (OIIC). The new company immediately took over the Government's 70% majority share in Tamoil Italia, a major Italian refiner and distributor. Additionally, OIIC purchased a 50% share in Coastal Corp.'s 80,000-bbl/d refinery in Hamburg, Federal Republic of Germany. OIIC had capital assets of $450 million; its equity owners were Libya's National Oil Co. (NOC), Libyan Arab Foreign Investment Co., and the Libyan Arab Foreign Bank.

Libya's biggest project, the Great Manmade River (GMR), continued to be a budgetary priority during the year. The project consisted of artesian fresh water from wells in the southwestern desert being pumped to agricultural centers in northern Libya. Dong Ah Construction Co. and Korea Express, both of the Republic or Korea, won the GMR phase 1 contract, worth $3.3 billion, in November 1983. Companies reported that work on phase 1 proceeded well in 1988 and that water could be flowing through some pipes by fall 1989. Approximately 750 kilometers of pipes to Sirte have been laid, with about 900 kilometers excavated. Two concrete pipe factories were constructed to support the GMR. By the end of 1988, they had produced 130,000 pieces of pipe, half the required amount for the project. The GMR was expected to be completed by 1991.

Negotiations for phase 2 of the GMR contract took place during the year. Final bidding on the $2.2 billion to $3 billion project was scheduled for 1989.

Production and Trade

Libya's main sources of foreign exchange continued to be its exports of crude oil and petrochemicals. Exploration and production of crude oil in Libya still required the support and technology of other industrialized countries. During the year, Yugoslavia's Hidromontaza signed an agreement with Sirte Oil Co. to supply, install, and commission equipment for processing liquid gas. Additionally, the Federal Republic of Germany's MAN Gutehoffnungshuette had won a contract with the Arabian Gulf Oil Co. (Agoco), a subsidiary of NOC, to supply and renovate electrical equipment at the Nafoora Oilfield and to install a gas compressor and undertake tank repairs at the Beida and Messla Oilfields.

Production of crude oil was estimated in excess of 1.1 million bbl/d, about 1% more than in 1987. Total crude production was approximately 374 million barrels for 1988.

Libya's crude oil production for the year may have exceeded by at least 2% its 1988 quota of 996,000 bbl/d, as set by OPEC. OPEC quotas for Libya in the first half of 1989 were set at 1,037,000 bbl/d. In July 1988, the prices of Libyan crudes Zuweitina, Sirtica, Brega, Es-Sider, Amna, and Sarir were standardized with the price of North Sea Brent crude. Oil that was bartered to pay debts and purchase capital equipment was priced in line with OPEC-agreed prices.

Libya continued its barter trade agreements, which included substituting oil for currency payments, with several countries. In September 1988, the Indian construction company Unitech took $6.5 million worth of oil in payment for its contract work. Several other Indian companies withdrew

TABLE 8

LIBYA: PRODUCTION OF MINERAL COMMODITIES[1]

Commodity		1984	1985	1986	1987[p]	1988[e]
Cement, hydraulic[e]	thousand metric tons	6,000	6,500	[3]2,077	[3]2,700	2,700
Gas, natural:[e]						
Gross	million cubic feet	295,000	292,000	292,000	292,000	292,000
Marketed[4]	do.	150,000	150,000	150,000	150,000	150,000
Gypsum[e]	thousand metric tons	180	180	180	180	180
Iron and steel: Crude steel[e]	metric tons	10,000	10,000	10,000	10,000	10,000
Lime[e]	thousand metric tons	260	260	260	260	260
Nitrogen: N content of ammonia	do.	494	411	351,986	[e]350	350
Petroleum:						
Crude	thousand 42-gallon barrels	[r]405,515	392,375	389,090	367,555	[3]374,125
Refinery products:						
Gasoline	do.	4,745	5,475	5,110	7,000	7,000
Kerosene and jet fuel	do.	5,475	5,840	[e]6,935	11,000	11,000
Distillate fuel oil	do.	9,490	10,585	[e]17,885	15,000	15,000
Residual fuel oil	do.	16,060	18,615	[e]20,805	15,000	15,000
Other	do.	9,470	5,840	[e]3,285	1,000	1,000
Refinery fuel and losses	do.	1,825	1,825	[e]2,190	2,000	2,000
Total	**do.**	**47,085**	**48,180**	**61,320**	**51,000**	**51,000**
Salt	metric tons	12	12	12	12	12
Sulfur, byproduct of petroleum and and natural gas[e]	do.	14	14	14	14	14

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

[1]Table includes data available through Mar. 25, 1988.

[2]In addition to the commodities listed, a variety of construction materials (sand and gravel, crushed stone, brick, and tile) is produced, but available information is inadequate to make reliable estimates of output levels. Natural gas liquids are also produced but are blended with crude petroleum and are reported as part of that total.

[3]Reported figure.

[4]Excludes gas reinjected into reservoirs.

from proposed oil-for-debt swap agreements in 1988 because of falling crude oil prices and warnings by the state-owned Reserve Bank of India that a loss of more than 15% on crude sales could not be tolerated. Libya agreed to resume oil deliveries to Ghana after a 5-year hiatus following Ghana's failure to meet payments for the crude in 1983. Libya agreed to reschedule the oil debts without interest, but no agreement on the timing of the new shipments was made. Uganda received $6 million in petroleum products from Libya in 1988. The products were shipped from Libya to Dar es Salaam in Tanzania and then by rail to Uganda. Libya negotiated an agreement in November with Malta to renew oil supplies in 1989. The $38 million in petroleum products consisted of 191,400 barrels of liquefied petroleum gas (LPG), 525,000 barrels of fuel oil for power stations, and 525,000 barrels of fuel oil for industry. Malta was an important transportation and shipping center for Libya. Malta's Sea Services, a leading supply ship operation, was responsible for the towing of the Scarabeo 4 offshore oil rig from Malta to the Libyan offshore Bouri Oilfield.

Commodity Review

Metals.—**Iron and Steel.**—The Misurata iron and steel plant failed to start up during 1988 as planned. The $6 billion plant, 130 kilometers east of Tripoli, was to be the largest industrial enterprise in Libya. The delay in 1988 makes it several years behind schedule. Problems with power supply and financing were two of the main delaying factors in 1988. The Misurata iron and steel plant's phase 1 commercial production, with a designed annual capacity of 1,324,000 tons of liquid steel, was rescheduled to begin officially in September 1989. The plant's 480-megawatt power station, contracted to Hyundai Engineering & Construction Co. of the Republic of Korea, was expected to be completed in early 1989. Two of the power station's six generators were undergoing tests in late 1988 and will be used to power the direct-reduction plant. The first iron pellets from Brazil's Cia. Vale do Rio Doce were to arrive in March 1989. The large volumes of gas to be used to reduce the iron pellets will be supplied by Libya from domestic production.

Industrial Minerals.—**Cement.**—Libya had a mill capacity of 6.5 million metric tons of cement per year and a clinker capacity of 6.4 million metric tons per year.

Mineral Fuels.—**Natural Gas.**—An agreement was signed during the year among Libya, Algeria, and Tunisia for the laying of a gas pipeline from Algeria to Libya through Tunisia. The proposed pipeline would carry an estimated 90 million cubic meters of Algerian gas.

Petroleum.—Exploration.—A series of accords were signed during the year between Libya and Tunisia for joint exploration of the Gulf of Gabes oil reserves. Agreement was also reached between the two countries on the development of a section of the Continental Shelf once claimed by Tunisia but awarded to Libya by an International Court of Justice ruling in December 1985. Libya gained approximately 3,367 square kilometers of seabed with hydrocarbon potential.

North African Geophysical Exploration Co. (Nageco) had three seismic crews doing onshore surveys during the year. NOC owned 51% of the venture; the remainder was owned by Western Geophysical Co. of Canada.

Production.—The African Petroleum Producers' Association (APPA) was formed in January 1987 and consisted of eight African oil exporting countries (Algeria, Angola, Benin, Cameroon, Congo, Gabon, Libya, and Nigeria). Of the APPA members, only Nigeria produced more oil than Libya in 1988.

The most notable event of the year for Libyan oil production was the inauguration of the first offshore field. The Bouri offshore oilfield had a phase 1 development cost of $1.5 billion and was 93 kilometers northwest of Tripoli in the Gulf of Gabes. The field was 3 kilometers wide by 20 meters long and was covered by a water depth of 558 meters. The field was jointly developed by NOC and Italy's Agip-North Africa Middle East after its discovery in 1976. Production commenced in August 1988 at 8,000 bbl/d and was to be increased to 50,000 bbl/d by yearend. The Bouri

TABLE 9

LIBYA: 1988 AVERAGE DAILY PRODUCTION OF NATURAL GAS

Company, plant, location	Production—1,000-gallons per day (12-month average)		
	LP-gas mix	Raw NGL mix	Other
Oasis Oil Co. of Libya Inc.			
Bahi, Concession 32	—	—	160.0
Dahra, Concession 32	—	—	11.0
Defa, Concession 59 and 71	—	—	210.0
Waha, Concession 59W	—	—	170.0
Occidental of Libya Inc.			
103A, Sirte Basin, Petroleum Zone II	—	666.0	—
103D, Sirte Basin, Petroleum Zone II	—	375.0	—
Socialist People's Libyan Arab Jamahirya, Marsa Brega	37.8	4,536.0	—
Total	**37.8**	**5,577.0**	**551.0**

Source: Oil and Gas Journal, July 11, 1988.

Field contains an estimated 5 billion barrels of oil and 2.5 trillion cubic feet of gas reserves with production levels planned to increase by 150,000 bbl/d by 1990. It was estimated that production can be maintained at this level for 35 years without enhanced recovery. Subsequently, Libya informed OPEC of its desire to avoid exceeding its quota by cutting back light crude production from onshore fields as the Bouri Field output increases.

Refining.—Libya's three older oil refineries had a total throughput crude oil capacity of 329,400 bbl/d, with catalytic reforming accounting for 13,982 bbl/d. The three refineries and their capacities at yearend were the Azzawiya Oil Refining Co. at 120,000 bbl/d, Ras Lanuf Oil and Gas Processing Co. at 201,000 bbl/d, and Sirte Oil at 8,400 bbl/d. Additionally, a new oil refinery opened in Tobruk in early April. The new facility, in Butnam municipality, had a capacity of 220,000 bbl/d and employed 224 Libyans.

Western Europe was the main outlet for Libya's petroleum exports. The Organization for Economic Cooperation and Development (OECD) reported that Libya's exports to Europe in 1988 averaged 1,069,000 bbl/d of which 1 million barrels was crude oil and the remainder was petroleum products consisting almost entirely of naphtha and fuel oils.

MOROCCO[7]

Phosphate mining and chemical fertilizer production were the predominant mineral industries of Morocco. Moroccan phosphate rock production increased by 17% in 1988. Production was stimulated by a partial recovery of world phosphate market prices and vigorous growth in local beneficiation of rock into higher value-added derivatives such as phosphoric acid and fertilizers. Phosphoric acid and fertilizer production capacity became 100% on-stream during the year. Plans were announced for a doubling of this production capacity by 1992.

Apart from phosphate rock production, the remaining mineral activity in Morocco had mixed results, but, in general, performance was good in 1988. Nonphosphate mineral production and exports grew by 2% and 9%, respectively.

Government Policies and Programs

During the year, the Government was establishing plans for the future privatization of certain industrial operations. Speculation on the industrial operations that would be selected for privatization targeted the iron and steel industry, coal mining, and other joint-venture metal and industrial operators. Moroccan legislation required that these joint-venture operations were to be partly controlled by the Government's Bureau de Recherches et de Participations Minières (BRPM).

Ongoing conflict between the Moroccan Government and the Polisario guerrillas over the sovereignty of the Western Sahara continued in 1988, although dialogue directed at a settlement surfaced during the year.

Production and Trade

Phosphate rock production increased 17% over the previous year. Phosphate rock and finished fertilizer exports were 15.8 million tons, an increase of 9.5% over those of 1987. Higher international sales prices resulted in a 34% increase in export receipts. In particular, finished fertilizer sales alone increased 70% in volume and 84% in value. The total phosphate sector rock and fertilizer export revenues were estimated at about $1.5 billion for 1988, and the projected increase in 1989 was estimated to be roughly $2 billion. Major markets for Moroccan phosphate exports involved 36 countries including Spain, Belgium, Luxembourg, and Mexico as the principal clients.

Commercially, Morocco continued its strong ties to the European Community during the year. The exceptionally strong growth of phosphate rock and derivative sales receipts for 1988 helped to decrease the Moroccan trade deficit to $1.14 billion[8] compared to $1.4 billion for 1987. Continued low, world-market prices for grain and crude oil imports also helped during the year.

Morocco's energy import bill remained a problem in 1988. Crude oil imports to Morocco from Iraq, Kuwait, and other Middle Eastern countries amounted to $525 million. Large oil shale reserves remained uneconomic due to lower world oil prices.

Total sales for steel in 1988 showed an increase of approximately 16% more than those of the previous year. Importation of steel bars was approximately 328,000 tons, an increase of nearly 20% more than in 1987. The Moroccan Ministry of Industry and Commerce reported that Moroccan export controls on ferrous scrap exports were lifted in January 1986. Since that time, Morocco freely exported between 88,000 and 110,000 tons per year.

Commodity Review

Metals.—The Bou Azzer cobalt mine reopened in 1987 after a 6-year closure. The Moroccan Compagnie de Tifnout Tiranimine (CTT) resumed mining in the Bou Azzer district, which was in the Anti-Atlas Mountains of central Morocco. Geologically, the cobalt ore was associated with copper-iron-nickel arsenides in altered igneous rocks of an ophiolite complex. Typically, cobalt mining worldwide was as a byproduct of either copper or nickel mining. However, Bou Azzer represented the only primary cobalt mine in the world and accounted for about 6% of world production during the 1970's and early 1980's.

The Douar Lahjar massive polymetallic sulfides exploration and development program in the Guesmassa area, south of Marrakech, continued during the year. The prospect was under the direction of Cie. Minière de Guesmassa, a joint venture of BRPM and Omnium Nord Afri-

TABLE 10

MOROCCO: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]	1984	1985	1986	1987[p]	1988[e]
METALS					
Antimony concentrate:					
Gross weight	2,209	1,749	1,468	1,058	[3]555
Sb content	972	[e]750	617	444	[3]250
Cobalt concentrate:					
Gross weight	—	—	—	2,113	[3]2,384
Co content	—	—	—	224	[3]253
Copper:					
Concentrates, gross weight	65,470	61,804	58,707	46,251	[3 4]41,001
Matte, gross weight	1,361	2,481	1,349	[r]2,441	[3 5]2,981
Cu content, concentrates and matte	22,093	21,625	20,165	16,541	[3]15,396
Iron and steel:					
Iron ore:					
Gross weight	162,984	190,528	195,600	210,200	[3]114,209
Fe content	101,050	118,000	123,228	128,100	69,668
Metal:					
Pig iron[e]	15,000	15,000	15,000	15,000	15,000
Steel, crude[e]	6,000	6,000	6,000	6,000	7,200
Lead:					
Concentrate:					
Gross weight	143,890	152,549	104,398	105,090	[3]100,221
Pb content	100,723	106,784	76,211	75,665	[3]72,159
Cupreous Matte, Pb content	218	645	351	635	[3]775
Metal:					
Smelter, primary only	46,100	59,500	60,000	62,500	[3]68,410
Refined:					
Primary	46,054	59,470	[e]60,000	62,497	[3]68,410
Secondary[e]	2,000	2,000	2,000	2,000	2,000
Total[e]	**48,054**	**61,470**	**62,000**	**64,497**	**70,410**
Manganese ore, largely chemical-grade	56,786	43,690	40,334	42,500	30,100
Nickel, Ni content of cobalt ore[e]	—	—	—	—	—
Silver: Ag content of concentrates and matte	2,629	2,800	1,991	1,975	[3 6]1,847
Ag content of mine and smelter bullion thousand troy ounces	2,154	2,705	5,252	3,482	[3 7]5,426
Total do.	**4,783**	**5,505**	**7,243**	**5,457**	**7,273**
Zinc concentrate:					
Gross weight	20,247	27,153	24,344	19,874	[3]21,304
Zn content[e]	10,700	14,700	13,100	10,300	[3]10,865
INDUSTRIAL MINERALS					
Barite	561,321	500,000	189,881	143,503	[3]321,562
Cement, hydraulic thousand tons	3,588	3,697	[e]3,700	3,800	[3]4,220

See footnotes at end of table.

TABLE 10—Continued

MOROCCO: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1984	1985	1986	1987[p]	1988[e]
INDUSTRIAL MINERALS—Continued						
Clays, crude:						
Bentonite		1,825	2,877	3,834	2,948	[3]3,445
Fuller's earth (smectite)		33,406	24,425	35,100	46,271	[3]52,694
Montmorillonite (ghassoul)		3,382	4,656	4,313	4,981	[3]4,367
Feldspar[e]		1,000	1,000	1,000	1,000	1,000
Fluorspar, acid-grade		65,900	74,350	83,000	78,000	[3]100,500
Gypsum[e]		450,000	450,000	450,000	450,000	450,000
Mica		[3]1,200	1,440	[e]1,500	1,500	1,500
Mineral water		70,000	[e]70,000	[e]70,000	70,000	70,000
Phosphate rock (includes Western Sahara)	thousand tons	21,245	20,737	21,178	21,300	[3]25,015
Salt, rock		62,740	92,263	96,514	107,838	[3]132,661
MINERAL FUELS AND RELATED MATERIALS						
Coal, anthracite	thousand tons	838	774	[e]775	634	637
Gas, natural:						
Gross[e]	million cubic feet	2,700	2,600	2,600	2,600	2,600
Marketed[e]	do.	1,100	2,000	2,000	2,000	2,000
Petroleum:						
Crude[e]	thousand 42-gallon barrels	270	260	260	260	260
Refinery products:						
Distillate fuel oil	do.	9,500	9,500	9,500	9,500	9,500
Gasoline	do.	3,300	3,300	3,300	3,300	3,300
Jet fuel	do.	1,500	1,500	1,500	1,500	1,500
Kerosene	do.	750	750	750	750	750
Other	do.	2,100	2,100	2,100	2,100	2,100
Refinery fuel and losses	do.	1,500	1,500	1,500	1,500	1,500
Residual fuel oil	do.	13,000	13,000	13,000	13,000	13,000
Total	**do.**	**31,650**	**31,650**	**31,650**	**31,650**	**31,650**

[e]Estimated. [p]Preliminary. [r]Revised.
[1]Includes data available through June 1, 1987.
[2]In addition to the commodities listed, a variety of crude construction materials is produced, but available information is inadequate to make reliable estimates of output levels. Limestone quarried for cement manufacture is substantial; however, information is inadequate.
[3]Reported figure.
[4]Includes following types of concentrates: Copper (37,879 tons at 35% Cu); silver-copper (355 tons at 38.29% Cu, 2,107 grams per ton Ag); and gold-silver-copper (2,767 tons at 9.9% Cu, 105.3 grams per ton Au, 770 grams per ton Ag) and gold-silver-copper (2,767 tons at 9.9% Cu, 105.3 grams per ton Au, 770 grams per ton Ag).
[5]Cupreous matte containing 58% Cu, 26% Pb, 1,500 grams per ton Ag.
[6]Contained in copper concentrates and matte identified in footnotes[4] and[5] and in lead concentrates (100,221 tons at 500 grams per ton Ag).
[7]Contained in a presumably mine-produced bullion: (132 tons at 98.9% Ag) and lead smelter product (38.5 tons at 99.8% Ag).

cain. Omnium Nord Africain was related to the United Kingdom based Omnium Natural Resources, a subsidiary of the Swiss merchant Bank Société Financière Omnium (SFO).

BRPM metal exploration activities during the year centered on the Ougnat area and in the Anti-Atlas and High Atlas mountain ranges. Specifically, BRPM had targeted prospects of copper at Tizert, silver at Koudiat al-Hamra, and gold at Boumaadine.

Zones of mineralization in the central Moroccan lead area and the eastern Rif were also BRPM exploration targets in 1988.

Uranium extraction from phosphate rock remained too costly; however, exploration for significant uranium deposits continued.

Industrial Minerals.—**Cement.**—Moroccan cement production increased during the year by approximately 11% over the 1987 figure. Total cement production for 1988 was approximately 4.22 million tons. Modernization of the cement industry was to include installation of a flash dryer and a high-efficiency separator at the Société des Ciments d'Agadir's raw grinding plant.

Phosphate Fertilizers.—Phosphate rock occurred in four geologically related provinces in Morocco. These areas, in the following order, from north to south were: (1) the Khouribga Plateau, the largest and most mined area; (2) the Ganntour Plateau; (3) the unexploited Meskalas reserve; and (4) the Bou Craa reserve in the Western Sahara. These four provinces possessed 22 billion metric tons of phosphate rock or between one-half to three-quarters of the worldwide reserve base.

The Moroccan phosphate parastatal, Office Cherifien des Phosphates (OCP), controlled mining, beneficiation, and marketing of phosphate rock and fertilizers. Phosphate rock production increased to 25 million tons in 1988, 17% greater than the 1987 figure. Additionally, the exports of phosphate rock and derivative products for 1988 increased 9.5% to 15.8 million tons, rebounding after a 3-year sales low.

Production at the Bou Craa complex in the Western Sahara increased over 60% to 1.5 million tons. Bou Craa's rated production capacity was 2.2 million tons. Increased global phosphate rock sales were responsible for the increased production in Morocco. This was especially true of rock processed in domestic plants that produced finished fertilizers and phosphoric acid for the export market. Local sales of phosphate rock rose by about one-third and was a reflection of increased emphasis on production of phosphoric acid and higher value-added downstream products. Morocco was capable of local production of phosphoric acid as well as the fertilizers monammonium phosphate (MAP), ammonium sulfur phosphate (ASP), diammonium phosphate (DAP), nitrogen-phosphorus-potassium (NPK), and triple superphosphate (TSP). Overall production of these downstream derivative products increased nearly 50% when the Jorf Lasfar phosphoric acid plant, south of Casablanca, was brought on-line after completion of production modifications and improvements by European contractors.

As part of the Government's National Plan for Economic and Social Development, OCP sanctioned prefeasibility work beginning in 1988 by several European contractors. The objective was to effectively double the processing capacity at Jorf Lasfar by 1992. The initial phase of the $1.05 billion scheme called for construction of Maroc Phosphore 5 and 6. The initial phase involved the construction of a 100-megawatt powerplant, sulfuric-and phosphoric-acid production plants, and a production plant for TSP, MAP, and DAP. Following this initial phase, the construction of Maroc Phosphore 7 and 8 would begin. This large investment was expected to increase Morocco's share of the world phosphate and finished fertilizer market. Greater competition with the United States phosphate industry would also be augmented by the Moroccan phosphate construction investment.

Barite production more than doubled in 1988 to 321,562 tons. Export receipts for barite also doubled to $16.6 million. In addition, flourine production rose to 100,500 tons.

Mineral Fuels.—**Coal.**—Morocco's only coal mine was in the northeastern town of Jerada near the Algerian border. The mine was operated by the Moroccan Government parastatal, Charbonnages du Maroc, and was scheduled to produce 1 million metric tons of coal in 1988. Production has stagnated, however, in the last several years due to managerial and technical problems, and anthracite coal production was approximately 637,000 metric tons. Technical problems were mainly centered on the difficulties inherent in mining a relatively thin (less than 1-foot) coal seam. Further complications occurred in late 1988 when union leaders called for a strike to protest unsafe working conditions and insufficient compensation for miners. A labor agreement did not materialize during the year, and, if conditions persist, the 1989 production at the Jerada coal mine could be less than that of 1988. This situation could result in increased reliance on imported coal for national needs. Independent of labor problems, Morocco's demand for imported coal increased substantially during the year. The situation was due primarily to a shift in national strategy away from fuel oil to coal for electrical generation and other industrial applications.

The National Electricity Office power station in Mohammedia had a requirement for 800,000 metric tons of coal during the year. Producers in the United States and Colombia made bids in past years for this contract, the largest in the Moroccan coal market. In December 1988, the United States exported 35,300 metric tons of steam coal to Morocco.

Natural Gas.—Total natural gas production for 1988 was estimated to be 2.6 billion cubic feet. Daily production was approximately 8 million cubic feet. Reserves of natural gas were estimated at between 70 and 100 billion cubic feet.

Discussion between Morocco and Algeria during the year centered on the revival of the plan to construct a natural gas pipeline from Algeria through Morocco and to supply Spain and Europe. Estimated costs for feasibility studies, engineering, and construction of the pipeline were $2.2 billion. This project could be of benefit to the Moroccan steel industry as a power source for steel manufacturing. In addition, preliminary discussions were held on a joint venture involving Morocco, Algeria, and the United States to liquify Algerian gas at a proposed Moroccan liquid natural gas plant.

Petroleum.—Ratification of the new hydrocarbon law during the year was delayed by the Moroccan Parliament. The law, as proposed, would diminish uncertainties regarding existing negotiating parameters for petroleum exploration concessions in Morocco. It would also have been considered to be an important development for many foreign oil companies. Passage of the law, however, could not guarantee increased interest in Moroccan exploration on the part of oil companies, but it would have been a positive signal in a highly competitive sector.

Activity increased during the year as the state oil company, Office Nationale de Recherches et d'Exploitation des Pétroles (ONAREP), planned 10 exploration wells and a doubling of seismic work. The 1988 exploration budget was funded at $50 million. The necessary capital for exploration was to be supplied at a ratio of 40% by ONAREP and 60% by interested partners. Seven wells were drilled in 1987 at an average total depth of 7,127 feet. Production averaged 712 bbl/d in 1987 and probably did not exceed that amount in 1988.

Preliminary drilling of the first well offshore of Agadir took place in 1988. The Agadir prospect was selected following 2 years of evaluation of seismic data by Petro Canada International Assistance Corp. (PCIAC). Total depth for the well was planned at 10,827 feet, and the target reservoir was at 7,545 to 8,530 feet. Providing that the well was successful, Petro Canada could be offered a production-sharing agreement.

ONAREP underwent a massive reduction in the work force in June. Staff reductions of up to 40% were realized by October 1988, and corporate restructuring would seem to be inevitable. Corporate restructuring could curtail inefficiency in the Moroccan petroleum sector, which centered on ONAREP's shortage of experienced exploration personnel and the lack of an organized seismic data analysis and retrieval system.

A new port for the unloading of petroleum and natural gas at Mohammedia went into operation in 1988. The new port was designed to accommodate Morocco's 1988 and future needs for the unloading of crude oil and natural gas. Design and construction of the port took place between 1980 and 1987. The port was capable of unloading a 110,000-ton tanker in less than 24 hours. The facility included a long seawall to protect the port and an offshore platform, which included two oil jetties. The first jetty was 56 feet deep and had five automation devices to unload crude oil at a rate of 176,678 cubic feet per hour. The second jetty was 61 feet deep and was also equipped with five automation devices to unload crude oil at rates between 212,000 and 353,357 cubic feet per hour.

TUNISIA[9]

Economic conditions moderated in Tunisia during 1988. Mineral production showed modest gains in most areas. Production of barite, fluorspar, iron ore, lead and zinc concentrates, and marine salt increased. Production of Tunisia's two principal mineral commodities, phosphate rock and crude petroleum, decreased. Mediocre performance in the domestic economy was offset by an increase in export trade receipts, from $3.3 billion[10] in 1987 to $4.1 billion in 1988. Import totals rose from $3.5 billion in 1987 to $4.4 billion in 1988. Tunisia's trade deficit increased 50% to $300 million due to higher commodity prices. The shrinkage in the agricultural sector slowed the GDP growth to a marginal increase of 0.9%, to $10 billion. The gross national product increased by $696 million to $10.3 billion.

Exhaustion of known deposits and antiquated equipment continued to be problems for the Tunisian mineral industry. The Government attempted to stimulate foreign investment in petroleum exploration and development. In 1988, Tunisia's energy sector was running out of easily developed resources. Government investment in the petroleum and natural gas sector totaled $143 million in 1988. For 1989, Tunisia budgeted $150 million for exploration and development in an attempt to curtail falling production levels. Based on 1988 figures, it was predicted that Tunisia could be a net energy importer by 1991-92.

Government Policies and Programs

The Tunisian effort to increase incentives for exploration was initiated with the 1985 hydrocarbons law. The legislation was amended in 1987 and was proposed for modification again in 1989. The 1987 changes had some positive effects in 1988. Foreign investors indicated that staff cost savings and the sliding scale introduced for governmental assessment of tax royalties have been welcome developments. The production-sharing provision of the hydrocarbons law led to the first production-sharing agreement on October 27, 1988, between Royal Dutch/Shell-Shell Tunirex and the state oil company Enterprise Tunisienne d'Activities Petrolieres (ETAP). The agreement calls for the sharing of the 6,012-square-kilometer Metlaoui permit.

Proposed amendments to the hydrocarbon law could be expected in order to encourage further exploration in a market already perceived as favorable to international operators. The 1987 amendments involved consultations with the principal operators before legislation was enacted. Because no consultations had taken place in 1988 with firms already active in Tunisia, it is expected that forthcoming amendments will be aimed at newcomers. Few details exist and these details depend upon further fiscal considerations.

The hydrocarbon legislation also sought to reduce the need for imports of Algerian natural gas. The French company Elf Aquitaine Tunisie (EAT) and the Italian firm Aziende Generali Italiana Petroli-Minière S.p.A. (AGIP) expressed interest in the natural gas arena. British Gas Corp. took over the 1,984-square-kilometer Miskar Gasfield from the U.S. firm, Tenneco. The United Kingdom utility firm estimated that it would cost $500 to $600 million to develop the field depending on the quality of the gas and the necessary infrastructure development. This could become the company's first international development as an operator. The Government officials were hopeful that the operations of British Gas will stimulate further international investment in the Tunisian energy sector.

In June 1988, the Government created the Ministry of Industry and Commerce and the Ministry of Energy and Mines to perform duties formerly handled by the Ministry of National Economy.

Production and Trade

Output of the key industrial minerals of Tunisia, crude oil and phosphate rock, decreased slightly in 1988 for the second consecutive year. Crude oil production decreased approximately 2%. Total hydrocarbon production, including petroleum, natural gas liquids, and refined petroleum products, fell to below 38,445,000 barrels. This resulted in a 2% shrinkage of the petroleum sector's contribution to the GDP. A slight increase in world phosphate prices helped the phosphate industry show a 1% growth in value. Production of phosphate rock was down nearly 5%. Total phosphate rock production by the state-operated Cie des Phosphates de Gafsa (CPG) was 6.1 million tons, approximately 25% of which was exported. The main export markets for Tunisian phosphate were Belgium, France, Indonesia, and Turkey.

Tunisia's largest phosphate-based fertilizer production company was Société Industrielle d'Acide Phosphorique et d'Engrais (SIAPE). France and Italy were SIAPE's biggest triple superphosphate (TSP) customers. China, the U.S.S.R., and the United States were the principal purchasers of superphosphoric acid. SIAPE has licensed its phosphate production process for utilization in Bulgaria, Greece, Romania, and Turkey. The company was planning to build a plant in China and was bidding on one planned in Algeria. SIAPE was an equity and a technical partner in the Chinese plant.

Small-scale mining involved the production of lead, zinc, fluorite, and barite from Fej Lehdoum, a state-owned operation mining an ore grading an average 4.7% to 10.8% total lead and zinc; Zreiba-Jdidi mines, owned by Fluobar Co. of which the Arab Mining Co. (ARMICO) was a major shareholder; and Bou Jaber, a state-owned operation producing ore grading 34.7% barite, 3.9% zinc, 1.1% lead, and 9.8% fluorite.

Stronger relations were established between Tunisia and its North African neighbors in 1988. The Maghreb Arab Union fostered economic cooperation between the member nations of Algeria, Libya, Mauritania, Morocco, and Tunisia. Trade between Tunisia and the other member nations of the UMA was previously very limited.

Commodity Review

Metals.—**Iron and Steel.**—Tunisian iron and steel production fell nearly 4% due to a probable relining of the blast furnace with refractory bricks at the nation's only integrated steel plant, El Fouladh at Menzel Bourguiba. This maintenance process occurs every 5 years.

Industrial Minerals.—**Cement.**—Cement production increased slightly in 1988. Exports of cement rose for the fourth consecutive year. Tunisia's mill capacity for cement was 5 million metric tons. Clinker capacity was 4.8 million metric tons. Société Tuniso-Algerienne de Ciment Blanc commenced startup in 1987 of its 210,000-metric-ton-per-year white cement plant in Feriana, Tunisia. This joint venture between Algeria and Tunisia was the first plant of its kind in Africa and the third largest in the world. The white cement produced was distributed equally between both countries. Tunisia's coastal cement plants were geographically well placed to take advantage of the tourism construction boom on both shores of the Mediterranean.

Fertilizer Materials.—Domestic companies consumed 75% of the phosphate rock produced in Tunisia and processed it into phosphate products such as triple superphosphate (TSP), monoammonium phosphate (MAP), diammonium phosphate (DAP), and dicalcium phosphate (DCP). Eighty percent of the resultant higher value-added products were exported along with 25% of phosphate rock output. The industry hopes eventually to have the capacity to sell all of the phosphate rock to domestic processors. Fertilizer material production figures for the year were as follows, in metric tons: TSP at 921,377 metric tons; MAP at 59,983 metric tons; DAP at 544,586 metric tons; and DCP at 45,456 metric tons.

SIAPE owns two sites in Sfax and a new facility in La Skhirra. SIAPE and Industries Chimiques de Gafsa (ICG) were processing 75% of Tunisia's phosphate rock output. SIAPE experienced a closure in mid-November 1988 of its 335,000 metric tons per year TSP factory A in Sfax. The facility was closed because of community protests against serious pollution problems precipitated by sulfur dioxide emissions and phosphogypsum waste. The plant was scheduled to reopen in March 1989 after the installation of pollution control equipment. Additionally, the obsolete sulfuric acid unit at factory A in Sfax had been closed permanently

TABLE 11

TUNISIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1984	1985	1986	1987	1988[e]
Metals						
Iron and steel:						
Iron ore and concentrate, gross weight	thousand tons	308	306	311	[3]295	[3]325
Metal:						
Pig iron	do.	150	[e]150	150	150	150
Steel, crude	do.	169	170	181	180	180
Lead:						
Mine output, Pb content		4,056	2,484	1,930	[3]3,465	[3]3,653
Metal:						
Primary[4]		8,400	2,040	2,208	2,200	[3]2,200
Secondary[e]		500	500	500	500	500
Total[e]		**8,900**	**2,540**	**2,708**	**2,700**	**2,700**
Silver metal, primary	thousand troy ounces	85	26	50	50	50
Zinc, mine output, Zn content		6,660	5,580	4,488	4,500	[3]8,500
INDUSTRIAL METALS						
Barite		12,100	20,000	15,718	[r]14,412	[3]18,868
Cement, hydraulic	thousand tons	2,777	3,070	2,984	3,400	3,228
Clays, construction[e]	do.	350	350	350	350	350
Flourspar, chemical- and metallurgical-grades		44,510	42,240	36,828	43,298	[3]55,416
Gypsum[e]		85,000	90,000	100,000	100,000	100,000
Lime	thousand tons	600	[e]600	650	650	650
Phosphate rock, gross weight	do.	5,346	4,530	5,951	[3]6,390	[3]6,103
Salt, marine	do.	330	382	415	[3]425	[3]485
MINERAL FUELS AND RELATED MATERIALS						
Gas, natural:						
Gross[e]	million cubic feet	[r]18,000	[r]16,400	[r]15,400	[r]13,800	13,000
Marketed	do.	[e]9,000	[e]8,200	[e]7,700	[e]6,900	6,500
Petroleum:						
Crude	thousand 42-gallon barrels	[r]43,800	[r]42,916	[r]39,055	37,960	[3]37,230
Refinery products:						
Gasoline	do.	1,794	[e]1,800	[r]1,825	1,800	1,800
Kerosene	do.	2,402	[e]2,400	[r]1,095	2,400	2,400
Distillate fuel oil	do.	3,156	[e]3,000	[r]3,650	3,000	3,000
Other	do.	394	[e]400	[r]730	400	400
Refinery fuel and losses	do.	160	[e]200	[r]1,095	200	200
Residual fuel oil	do.	3,936	[e]4,000	[r]4,380	4,000	4,000
Total	**do.**	**11,842**	**[e]11,800**	**[r]12,775**	**11,800**	**11,800**

[e] Estimated. [p] Preliminary.
[1] Table includes data available through June 9, 1988.
[2] In addition to the commodities listed, a variety of crude construction materials (common clays, sand and gravel, and stone) is produced, but output is not reported, and available information is inadequate to make reliable estimates of output levels. Limestone quarried for cement manufacture is substantial; however information is inadequate to make accurate estimates of output.
[3] Reported figure.
[4] From domestic and imported ores.

TABLE 12

TUNISIA: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987 United States	Destinations, 1987 Other (principal)
METALS				
Aluminum:				
Oxides and hydroxides	46	—		
Metal including alloys:				
Scrap	559	1,103	—	Italy 346; France 223; Belgium-Luxembourg 178.
Unwrought	—	487	—	Italy 279; Belgium-Luxembourg 208.
Semimanufactures	1,641	754	—	Algeria 716; France 30.
Copper: Metal including alloys:				
Scrap	1,051	2,088	—	Spain 600; Switzerland 374; France 240.
Semimanufactures	—	20	—	Morocco 18; France 2.
Iron and steel:				
Iron ore and concentrate excluding roasted pyrite	3,025	2,933	—	All to France.
Metal:				
Scrap	1,457	243	—	France 90; Belgium-Luxembourg 84; Netherlands 68.
Steel, primary forms	765	3,008	—	Pakistan 2,004; Turkey 1,004.
Semimanufactures:				
Bars, rods, angles, shapes, sections	57	62	—	Burkina Faso 60.
Universals, plates, sheets	(2)	1,136	—	All to United Kingdom.
Hoop and strip	10	36	—	All to France.
Wire	499	2,744	—	Algeria 2,599; Martinique 80.
Tubes, pipes, fittings	(3)	11,143	—	Algeria 10,660; Switzerland 359.
Lead:				
Ore and concentrate	3,000	2,000	—	All to Italy.
Oxides	335	—		
Metal including alloys:				
Scrap	588	1,592	—	Italy 914; Belgium-Luxembourg 436.
Unwrought	—	60	—	All to France.
Magnesium: Metal including alloys, scrap	14	—		
Zinc:				
Ore and concentrate	(4)	15,256	—	France 7,231; Belgium-Luxembourg 6,175.
Metal including alloys, scrap	20	24	—	All to Italy.
Zirconium: Metal including alloys, scrap	—	24	—	Do.
Other: Ores and concentrates	—	11,000	—	Do.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.: Grinding and polishing wheels and stones	5	15	NA	NA.
Barite and witherite	—	4,822	—	Angola 3,801; Gabon 1,001.
Cement value, thousands	$10,408	$24,986	—	Spain $13,565; Cameroon $5,715.
Diamond: Gem, not set or strung do.	$6,738	$8,462	—	All to Belgium-Luxembourg.

See footnotes at end of table.

TABLE 12—Continued

TUNISIA: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Destinations, 1987	
				United States	Other (principal)
INDUSTRIAL MINERALS—Continued					
Feldspar, fluorspar, related materials		6,100	8,536	—	Italy 8,486.
Fertilizer materials: Manufactured:					
Nitrogenous		32,988	71,750	—	France 70,256.
Phosphatic		1,335,683	1,614,178	47,500	Italy 259,703; U.S.S.R. 199,855; France 197,461.
Lime		—	4	—	All to Togo.
Phosphates, crude	thousand tons	1,206	1,241	—	Romania 232; Greece 200; France 184.
Salt and brine		359,568	340,702	26,000	Italy 155,234; Denmark 55,031.
Stone, sand and gravel:					
Dimension stone, worked		([5])	65	—	Saudi Arabia 26; Algeria 21; Senegal 18.
Quartz and quartzite		1	1	—	All to Italy.
Sand other than metal-bearing		15	5	—	France 2; Italy 2.
Other:					
Crude	value, thousands	—	$2	NA	NA.
Slag and dross, not metal-bearing		1,024	2,000	—	All to Italy.
MINERAL FUELS AND RELATED MATERIALS					
Petroleum:					
Crude	thousand 42-gallon barrels	28,714	26,038	586	Italy 10,277; West Germany 7,273.
Refinery products:					
Liquefied petroleum gas	do.	—	194	—	Italy 176; France 18.
Gasoline, motor	do.	519	808	—	France 190; Greece 162; United Kingdom 141.
Kerosene and jet fuel	do.	35	—		
Distillate fuel oil	do.	([6])	—		
Lubricants	do.	([5])	([5])	—	All to Algeria.
Residual fuel oil	do.	1,488	1,786	—	France 1,487; Yugoslavia 166.
Bituminous mixtures	do.	18	—		

NA Not available.
[1] Table prepared by Virgina A. Woodson.
[2] Unreported quantity valued at $4,046,000.
[3] Unreported quantity valued at $15,106,000.
[4] Unreported quantity valued at $713,000.
[5] Less than 1/2 unit.
[6] Residual fuel was inadvertently reported as distillate fuel oil in the last edition of this table.

TABLE 13

TUNISIA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987	
			United States	Other (principal)
METALS				
Alkali and alkaline-earth metals	—	1	([2])	Mainly from France.
Aluminum:				
Ore and concentrate	—	508	([2])	Italy 458; Spain 50.
Oxides and hydroxides	26,859	21,285	([2])	Italy 16,765; France 4,472.
Metal including alloys:				
Unwrought	1,956	937	—	Netherlands 497; Canada 350.
Semimanufactures	2,640	3,608	2	Italy 1,192; Egypt 586; France 572.
Chromium: Oxides and hydroxides	27	36	—	West Germany 16; France 13.
Cobalt: Oxides and hydroxides value, thousands	$10	$1	—	All from Italy.
Copper:				
Matte and speiss including cement copper	96	96	—	Italy 76; France 20.
Metal including alloys:				
Scrap	2	—		
Unwrought	316	601	—	Italy 428; United Kingdom 100.
Semimanufactures	7,438	7,493	—	France 4,472; Belgium-Luxembourg 1,723.
Iron and steel:				
Iron ore and concentrate excluding roasted pyrite	70,689	63,066	—	All from Morocco.
Metal:				
Scrap	537	1,753	400	Algeria 1,196; France 156.
Pig iron, cast iron, related materials	1,422	1,501	—	Turkey 750; Brazil 500; Canada 125.
Ferroalloys:				
Ferromanganese	370	32	—	All from France.
Unspecified	1,364	840	—	Yugoslavia 739; Norway 60.
Steel, primary forms	38,382	39,388	—	Spain 39,354.
Semimanufactures:				
Bars, rods, angles, shapes, sections	104,072	88,380	—	Spain 40,014; Romania 17,753; Portugal 9,039.
Universals, plates, sheets	110,625	102,595	([2])	France 25,267; Italy 21,123; West Germany 17,283.
Hoop and strip	3,544	3,221	—	France 1,462; Italy 1,029; Spain 49.
Rails and accessories	243	4,535	—	Republic of Korea 4,202; France 188.
Wire	2,576	2,257	([2])	France 1,121; Italy 529.
Tubes, pipes, fittings	17,912	15,000	836	West Germany 5,075; Italy 2,390; France 1,802.
Castings and forgings, rough	59	178	—	France 89; Spain 88.
Lead:				
Oxides	115	201	—	France 86; Spain 45; Italy 22.
Metal including alloys:				
Scrap	—	3	—	All from France.
Unwrought	2,709	3,038	—	Morocco 2,292; Belgium- Luxembourg 497.
Semimanufactures	9	23	—	France 22.

See footnotes at end of table.

TABLE 13—Continued

TUNISIA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS—Continued				
Magnesium: Metal including alloys, semimanufactures value, thousands	$9	$5	—	All from France.
Manganese:				
Ore and concentrate, metallurgical-grade	155	181	—	Gabon 180.
Oxides	103	77	—	France 25; West Germany 24; Belgium-Luxembourg 21.
Mercury 76-pound flasks	319	319	—	Mainly from Nigeria.
Molybdenum: Metal including alloys, all forms value, thousands	$18	$20	—	Netherlands $8; Austria $6; Switzerland $3.
Nickel:				
Matte and speiss do.	$2	$10	—	Brazil $3; France $3; United Kingdom $3.
Metal including alloys, semimanufactures	90	70	—	France 19; Norway 17; Austria 11.
Platinum-group metals: Metal including alloys, unwrought and partly wrought value, thousands	$30	$1	—	All from France.
Silver: Metal including alloys, unwrought and partly wrought do.	$70	$50	—	France $23; Italy $18.
Tin:				
Metal including alloys:				
Scrap	—	1	—	All from France.
Unwrought	36	39	—	Indonesia 16; Malaysia 15.
Semimanufactures	19	27	—	West Germany 11; France 8.
Titanium: Oxides	307	339	55	West Germany 116; France 82.
Tungsten: Metal including alloys, all forms value, thousands	$23	$45	—	France $25; Netherlands $19.
Zinc:				
Oxides	375	223	—	France 123; Italy 49; West Germany 26.
Metal including alloys:				
Unwrought	2,271	1,168	—	Belgium-Luxembourg 567; Italy 204; Spain 200.
Semimanufactures	334	279	—	Spain 175; France 72.
Other:				
Ores and concentrates	60	47	—	Italy 44; Spain 3.
Oxides and hydroxides	131	162	39	West Germany 70; France 24.
Base metals including alloys, all forms	—	35	(2)	China 32.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	708	2,618	—	Turkey 1,845; Italy 241; Iceland 232.
Artificial: Corundum	183	153	—	France 108; Italy 37.
Dust and powder of precious and semiprecious stones including diamond value, thousands	$43	$11	—	All from Belgium-Luxembourg.

See footnotes at end of table.

TABLE 13—Continued

TUNISIA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
INDUSTRIAL MINERALS—Continued					
Abrasives, n.e.s.—Continued					
Grinding and polishing wheels and stones		177	227	([2])	Italy 106; Spain 57; France 23.
Asbestos, crude		9,207	7,057	—	Zimbabwe 4,251; Canada 1,939.
Barite and witherite		90	20	—	All from France.
Boron materials:					
Crude natural borates		—	1	—	Mainly from Turkey.
Oxides and acids		48	33	—	Italy 20; France 6.
Cement		60,272	60,064	—	France 52,464; Italy 4,650.
Chalk		2,354	1,847	—	France 1,497; Italy 350.
Clays, crude		34,932	58,663	12	Spain 18,373; Morocco 16,395; Italy 7,242.
Diamond: Gem, not set or strung	value, thousands	$11,255	$12,024	—	Belgium-Luxembourg $9,984; Tanzania $1,397.
Diatomite and other infusorial earth		167	436	—	Algeria 380; France 35.
Feldspar, fluorspar, related materials		8,190	4,302	—	Spain 2,840; France 935.
Fertilizer materials: Manufactured:					
Ammonia		203,801	273,651	102,750	Kuwait 65,233; Bahrain 53,846.
Nitrogenous		8,169	12,514	—	Italy 8,504; Belgium-Luxembourg 3,055.
Phosphatic		150	—		
Potassic		15,021	3,501	—	Italy 3,001; Belgium-Luxembourg 500.
Unspecified and mixed		75	13	—	West Germany 12; Spain 1.
Graphite, natural		1	11	—	All from France.
Gypsum and plaster		519	478	—	Do.
Lime		131	14	—	Do.
Magnesium compounds, unspecified		480	698	—	Greece 492; Netherlands 148.
Mica:					
Crude including splittings and waste		13	8	—	All from France.
Worked including agglomerated splittings	value, thousands	$9	$7	—	France $4; Italy $1.
Phosphates, crude	do.	$1	$1	—	All from France.
Pigments, mineral: Iron oxides and hydroxides, processed		168	280	—	West Germany 191; Spain 14; Italy 30.
Precious and semiprecious stones other than diamond:					
Natural	value, thousands	$5	$6	$6	
Synthetic	do.	—	$17	—	All from France.
Pyrite, unroasted		10	5	—	All from Italy.
Salt and brine		71	77	—	West Germany 60; Ireland 11.
Sodium compounds, n.e.s.:					
Carbonate, manufactured		6,299	4,722	—	Italy 2,626; Bulgaria 1,000; France 557.
Sulfate, manufactured		33,496	50,121	—	Spain 26,222; France 11,407; Romania 5,000.

See footnotes at end of table.

TABLE 13—Continued

TUNISIA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

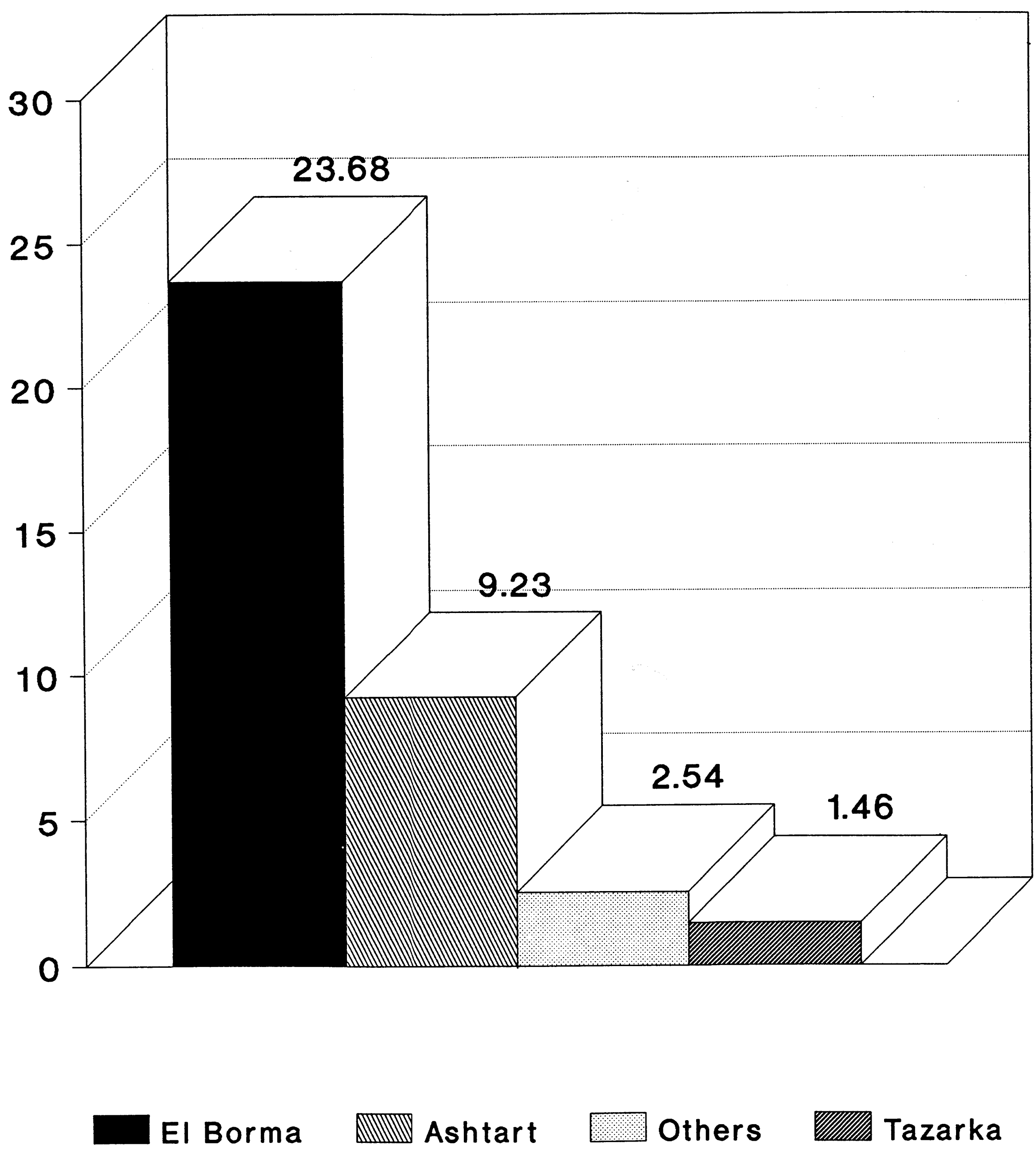
Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
INDUSTRIAL MINERALS—Continued				
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked	19,080	14,531	—	Italy 14,286.
Worked value, thousands	$132	$2	—	All from Morocco.
Dolomite, chiefly refractory-grade	509	125	—	Spain 100; West Germany 25.
Gravel and crushed rock	47,372	14,512	—	Italy 14,426.
Quartz and quartzite	925	1,336	—	Belgium-Luxembourg 1,261; Italy 55.
Sand other than metal-bearing	1,104	1,542	—	Belgium-Luxembourg 1,000; West Germany 516.
Sulfur:				
Elemental:				
Crude including native and byproduct thousand tons	1,096	1,120	94	Canada 443; Poland 202; Kuwait 96.
Colloidal, precipitated, sublimed	48	73	—	West Germany 50; France 14.
Sulfuric acid	46	4,224	9	Italy 4,181.
Talc, steatite, soapstone, pyrophyllite	1,044	1,191	—	France 823; Italy 207; Belgium-Luxembourg 125.
Other: Crude	9	11	—	West Germany 4; Italy 4.
MINERAL FUELS AND RELATED MATERIALS				
Asphalt and bitumen, natural	7	13	2	France 11.
Carbon black	1,595	1,917	—	Italy 1,403; France 182; West Germany 151.
Coal:				
Anthracite and bituminous	12,258	11,951	—	France 5,250; Morocco 3,553; Belgium-Luxembourg 3,148.
Lignite including briquets	4	—		
Coke and semicoke	81,153	92,164	—	Algeria 48,992; Italy 38,272.
Peat including briquets and litter	1	2	—	All from France.
Petroleum:				
Crude thousand 42-gallon barrels	2,973	2,974	—	All from Saudi Arabia.
Refinery products:				
Liquefied petroleum gas do.	5,901	2,930	—	Algeria 1,614; Italy 568; Spain 169.
Gasoline, motor do.	([2])	([2])	—	Mainly from Belgium-Luxembourg.
Mineral jelly and wax do.	7	12	([2])	West Germany 6; France 4.
Kerosene and jet fuel do.	702	1,074	—	Greece 750; Italy 324.
Distillate fuel oil do.	—	3,868	—	Greece 2,038; Italy 1,090; Bulgaria 347.
Lubricants do.	25	209	([2])	Saudi Arabia 152; Italy 28.
Residual fuel oil do.	5,402	2,956	([2])	Italy 882; France 737; Spain 754.
Bitumen and other residues do.	—	225	—	Turkey 135; Spain 89.
Bituminous mixtures do.	—	2	—	France 1; Spain 1.

[1] Table prepared by Virgina A. Woodson.
[2] Less than 1/2 unit.

FIGURE 2

TUNISIA—1988 CRUDE OIL PRODUCTION

(By field in million barrels per year)



because of environmental pollution. The future of the phosphoric acid unit was still being debated. The current acid requirements for the TSP plant were being supplied from SIAPE's La Skhirra site.

The operating capacity of the TSP unit was to be determined by prevailing market conditions. Full production of the TSP unit requires approximately 80,000 metric tons per year of P_2O_5 of acid. Factory B, also in Sfax, produced 200,000 metric tons per year of TSP. The plant was closed for 3 weeks during February and March 1988 for annual maintenance and cleaning. SIAPE's newest operation, SIAPE II, 80 kilometers south of Sfax, opened in 1988. SIAPE II was designed to produce 330,000 metric tons per year of superphosphoric acid. SIAPE also owns a bag production facility in Sidi Bouzid. Additionally, SIAPE's factory A and a bagging operation were on SIAPE's own quay in Sfax where both phosphate rock and fertilizer were stored and transferred directly to departing ships.

ICG, in Gafsa, was originally expected to produce 400,000 metric tons per year. Actual production figures were approximately 135,000 metric tons, according to SIAPE.

CPG called for submission of bids in April 1988 from U.S. companies to build an integrated phosphate treatment and handling facility for the phosphate deposit at Kef Eddour in southern Tunisia. Yearly production capacity at the site was expected to be 1.4 million metric tons of phosphate rock. The facility was to consist of two identical mechanical washing and treatment units utilizing screening and crushing, a storage area for the screened rock that was to be loaded on railroad cars and transported to processing plants in Gabes and Sfax, a homogenization unit, and an electrical equipment supply and installation unit.

***Mineral Fuels.*—Petroleum.**—At yearend, planned expansion to double the capacity of the Bizerte petroleum refinery awaited submission of bids from interested contractors. The expansion plan was one of several projects shelved in the early 1980's due to the economic crisis and the resultant cuts in capital investment. The plant produced an estimated average 30,000 bbl/d of refined petroleum products in 1988.

Bids also were to be submitted for a contract to develop the Ezzaouia oilfield in Tunisia. The 2,820-square-kilometer Zarzis permit contains the Ezzaouia oilfield, which was operated during the year by the U.S. company Marathon Petroleum Tunisia in partnership with ETAP, which owned 55% of the permit with Oranje-Nassau of the Netherlands and Elf Aquitaine Tunisie of France. The decision to develop this onshore field was a positive note in an otherwise depressed oil industry. Development was planned despite the fact that production was not expected to exceed 10,000 bbl/d. Reserves were being depleted and there was little hope of a major petroleum find.

The Italian firm AGIP Africa Ltd. began exploratory drilling in the El-Borma area to a depth of 4,000 meters. Production at the El-Borma Field was 65,000 bbl/d. Most of the natural gas produced in Tunisia was coming from the El-Borma Field. Preliminary geological surveys indicate deep oil reserves in structures similar to those found in Algeria and Libya. In May, the Government of Tunisia and the Government of Libya agreed to undertake a joint offshore hydrocarbon exploration project. In August, Tunisia accepted a 1982 International Court of Justice ruling that divided the Continental Shelf. Both countries were to operate jointly the 3,000-square-kilometer area 125 kilometers northwest of Libya's El Bouri offshore oil platform. Most of the area to be explored for oil was in the Libyan zone. Algeria, Libya, and Tunisia agreed to construct a natural gas pipeline. The March agreement specified a 400-kilometer pipeline from Algeria through Tunisia to Libya that would carry an estimated 3.6 billion cubic meters of gas per year at a construction cost of $400 million. The proposed pipeline would fuel a petrochemical and aluminum complex in Libya and provide revenue to Tunisia in the form of gas royalties.

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[1] Prepared by Bernadette Michalski, mineral specialist, Division of International Minerals.

[2] Where necessary, values have been converted from Algerian dinars (DA) to U.S. dollars at the rate of AD4.8497 = US$1.00 in 1987 and AD5.9148 = US$1.00 in 1988.

[3] Prepared by Thomas P. Dolley, physical scientist, Division of International Minerals.

[4] Where necessary, values have been converted from Egyptian pounds (LE) to U.S. dollars at the rate of LE2.21 = US$1.00.

[5] Prepared by Thomas P. Dolley, physical scientist, Divison of International Minerals.

[6] Where necessary, values have been converted from Libyan dinars (LD) to U.S. dollars at a rate of LD0.31594 = US$1.00.

[7] Thomas P. Dolley, physical scientist, Division of International Minerals.

[8] Where necessary, values have been converted from Moroccan dirhams (DH) to U.S. dollars at the rate of Dh8.21 = US$1.00.

[9] Thomas P. Dolley, physical scientist, Division of International Minerals.

[10] Where necessary, values have been converted from Tunisian dinars (D) to U.S. dollars at the rate of D0.83 = US$1.00.

THE MINERAL INDUSTRY OF

The Republic of South Africa

By George A. Morgan[1]

INTRODUCTION

The mineral industry remained buoyant in 1988 with generally higher prices for mineral commodities leading to higher output. As a result, numerous capacity expansion projects were underway or planned at mines, mills, and refineries. Among these projects were new gold, platinum-group metals, vanadium, and zirconium mines, and additional ferrochromium capacity. Mining and quarrying accounted for $10 billion[2] of a gross domestic product (GDP), at 1988 prices, of $79 billion, compared with $19.4 billion for manufacturing, $7.1 billion for transportation, and $10.5 billion for general government. Total employee remuneration for the mining and quarrying sector was $4.4 billion, and gross operating surplus was $5.6 billion.

Total mineral sales, including domestic sales and exports, were $15.1 billion, which was divided by commodities as follows: gold, $8.7 billion; coal, $2.6 billion; copper, $519 million; manganese, $149 million; limestone and lime products, $143 million; and chromite, $138 million. Exports of vanadium, of which South Africa was the world's largest producer, were $145 million. According to the Chamber of Mines (CM), which represents the major mining corporations in South Africa, tax revenue which accrued to the Government from mining was $1.6 billion, or 9.5% of all revenue collected, and consisted of $1.15 billion from gold, $62.6 million from diamond, $53.6 million from coal, $63.9 million from copper, and $230 million from all other mines. The CM represented most of the mining industry, which was dominated by six major corporations: Anglovaal Ltd., Anglo American Corp. of South Africa Ltd. (AAC), Barlow Rand Ltd. (BRL), General Mining Union Corp. Ltd. (Gencor), Gold Fields of South Africa Ltd. (GFSA), and Johannesburg Consolidated Investment Co. Ltd. (JCI).

The total cost of materials consumed by members of the CM was $1.68 billion. Although labor costs, primarily in terms of wages paid to the black labor force, have increased threefold over a 10-year period, there has not been a corresponding increase in labor productivity.

Inflation was estimated at 13% in 1988. The real growth rate of the GDP was 3.2%, and real gross fixed investment grew 6.5%. The volume of exports grew by 5.7%, but import volume rose 22.5%. The South African Reserve Bank reported that economic sanctions had contributed to a net outflow of over $10 billion from South Africa over the last 4 years. About $5 billion was used to pay off loans called in by foreign banks. The country's foreign debt was reduced from $27.5 billion in 1985 to $21.5 billion in 1988. Debt repayments were expected to be $1.7 billion in 1989, $1.9 billion in 1990, and $1.5 billion in 1991. The country's balance of payments had a surplus of over $1 billion.

The government mining engineer reported that the average number of employees at all mines in 1988 was 738,214, compared with 780,016 in 1987. Total deaths at mines were 674, or 0.91 death per 1,000 people employed. The injury rate was 15.38 accidents per 1,000 people employed.

The CM reported the average labor force and average earnings in its members' gold mines at the end of October as follows: skilled employees, 46,769, earning $1,392 per month; semiskilled employees, 98,392, earning $443 per month; and unskilled employees, 354,624, earning $248 per month. Comparable data for coal mines that were members of the CM were: skilled employees, 7,801, earning $1,382 per month; semiskilled employees, 9,866, earning $462 per month; and unskilled employees, 38,473, earning $283 per month. These data reflect employees in service at the end of the month, and do not include $93 per month of supplementary payments made to semiskilled and unskilled employees. Skilled workers were in grades C1 up to senior manager; semiskilled workers were in grades B1 to B4; and unskilled workers were in grades A1 to A4. Of a total labor force of 456,625 workers employed at CM's gold mines in 1988, 191,357 were foreign workers, originating from the following countries: Lesotho, 100,951; Mozambique, 44,084; Botswana, 17,061; Swaziland, 16,171; and Malawi, 13,090. Of a total of 46,699 employees at CM's coal mines, 8,430 were from nearby countries, mainly Lesotho and Mozambique. Owing to the high incidence of auto-immune deficiency syndrome virus found in Malawi workers, their employment in South Africa was to be terminated. The employment of labor from northern Mozambique was being reduced for similar reasons.

A major study determined that about 11% of professional geologists had emigrated over the past 3 years, and that the shortage of geologists could jeopardize resource development for self-reliance as a strategy against sanctions. Limitations already exist on the number of projects which can be undertaken by mining companies because of the lack of skilled labor.

GOVERNMENT POLICIES AND PROGRAMS

A new minerals bill was proposed which would restrict the Government to activity relating to licensing and overseeing mine safety and land rehabilitation. Prospecting and mining development rights would belong to owners of the land and of the mineral rights. A consolidation of the mining law would occur, with a single Act of 75 articles replacing the current 452 articles. The Government also may consider selling off state-owned land that has mineral rights attached.

Owing to taxation policy, which inhibited local manufacturers, action was taken to stimulate the domestic jewelry industry, primarily to enhance the export of value added products by using locally trained diamond cutters and jewelers.

The Ministry of Economic Affairs and Technology announced export and import concessions, including the reduction of the ad valorem excise tax from 35% to 20%. Additionally, the customs duty on sawn and cleaved imported diamonds was to be rebated in full. The Reserve Bank was also to make gold available at low interest rates to participating banks, which could lend the gold to jewelery manufacturers.

The Government introduced legislation to exempt companies, including mining companies, from having to disclose information on foreign operations, on the grounds that such disclosures could harm the national interest.

Several bills have been proposed in Parliament that could lead to privitization of state agencies, including the South African Transport Service (SATS), the Iron and Steel Corp. of South Africa (Iscor), and the Council for Mineral Technology (Mintek). Under provisions of one bill, Mintek, a world recognized mining and mineral technology research organization under the Minister of Economic Affairs and Technology, would have wide discretion to enter into partnerships with private entities, or even establish commercial production facilities for new processes. The intent of this action was to double export earnings from minerals over a 10-year period.

The Gold Mines Assistance Act (Act 82) of 1968 was repealed as of January 1, 1988. However, statutory control was maintained over 10 gold mines classified as assisted mines prior to the repeal. Because of the lower gold price and lack of overseas financing, the Government imposed surcharge taxes on numerous import items. Import controls and foreign currency allocations have also been proposed.

PRODUCTION AND TRADE

More than 60 different minerals were produced in 1988 from 1,068 active mines and quarries. Of the total active mines and quarries, 83 produced gold, 106 produced coal, and 64 produced diamond. Minerals were exported to 85 countries, with about 81% of total mineral sales by value destined for export.

Attempts to increase labor productivity continued. Mechanization of mining activity was being implemented, such as the use of trackless load-haul-dump (LHD) vehicles and jumbo drill rigs, which can reduce the cycle time for blasting by 33%. Working faces in the mines, while being shorter, could also advance by 50% to an average of 15 meters per month. The amount of waste rock mined in faulted or dike-prone areas would also be reduced.

Demand for trackless equipment was high, with South Africa purchasing 24% of the 850 LHD vehicles made worldwide in 1987 and 17% of the 300 jumbo drills sold worldwide in 1986, the latest year for which data were available. About 50% of this equipment was imported. JCI's Randfontein Estates and Western Areas gold mines were especially amenable to trackless mining as these mines had large reserves in wide stopes. Mobile, twin-boom hydraulic drill rigs capable of operating in stopes ranging in widths of only 0.8 meter to 1.2 meters have been put into place at all JCI's gold mines. Each rig, using a single operator, can drill two panels in a single shift, replacing eight hand-held drills each requiring two operators. The rigs have achieved 40 meters of drilling per hour, but are capable of drilling up to 60 meters per hour. A utility vehicle transports the rig to the stope, remaining in the gully end of the stope; the rig is then driven off of the vehicle into position.

South Africa transships about 50% of the total trade of Malawi, Zaire, Zambia, and Zimbabwe, including 60% of Zaire's zinc exports, 40% of its copper exports and 100% of its cobalt exports. About 8,000 exporters were registered in South Africa, of which about 5,700 have started operations in the last 2 years.

Owing to deregulation in road transportation and higher tariffs on railroad transport, more products were moving by road. For cement in particular, road transport has become the principal method for inland transport. Over 70% of shipments were by road. Because of higher rail tariffs, the cost of shipping coal by rail from the Transvaal to Richards Bay was 35% higher than the cost of seaborne freight shipped from Richards Bay to Rotterdam, Netherlands. Richards Bay Coal Terminal (RBCT), rated at 44 million tons per year of coal handling capacity, may be increased to about 48 million tons per year without much cost by making the terminal a 24-hour-per-day operation. Coal exports through RBCT were 40.5 million tons compared with 38.2 million tons in 1987. Both spot and contract prices for coal free-on-board RBCT exceeded $30 per ton.

Private transporters with a total labor force of 64,176 workers moved 312 million tons of merchandise in 1988, compared with 180.1 million tons in 1987. In terms of total transport earnings, 4% to 8% was from coal, ores, and minerals and 12.5% was from construction materials excluding cement. Combined road and railroad transport of SATS was 179.8 million tons.

COMMODITY REVIEW

Metals

Aluminum.—Alusaf (Pty.) Ltd., which produced aluminum from imported alumina, constructed a full-scale plant for the recovery of alumina from anode residues. The residues had previously been discarded.

Antimony.—Consolidated Murchison Ltd., the only producer of antimony in South Africa, reported $10 million in antimony sales for 1988. Exports were dependent upon an orderly pricing market, which has not occurred in the past 2 years owing to the intermittent exports of

TABLE 1

REPUBLIC OF SOUTH AFRICA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987[p]	1988[p]
METALS						
Aluminum metal		167,357	164,600	169,600	170,000	[e]170,000
Antimony concentrate:						
Gross weight		12,924	12,600	11,553	[e]11,500	10,855
Sb content		7,440	7,390	6,816	[e]6,800	6,673
Beryl concentrate (11% to 12% BeO)	kilograms	1,000	4,649	3,133	135	72
Chromite, gross weight:						
More than 48% Cr_2O_3	thousand tons	53	65	39	65	20
44% to 48% Cr_2O_3	do.	1,242	1,975	2,294	2,241	[e]2,721
Less than 44% Cr_2O_3	do.	1,711	1,658	1,574	1,483	1,503
Total[2]	**do.**	**[3]3,006**	**3,699**	**3,907**	**3,789**	**4,245**
Cobalt:[e]						
Mine output, Co content		690	690	690	720	720
Metal, elemental		500	500	500	520	520
Columbium-tantalum concentrate	kilograms	317	1	—	8	—
Copper:						
Mine output, Cu content		198,179	195,436	184,205	188,088	178,171
Metal:						
Smelter		178,700	191,700	[r e]192,000	[e]192,000	[e]180,000
Refined		155,722	164,304	158,631	152,699	[e]148,000
Gold, primary	thousand troy ounces	21,861	[r]21,565	20,513	19,348	19,881
Iron and steel:						
Ore and concentrate:						
Gross weight	thousand tons	24,647	24,414	24,483	22,008	25,248
Fe content	do.	15,749	15,076	15,424	13,865	15,906
Metal:						
Pig iron	do.	5,455	6,574	[e]6,800	[e]6,700	[e]6,500
Ferroalloys, blast furance and electric furnace:						
Ferrochromium	do.	867	851	870	951	[e]1,000
Ferromanganese	do.	237	331	337	315	447
Ferrosilicochromium	do.	27	5	55	14	[e]21
Ferrosilicomanganese	do.	181	261	303	314	295
Ferrosilicon	do.	89	75	83	83	[e]84
Ferrovanadium	do.	([4])	([4])	1	[e]1	[e]1
Silicon metal	do.	34	36	35	34	[e]34
Total[2]	**do.**	**[r]1,435**	**1,560**	**1,685**	**1,712**	**[e]1,882**
Crude steel	do.	7,827	8,582	[e]8,800	8,400	8,600
Semimanufactures:						
Hot-rolled products		NA	7,005	7,189	NA	NA
Iron castings		322	NA	NA	NA	NA
Steel castings and forgings		111	101	91	NA	NA

See footnotes at end of table.

TABLE 1—Continued

REPUBLIC OF SOUTH AFRICA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987[p]	1988[p]
METALS—Continued						
Lead:						
Mine output, Pb content		94,764	98,424	97,778	93,642	90,233
Smelter, secondary		30,794	32,836	40,463	38,268	37,361
Manganese:						
Ore and concentrate, gross weight:						
Metallurgical:						
More than 48% Mn	thousand tons	753	950	954	889	1,059
45% to 48% Mn	do.	448	213	338	438	568
40% to 45% Mn	do.	432	837	991	773	524
30% to 40% Mn	do.	1,225	1,442	1,280	666	1,181
Total[2]	**do.**	**2,858**	**3,443**	**3,564**	**2,767**	**3,331**
Chemical:						
More than 65% MnO_2	do.	([4])	1	4	3	2
35% to 65% MnO_2	do.	123	118	135	117	119
Less than 35% MnO_2	do.	69	38	16	5	2
Total[2]	**do.**	**192**	**158**	**156**	**125**	**123**
Grand total[2]	**do.**	**3,049**	**3,601**	**3,719**	**2,892**	**3,454**
Metal	do.	36,776	31,825	32,900	31,900	[e]28,000
Monazite[e]		1,000	1,000	1,000	1,200	1,200
Nickel:						
Mine output, Ni content[e]		25,000	25,000	31,000	34,300	[e]34,800
Metal, electrolytic[e]		[5]20,500	20,000	[r]25,000	27,400	[e]27,800
Platinum-group metals, metal content of concentrate, matte, refinery products[e 6]	thousand troy ounces	3,500	3,700	3,960	4,220	4,285
Silver:						
Mine output, Ag content	do.	6,997	6,700	7,145	6,691	6,469
Primary[e]	do.	2,000	2,000	2,000	1,900	[e]1,800
Tin:						
Concentrate:						
Gross weight[e]		5,900	5,600	5,250	3,620	3,400
Sn content		2,301	2,153	2,054	1,438	1,377
Metal, primary[7]		1,592	2,069	2,001	1,508	1,389
Titanium:[e]						
Rutile concentrate		56,000	55,000	55,000	55,000	55,000
Slag		417,300	435,000	435,000	650,000	700,000
Uranium oxide (U_3O_8)		6,762	[r]5,751	5,460	4,735	4,583
Vanadium:						
Vanadiferous slag, gross weight		45,911	57,340	[e]68,170	[e]69,000	[e]77,200
V content:						
Of vanadiferous slag[e]		6,500	8,085	9,600	[r]10,100	11,300
Of V_2O_3 and vanadate products[e]		6,017	5,930	5,761	[r]4,156	5,080
Total		**12,517**	**14,015**	**15,361**	**14,256**	**16,380**

See footnotes at end of table.

TABLE 1—Continued

REPUBLIC OF SOUTH AFRICA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987[p]	1988[p]
METALS—Continued						
Zinc:						
Concentrate:						
Gross weight[e]		200,000	190,000	200,000	220,000	175,000
Zn content		106,107	96,943	101,859	112,686	89,551
Metal, smelter		88,406	93,700	81,000	96,051	84,357
Zirconium concentrate (baddeleyite) and zircon		153,123	160,533	[r e]140,000	[r e]140,000	150,000
INDUSTRIAL MINERALS						
Asbestos						
Amosite		33,237	37,856	36,009	26,026	20,325
Chrysotile		75,414	92,318	91,001	101,722	113,468
Crocidolite		58,738	34,073	11,852	7,326	11,885
Total		**167,389**	**164,247**	**138,862**	**135,074**	**145,678**
Barite		4,467	4,387	8,653	8,617	8,735
Cement, hydraulic	thousand tons	8,188	7,034	6,712	7,256	8,486
Clays:						
Attapulgite		4,843	5,885	10,125	6,026	7,161
Bentonite		41,849	43,472	48,265	48,953	66,750
Fire clay		162,665	168,145	202,883	230,519	267,184
Flint clay		93,755	123,810	130,721	106,915	139,112
Kaolin		136,160	128,899	126,129	151,730	175,033
Corundum, natural		21	10	9	5	2
Diamond:						
Gem[e]	thousand carats	4,516	4,550	4,473	4,061	3,817
Industrial[e]	do.	5,627	5,652	5,755	4,990	4,687
Total	**do.**	**10,143**	**10,202**	**10,228**	**9,051**	**8,504**
Diatomite		258	[r]947	1,800	194	199
Feldspar		39,018	33,012	52,762	66,513	81,889
Fluorspar:						
Acid-grade		289,294	310,211	293,368	[e]279,000	[e]282,986
Ceramic-grade		4,502	5,724	7,703	[e]7,000	[e]8,000
Metallurgical-grade		25,410	33,272	32,814	[e]30,606	[e]37,435
Total		**319,206**	**349,207**	**333,885**	**316,606**	**328,421**
Gem stones, semiprecious:						
Emerald crystals	kilograms	440	102	23	—	—
Tiger's-eye	do.	111,500	178,821	257,554	452,147	368,462
Gypsum, crude		535,286	458,399	404,205	349,079	372,169
Kyanite and related materials:						
Andalusite		143,305	194,693	181,466	194,373	259,556
Sillimanite		1,311	1,337	1,330	1,243	781
Lime[7]	thousand tons	2,110	2,014	1,944	1,582	1,916
Magnesite, crude		33,059	28,898	61,186	74,961	74,088

See footnotes at end of table.

TABLE 1—Continued

REPUBLIC OF SOUTH AFRICA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987[p]	1988[p]
INDUSTRIAL MINERALS—Continued						
Mica:						
Sheet	kilograms	—	81	—	—	—
Waste		4,478	2,072	2,509	970	1,669
Nitrogen: N content of ammonia[e]	thousand tons	[5]580	580	580	500	560
Phosphate rock, gross weight	do.	[r]2,585	2,433	2,920	2,623	[e]2,800
Pigments, mineral, natural:						
Ochers		746	528	1,340	621	1,692
Oxides		245	224	161	147	105
Total		**991**	**752**	**1,501**	**768**	**1,797**
Pyrites, gross weight[e]		875,000	900,000	940,000	890,000	900,000
Quartz, quartzite, glass sand (silica)	thousand tons	1,471	1,518	1,655	1,937	2,011
Salt		615,531	722,482	752,440	705,531	678,225
Silcrete		1,153	47	—	—	—
Sodium sulfate		820	75	466	241	255
Stone, n.e.s.:						
Dimension:						
Granite:[7]						
Sawn slabs		13,345	11,708	10,946	17,242	9,639
Rough blocks		196,237	315,707	317,079	323,582	486,975
Marble	cubic meters	1,000	1,000	2,539	2,802	3,173
Slate		45,100	42,100	39,853	25,494	[7]25,522
Crushed and broken:						
Limestone	thousand tons	21,084	20,520	20,898	21,372	[e]24,097
Shale	do.	533	527	526	354	422
Sulfur:						
S content of pyrites	do.	464	562	499	468	[e]470
Byproduct:						
Of metallurgy[e]	do.	[6]91	85	108	105	[e]110
Of petroleum[e]	do.	30	100	110	110	[e]120
Total[e]	**do.**	**585**	**747**	**717**	**683**	**[e]700**
Talc and related materials:						
Talc		10,561	10,220	8,641	8,005	10,111
Pyrophyllite (wonderstone)		3,851	4,227	4,606	3,467	3,162
Vermiculite		173,759	184,070	193,657	228,863	209,177
MINERAL FUELS AND RELATED MATERIALS						
Coal:						
Anthracite	thousand tons	3,228	4,910	4,990	5,252	4,951
Bituminous	do.	159,681	168,606	171,871	171,294	176,599
Total	**do.**	**162,909**	**173,516**	**176,861**	**176,546**	**181,550**

See footnotes at end of table.

TABLE 1—Continued

REPUBLIC OF SOUTH AFRICA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987[p]	1988[p]
MINERAL FUELS AND RELATED MATERIALS—Continued						
Petroleum refinery products:						
Gasoline	thousand 42-gallon barrels	37,400	37,400	[e]37,500		
Jet fuel	do.	3,200	3,280	[e]3,300		
Kerosene	do.	3,488	3,410	[e]3,400		
Distillate fuel oil	do.	38,791	39,165	[e]39,200		
Residual fuel oil	do.	21,312	21,645	[e]21,600	NA	NA
Lubricants	do.	2,625	2,520	[e]2,500		
Other	do.	12,492	12,470	[e]12,500		
Refinery fuel and losses	do.	[e]6,000	[e]6,000	[e]6,000		
Total	**do.**	**125,308**	**125,890**	**[e]126,000**	**[e]126,000**	**[e]130,000**

[e]Estimated. [p]Preliminary. [r]Revised. NA Not available.
[1]Table includes data available through Sept. 6, 1989.
[2]Data may not add to totals shown because of independent rounding.
[3]Excludes Bophuthatswana, which was 401,000 metric tons.
[4]Less than 1/2 unit.
[5]Reported figure.
[6]Includes osmiridium from gold ores, estimated at 2,500 troy ounces per year.
[7]Domestic sales plus exports.

antimony from China. The recovery of gold substantially improved the company's performance. Mine operations were adversely affected by a 3-week strike by the National Union of Mineworkers. Operations at the Alpha shaft were put on care and maintenance because of high costs, and emphasis was on the development of ore reserves at the Monarch shaft, where similar antimony grades were found with higher gold content. Development continued on a backfilling method to reduce dilution from sidewall scaling. Ore milled was 508,700 tons for the year that ended in June 1988, and stocks were 1,747 tons. The grade of ore milled was 1.58% antimony, and concentrates graded 57.7%, with a recovery of 80.3%. An underground exploration program was successful in maintaining the level of ore reserves, and a surface drilling program indicated economic ore existed in three areas.

Chromite.—Chromite production was at a record high of 4.2 million tons as demand for ferrochromium rose. The Mooinooi Mine, with a capacity of 38,000 tons per month of finished product, was producing 48,000 tons per month of ore and 36,000 tons per month of product. About 21,000 tons was lumpy ore for the ferrochrome industry; the remaining fines were used domestically and also exported. Preparations were underway to mine the Middle Group 2 (MG2) chromitite seam, containing 1.6 meters of chromite; in addition, mining would continue on the 1.2-meter-thick MG1 seam. Total reserves in the two seams were 110 million tons, of which 65 million tons was in the MG1 seam over a strike length of 5 kilometers.

Lavino SA (Pty.) Ltd. reportedly had its Grootbroom Mine for sale at yearend. Production capacity was about 400,000 tons per year at the mine, which was owned by Applied Industrial Minerals Corp. (Aimcor) of the United States. Aimcor was expected to obtain $10–$20 million from the sale of the mine.

Cobalt.—The Zinc Corp. of South Africa Ltd. (Zincor) completed a design and feasibility study to recover cobalt as a byproduct of its zinc operation. A decision to proceed with the project would be made in 1989.

Copper.—Copper output by Palabora Mining Co. Ltd. (PMC) from its open pit mine was 118,456 tons, down 6% from 1987 owing to a maintenance shutdown of the smelter in February. PMC purchased 19,202 tons for further processing. PMC, one of the largest open pit operations in the world, mined a total of 71.5 million tons of rock. Milled ore was 29.2 million tons averaging 0.45% copper. Concentrate production was 294,429 tons grading

TABLE 2

REPUBLIC OF SOUTH AFRICA: APPARENT EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
METALS				
Aluminum:				
Ore and concentrate	[r]1,411	11,005	—	All to Turkey.
Oxides and hydroxides	3	115	—	Mainly to Ireland.
Ash and residue containing aluminum	1,126	NA	—	
Metal including alloys:				
Scrap	7,758	2,662	—	Japan 2,208; Taiwan 279.
Unwrought	[r]82,913	81,290	5,420	Japan 43,544; Taiwan 29,181.
Semimanufactures	[r]7,218	5,186	4,119	Taiwan 891; United Kingdom 120.
Antimony:				
Ore and concentrate	[2]964	3,947	3,930	Spain 17.
Oxides	5,410	NA	—	
Metal including alloys, all forms	14	—	—	
Arsenic: Oxides and acids	2,307	2,126	1,380	United Kingdom 746.
Beryllium:				
Ore and concentrate	35	NA	—	
Metal including alloys, all forms	1	—	—	
Cadmium: Metal including alloys, all forms	28	NA	—	
Chromium:				
Ore and concentrate thousand tons	[2]1,009	[2]1,178	238	Japan 455; United Kingdom 112.
Oxides and hydroxides	1,135	250,765	250,765	
Metal including alloys, all forms	15	—	—	
Cobalt:				
Oxides and hydroxides	[r]3	3	—	Argentina 2; Turkey 1.
Metal including alloys, all forms	99	191	—	United Kingdom 171; Netherlands 20.
Columbium and tantalum: Metal including alloys, all forms: Columbium (niobium)	2	—	—	
Copper:				
Ore and concentrate	37,707	32,730	—	Japan 29,223; Italy 3,502.
Matte and speiss including cement copper	1,388	511	—	All to Greece.
Oxides and hydroxides	6	33	—	Belgium-Luxembourg 17; Netherlands 14.
Sulfate	NA	50	—	All to United Kingdom.
Ash and residue containing copper	NA	22,843	—	United Kingdom 22,173; Belgium-Luxembourg 670.
Metal including alloys:				
Scrap	11,941	3,680	16	Taiwan 1,306; Belgium-Luxembourg 1,270.
Unwrought	[r]153,494	101,140	4,722	Belgium-Luxembourg 22,061; Turkey 21,855; Italy 16,959.
Semimanufactures	[r]6,676	4,875	3,359	Hong Kong 487; Canada 340.
Gold:				
Ore and concentrate value, thousands	$371	NA	—	

See footnotes at end of table.

TABLE 2—Continued

REPUBLIC OF SOUTH AFRICA: APPARENT EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
METALS—Continued				
Gold—Continued				
Waste and sweepings value, thousands	$13	$458	—	All to United Kingdom.
Metal including alloys, unwrought and partly wrought thousand troy ounces	[r] [3]6,217	3,794	—	Italy 2,730; Taiwan 726; West Germany 258.
Iron and steel:				
Iron ore and concentrate:				
Including roasted pyrite	18	262,312	—	Turkey 262,263.
Excluding roasted pyrite thousand tons	[r]10,061	[2]8,802	—	Japan 5,583; United Kingdom 1,578.
Pyrites, roasted	—	2	2	
Metal:				
Scrap	[r]145,903	69,913	—	Turkey 40,395; Taiwan 29,156.
Pig iron, cast iron, related materials	630,003	458,083	—	Japan 314,386; Spain 87,086; Taiwan 40,448.
Ferroalloys:				
Ferrochromium	[2]877,971	[2]828,310	195,968	Italy 41,583; Canada 25,475.
Ferromanganese	[2]529,413	213,577	131,004	Turkey 30,213; Taiwan 17,644.
Ferromolybdenum	2	4	—	All to Netherlands.
Ferronickel	58	5	3	United Kingdom 2.
Ferrosilicochromium	1,081	1,559	958	Italy 551; Spain 50.
Ferrosilicomanganese	114,303	71,521	59,969	Spain 11,552.
Ferrosilicon	[2]40,069	11,707	807	Taiwan 8,644; Spain 2,256.
Silicon metal	[2]29,985	16,202	2,484	United Kingdom 9,840; Netherlands 2,395.
Unspecified	367,309	422,055	15	Japan 308,937; United Kingdom 49,594.
Steel, primary forms	[r]569,816	835,953	—	Taiwan 361,195; Turkey 246,032; Japan 86,161.
Semimanufactures:				
Bars, rods, angles, shapes, sections	[r]648,274	407,311	20,699	Hong Kong 263,592; United Kingdom 36,228; Turkey 29,653.
Universals, plates, sheets	[r]672,017	313,365	760	Turkey 73,279; Taiwan 68,741; Hong Kong 64,516.
Hoop and strip	[r]32,660	837	—	United Kingdom 703; Taiwan 70.
Rails and accessories	[r]10,927	22,082	—	Taiwan 13,017; Turkey 9,065.
Wire	[r]32,008	15,802	169	Turkey 5,037; Portugal 3,192; United Kingdom 2,600.
Tubes, pipes, fittings	[r]89,437	76,135	39	Hong Kong 34,700; Taiwan 22,685; United Kingdom 6,482.
Castings and forgings, rough	1,008	415	—	Belgium-Luxembourg 397; United Kingdom 18.
Unspecified	125	—	—	
Lead:				
Ore and concentrate	[2]102,637	[2]90,790	—	Japan 35,265; Italy 16,230; Spain 12,690.
Oxides	190	173	—	Canada 162; United Kingdom 10.

See footnotes at end of table.

TABLE 2—Continued

REPUBLIC OF SOUTH AFRICA: APPARENT EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
METALS—Continued				
Lead—Continued				
Ash and residue containing lead	985	NA	—	
Metal including alloys:				
Scrap	r2,310	1,546	—	Turkey 999; Taiwan 319.
Unwrought	17,660	12,929	—	Italy 969; Hong Kong 40.
Semimanufactures	1,457	146	—	Hong Kong 131; United Kingdom 15.
Unspecified	—	21	—	All to Netherlands.
Lithium: Ore and concentrates	1,509	NA	—	
Magnesium: Metal including alloys:				
Scrap	296	64	—	United Kingdom 40; Italy 24.
Semimanufactures	11	—	—	
Unspecified	NA	562	—	All to Italy.
Manganese:				
Ore and concentrate: Metallurgical-grade thousand tons	[2]2,416	[2]1,562	([4])	Japan 775; Spain 77.
Oxides	r4,175	3,608	733	Spain 1,842; Taiwan 528.
Metal including alloys, all forms	19,759	10,985	8,015	United Kingdom 1,483; Belgium-Luxembourg 1,424.
Molybdenum:				
Ore and concentrate	NA	120	—	All to United Kingdom.
Metal including alloys, all forms	22	NA	—	
Nickel:				
Ore and concentrate	20	—	—	
Matte and speiss	29,165	159	—	Belgium-Luxembourg 132; Italy 24.
Ash and residue containing nickel	4	—	—	
Metal including alloys:				
Scrap	261	297	—	United Kingdom 271; Netherlands 21.
Unwrought	r17,660	7,544	2,070	United Kingdom 2,080; Italy 1,731.
Semimanufactures	782	739	722	Italy 16.
Platinum-group metals:				
Waste and sweepings value, thousands	NA	$2,358	—	Italy $2,162; United Kingdom $196
Metals including alloys, unwrought and partly wrought:				
Palladium thousand troy ounces	529	701	701	
Platinum do.	1,315	[5]1,212	882	West Germany 228; United Kingdom 50.
Rhodium do.	98	109	109	
Iridium, osmium, ruthenium do.	111	65	65	
Unspecified do.	[6]1,116	250	1	West Germany 98; Switzerland 83.
Rhenium: Metal including alloys, all forms	—	6	—	All to United Kingdom.
Silver:				
Ore and concentrate, Ag content value, thousands	r$116,374	$88,738	—	All to United Kingdom.
Waste and sweepings do.	$5,781	$2,756	—	Italy $2,162; Canada $265.
Metal including alloys, unwrought and partly wrought thousand troy ounces	1,951	1,478	—	United Kingdom 1,138; West Germany 320.

See footnotes at end of table.

TABLE 2—Continued

REPUBLIC OF SOUTH AFRICA: APPARENT EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Destinations, 1987	
				United States	Other (principal)
METALS—Continued					
Tin:					
Ore and concentrate		r 2 2,001	2 1,508	—	
Oxides		r 49	NA	—	
Ash and residue containing tin		96	72	—	United Kingdom 55; Belgium-Luxembourg 17.
Metal including alloys:					
Scrap		17	NA	—	
Unwrought		r 150	413	—	United Kingdom 269; Italy 103.
Semimanufactures		281	NA	—	
Titanium:					
Ore and concentrate		56,594	41,930	26,204	Netherlands 6,109; Belgium-Luxembourg 4,007.
Oxides		1,760	1,866	1,856	Turkey 10.
Ash and residue containing titanium		152,239	—	—	
Metal including alloys:					
Semimanufactures		—	14	—	All to United Kingdom.
Unspecified		13	—	—	
Tungsten:					
Ore and concentrate		NA	1,677	—	All to Canada.
Metal including alloys:					
Scrap		11	18	17	United Kingdom 1.
Unwrought	kilograms	—	607	607	
Unspecified		18	17	16	Do.
Uranium and thorium:					
Ore and concentrate	value, thousands	$32,139	$6,365	—	All to Canada.
Oxides and other compounds		4,204	NA	—	
Metal including alloys, all forms	value, thousands	NA	$42	—	All to Ireland.
Vanadium:					
Oxides and hydroxides		r 5,418	2,765	221	Belgium-Luxembourg 1,245; Canada 1,168.
V_2O_5 content of all products		29,728	—	—	
Ash and residue containing vanadium		NA	12,040	—	All to Belgium-Luxembourg.
Zinc:					
Ore and concentrate		2 29,510	2 15,506	—	NA.
Oxides		r 88	54	—	New Zealand 36; Taiwan 18.
Blue powder		NA	36	—	All to Bèlgium-Luxembourg.
Matte		NA	325	—	Do.
Ash and residue containing zinc		NA	530	—	Spain 384; Belgium-Luxembourg 146.
Metal including alloys:					
Scrap		r 134	NA	—	
Unwrought		r 13,257	50	—	All to Switzerland.
Semimanufactures		370	599	70	Portugal 409; United Kingdom 77.

See footnotes at end of table.

TABLE 2—Continued

REPUBLIC OF SOUTH AFRICA: APPARENT EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987	
			United States	Other (principal)
METALS—Continued				
Zirconium:				
Ore and concentrate	120,211	66,520	16,964	Spain 16,240; United Kingdom 11,609.
Metal including alloys, unwrought	—	1	—	All to Italy.
Other:				
Ores and concentrates:				
Of base metals	90,993	626,545	607,613	Japan 16,055; Argentina 1,887.
Of precious metals, n.e.s. value, thousands	$137	$2,423	—	All to Spain.
Oxides and hydroxides	565	173	—	Taiwan 162; Belgium-Luxembourg 11.
Ashes and residues	66,064	291,633	215,633	Italy 75,247.
Base metals including alloys, all forms	3,689	18,756	—	Belgium-Luxembourg 12,163; Japan 4,800.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	37	2,034	1,981	Italy 53.
Dust and powder of precious and semiprecious stones including diamond value, thousands	$393	$161	$114	Italy $28; Hong Kong $8.
Grinding and polishing wheels and stones do.	$12	$12	—	Republic of Korea $9; New Zealand $3.
Asbestos, crude	[2]135,249	[2]134,607	3,826	Japan 69,030; Turkey 7,926; Thailand 4,164.
Barite and witherite	NA	9,000	—	All to Ireland.
Cement	[r]5,031	53	—	All to United Kingdom.
Clays, crude:				
Bentonite	[2]1,600	[2]580	—	NA.
Chamotte earth	5,834	1,974	—	All to United Kingdom.
Flint clay	[2]14,100	[2]13,582	—	NA.
Kaolin	[2]1,600	[2]682	—	United Kingdom 105; Italy 20.
Unspecified	6,372	29,282	—	Japan 25,841; New Zealand 2,418.
Diamond:				
Gem, not set or strung value, thousands	$499,656	$370,745	$83,356	Switzerland $129,829; Belgium-Luxembourg $116,936.
Industrial stones do.	[r]$16,082	$1,708	$1,558	Belgium-Luxembourg $65; Italy $36.
Dust and powder do.	$387	$119	$112	Taiwan $7.
Feldspar, fluorspar, related materials:				
Feldspar	[2]910	[2]3,475	—	NA.
Fluorspar	[2]288,070	[2]281,427	—	NA.
Unspecified	NA	217,193	162,988	Japan 47,299; Italy 5,331.
Fertilizer materials:				
Crude, n.e.s.	280	1,855	—	Belgium-Luxembourg 1,368; Taiwan 220.

See footnotes at end of table.

TABLE 2—Continued

REPUBLIC OF SOUTH AFRICA: APPARENT EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
INDUSTRIAL MINERALS—Continued				
Fertilizer materials—Continued				
Manufactured:				
Ammonia	—	331	331	
Nitrogenous	24,712	26,535	—	Turkey 15,510; Belgium-Luxembourg 5,750; Netherlands 5,275.
Phosphatic	[r]4,783	200	—	All to Taiwan.
Potassic	3,089	NA	—	
Unspecified and mixed	[r]84,854	11,630	60	Spain 9,500; Taiwan 2,044.
Graphite, natural	436	286	160	United Kingdom 126.
Gypsum and plaster	[2]663	60	—	All to Argentina.
Kyanite and related materials:				
Andalusite	[2]113,514	[2]117,622	—	NA.
Sillimanite	[2]748	[2]979	—	NA.
Unspecified	NA	34,259	—	United Kingdom 24,677; Netherlands 3,644.
Lime	22	NA	—	
Magnesium compounds:				
Magnesite, crude	388	2,131	—	Canada 2,005; United Kingdom 126.
Other	NA	1,000	1,000	
Mica:				
Crude including splittings and waste	[7]1,065	[2]1,105	—	United Kingdom 600; Japan 256; Italy 50.
Worked including agglomerated splittings value, thousands	$10	$6	—	All to Republic of Korea.
Phosphates crude	775,199	761,474	—	Belgium-Luxembourg 354,145; Netherlands 171,012.
Phosphorus, elemental	1,716	1,216	47	Taiwan 1,102; Belgium-Luxembourg 52.
Pigments, mineral:				
Natural crude	141	261	—	United Kingdom 161; Belgium-Luxembourg 100.
Iron oxides and hydroxides, processed	605	1,360	—	Taiwan 1,326; United Kingdom 19.
Precious and semiprecious stones other than diamond:				
Natural value, thousands	$16,890	$12,906	$470	Japan $6,912; Taiwan $2,401.
Synthetic do.	$60	NA	—	
Pyrite, unroasted	NA	2,214	2,214	
Salt and brine	[2]88,761	[2]81,715	4,185	NA.
Sodium compounds, n.e.s.:				
Carbonate, manufactured	36	NA	—	
Sulfate, manufactured	133	62	—	All to Canada.

See footnotes at end of table.

TABLE 2—Continued

REPUBLIC OF SOUTH AFRICA: APPARENT EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
INDUSTRIAL MINERALS—Continued				
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked	333,067	285,750	10,748	Italy 146,709; Japan 60,924; Canada 18,061.
Worked	2,956	4,877	783	United Kingdom 2,420; Japan 1,148.
Dolomite, chiefly refractory-grade	20	NA	—	
Gravel and crushed rock	21	206	206	
Limestone other than dimension	r [2]76,239	[2]74,501	—	NA.
Quartz and quartzite	4,049	62	20	Japan 18; Switzerland 17.
Sand other than metal-bearing	r 18,824	11,971	—	Belgium-Luxembourg 11,895.
Talc, steatite, soapstone, pyrophyllite	541	NA	—	
Vermiculite	[2]190,593	[2]186,273	—	United Kingdom 44,730; Italy 9,542; Canada 8,135.
Other:				
Crude	NA	76,450	37,682	Japan 13,130; United Kingdom 10,815.
Slag and dross, not metal-bearing	89,760	88,388	—	Japan 88,387.
MINERAL FUELS AND RELATED MATERIALS				
Asphalt and bitumen, natural	NA	1,071	—	All to Canada.
Carbon black	r 17,753	35	—	Hong Kong 29; Greece 6.
Coal:				
Anthracite and bituminous thousand tons	[2]45,486	[2]42,431	—	Japan 7,560; Italy 5,341; Hong Kong 2,559.
Briquets of anthracite and bituminous coal	120,987	610	—	United Kingdom 487; Italy 121.
Lignite including briquets	r 126,154	228,290	—	All to Turkey.
Coke and semicoke	r 160,652	1,087	—	Netherlands 1,065; Spain 22.
Peat including briquets and litter	NA	68	—	All to Ireland.
Petroleum:				
Crude thousand 42-gallon barrels	r 182	—	—	
Refinery products:				
Liquefied petroleum gas do.	32	NA	—	
Gasoline do.	1,249	31	31	
Mineral jelly and wax do.	[8]234	155	92	Japan 25; United Kingdom 16.
Kerosene and jet fuel do.	388	56	56	
Distillate fuel oil do.	521	801	26	Spain 775.
Lubricants do.	3	287	—	Hong Kong 279; United Kingdom 8.
Nonlubricating oils value, thousands	—	$1	$1	
Residual fuel oil thousand 42-gallon barrels	296	1,047	182	Italy 506; Spain 359.
Bitumen and other residues do.	—	2	2	
Petroleum coke do.	136	NA	—	

r Revised. NA Not available.
[1] Table prepared by Virginia A. Woodson. Because official South African trade statistics provide data only on the value of total exports of each commodity class (with no data on destinations) and not on quantity of material exported, this table has been compiled from a variety of sources including the data issued by the Department of Mineral and Energy Affairs and official trade returns of trading partner countries. Data issued by the Government of the Republic of South Africa are footnoted; other figures are compiled from a variety of sources with specifics on destination obtained from the import statistics of the trading partners. Data presented are exports by the common customs area of Botswana, Lesotho, the Republic of South Africa, and Swaziland.
[2] Data issued by the Government of the Republic of South Africa.
[3] Excludes unreported quantity valued at $329,000 imported by Sweden.
[4] Less than 1/2 unit.
[5] Excludes unreported quantity imported by Japan valued at $551,584,000.
[6] Incomplete total; excludes imports reported in value only.
[7] Excludes unreported quantity valued at $29,000 imported by Japan.
[8] Excludes unreported quantity valued at $61,000 imported by New Zealand.

TABLE 3

REPUBLIC OF SOUTH AFRICA: APPARENT IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1987	Sources: United States	Sources: Other (principal)
METALS			
Alkali and alkaline-earth metals	1	—	All from Italy.
Aluminum:			
Ore and concentrate	120	—	All from United Kingdom.
Oxides and hydroxides	9,445	143	Japan 4,610; Netherlands 3,388.
Ash and residue containing aluminum	1,268	—	All from United Kingdom.
Metal including alloys:			
Scrap	155	—	United Kingdom 41; Netherlands 14.
Unwrought	189	80	United Kingdom 91; Japan 18.
Semimanufactures	7,541	146	Australia 2,683; United Kingdom 1,619; Japan 1,295.
Antimony: Metal including alloys, all forms	1	—	All from United Kingdom.
Beryllium: Metal including alloys, all forms	224	224	
Bismuth: Metal including alloys, all forms	2	—	Netherlands 1; United Kingdom 1.
Cadmium: Metal including alloys, all forms	1	—	All from United Kingdom.
Chromium:			
Ore and concentrate	5,500	—	All from Turkey.
Oxides and hydroxides	34	18	Japan 14; Belgium-Luxembourg 2.
Metal including alloys, all forms	75	2	United Kingdom 72.
Cobalt:			
Oxides and hydroxides	6	—	All from United Kingdom.
Metal including alloys, all forms	15	([2])	Mainly from United Kingdom.
Columbium and tantalum: Metal including alloys, all forms	1	1	
Copper:			
Ore and concentrate	32	—	All from United Kingdom.
Oxides and hydroxides	24	—	Do.
Sulfate	5	—	All from Hong Kong.
Metal including alloys:			
Scrap	8	—	All from United Kingdom.
Unwrought	177	98	United Kingdom 46; Belgium-Luxembourg 33.
Semimanufactures	1,983	—	Italy 645; United Kingdom 459; Australia 354.
Gold:			
Waste and sweepings value, thousands	$144	$143	United Kingdom $1.
Metal including alloys, unwrought and partly wrought do.	$1,167	$15	United Kingdom $1,094; Switzerland $58.
Iron and steel:			
Iron ore and concentrate excluding roasted pyrite	50	—	United Kingdom 49; Taiwan 1.
Metal:			
Scrap	344	298	United Kingdom 26; Italy 20.
Pig iron, cast iron, related materials	345	1	United Kingdom 323; Canada 20.
Ferroalloys:			
Ferromanganese	109	—	All from Italy.
Ferromolybdenum	100	([2])	Mainly from Spain.
Ferrosilicon	392	192	Hong Kong 300.
Unspecified	1,938	19	Italy 1,072; United Kingdom 719.

See footnotes at end of table.

TABLE 3—Continued

REPUBLIC OF SOUTH AFRICA: APPARENT IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1987	Sources: United States	Sources: Other (principal)
METALS—Continued				
Iron and steel—Continued				
Metal—Continued				
Steel, primary forms		161	1	Japan 76; United Kingdom 72.
Semimanufactures:				
Bars, rods, angles, shapes, sections		7,448	134	United Kingdom 2,996; Japan 2,675; Ireland 760.
Universals, plates, sheets		36,232	126	Japan 33,165; Belgium-Luxembourg 994.
Hoop and strip		6,441	49	Italy 3,217; United Kingdom 1,300; Belgium-Luxembourg 949.
Rails and accessories		86	—	Belgium-Luxembourg 35; Italy 25; Canada 24.
Wire		5,049	8	United Kingdom 1,892; Belgium-Luxembourg 1,508; Ireland 591.
Tubes, pipes, fittings		55,056	1,344	Japan 42,312; Spain 3,542.
Castings and forgings, rough		3,806	4	Italy 3,186; Belgium-Luxembourg 457.
Lead:				
Ore and concentrate		15,721	—	All from Australia.
Oxides		31	—	All from Hong Kong.
Metal including alloys:				
Scrap		203	203	
Unwrought		259	16	United Kingdom 243.
Semimanufactures		12	—	Mainly from Japan.
Lithium: Oxides and hydroxides		94	94	
Magnesium: Metal including alloys:				
Unwrought		18	18	
Semimanufactures		103	80	Canada 11; United Kingdom 7.
Manganese:				
Ore and concentrate: Metallurgical-grade		4,196	—	All from Netherlands.
Oxides		35	19	United Kingdom 16.
Mercury	76-pound flasks	754	—	All from United Kingdom.
Molybdenum:				
Ore and concentrate		276	—	United Kingdom 239; Netherlands 37.
Oxides and hydroxides		85	—	All from United Kingdom.
Metal including alloys:				
Semimanufactures		2	—	Do.
Unspecified		8	4	Ireland 2; United Kingdom 2.
Nickel: Metal including alloys:				
Scrap		6	6	
Unwrought		5	—	All from United Kingdom.
Semimanufactures		96	5	United Kingdom 80; Canada 6.
Platinum-group metals:				
Waste and sweepings	value, thousands	$10,499	—	All from United Kingdom.
Metals including alloys, unwrought and partly wrought	do.	$2,131	$1,223	United Kingdom $630; Belgium-Luxembourg $270.

See footnotes at end of table.

TABLE 3—Continued

REPUBLIC OF SOUTH AFRICA: APPARENT IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1987	Sources: United States	Sources: Other (principal)
METALS—Continued			
Rare-earth metals including alloys, all forms kilograms	1,996	1,996	
Selenium, elemental	14	—	All from United Kingdom.
Silver:			
Waste and sweepings value, thousands	$1,117	—	Do.
Metal including alloys, unwrought and partly wrought do.	$49	—	United Kingdom $30; Switzerland $9.
Tin:			
Ore and concentrate	1	—	All from United Kingdom.
Oxides	15	—	Japan 13; United Kingdom 2.
Metal including alloys:			
Unwrought	14	—	All from United Kingdom.
Semimanufactures	43	—	United Kingdom 25; Italy 18.
Titanium:			
Ore and concentrate	2	—	All from Italy.
Oxides	2	—	All from United Kingdom.
Metal including alloys:			
Scrap	38	25	United Kingdom 13.
Semimanufactures	9	1	United Kingdom 8.
Unspecified	9	9	
Tungsten:			
Ore and concentrate	90	—	Australia 70; Spain 20.
Metal including alloys:			
Scrap	5	—	All from United Kingdom.
Semimanufactures	19	14	United Kingdom 4.
Unspecified	11	1	United Kingdom 9.
Zinc:			
Oxides	185	—	Hong Kong 164; New Zealand 17.
Ash and residue containing zinc	23	—	All from Netherlands.
Metal including alloys:			
Scrap	199	—	United Kingdom 100; Belgium-Luxembourg 99.
Unwrought	841	—	All from Hong Kong.
Semimanufactures	4	3	United Kingdom 1.
Zirconium:			
Ore and concentrate	1	—	All from United Kingdom.
Metal including alloys, semimanufactures	2	([2])	Mainly from United Kingdom.
Other:			
Ores and concentrates	159	72	Canada 69; United Kingdom 18.
Oxides and hydroxides	11	—	All from United Kingdom.
Ashes and residues	1,950	—	United Kingdom 1,296; Japan 658.
Base metals including alloys, all forms	231	1	United Kingdom 117; Japan 59; Hong Kong 54.

See footnotes at end of table.

TABLE 3—Continued

REPUBLIC OF SOUTH AFRICA: APPARENT IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1987	Sources: United States	Sources: Other (principal)
INDUSTRIAL MINERALS			
Abrasives, n.e.s.:			
Natural: Corundum, emery, pumice, etc.	2,096	511	Hong Kong 799; Turkey 276.
Artificial:			
Corundum	1,478	—	Japan 1,148; United Kingdom 231.
Silicon carbide	68	—	Italy 38; Spain 20.
Dust and powder of precious and semiprecious stones including diamond value, thousands	$279	—	United Kingdom $245; Belgium-Luxembourg $34.
Grinding and polishing wheels and stones	229	12	Italy 81; Taiwan 46; Belgium-Luxembourg 16.
Asbestos, crude	215	62	Ireland 144; Netherlands 8.
Barite and witherite	354	—	United Kingdom 204; Australia 75; Hong Kong 75.
Boron materials:			
Crude natural borates	1,630	—	All from Turkey.
Oxides and acids	941	132	Turkey 738; Argentina 36.
Bromine	1	—	All from United Kingdom.
Cement	57,746	137	Italy 54,236; Netherlands 1,738.
Chalk	1,988	—	United Kingdom 1,913; Belgium-Luxembourg 72.
Clays, crude:			
Bentonite	12,773	12,334	United Kingdom 438.
Fire clay	6	6	
Kaolin	20,487	17,693	United Kingdom 2,794.
Unspecified	2,278	1,370	United Kingdom 849; Japan 25.
Diamond:			
Gem, not set or strung value, thousands	$30,899	$1,888	Belgium-Luxembourg $26,970; United Kingdom $827.
Industrial stones do.	$222	—	Belgium-Luxembourg $162; United Kingdom $51.
Diatomite and other infusorial earth	32	—	Japan 25; Australia 7.
Feldspar, fluorspar, related materials	6	—	All from Switzerland.
Fertilizer materials:			
Crude, n.e.s.	136	76	Belgium-Luxembourg 60.
Manufactured:			
Ammonia	12,419	—	Canada 12,418.
Nitrogenous	730	104	Netherlands 348; Italy 144.
Phosphatic	108	—	Ireland 80; Belgium-Luxembourg 28.
Potassic	14,833	—	Canada 14,750; United Kingdom 133.
Unspecified and mixed	10,834	48	Belgium-Luxembourg 8,430; Japan 2,241.
Graphite, natural	540	15	United Kingdom 525.
Gypsum and plaster	15,836	1,045	Spain 14,728.
Kyanite and related materials	276	—	All from United Kingdom.
Lime	582	21	Japan 342; United Kingdom 218.
Magnesium compounds:			
Magnesite, crude	[3]8,903	3	Netherlands 8,500; Greece 400.
Oxides and hydroxides	600	—	All from Hong Kong.
Other	648	21	Hong Kong 627.

See footnotes at end of table.

TABLE 3—Continued

REPUBLIC OF SOUTH AFRICA: APPARENT IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1987	Sources: United States	Sources: Other (principal)
INDUSTRIAL MINERALS—Continued			
Meerschaum, amber, jet	204	([2])	Mainly from Spain.
Mica:			
Crude including splittings and waste	17	—	Hong Kong 11; Netherlands 6.
Worked including agglomerated splittings	41	3	Switzerland 20; Hong Kong 9; United Kingdom 7.
Nitrates, crude	184	—	All from Hong Kong.
Phosphates, crude	21	—	All from United Kingdom.
Pigments, mineral: Iron oxides and hydroxides, processed	262	35	Italy 153; Spain 74.
Precious and semiprecious stones other than diamond:			
Natural value, thousands	$446	$66	Switzerland $287; Hong Kong $33.
Synthetic do.	$251	—	Switzerland $145; United Kingdom $74.
Pyrite, unroasted	14	—	All from United Kingdom.
Salt and brine	1,142	—	United Kingdom 1,141.
Sodium compounds, n.e.s.:			
Carbonate, manufactured	141,102	134,121	Spain 5,478; Turkey 1,500.
Sulfate, manufactured	1,249	—	Hong Kong 960; Spain 289.
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked	2,348	—	Ireland 1,557; Italy 650.
Worked	2,136	9	Italy 1,866; Portugal 145.
Gravel and crushed rock	61	40	Switzerland 11; Netherlands 6.
Quartz and quartzite	24	—	Netherlands 22; Switzerland 2.
Sand other than metal-bearing	3,310	2,779	Ireland 416; Belgium-Luxembourg 88.
Sulfur:			
Elemental:			
Crude including native and byproduct	212,215	67	Canada 212,099.
Colloidal, precipitated, sublimed	60	—	United Kingdom 42; Taiwan 18.
Sulfuric acid	51,773	—	Japan 51,754.
Talc, steatite, soapstone, pyrophyllite	4,195	683	Belgium-Luxembourg 1,689; Australia 1,185.
Other:			
Crude	8,592	—	Greece 5,020; Ireland 1,760; Turkey 1,470.
Slag and dross, not metal-bearing	915	—	Taiwan 870; United Kingdom 45.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	317	[4]297	United Kingdom 20.
Carbon:			
Carbon black	1,082	395	Netherlands 490; United Kingdom 175.
Gas carbon	262	—	All from United Kingdom.
Coal:			
Anthracite and bituminous	85,114	55,925	Ireland 29,171.
Lignite including briquets	44	—	All from United Kingdom.

See footnotes at end of table.

TABLE 3—Continued

REPUBLIC OF SOUTH AFRICA: APPARENT IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1987	Sources: United States	Sources: Other (principal)
MINERAL FUELS AND RELATED MATERIALS—Continued				
Coke and semicoke		58	—	United Kingdom 55; Japan 3.
Peat including briquets and litter		391	—	Canada 300; Netherlands 91.
Petroleum, refinery products:				
Liquefied petroleum gas	42-gallon barrels	2,327	1,805	Greece 278; Italy 128.
Gasoline	do.	47,892	—	Belgium-Luxembourg 46,240; United Kingdom 1,335.
Mineral jelly and wax	do.	57,719	8	Hong Kong 17,290; United Kingdom 9,035; Japan 7,334.
Kerosene and jet fuel	do.	5,966	548	Belgium-Luxembourg 5,410.
Distillate fuel oil	do.	3,320	—	United Kingdom 2,686; Belgium-Luxembourg 582.
Lubricants	do.	145,314	4,510	Italy 49,931; United Kingdom 43,568; Spain 34,923.
Residual fuel oil	do.	2,338	—	Belgium-Luxembourg 1,305; Argentina 666.
Asphalt	do.	655	655	
Bituminous mixtures	do.	333	—	Netherlands 206; United Kingdom 121.
Petroleum coke	do.	399,487	341,693	United Kingdom 57,794.

[1] Table prepared by Virginia A. Woodson. This table should not be taken as a complete representation of this country's mineral imports. These data have been compiled from United Nations information and data available from trading partner countries. Data presented are imports by the common customs area of Botswana, Lesotho, the Republic of South Africa, and Swaziland. Comparable data for 1986 are not available.
[2] Less than 1/2 unit.
[3] Excludes unreported quantities imported from Japan valued at $843,000 and Canada valued at $23,000.
[4] Includes limestone rock, etc.

37.9% copper, with a recovery of 84.1%. Sales were 119,303 tons of copper valued at $312.2 million compared with 124,719 tons and $212.4 million in 1987. Construction of the in-pit crusher and conveyor system was virtually completed by yearend, in preparation for underground mining. PMC's unit cost of production increased 25.4% to $0.57 per pound of copper cathode, owing to higher labor, energy, and materials costs.

Messina Ltd. produced 578,310 tons of ore grading 1.55% copper, from which 8,252 tons of copper in concentrate were produced. Sales were 7,933 tons of recoverable copper to PMC. Production costs per ton of recoverable copper were up 23% to $0.63 per pound. Cost per ton of ore milled was $13.79. Ore reserves again declined, totaling 1.73 million tons grading 1.45% copper, and a provision of $1.3 million was made toward the cost of rehabilitating the mining sites.

Prieska Copper Mines Ltd. (PCM) also continued to wind down mining operations at Copperton. Ore milled was 2.145 million tons grading 0.79% copper and 2.05% zinc. Copper concentrate production was 49,030 tons grading 29.7% copper; zinc concentrate output was 74,532 tons grading 52.2% zinc. Pyrite concentrate output was 38,184 tons, compared with 200,248 tons in 1987. Ore reserves as of June 30, 1988, were 986,810 tons. PCM estimated total mine rehabilitation costs at $5.8 million, and expected underground mining to cease before June 1989.

Gold.—The CM reported that 112.7 million tons of ore were milled by its members, compared with 107.6 million tons in 1987. The average grade of ore milled declined to 0.165 troy ounce per ton from 0.170 troy ounce per ton. Total working revenue from these mines was $7.83 billion, or $75.69 per ton of ore milled, equivalent to $455.65 per ounce of gold recovered. The average production cost per ton of ore milled was $47.22, equivalent to $284.26 per ounce produced. An average working profit of $28.47 per ton of ore milled was realized, or $171.39 per ounce of gold recovered. Working profit in 1987 was $184.49 per ounce of gold recovered.

Working costs rose in the second half of the year owing to wage settlements made with the National Union of Mineworkers in July of 13% to 15% in various wage groups. A number of gold producers experienced higher working costs, which, compounded by lower gold

TABLE 4

REPUBLIC OF SOUTH AFRICA: VALUE OF DOMESTIC SALES AND EXPORTS OF MAJOR MINERAL COMMODITIES

(Thousand U.S. dollars)

Commodity	Domestic sales			Exports		
	1986	1987	1988[p]	1986	1987	1988[p]
METALS						
Chromite	51,428	68,502	60,972	43,508	65,974	77,102
Copper	109,392	121,075	200,708	138,849	182,960	218,358
Gold	([1])	([1])	([1])	7,618,477	8,628,625	8,705,759
Iron ore	76,747	100,370	100,259	132,067	131,845	140,818
Lead concentrate	—	14	68	25,459	37,256	38,645
Manganese	30,051	29,875	26,079	89,504	57,077	123,144
Nickel	20,999	26,454	63,667	29,770	25,478	71,253
Silver	1,763	1,428	2,036	30,845	35,028	32,006
Tin	6,331	7,789	9,265	7,069	3,484	1,270
Titanium	[e]14,000	NA	NA	[e]22,000	NA	NA
Uranium[e]	NA	NA	NA	150,000	NA	NA
Vanadium	[e]3,800	NA	NA	[e]65,000	NA	NA
Zinc	23,280	46,431	41,856	10,593	5,648	15,581
Zirconium	NA	NA	NA	[e]30,000	NA	NA
INDUSTRIAL MINERALS						
Asbestos	2,116	3,226	2,176	41,547	40,218	42,996
Cement[e]	275,000	NA	NA	30,000	NA	NA
Clays, flint	2,294	3,613	3,536	1,069	1,156	1,615
Clays, other	6,447	8,441	12,069	120	48	35
Diamond	([1])	([1])	([1])	465,501	NA	NA
Feldspar	2,440	2,845	4,022	75	334	440
Fluorspar	2,466	4,539	3,352	24,872	26,634	34,890
Granite	1,326	2,664	2,383	20,546	33,829	47,152
Gypsum	3,167	3,487	3,822	4	—	—
Kyanite-related materials:						
Andalusite	6,242	6,120	6,752	9,823	13,024	12,375
Sillimanite	46	6	—	80	153	179
Limestone and lime products	101,757	130,858	139,606	2,499	3,067	3,369
Magnesite	1,957	2,239	2,680	—	—	—
Mica	278	362	440	257	547	477
Phosphate rock	[e]35,000	NA	NA	[e]15,000	NA	NA
Pyrite-sulfur	26,064	33,579	37,700	—	136	—
Salt	18,833	21,158	23,814	2,253	2,235	2,308
Silica, sand	12,967	18,169	20,289	17	23	10
Slate	1,118	777	857	2,928	1,395	1,073
Stone, other	1,203	4,964	1,249	267	48	3
Vermiculite	250	282	293	15,095	15,579	15,172
Wonderstone	98	222	426	NA	NA	NA
Miscellaneous	90,569	459,484	1,014,075	1,187,380	1,327,018	1,177,073

See footnotes at end of table.

TABLE 4—Continued

REPUBLIC OF SOUTH AFRICA: VALUE OF DOMESTIC SALES AND EXPORTS OF MAJOR MINERAL COMMODITIES

(Thousand U.S. dollars)

Commodity	Domestic sales			Exports		
	1986	1987	1988[p]	1986	1987	1988[p]
MINERAL FUELS						
Coal:						
Anthracite	12,681	16,267	19,099	132,472	90,279	103,497
Bituminous	958,388	1,227,270	1,315,800	1,259,245	1,026,410	1,104,500
Total	**1,901,098**	**2,352,510**	**3,119,350**	**11,088,687**	**11,755,008**	**11,971,100**

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

[1]Value, if any is included under exports.

Sources: Republic of South Africa Department of Mineral and Energy Affairs, South Africa's Mineral Industry 1987; Minerals Bureau, Mineral Production and Sales Statistics, 1987 and 1988.

prices, threatened their operations. West Rand Consolidated Mine had begun to reduce its work force by 20%. The Leslie Mine began reducing its work force by 1,500 from a total of 4,600, and was lowering its mill throughput in order to raise recovery and reduce operating costs.

AAC's East Rand Gold and Uranium Co. (ERGO) was expected to spend $4.4 million for a new sand milling plant for treating sand from the Brakpan and Modder B sand dumps. ERGO treated 37 million tons of slimes and sands in 1988, from which 385,551 troy ounces of gold was recovered. Average grade of the sands and slimes has declined from 0.026 troy ounce per ton at the start of operations in 1979 to the present 0.018 troy ounce per ton.

GFSA completed its study of the savings derived from operation of a multivariable control system to 12 of its milling circuits at East Driefontein Mine. During an 8-year operating period, the controller allowed a 7% to 8% increase in mill capacity, and an annual savings of about $292,000 per mill.

Exploration in the West Witwatersrand gold field, extending about 100 kilometers from the Durban Deep Mine east of Randfontein to Potchefstroom, could yield several new gold mines. Deep-seated ore bodies ranging from 2,500 meters to 3,700 meters below surface would be mined. Individual strata were found to have thicknesses of up to 100 meters, and individual grades of 0.386 troy ounce per ton. The massive seams would require special pillar designs to handle the rock stress at the depths considered.

Capital expenditures by the gold industry for new projects, including exploration, were expected to total about $5.3 billion by 1990. About 15 major ore bodies were expected to be developed, either as new mines or as extensions to existing mines. These mines would each produce about 3 million tons of ore annually and have reserves lasting 30 years. Between 5 and 10 years would be required for development. Anglovaal, which held 100,000 hectares under option between Bothaville and the Orange Free State gold field, commenced exercising some options and buying the mineral rights.

Gencor, which initiated a bacterial gold leach pilot plant in 1987 using *thiobacillus ferrooxidans,* expected to replace roasters at the Fairview Mine with a full-scale bacterial plant to treat 1,000 tons of concentrate per month, equivalent to 20,000 tons of ore.

Iron and Steel.—Samancor was considering the construction of a stainless steel mill in a joint venture with Highveld Steel and Vanadium Corp. (Hiveld). Annual output of stainless steel billet was expected to be between 250,000 tons and 500,000 tons. Stainless steel finishing plants in Taiwan would be the major consumers. Stainless steel output in South Africa was all by Middelburg Steel and Alloys (Pty.) Ltd. (MSA), which was expanding production capacity from 100,000 to 150,000 tons per year. Output included billets for long stainless steel products, and flats, rounds, squares, and channels for 3CR12 products, a special grade stainless steel that was replacing carbon steels in corrosive environments. About 50% of MSA's output was exported.

Both producers' actions were part of a trend to increase the value added in mineral product processing, and to upgrade the quality of the products available for export.

Iscor commenced startup at its Pretoria works of what was reported to be the first commercial direct coal reduction (Corex) process. Supplied by Voest Alpine Industrienanlagebau of Austria, the plant has the capacity to produce 300,000 tons per year of pig iron. It is capable of using low-ranked coals for production of carbon monoxide and hydrogen gas in a fluidized bed to reduce iron ore to sponge iron, which is then fed to the melter-gasifier for pig

TABLE 5

REPUBLIC OF SOUTH AFRICA: GOLD PRODUCTION AND ORE RESERVES, BY PRODUCER

Producer	Production (troy ounces)				Developed ore	
	1985	1986	1987	1988[p]	Thousand metric tons	Troy ounces per ton
AAC Joint Metallurgical Scheme	121,777	88,199	87,842	71,117	NA	NA
Barberton	55,945	53,740	55,331	48,814	NA	NA
Blyvooruitzicht	426,084	425,617	383,069	328,082	1,940	0.463
Bracken	122,333	98,703	84,878	77,515	920	.203
Buffelsfontein:						
Buffelsfontein section	1,230,771	1,128,888	549,285	498,024	6,881	.313
Beatrix section	—	—	395,293	413,137	3,520	.240
Consolidated Murchison Ltd.	[e]27,000	26,942	21,556	26,170	NA	NA
Deelkraal	231,032	243,947	264,475	310,560	3,018	.238
Doornfontein	306,528	278,464	259,276	243,677	4,440	.246
Driefontein Consolidated Ltd:						
East Driefontein	914,205	888,321	1,060,790	1,045,657	8,028	.455
West Driefontein	1,157,435	1,033,182	1,053,257	901,827	7,585	.439
Durban Deep	242,645	239,790	231,389	227,675	3,298	.148
East Rand Gold and Uranium Co. Ltd. (Ergo)	222,965	280,386	254,601	386,291	NA	NA
East Rand Proprietary Mine	329,590	296,539	284,241	291,231	10,427	.183
Elandsrand	378,430	380,536	351,031	388,056	3,977	.300
Free State Geduld	857,626	(1)	(1)	(1)	(1)	(1)
Freegold:						
North region	(1)	1,715,719	1,523,879	1,585,984	21,684	.334
South region	(2)	1,707,974	1,629,809	1,840,525	28,951	.289
Grootvlei	220,342	184,384	145,990	137,155	1,470	.198
Harmony	1,057,147	923,690	894,915	879,097	27,226	.170
Hartebeestfontein	926,921	993,855	1,015,769	1,034,320	15,330	.399
Kinross	473,474	397,238	381,211	378,060	7,220	.286
Kloof	1,001,173	927,258	969,344	934,219	5,290	.589
Leslie	125,507	112,302	105,294	105,101	830	.248
Libanon	282,116	287,157	273,660	236,372	4,151	.215
Loraine	286,604	280,804	262,221	271,063	6,491	.272
Marievale	36,533	32,344	26,743	25,656	440	.179
President Brand	670,869	(2)	(2)	(2)	(2)	(2)
President Steyn	738,752	(2)	(2)	(2)	(2)	(2)
Randfontein	1,035,606	869,966	761,554	892,632	13,541	.188
St. Helena	397,441	313,244	285,530	324,626	5,620	.318
St. Helena-Oryx	—	—	—	1,566	NA	NA
Stilfontein	319,215	275,072	231,482	138,245	2,812	.302
Unisel	298,391	302,442	241,870	191,361	2,780	.283
Vaal Reefs	2,615,636	2,620,327	2,337,700	2,586,675	33,024	.301
Venterspost	188,844	189,782	201,884	180,133	4,475	.191
Western Areas	527,657	516,790	410,211	407,574	6,692	.192
Western Deep Levels	1,204,613	1,196,009	1,102,647	1,261,053	7,357	.561

See footnotes at end of table.

TABLE 5—Continued

REPUBLIC OF SOUTH AFRICA: GOLD PRODUCTION AND ORE RESERVES, BY PRODUCER

Producer	Production (troy ounces)				Developed ore	
	1985	1986	1987	1988[p]	Thousand metric tons	Troy ounces per ton
Western Holdings	1,244,062	([1])	([1])	([1])	([1])	([1])
West Rand Consolidated	130,457	125,163	127,458	117,746	4,828	.219
Winkelhaak	445,956	442,419	383,494	379,208	9,270	.283
Witwatersrand Nigel	26,171	40,510	35,169	[e]32,000	NA	NA
Other Producers	687,377	592,146	663,352	740,925	NA	NA
Total or average	**21,565,230**	**20,513,665**	**19,347,500**	**19,939,129**	**263,506**	**.289**

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

[1] Free State Geduld and Western Holdings are included with Freegold, north region, commencing in 1986.

[2] President Brand and President Steyn are included with Freegold, south region, commencing in 1986.

Sources: Chamber of Mines of South Africa. Quarterly Analysis of Working Results, Oct.–Dec. 1985-88; supplements to the Mining Journal (London), 1985-88. Consolidated Murchison Ltd. Annual Reports 1984-88.

iron production. The Pretoria works used only its one remaining blast furnace, as the Corex process obviates the need for coke ovens, sintering plants, and blast furnaces. Because the process allows greater flexibility in feed material, reduces operating costs, and has less environmental impact, it may increase Iscor's competitiveness worldwide. The technique has also been tried for ferromanganese output, but a commercial plant for such use has not been proposed.

Ferroalloys.—Exports of ferrochrome in 1988 were $663 million. Output by four major South African producers was expected to increase by 315,000 tons per year to 1.365 million tons. Chromecorp Technology Corp.'s (CTC) new smelter was to start up 120,000 tons of capacity in December 1989, at a cost of $29 million, and CTC may add a third furnace to produce another 60,000 tons per year. In addition, 120,000 tons would be added by Tubatse Ferrochrome (Pty.) Ltd. and 25,000 tons by MSA. Consolidated Metallurgical Industries (CMI) produced 150,000 tons per year and expected an initial expansion of 10,000 tons, with 40,000 tons to be added upon completion of its third furnace at yearend 1989. CTC's plant was supplied by the company's Chroombronne Mine; charge chrome output was exported mainly to the Federal Republic of Germany, France, Italy, Spain, and North America.

Samancor (Pty.) Ltd. estimated that demand for ferrochromium was 20% greater than installed capacity. Its 300,000-ton-per-year Ferrometals (Pty.) Ltd. plant and its 150,000-ton-per-year Tubatse Ferrochrome (Pty.) Ltd. plant operated at full capacity supplying long-term contracts for stainless steel producers. Samancor was to sell its ferrochrome through Strategic Minerals Corp. rather than through its own marketing unit Metals & Minerals Ltd. Metals & Minerals Ltd. was to change its name to Metals and Minerals Corp. and specialize in marketing manganese. Samancor and Gencor, the latter owning 50% of Samancor, agreed to rationalize their interests effective July 1, 1989. Samancor was to acquire Gencor's 51% interest in Tubatse Ferrochrome (Pty.) Ltd. and its 49% interest in the Cromore Mine, making them wholly owned subsidiaries. Samancor has had management responsibilities for both companies.

MSA was increasing the rating of its ferrochromium plasma-arc furnace at Krugersdorp from 16 megavolt amperes to 40 megavolt amperes at a cost of $13.3 million. An additional 30,000 tons per year of ferrochromium can be produced with the change. MSA also was proceeding with construction of a chromium direct-reduction (CDR) plant using technology developed by itself and Krupp Industrietechnik of the Federal Republic of Germany. The CDR plant would have a capacity of 120,000 tons per year, reduce electricity consumption by 75%, use low-grade coals, and give higher chromium recovery. It was expected to be operational by May 1990. The ferrochrome produced will be hot charged to MSA's stainless steel facility. Currently 260,000 tons of MSA's annual capacity of 280,000 tons of charge chrome was by submerged-arc technology. Completion of both projects would result in a total ferrochrome capacity of 400,000 tons per year for MSA.

Iron Ore.—The Vanderbijl pit was commissioned at the Thabazimbi Mine to replace the Donkerpoort pit, which was depleted of ore. The Thabazimbi Mine was operated at its full capacity of 2 million tons per year.

Magnetite concentrate output by PMC was 55,556 tons grading 64.6% iron and 2.05% titanium dioxide, and sales were 96,440 tons.

Manganese.—Samancor completed construction of its sinter plant near the Mamatwan Mine, with a capacity of 500,000 tons per year. About 100,000 tons was available for export; the remainder was for use primarily at the company's Meyerton ferroalloys plant. Standard-grade sinter containing 44% manganese is produced. A high-grade sinter containing 50.6% manganese was to be produced upon completion of a heavy-medium separation plant, scheduled for September 1989. Shipments to the Meyerton plant commenced in October. Ore for the sinter plant was from the Mamatwan Mine and contained about 38% manganese.

Nickel.—PMC's nickel sulfate refining plant produced 403 tons of refined nickel hexahydrate as a byproduct of copper output, compared with 411 tons in 1987.

Platinum-Group Metals (PGM).—Five new mines were being developed, and expansion was underway by the existing three primary PGM producers on the Bushveld Complex. By 1993, total output could be increased by 750,000 troy ounces of platinum per year. Most production would be from the Merensky Reef; however, Upper Group 2 (UG2) chromitite ore output, which in 1988 accounted for about 7.5% of total PGM production, was projected to account for about 18% by 1992 and 25% by 1996. Its exploitation was expected to provide higher quantities of rhodium for catalytic converters to meet the growing demand of American, European, and Japanese automobile environmental regulatory legislation.

Rand Mines took 72.6% control of Lefkochrysos Platinum Ltd.'s Lefkochrysos Mine near Brits for $221 million owing to cost overruns, which were 30% above the original $135 million estimate, and the weakened financial condition of Golden Dumps Pty. Ltd., which managed Lefkochrysos. BRL controlled two PGM deposits under development on the Bushveld Complex through Barplats Investment Ltd. BRL planned to restrict work at Rhodium Reefs and concentrate on completion of development at Lefkochrysos. Initial output was scheduled for May 1989, at 160,000 tons to 180,000 tons of ore per month mill throughput. Infrastructure was nearly completed, as was the base metal refinery near Brakpan. All marketing of Lefkochrysos production would be by Rand Mines. Rhodium Reefs was to be developed at 160,000 tons of ore per month by 1992, initially from De Goedeverwachting farm, which has shallower reserves than Kennedy's Vale. The De Goedeverwachting farm, southeast of Steelpoort, was acquired from Lebowa, which had reacquired it from Rustenburg Platinum Mines.

Keeley Group Holdings Ltd. acquired a controlling interest in Bafokeng Minerals Ltd., which has mineral rights in South Africa. The Bafokeng facility is adjacent to land mined by Impala platinum in Bophuthatswana. About $1.3 million was to be spent by Keeley on exploration of the Merensky Reef, at about 900 meters depth in "the deeps."

Rustenburg Platinum Mines neared completion of its $111 million Bophuthatswana Precious Metals Refinery in Bophuthatswana. It would replace both the Royston Refinery, which produced about 600,000 troy ounces of platinum per year in the United Kingdom, and the Wadeville refinery at Germiston, South Africa. Transportation costs were predicted to be lower, turnaround time from smelting to refining would be greatly reduced, and security would be improved.

Impala Platinum Holdings Ltd. (Implats) reported that, for the year that ended June 30, 1988, turnover was $703 million, and the costs of goods and services was $202 million. Total wages and salaries paid to a labor force of 50,000 were $232.3 million, of which 89% was earned by workers from Bophuthatswana. Total taxes and lease payments in the same period were $137.9 million, of which Bophuthatswana accounted for 79%; the Republic of South Africa, 20%; and the United Kingdom, 1%. Legal proceedings were underway with the Bafokeng Tribe, holder of the mineral rights on land on which Impala mined in Bophuthatswana, regarding disagreement over compensation for the right to mine on tribal territory.

Implats wholly owned Gazelle Platinum Ltd. continued development of the Karee Mine. Minable reserves at the Karee Mine, as determined from 55 drill holes, were 130 million tons for the Merensky Reef and 180 million tons for the UG2 reef. Both ore horizons outcropped over a strike length of 6.6 kilometers between the operating mines of Western Platinum Ltd. and RPM, dipping north at about 10°. Trackless mining methods were being employed using a decline ramp in the Merensky Reef. Initial output was scheduled for 1990 at 100,000 troy ounces of platinum per year.

Following an offer made in April 1988, Implats indicated that it had made progress in acquiring 55% of Messina Ltd. Acquisition was subject to the outcome of negotiations underway by Messina with the Lebowa Government, as Messina's new PGM site lies within its jurisdiction. Messina was sinking two ventilation shafts for the extraction of bulk samples from the Merensky reef and the UG2 reef. Trial mining would also be conducted from these shafts. Messina completed 13 drill holes with intersections in the Merensky and UG2 reefs, 3 of which occurred at over 1,000 meters depth. Reserves calculated to 950 meters in the Merensky reef were 26 million tons grading 0.190 troy ounce per ton of PGM and gold; reserves in the UG2 reef were 33.8 million tons grading 0.214 troy ounce per ton combined PGM and gold. Mine production capacity was planned at 60,000 tons per month of Merensky reef ore and 100,000 tons per month of UG2 ore. Capital expenditures were $1.9 million in 1988, and total expenditures to date were $3.7 million. About 5,000 troy ounces per year were extracted from the site during test mining. Output was expected to start in 1990 at a rate of about 30,000 troy ounces per year.

Rare Earths.—The Phosphate Development Corp.'s (Foskor) plant produced an apatite concentrate containing 0.5% rare-earth oxides. About 20% of this accumulates in the sludge at a concentration of 2% to 7% total rare-earth oxides and may be recoverable. Tests to leach yttrium from the heavy fraction were conducted, and yttrium with a purity of 98.7% was achieved after separation of dysprosium, holmium, and erbium.

Tin.—Zaaiplaats Mining Co., formerly Zaaiplaats Tin, announced a rights offer to raise $3.3 million for financing a new tailings plant and a smelting facility at the Zaaiplaats Mine.

Output by Rooiberg Tin Ltd., a GFSA subsidiary, was 1,257 tons of metal from concentrates. Ore production, mainly from the Leeuwpoort C Mine, was 324,596 tons, and ore feed to the crushers was 292,900 tons grading 0.52% tin. Following heavy-medium separation, ore feed to the mill was 66,414 tons grading 2.09% tin. The gravity plant recovered 1,874 tons of concentrate grading 56.7% tin. A total of 17,439 tons of slimes grading 0.4% ton was retreated. Recovery from smelter slag was only 62 tons, as the slag stockpile was exhausted, and only newly generated slag was being retreated. Total working expenditures were $9.2 million, or $28.61 per ton of ore mined, which was spent as follows: labor, $15.58 per ton; electricity, $2.98 per ton; supplies, $8.14 per ton; and other, $1.91 per ton. Rooiberg's total labor force at yearend was 1,190 workers.

Union Tin Mine Ltd., also a GFSA subsidiary, which ceased operation in 1986 owing to low metal prices, commenced the sale of its assets and completed the sale of its gravity plant and power generators. The company maintained ownership of mineral rights on the Doornhoek and Welgevonden farms.

Titanium.—Rhombus Mining and Exploration Ltd. announced a call for bids for the construction of facilities to produce annually 300,000 tons of ilmenite, 25,000 tons of rutile, and 30,000 tons of zircon from beach sands. Output would be as concentrates from coastal deposits in the Transkei, 75 kilometers north of East London. Mining would be by floating dredgers followed by gravity concentration at the rate of 1,000 tons of sand per hour, or 7 million tons of sand per year. Estimated resources were 250 million tons of heavy-mineral sands grading 5% ilmenite, 0.4% rutile, and 0.6% zircon.

Another deposit, the location of which was not revealed but which contained 25 million tons of titaniferous sands, was under investigation for development; the deposit was purchased from an Australian company.

Vanadium.—Increased demand for vanadium drove prices up and a shortfall from South Africa was experienced, because users bought more costly material elsewhere to meet needs. These buyers were expected to resume buying from South African sources when the market slowed.

The Republic of South Africa was the world's leading producer of vanadium. High demand for vanadium in high-strength low-alloy steels has led to expansion plans by Hiveld, and several new producers were planning to start up production facilities. Hiveld operated at full capacity in 1988 and planned to spend $73.9 million on capacity increases for vanadium and other products. Construction of a new rotary kiln was planned at Hiveld's Vantra Div., which would increase the units' vanadium pentoxide production capacity to 7,650 tons per year from 5,850 tons per year. Total output by Hiveld was 22,500 tons of contained vanadium pentoxide in both flake form and vanadiferous slag. Despite heavy demand, pricing by Hiveld was restrained to improve the competitiveness of vanadium steels. Profits by Hiveld were $53.7 million, compared with $27.9 million in 1987.

Three other producers in South Africa were Transvaal Alloys Pty. Ltd., Vametco Minerals Corp., and Vanadium South Africa Ltd. (Vansa). Vansa commenced production in August with a capacity of 3,000 tons of vanadium pentoxide per year. About 18% of output was sold on the spot market. Total capacity was expected to increase by yearend 1990 to 3,600 tons vanadium pentoxide. Proven ore reserves at Vansa were 2.9 million tons averaging 1.9% vanadium pentoxide, with an additional 1.4 million tons averaging 0.9% vanadium pentoxide. Employment was 300 workers, including 30 in mining, 200 at the recovery plant, and 70 for administration and services.

Rhombus Mining Pty. Ltd., through its newly created subsidiary Rhombus Explorations Ltd. (Rhoex), was expected to develop vanadiferous magnetite resources near Brits, on the Lospersfontein, Waaikraal, and Berseba farms, in Bophuthatswana. Initial output from the deposit, which is in the Bushveld Complex, would be 250,000 tons per year of ore, commencing in July 1990. Rhoex's 70% subsidiary, Rhombus Vanadium Holdings Ltd. (Rhovan), will control the operation. Other participants include Union Steel Corp., a subsidiary of Iscor, which will receive the ore for processing to vanadium flake, and Rhombus Mining. Vanadium pentoxide flake capacity would be 9,000 tons per year, and capital cost would be $9.7 million. Output, under long-term contract, was to go to Union Steel, which would utilize facilities at Vereeniging and add additional equipment valued at $8.8 million to produce flake.

Severin Mining and Development Co. Ltd. (Sevmin) was considerating the listing of a vanadium project on the Johannesburg Stock Exchange. Sevmin secured a long-term supply contract with a European company and planned to produce 1,500 tons per year of vanadium pentoxide from a deposit northwest of Brits. Exploration, including drilling, and process design have been completed.

Zinc.—Output of zinc metal by Zincor, a subsidiary of GFSA, was 84,257 tons, down from 1987 owing to poor acid plant performance, a 3-week labor strike in October, and interruptions in concentrate shipments and electricity. About 1,000 tons was imported to meet demand for high grade zinc. Zincor received a total of 191,333 tons of raw feed material containing 100,191 tons of zinc. The high loss of zinc in sulfides in the filtrate from the magnesium preleach plant was being rectified. Total cost of production was $1,092 per ton, spent as follows: wages and salaries, $28.35 per ton; raw materials, $830 per ton; electricity, $122 per ton; water, $4.34 per ton; supplies, $37.22 per ton; maintenance costs, $45.36 per ton, and service costs, $25.62 per ton. Sulfuric acid was produced as a byproduct, and cobalt and copper sulfate may also be recovered. According to Zincor, consumption of zinc in South Africa was as follows: galvanizing, 71.6%; copper zinc alloy, 8.2%; zinc aluminum alloy, 4.7%; fabricated zinc, 5.6%; zinc dust, 3.1%; and batteries, 6.8%.

Shell South Africa (Pty.) Ltd.'s Pering Mine milled 1.13 million tons of ore grading 3.7% zinc and 0.7% lead. Higher recovery from the ore ensued with lower mill throughput, owing to a reduction of oxidized ore treated. Output was 36,000 tons of zinc in concentrate, most of which was sold to Zincor. Output of lead concentrate containing 6,000 tons of metal was sold to Tsumeb Corp. Ltd. in Namibia. Comparable data for 1987 were 1.14 million tons of ore milled grading 3.4% zinc and 0.6% lead, which yielded 31,000 tons of zinc in concentrate and 5,000 tons of lead in concentrate.

Zirconium.—Very high world demand for zircon resulted in nearly a threefold increase in prices and was an incentive to increase production facilities at Richards Bay. The shortfall in world production was estimated to be 50,000 tons. Exploration was underway for additional deposits, and Mintek was testing beneficiation requirements for beach sands from several areas. Mineralogical characteristics were varied within the same deposit because of mixed sources for the zircon; zircon exposed to radiation or containing thorium was limited in use because of radiation limits.

Output of baddeleyite from the Palaborwa Carbonatite Complex was about 24,000 tons per year, of which about 15,000 tons was for electronics, refractories, and ceramics. About 3,000 tons was for ceramic pigment manufacture, and 2,000 tons was for production of acid-zirconium-sulfate-tetrahydrate (AZST) output, which was used in tanning, zirconium chemicals, and dialysis.

In 1988, PMC processed a record 13,017 tons of baddeleyite into chemicals, mainly owing to improved separation of copper from the heavy-minerals concentrates using a copper flotation cell and a new concentration table. AZST output was 1,781 tons compared with 1,530 in 1987. Output of zirconium oxide for ceramic coloring was 786 tons. Sales of zirconia products by PMC in 1988 were 14,206 tons, valued at $17.5 million.

AAC had a feasibility study underway to extract heavy minerals from sand deposits in Namaqualand, Cape Province, 50 kilometers north of the Olifants River and within 15 kilometers of the coast. The study was due for completion in 1990 and projected a production of 100,000 tons per year of zircon. Annual output would also include 25,000 tons rutile, 1,000 tons of monazite, and ilmenite, which was expected to commence in early 1992. A wet concentration pilot plant was in operation at the site, with most of the resources located on farms owned by De Beers.

The Atomic Energy Corp. of South Africa Ltd. (AEC) was the sole producer of zirconium metal and zirconium alloys in South Africa. About 7.5 tons of Zircaloy-4 alloy in ingots was produced.

Industrial Minerals

Abrasives.—The Electricity Supply Commission (Escom) introduced cast basalt in place of alumina as the lining material at the inner bend in pipes used for transferring pulverized coal from the mill to the furnaces of its powerplants. Pulverized coal is blown through 718-millimeter-diameter steel pipes to burners at 25 tons per hour and 20 meters per second. The $1.3 million retrofit at the Kendal power station resulted in annual savings of $265,000.

Andalusite.—Total reserves of andalusite were 50.5 million tons, primarily in the Bushveld Complex where it is found in metamorphosed shales of the Strubenskop Formation near Zeerust, the weathered shales of the Timeball Hill Formation at Thabazimbi, and the hornfels and schists of the eastern Transvaal near Penge, all of the Pretoria Group. Six mines were operational, including the Annesley Mine of Annesley Andalusite (Pty.) Ltd., the Krugerspost Mine of Cullinan Refractories (Pty.) Ltd., and the Timeball Hill Mine of Weedon Corp. Considerable variation in quality occurs, necessitating customized modifications of recovery processes to obtain market acceptable material. Concentrate grades averaging almost 60% alumina have been obtained using processes developed by Mintek. Export destinations of 117,622 tons sold in 1987, the latest year available, were as follows: Western Europe, 56%; Asia, 22%; North America, 18%; Central and South America, 2%; and Oceania, 2%. Zaaiplaats Mining Co. acquired 50.04% of the capital and loan account of Annesley Andalusite (Pty.) Ltd. Zaaiplaats intended to modify the plant at Annesley and provide additional facilities to increase production.

Asbestos.—Gencor sold Griqualand Exploration and Finance Co. (Pty.)

Ltd. (Gefco), to Hanova Mining, a consortium of executives of Gefco. Hanova acquired 60% of Gefco from Gencor, including that portion of Msauli Asbes Beperk that Gencor sold to Gefco.

Cement.—The South African Cement Producers Association consisted of Anglo Alpha Ltd., Blue Circle Ltd., Natal Portland Cement Co. (Pty.) Ltd., and the Pretoria Portland Cement Co. Ltd. (PPC). Sales were 8.4 million tons, including about 21,000 tons exported to St. Helena, the Comoros, Zimbabwe, and other neighboring countries. Clinker was also shipped to Mozambique. Installed cement production capacity was 12.4 million tons from 28 kilns, of which 21 were dry process kilns. Raw materials consumption in 1988 consisted of 11.6 million tons of limestone, 333,000 tons of gypsum, 444,000 tons of fly ash, and 1.2 million tons of coal. Electricity consumption was 958 million kilowatt hours. Cement Distributors (Pty.) Ltd., owned by the cement producers, acted as a specialized distribution company for shipment of cement by railroad. Of total cement shipped, 73% was by road and 27% by railroad.

Holderbank Corp. of Switzerland was the majority shareholder of Anglo-Alpha Ltd., with 46% of total shares; Anglovaal Ltd. held about 6.5%. Anglo-Alpha Ltd.'s product line included cement, stone aggregates, building sand, lime, limestone products, and ready-mixed cement, which was distributed through 42 production and distribution centers. The cement division's operating income in 1987, the latest year available, was $30 million, with net assets of $330 million. Cement production capacity was 3.6 million tons, and actual output was 2.2 million tons from plants at Dudfield, near Lichtenburg; at Roodepoort, on the west Rand; and at Ulco, in the northwestern Cape. Anglo-Alpha Ltd. began utilization of granulated blast furnace slag from Iscor in a blended cement product. It also expected to use ash from electric power utilities in its cement products. A 15,000-ton-per-year condensed silica fume densification plant was built to handle unmanageable silica fume, which was used as a superpozzolan for very high strength concretes.

Pretoria Portland Cement Co. had a production capacity of 5.220 million tons and sales of 3.237 million tons, indicating a plant utilization of 59%. PPC consumed about 140,000 tons of blast furnace slag and fly ash from the country's steel and electric power industries. The company, which was about 62% controlled by BRL, had seven cement plants, seven limestone quarries, and one gypsum quarry. PPC's synthetic gypsum plant supplied the requirements of the company's Hercules and Jupiter cement plants in the Pretoria-Johannesburg area. A pilot plant to test a more cost-effective process for the plant was built, and test results were under evaluation. The Slurry Cement Plant in western Transvaal supplied Botswana and Bophuthatswana. PPC owned 50% of Namib Portland Cement Ltd., with a facility at Windhoek, Namibia; 33% of Slagment (Pty.) Ltd.; and 25% of Ash Resources (Pty.) Ltd. Total labor force at the cement plants was 1,818 and at the quarries 402.

Diamond.—The Rembrandt Group, through Trans Hex Group Ltd., continued to develop diamond deposits on the coast of Cape Province and along the Orange River. Heavy overburden was encountered at its Hondeklip Bay operation, resulting in higher costs during a period of lower sales for small gem stones. A third heavy-medium separation plant was inaugurated at the Baken section of its Orange River plant.

Demand for diamond continued to be strong, and De Beers Central Selling Organization, the largest diamond marketing agency in the world, reported record sales.

De Beers Consolidated Mines Ltd. had lower production because of technical problems and abnormally heavy rains. At the De Beers Mine, ore reserves in the sublevel caving area were depleted, and production was started from the vertical crater retreat mining system imported from Canada. Output was 69,135 carats from 348,000 tons of treated ore yielding 19.9 carats per 100 tons. Sublevel caving and block caving at the Dutoitspan Mine yielded 115,825 carats from 773,000 tons of treated ore grading 15 carats per 100 tons. The Bultfontein Mine produced 226,078 carats from 654,000 tons of treated ore, yielding 34.6 carats per 100 tons. A shaft that served both the Bultfontein and Dutoitspan Mines for handling ore below the 760-meter level was completed. Mining at the Wesselton Mine moved below the 904-meter level, and work was underway to develop a haulage system at the 995-meter level. Output was 276,239 carats from 1.3 million tons of treated ore, yielding 21.5 carats per 100 tons. The dump retreatment section at Wesselton produced 256,129 carats from 1.4 million tons of treated ore, yielding 18.2 carats per 100 tons. Output at the recommissioned Koffiefontein Mine began in July 1988, with production for the year of 23,722 carats from 90,000 tons of underground ore and 354,000 tons of surface ore, yielding 5.3 carats per 100 tons. Recommissioning was adversely affected by heavy rains, which flooded the No. 2 shaft and damaged underground installations. Full production from the low-grade mine was expected by the second quarter of 1989.

Flooding also affected the open pit Finsch Mine, De Beers' largest producer, where output was 3,919,662 carats from 4.9 million tons of treated ore, yielding 80.2 carats per 100 tons. Mining underground was to entirely replace open pit mining by 1990. Two of eight major rock passes with conveying systems were completed on 65 level, allowing the development rate of the underground workings to double.

De Beers' Namaqualand mines produced a total of 951,993 carats from 6.0 million tons of treated ore, yielding 15.9 carats per 100 tons. A total of 22.4

million tons of overburden was stripped, compared with 23.6 million tons in 1987. At the Buffels inland complex in Namaqualand, reserves at the Langhoogte Mine were exhausted, and output commenced at Nuttabooi.

Output at the Premier Mine was 2,239,286 carats from 7.7 million tons of treated ore, yielding 29.1 carats per 100 tons. Ore dilution was experienced from both the sidewall and the gabbro sill, and ground support difficulty again occurred below the sill. Work was in progress on the construction of the No. 3 winze conveyor system and on ground and water handling systems on the 763-meter level. Improved recovery technology at the Premier Mine for diamond liberation and for the reduction of diamond breakage occurred with the installation of recrush interparticle crushers. Problems were experienced with excessive wear rates on the roll surfaces of the crushers.

A $4.4 million feasibility study continued by De Beers on development of the Venetia ore body near Alldays in northern Transvaal Province. Discussions were held with the Government regarding fiscal and operational consideration for the mine. If developed, capital expenditures would exceed $354 million for treatment of 3.3 million tons of ore per year over 20 years. Total output would be over 4 million carats of medium-quality diamonds.

Channel Mining Investments Ltd. announced the sale of its diamond-mining interests to a consortium of foreign investors for $7.3 million. Channel was to continue as manager and administrator for the Helam Mine, a narrow, near-vertical kimberlite on the Nooitgedacht farm in the Swartruggens district.

The Government-managed alluvial diggings at Alexander Bay have been in existence for 60 years and employed nearly 2,000 people in 1988. The operation is a significant contributor to Namaqualand's economy. Overburden removal was 3.9 million cubic meters. A total of 1.1 million cubic meters of diamond bearing gravel were mined, yielding 113,082 carats, or 10.5 carats per cubic meter. Seabed recovery in concession area 1 was adversely affected by flood waters from the Orange River, and visibility improved only starting in August. Average stone size was 0.38 carat, and 15.5% of the diamonds were larger than 1 carat. The largest stone recovered was 37.2 carats.

Fertilizers.—Fedmis Corp. ceased sales on September 1, and its facilities were sold to African Explosives and Chemicals Industries (AECI), the South African Coal, Oil, and Gas Corp. Ltd. (Sasol), and Omnia Ltd. AECI acquired the company's ammonia and fertilizer plant at Milnerton, Cape Town; Sasol acquired the nitrogen and phosphate facility at Sasolburg; and Omnia took over Fedmis's share of the ammonia terminal at Richards Bay. Sasol may eliminate some fertilizer production capacity in its portion of the Fedmis assets, which included a calcined ammonium nitrate (CAN) plant with capacity of 75,000 tons per year contained nitrogen, a 124,000-ton-per-year blending unit, a nitric acid plant with a capacity of 173,000 tons per year contained nitrogen, and a single superphosphate (SSP) and triple superphosphate (TSP) unit. The CAN, SSP, and TSP units may be closed.

Granite.—Kudu Granite (Pty.) Ltd. completely electrified quarrying operations at Marikana and commenced

TABLE 6

REPUBLIC OF SOUTH AFRICA: MARKETED DIAMOND OUTPUT, BY PROVINCE

Province	1986		1987		1988	
	Output (carats)	Price per carat	Output (carats)	Price per carat	Output (carats)	Price per carat
Mine diamond:						
Transvaal	2,884,380	$24.07	2,491,283	NA	2,248,709	NA
Cape Province	6,077,429	34.84	5,172,524	NA	4,925,109	NA
Orange Free State	31,929	94.67	22,204	NA	43,994	NA
Total [1]	**8,993,738**	**31.60**	**7,686,011**	**NA**	**7,217,812**	**NA**
Alluvial diamond:						
Transvaal	47,422	178.71	36,411	NA	36,010	NA
Cape Province	1,186,042	122.04	1,327,441	NA	1,179,598	NA
Orange Free State	2,130	500.15	992	NA	571	NA
Total [1]	**1,235,593**	**42.87**	**1,364,844**	**NA**	**1,216,178**	**NA**
Grand total [1]	**10,229,331**	**124.87**	**9,050,855**	**NA**	**8,504,016**	**NA**

[p] Preliminary. NA Not available.
[1] Data may not add to totals shown because of independent rounding.

Source: Minerals Bureau, Mineral Production and Sales Statistics, 1986, 1987, and 1988. R1 = $0.4408 for 1986.

opening two new quarries to supply increased demand, primarily from Europe. Environment and conservation measures were taken regarding blasting procedures, and waste rock disposal was designed to minimize surface disturbance and to enhance growth of indigenous plant species to reclaim the area for cattle.

Aurora Granite (Pty.) Ltd. had two black granite quarries in the Belfast and Groblersdat districts, and was the fourth granite producer to be listed on the Johannesburg Stock Exchange since 1987. Black granite is a commercial term for norite. On the Kwaggaskop farm, Aurora had three quarries developed with a production capacity of 500 cubic meters per month of salable product, at $1,000 to $1,400 per cubic meter. Exceptionally high-quality black granite was to be mined on the Rooikraal farm at a rate of 2,000 cubic meters per month. Recovery would be between 3% and 7%, but price would be $1,200 to $1,700 per cubic meter.

Gypsum.—Rhino Gypsum Industries (Pty.) Ltd. produced gypsum grading 84% calcium sulfate using a Wirtgen continuous surface miner, made in the Federal Republic of Germany. The surface miner was rated to loosen, crush, and load 80 tons per hour, although levels of up to 220 tons per hour have been achieved. The continuous surface miner cuts to a depth of 150 millimeters, allows grade flexibility owing to its high mobility, and had low operating cost.

Lime.—PPC Lime Ltd., 100% owned by PPC, was the major producer of lime and limestone products in the Republic of South Africa. The plant, located at Lime Acres in northern Cape Province, had 9 kilns and an annual production capacity of 2.1 million tons of lime. The labor force was 732. Operations were disrupted in late February by flooding caused by an abnormal rainfall of 25 inches over a 4-day period.

Marble.—A marble quarry at Vredendal in Cape Province was to reopen after the purchase of the mineral rights on the Moedverloren farm. Most production would be exported owing to high world demand and the shortage of quality marble. Onyx was also found at the site.

Serpentine.—Samancor completed rehabilitation of its Honingklip serpentine mine, 15 kilometers north of Krugersdorp, which was closed in 1986. Rehabilitation included contouring, revegetation, and irrigation, all at a cost of $200,000.

Soda Ash.—Soda ash consumption in South Africa is about 260,000 tons per year, of which 40% is for glass manufacture, 25% for metallurgical applications, and 20% for the paper industry.

AECI dropped its plans for the manufacture of sodium carbonate in South Africa and decided, in a joint venture with AAC and the Botswana Government, to develop the Sua Pan deposit in Botswana. AAC and AECI combined hold 52% and the Botswana Government the remainder of the $407 million project. Output was to be 300,000 tons per year of soda ash and 650,000 tons per year of salt, with most of the soda ash to be consumed in South Africa.

Sulfur.—Sales of sulfuric acid by PMC were 98,019 tons in 1988.

Vermiculite.—Output of vermiculite concentrate by PMC from 1.4 million tons of treated ore and 414,652 tons of reclaimed tailings was 203,101 tons, grading 88.5% vermiculite. Sales of vermiculite and vermiculite products were 196,104 tons valued at $37.7 million in 1988. Market demand for micron-size vermiculite declined, while superfine-size output increased.

Mineral Fuels

South Africa, Mozambique, and Portugal considered joint efforts to reactivate the Cahora Bassa hydroelectric plant and powerline to South Africa. Completed in 1977, the line provided 10% of South Africa's electricity needs and foreign exchange for Mozambique. Contracts for electricity were terminated in 1983 owing to intermittent supply caused by damage from warring parties.

Escom's announcement of the closure of older electric generating plants was likely to negatively affect coal output by Amcoal Corp., Trans-Natal Coal Corp., GFSA, and BRL. Because of the decline in overall economic activity, Escom has 10% excess capacity for electricity generation, and was reducing its labor force. By 1990, the total employment was expected to be about 51,000. Shutdown of the excess capacity would save about $287 million over a 5-year period.

Total electricity available for distribution was 140,802 gigawatt-hours (GWH) from 156,738 GWH produced. Purchases of electricity from outside entities were 370 GWH, and sales to outside entities were 4,062 GWH.

Coal.—Despite the ban on imports of coal by Denmark, the Netherlands, and the United States, coal exports by South Africa were close to the maximum that could be moved through the Richards Bay terminal. Most new growth has been in the Far East, as exemplified by Taiwan's purchase of 0.6 million ton with the option for an equivalent amount. Reasons for the high level of exports were quality, reliability, competitive pricing, and consistent good service. About 2 million tons may also be shipped from Durban and the Mozambique port of Maputo.

Total coal exports in 1987, the latest year for which a breakdown is available, were over 42.4 million tons, which was exported as follows: Europe received 48%; Japan, 18%; Republic of Korea, 14%; Hong Kong, 6%; Taiwan, 6%; and Israel, 5%. Trans-Natal Coal Corp.'s largest market was Japan. An export ceiling was placed on coal exports to Japan by the Japanese, effectively cutting Trans-Natal's export volume by 20%. The ceiling is based on the value of the landed coal in Japan. Increases in price for coal resulted in a cut in the export volume permitted to Japan.

Anglo-Alpha Ltd., in a 50-50 joint venture with Anglovaal Ltd., commenced production at the Klipspruit Mine near Newcastle in Natal. The underground mine has yet to reach the planned 350,000-ton-per-year output level owing to unspecified problems.

Sasol announced plans to spend $398 million over the next 4 years, including $221 million for a new coal mine in the Secunda area and $172 million for the plastics industry. The mine will be both open pit and underground, supplying a total of about 7 million tons per year of coal. Sasol produced about 35 million tons per year, or 27% of total output. The Secunda underground mine complex consisted of the Twistdraai, Branddspruit, Bosjesspruit, and Middelbult underground mines, and the Sigma colliery at Sasolburg, and reportedly was the largest underground coal mining complex in the world.

Output of 4,000 tons per week of high-quality coking coal at the Tshikondeni Mine in Venda by Iscor was to be increased to 14,000 tons per week by 1991. Iscor was proceeding with the expansion based on the construction of a 123-kilometer-long railroad to the siding at Huntleigh. Transport is currently done by 30-ton trucks. Diesel-powered generators supply the mines' full electrical requirements. The main seam averages 3.25 meters thick in the southwestern area and 2.65 meters thick in the northwestern area. Ash content is 16%.

Petroleum.—A waste product from the Sasol process has been successfully used as a fuel for local shipping and was in demand from foreign carriers with engines rated at over 2,000 horsepower. The product, WO 20, was desirable because of its low cost, and its use resulted in clean exhausts and low-carbon buildup.

Uranium.—Low uranium prices and embargoes by the United States and Japan on the purchase of uranium produced in South Africa have resulted in the shutdown of many uranium recovery plants, where output was nearly all as a byproduct or coproduct of gold. The Chemwes, Driefontein, Harmony, and Randfontein uranium recovery plants all closed in 1988. The Nuclear Fuels Corp. of South Africa (Pty.) Ltd. (Nufcor) reported that the 10-year forward production forecast was 82 million pounds, compared with 124 million pounds prior to the embargo. The 10-year forward contracts for sales of uranium totaled 38 million pounds, compared with 107 million pounds prior to the embargo. South African derived uranium supplied about 11% of Japanese imports, mainly through the United States which processed material imported from Nufcor.

The AEC provided the first four locally manufactured fuel elements to Escom's Koeberg Powerplant; uranium for the fuel elements was enriched at Valindaba from locally produced uranium. Production from the semicommercial enrichment plant at Valindaba was sufficient to supply Koeberg's fuel requirements. Output of UF_4 was 450 tons and of UF_6 425 tons.

In situ leaching of uranium deposits in the Karoo sandstones was believed possible using oxygen and carbon dioxide dissolved in pressurized water. Although nearly all output was derived as a byproduct or coproduct of gold mining from the Witwatersrand, feasibility of the method would expand reserves and provide an additional production source not dependent on deep level shafts. Mineralized zones in the Karoo are discontinuous, extend a few meters, and have a maximum thickness of 7 meters. Coffinite is the main uranium mineral, with associated arsenic, cobalt, lead, manganese, molybdenum, phosphorus, vanadium, and zinc. Grades vary from trace amounts to more than 20 kilograms of uranium oxide per ton. Average grade is 1 kilogram of uranium oxide per ton over a 1-meter width. Resources were 536,000 tons of uranium based on production costs of less than $130 per kilogram.

Production by PMC of calcined uranium oxide was 87.5 tons, well below the previous year's 176 tons owing to lower content in the ore. Sales of uranium concentrate were 289.6 tons, valued at $11.6 million.

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[1] Physical scientist, Division of International Minerals.

[2] Where necessary, values have been converted from South African rands (R) to U.S. dollars at the rate of R2.04=US$1 for 1987 and R2.26=US$1 for 1988.

TABLE 7

REPUBLIC OF SOUTH AFRICA: PRODUCTION OF U_3O_8, BY PRODUCER

(Kilograms)

Company or mine	1984	1985	1986	1987[p]	1988[p]
AAC Joint Metallurgical Scheme[1]	596,787	602,104	529,811	462,786	485,900
Blyvooruitzicht	233,092	—	—	—	—
Buffelsfontein	613,500	713,500	597,000	446,900	429,000
East Rand Gold and Uranium Co. Ltd.	216,131	150,997	155,780	116,516	178,316
Harmony	496,680	426,300	330,243	178,100	158,900
Hartebeestfontein	436,283	428,367	465,059	415,324	368,923
Palabora Copper	159,769	217,828	185,443	176,000	87,496
Randfontein	592,776	609,332	600,498	461,992	220,568
St Helena-Beisa	353,294	—	—	—	—
Vaal Reefs	1,962,977	1,881,828	1,930,044	1,676,817	1,886,333
West Driefontein	159,638	86,705	81,435	72,971	32,556
Western Areas	305,403	311,836	265,211	205,112	201,184
Western Deep Levels	145,632	54,036	—	—	—
Miscellaneous	489,646	268,421	319,745	522,512	533,746
Total	**6,761,608**	**5,751,254**	**5,460,269**	**4,735,030**	**4,582,922**

[p] Preliminary.

[1] Includes recovery of U_3O_8 from concentrates and tailings produced by the Free State Geduld, Free State Saaiplaas, President Brand, President Steyn, Welkom, and Western Holdings Mines, all subsidiaries of Anglo American Corp. Ltd. in the Orange Free State Province.

Sources: Chamber of Mines of South Africa. Quarterly Analysis of Working Results, Oct.–Dec. 1984–88; Department of Mineral and Energy Affairs, Annual Reports 1984–87; East Rand Gold and Uranium Co. Ltd., Annual and Quarterly reports, 1984–88; Minerals Bureau, Mineral Production and Sales Statistics, 1985–88; Palabora Mining Co. Ltd., Annual Reports 1984–88.

THE MINERAL INDUSTRIES OF

SOUTHERN AFRICA

By Lloyd E. Antonides, George A. Morgan, Harold R. Newman, and Hendrik G. van Oss

ANGOLA[1]

The Angolan economy in 1988 was dominated by the production and export of crude oil and by the ongoing civil war. Oil exports accounted for about 95% of the country's foreign exchange earnings. Expenditures related to military activities accounted for 40% of Government revenues and dominated the makeup of the country's imports.

The oil-producing regions of the country were under heavy military protection and consequently were relatively unaffected by the civil war. Crude oil production was at record-high levels during the year, which mitigated the low world oil prices in 1988. Oil exploration and development activities were also at a high level. Interest in exploration offshore southern Angola increased as prospects improved for an agreement, signed at yearend, providing for the withdrawal of foreign troops from the region.

Most mining operations in the country continued to be hampered by the civil war. Efforts, begun in 1986, to resume large-scale mining continued, with the result that production increased dramatically. As Angola has very large reserves of high-quality gem diamonds, it was felt that the country would become a major world producer of diamonds once hostilities ceased.

Preliminary work to rehabilitate the Benguela railroad began toward yearend, but was greatly hampered by the ongoing guerrilla activities. Partial funding for the project by various regional and European countries had been reaffirmed early in the year, but this was mainly for surveying of the railroad and some rehabilitation work at the Port of Lobito. The Government was seeking to join the International Monetary Fund (IMF) to attract World Bank funding for the bulk of the almost $600 million project.

Work continued on the 520-megawatt Capanda dam and hydroelectric project on the Kwanza River in Malange Province. Planned electrical capacity will almost double the country's supply. Construction was by the Brazilian firm Construtora Noberto Odebrecht and was scheduled for completion by yearend 1992, for a total cost of about $1 billion.

Production and Trade

Production of most mineral commodities was estimated to have increased in 1988, although most mining operations continued to be hampered by warfare. Little reliable information was available on the production of many commodities.

Angola was the second largest oil producer in Sub-Saharan Africa after Nigeria. Oil production increased more than 25% to a record level of about 165

TABLE 1

ANGOLA: PRODUCTION OF MINERAL COMMODITIES[1]

Commodity[2]		1984	1985	1986	1987[p]	1988[e]
Asphalt and bitumen, natural[e]	metric tons	25,000	25,000	25,000	25,000	25,000
Cement, hydraulic[e]	thousand metric tons	350	350	350	350	1,000
Diamond:[3]						
Gem[e]	thousand carats	652	464	240	[r]675	950
Industrial stones[e]	do.	250	250	10	[r]75	50
Total	**do.**	**902**	**714**	**250**	**[r]750**	**1,000**
Gas, natural:[e]						
Gross	million cubic feet	[r]85,000	[r]85,000	[r]85,000	[r]97,000	97,000
Marketable	do.	[r]17,500	[r]17,500	[r]17,500	[r]20,000	20,000
Gypsum[e]	metric tons	20,000	20,000	20,000	20,000	20,000
Iron and steel:						
Iron ore[e]	do.	—	—	—	—	22,000
Steel, crude[e]	do.	10,000	10,000	10,000	10,000	10,000
Petroleum:						
Crude	thousand 42-gallon barrels	[r]75,900	89,060	102,930	131,190	165,000
Refinery products[e]	do.	[r]7,300	[r]7,665	[r]9,855	[r]9,490	[e]10,000
Salt[e]	metric tons	50,000	[r]50,000	[r]55,000	[r]60,000	70,000

[e]Estimated. [p]Preliminary. [r]Revised.
[1]Table includes data available through Nov. 16, 1989.
[2]In addition to the commodities listed, a variety of crude construction materials (clays, sand and gravel, and broken stone) presumably is produced for local consumption, but information is inadequate to make reliable estimates of output levels.
[3]Does not include smuggled artisanal production.

million barrels. Because of low world oil prices, revenues from oil exports were about the same as in 1987, or about $2.1 billion.

Diamond production increased by one-third to an estimated 1 million carats, not counting unrecorded artisanal production. Revenues from official sales were an estimated $180 million.

Salt production increased significantly, largely owing to rehabilitation of state-owned saltworks in Namibe Province. Reportedly, production of iron ore resumed at the Kassinga Mine for the first time since 1975. Production was estimated at 22,000 tons. In 1981, open pit reserves at this mine were estimated to be 21.7 million tons grading 44% iron.

The United States continued to be the largest importer of Angolan oil, despite political pressure to reduce this level. In 1988, the United States imported 70.3 million barrels of crude oil from Angola, in addition to 2.8 million barrels of residual fuel oil. These represented 3.8% of total United States petroleum imports.

Angola had about $1 billion per year in bilateral trade with Brazil. It purchased about 25% of Brazil's exports to Africa, largely food, automobiles, farm machinery, and equipment for the Capanda Dam project. Angola exported oil to Brazil, including about 20,000 barrels per day as partial repayment of about $1.1 billion in loans from Brazil. Angola had trade with the Soviet Union worth an estimated $250 million. Imports from the Soviet Union included military hardware and construction material.

Commodity Review

***Industrial Minerals.*—Clays.**—In September, the Ministry of Industry announced that the kaolin deposits in Huila Province would start to be mined toward yearend and that the expected production rate would be 150,000 tons per year.

Diamond.—Official diamond production continued to be through the parastatal Empresa Nacional de Diamantes de Angola (Endiama). Many of the diamonds were mined from the rich Cuango River alluvial deposits by Roan Selection Trust International, under a contract signed with Endiama in late 1986. In July 1987, Endiama signed a contract with Sociedade Portuguesa de Empreendimentos to rehabilitate mining equipment and to prospect for diamonds in the Lucapa zone in Luanda Norte Province. Several untapped diamondiferous kimberlites are known to exist in this region, of which three are reportedly very large. It was estimated that production from Lucapa could eventually boost the value of Angola's diamond production to between $500 million and $1 billion. Diamond sales have been through private channels ever since Angola ended its contract with De Beers' Central Selling Organization (CSO) in 1986. However, preliminary negotiations were underway with De Beers for the company to finance and develop the Lucapa area kimberlites. Because of the considerable costs projected for development, it was considered likely that the sales contract with the CSO would eventually be renewed.

Production estimate of about 1 million carats in 1988, reported by Endiama, did not include unrecorded artisanal production. Reliable estimates of the latter were not available, but the production was believed to be large. It was widely believed that opposition forces in the civil war were financing at least part of their efforts through the sale of such diamonds.

Salt.—Little information has been available in recent years on Angolan salt production and that only for production from Namibe Province. Traditionally, salt has also been produced in Benguela and Zaire Provinces.

Namibe Province has six saltworks, of which three were in the municipality of Tomwa, two in Namibe, and one in Bentiaba. Five of these saltworks, accounting for 80% of the production, were state-owned. Production from Namibe Province in 1986 slightly exceeded the record-high pre-Independence production of 23,000 tons. Production was 32,000 tons in 1987 and an estimated 36,000 tons in 1988. It was estimated that the Province exported 12,000 tons of salt in 1988. The increase in production was credited to a continuing program of rehabilitation of the saltworks and retraining of the salt workers. The Italian Government was reportedly contributing $3.5 million to this program.

Mineral Fuels.—Angola was not a member of the Organization of Petroleum Exporting Countries and hence was not subject to its production constraints. Angola produced crude oil at a record average rate of about 452,000 barrels per day in 1988, the sixth consecutive year of increase, and more than three times the rate in 1982. Production continued to increase during the year, with a reported rate in November and December of 456,000 barrels per day. The record production offset the lower world oil prices. Angola's oil production was expected to reach 500,000 to 520,000 barrels per day by yearend 1990.

Virtually all of the country's oil production came from onshore and offshore Cabinda and from offshore blocks Nos. 1 to 3 in the northern part of the country. Cabinda Gulf Oil Co. (Cabgoc), a subsidiary of Chevron Oil Co., was the dominant oil producer with about 58% of the country's production. Other operators in Angola included American companies Conoco Inc., Marathon Oil Co., and Texaco Inc., as well as Société Nationale Elf Aquitaine (Elf) of France, Azienda Generali Italiana Petroli S.p.A. (Agip) of Italy, and British Petroleum Co. of the United Kingdom.

Oil exploration continued at a high rate, and substantial development was underway in both major producing areas. Offshore Cabinda, Cabgoc tied in two new deposits to facilities at its 13 producing fields. The Numbi and Wamba Fields received new platforms. The company expected to add two new pipelines to the fields in 1989, at which time the fields' production would reach 40,000 and 80,000 barrels per day, respectively. Cabgoc's total production was approximately 270,000 barrels per day toward yearend, and the company predicted that its output would rise to 300,000 barrels per day in 1990. Elf started up its new Bufalo Field in Block 3, and two other fields, Impala and Punja, were scheduled for startup in 1990. Elf produced at a rate of 120,000 barrels per day during 1988 and predicted that its 1990 Angolan production would be 150,000 barrels per day. Texaco was predicting an output of 40,000 barrels per day from its Block 2 concession by yearend, in addition to its 30,000-barrel-per-day onshore production. In July, Texaco and its partners announced their eighth discovery in Block 2, 12 kilometers offshore. The well tested at 2,880 barrels per day of 36° API crude. Its location was close to the producing Cuntala Field and was expected to be developed quickly.

Increased interest in exploration offshore Angola was due in part to recent improvements in seismic exploration technology and to a relative lack of available exploration leases elsewhere. United States-mediated negotiations, providing for the withdrawal of foreign troops from Angola, led to prospects for peace in the southern part of the country, and renewed interest in the southern offshore concessions (Blocks 9 to 13). These southern blocks, however, were not considered to have as much potential as those to the north. Several European and Japanese companies were bidding for the central-Cabinda onshore concession that state-owned Sociedade Nacional de Combustiveis de Angola (Sonangol) opened in 1986. British National Oil Corp. was awarded a 20% interest in Block 8, where Petrofina S.A. of Belgium and Compagnie Francaise des Petroles (TOTAL) each held 40%. TOTAL acquired a 15% share in Block 6, reducing Conoco's holding to 60%. Unocal held 25% of the concession.

Cabgoc sold 9.8% of the Cabinda concession to Agip, retaining 39.2%. The sale price reportedly was about $190 million. Sonangol held the remaining 51% of the concession. Braspetro, a subsidiary of Petrobras International S.A. of Brazil, purchased a 20-million-barrel oil reserve in Angola from Texaco for a reported $55 million. This represented about 10% of the reserves in Block 2, where Braspetro was doing exploration under a risk contract. The purchase boosted Braspetro's share of the field to 27.5%. Texaco assigned a further 10% of Block 2 reserves to TOTAL, which boosted TOTAL's share to 27.5% also. Texaco retained 20% of the concession, and the remaining 25% was held by Sonangol.

Sonangol's offshore fuel terminal at Lobito was under construction during the year. The terminal was to have 15 storage tanks with a total capacity of 53,000 cubic meters of fuel and lubricants. The $40 million terminal was being built and financed by Italian entities.

BOTSWANA[2]

Minerals remained the base of Botswana's healthy economy in 1988, as had been the case for more than a decade. Diamonds were the leading commodity. The Bank of Botswana calculated that exports earned the equivalent of $1.063 billion,[3] or about 75% of the country's total export revenue. The value of production was larger than that of any other country, for the fourth consecutive year. The volume, 16.2% of world production, was the third largest after Australia and Zaire. According to published data on domestic mining companies, the country's single producer was Botswana's second largest employer, averaging 4,509 employees for the year. This was 44% of the average 10,291 workers reported in the domestic mineral industry. Total employment in the formal sector was estimated at 150,000, which reportedly included 20,000 to 25,000 working in the South African mining industry.

Nickel-copper-cobalt matte, produced by BCL Ltd.'s mining and smelting complex and refined outside the country, was the next largest source of export earnings for Botswana; this was calculated by the Bank as equivalent to $227 million or about 15% of the national total. BCL was said to be the largest private employer, averaging 4,790 employees. Data showed that the third-ranking export was beef, which earned only the Bank-calculated equivalent of $52 million. Cattle raising, however, provided a livelihood for most of the rural population, which was estimated at more than 80% of the roughly 1.2 million people in the mostly arid, Texas-sized country. Beef earnings began rising after a 6-year drought ended in January 1988; even without droughts, however, mining would remain the key element in the economy because mineral commodities provided about 90% of export earnings in 1988.

Statistically, the mineral industry contributed about 50% to the gross domestic product (GDP) and about 60% of Government revenue in 1988, according to estimates reported in mid-1989. For the economy overall, IMF figures showed the GDP for the year ending June 30, 1988, to be $1.80 billion, up 19% in pula terms, or 10% in dollars, from the year earlier. Other estimates indicated that for calendar year 1988 growth in GDP had slowed to between 8% and 9%, compared with a compound real rate of growth of more than 12% for over a decade. However, even the lower rate kept Botswana in the top ranks of the world's fastest growing economies, especially in Africa. Inflation was reported to have increased, from 1987's slightly less than 10%, to slightly more than 10%, and the pula depreciated against the U.S.

dollar by 8%, according to the IMF's year average exchange rate.

Although trade and balance of payment surpluses were large and foreign reserves continued to increase, Government officials expressed concern that Government expenditures were increasing at a rate that would overtake revenue in a few years, and production was expected to level off within 2 years. The Government also reiterated concern over the employment problem. About 25% or 40,000 of the formal sector type workers were without jobs; although each year 25,000 new job seekers were entering the market, at most 20,000 new jobs were opening up, despite a construction boom. The linkage between shortage of skilled workers, the need for more education, and the need for special inducements for expatriate workers was also pointed out. However, the expatriate workers' higher pay continued to be a cause of labor friction. The need for more infrastructure and better housing were other concerns.

The Government also was trying to encourage private enterprise, as well as diversification away from heavy reliance on mining, especially diamonds. Labor-intensive manufacturing was the stated thrust, and foreign investment was invited. At the same time, official statements and actions clearly indicated that the Government wanted to continue to attract more and wider investments in capital-intensive mining, especially where it added to the infrastructure. Most of the existing infrastructure was near the eastern border in a 100-kilometer-wide by 650 kilometers long strip along the railroad from Zimbabwe to Republic of South Africa. The country's multiparty democratic Government had a history of stability since independence in 1966 and was trying to provide an attractive investment climate.

Production and Trade

Production of most mineral commodities increased in volume during 1988, according to statistics released by the Government and private sources. Increases were at double digit rates in almost every case. However, gold and lime were down substantially, and gem stones were down slightly. Higher commodity prices were a spur to increased output, and apparently, most producers had the capability to respond in market-oriented Botswana.

TABLE 2

BOTSWANA: ESTIMATED VALUE OF MINERAL PRODUCTION

	1988	1989
Diamonds	$936,190,000	$715,200,000
Nickel-copper-cobalt	236,676,000	85,007,000
Coal	6,223,000	6,140,000
Gold-silver	280,000	389,000
Semiprecious stones	10,000	15,000
Lime	14,000	17,000
Crushed stone	4,759,000	3,451,000
Sand	415,000	342,000
Total	**1,186,567,000**	**810,561,000**

Source: Botswana Department of Mines.

Value in pula increased even more than volume of production for most major commodities, due to the higher market prices. When measured in pula, the rise was also due to inflation and, for those commodities that were exported, depreciation of the pula's foreign exchange value.

Value of mineral exports was nearly the same in pula for 1988 and 1987 based on Bank of Botswana estimates of export values converted to millions of dollars, as shown in table 3.

The mineral component of "Other exports" probably had about the same pula value in both years converted to $330,000 in 1988 and to $358,000 in 1987. But, as shown above, in equivalent dollars, 1988's total mineral export value was less than 1987's due to the change in exchange rates. However, failure to show an increase in export value, when there was such a substantial increase in production value, was due to the sale of a large stockpile of diamonds in 1987, reportedly for the equivalent of about $596 million plus shares of stock and other nonmonetary benefits.

Government statistics show more than 85% of exports, by value, went to European nations other than the United Kingdom. Although shipments to jewelry centers presumably accounted for most of this, 75% for the nickel-copper-cobalt smelter matte was sold to refineries in Norway and the balance to refineries in Zimbabwe.

Value of imports (c.i.f.), cited in IMF data in million pula, were P1,871.8 in 1988 and P1,571.2 in 1987. South Africa continued to be the major trading partner and was said to be the source of transhipment of a least 80% of Botswana's imports. Almost all exports also passed through South Africa.

TABLE 3

BOTSWANA: ESTIMATED VALUE OF MINERAL EXPORTS

(Million U.S. dollars)

	1988	1987
Diamonds	1,081.0	1,341.8
Nickel-copper	231.8	76.7
Total	**1,312.8**	**1,418.5**
Other exports	175.9	174.0
Grand total	**1,488.7**	**1,592.5**

Source: Bank of Botswana.

TABLE 4

BOTSWANA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987[p]	1988[e]
Coal, not further described		392,851	437,053	499,373	579,409	[2]612,873
Cobalt: Co content of smelter product[3 4]		259	222	163	181	[2]291
Copper:						
Mine output, Cu content of ore milled[e 5]		[r]26,436	[r]27,274	[r]27,499	[r]27,888	27,303
Cu content of smelter product[3]		21,471	21,692	21,336	18,933	[2]24,428
Diamond:						
Gem and near gem[e]	thousand carats	[r]5,810	6,318	[r]9,590	[r]9,368	10,660
Industrial stones[e]	do.	7,104	6,317	3,500	3,840	4,569
Total	**do.**	**[r]12,914**	**12,635**	**13,090**	**13,208**	**[2]15,229**
Gem stones, semiprecious, rough, not further described[6]	kilograms	[r]36,700	[r]14,310	4,900	40,103	[2]38,000
Gold[7]	troy ounces	575	407	810	1,019	[2]675
Lime		43	2,600	225	325	[2]226
Nickel:						
Mine output, Ni content of ore milled[e 5]		[r]24,570	[r]26,300	[r]25,558	[r]25,920	25,971
Ni content of smelter product[3]		18,604	19,565	18,974	16,528	[2]22,539
Smelter product, gross weight[3]		51,845	51,507	47,930	43,238	[2]57,530
Sand and gravel	cubic meters	188,498	102,524	129,181	122,203	[2]179,936
Stone, crushed, not further described	do.	436,604	132,966	177,792	225,362	[2]337,677

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

[1]Table includes data available through July 1, 1989.

[2]Reported figure.

[3]Smelter product is granulated nickel-copper-cobalt matte.

[4]Figures also used for recoverable mine output in world production tables appearing in Volume I of the Minerals Yearbook.

[5]Calculated from reported tonnage and head grade of ore milled.

[6]Sales; probably principally agate.

[7]Gold production figures include silver reported as follows: 1984—"less than 1 kilogram" (i.e. 32 troy ounces, less than 5.6% of total); and 1987—"about 2% of total gold and silver listed" (i.e. about 20 troy ounces).

Heavy reliance on trade with South Africa was expected to continue because of proximity, location of ports, size of market, source of financing, and other economic realities, not the least of which was comembership in the Southern African Customs Unions (SACU).

Commodity Review

Metals.—**Cobalt.**—A 60% increase in cobalt content of the nickel-copper-cobalt matte produced by BCL Ltd. was roughly double the increase in either nickel or copper. This indicated a higher cobalt content in ore or better recoveries in processing. The matte was exported and metal recovered and refined in Norway and Zimbabwe.

Copper.—The increase in output of copper contained in nickel-copper-cobalt matte was in line with the increase in total matte produced by BCL Ltd. It, too, was recovered and refined in Norway and Zimbabwe.

A subsidiary of Falconbridge Ltd. of Canada was reportedly investigating copper mineralization near Francistown, 425 kilometers northeast of Gaborone. The attraction was said to be partly the new railroad planned for the Sua Pan soda ash project, about 175 kilometers northwest of Francistown. Copper deposits were known for many years to exist in a belt extending almost the whole distance westerly to Sua Pan, as well as east and south of Francistown. The entire belt apparently was in the area that Bamangwato Concessions Ltd., now BCL Ltd., explored in the 1960's prior to deciding to develop the Selebi-Phikwe nickel-copper-cobalt deposits, south of Francistown.

Copper mineralization was also known to be in an area much further west in the Kalahari Desert, about 500 kilometers west of Francistown near Lake Ngami and Maun. Previous reports claimed copper mineralization trends extended from Lake Ngami northeasterly into Zambia and westerly into Namibia.

Gold and Silver.—Gold continued to receive much attention. Prospecting was actively pursued, and one new mine, Map Nora, joined the ranks of several relatively small mining operations. Additional mining leases were applied for, and another one was issued to reopen old mines and/or rework tailing dumps in the Francistown area. Some silver generally is present in the ore. Most exploration was in the same area, but there apparently also was exploration in the central Kalahari Desert region, 500 kilometers to the west, where Cominco International Resources of Canada reportedly started drilling. This work was on part of a prospecting concession, described as horseshoe shaped, at least 1,000 square kilometers (one apparently normal concession unit) and possibly as much as 11,000 square kilometers according to another report. The work was in a larger area covered by an aeromagnetic survey that reportedly was funded by a Canadian aid program in the 1970's.

The Map Nora Mine of Shashe Mines (Pty.) Ltd., 8 kilometers south of Francistown, began production in December 1988, after 18 months of underground development that included a 325-meter, vertical shaft. Planned ore output is 6,600 tons per month. This apparently was the most recent shaft sinking event in a long history of gold mining, dating probably 1,400 years or more, in the Tati schist belt. In this vicinity, the first European gold-mining enterprise in southern Africa was said to have started production in 1869. About that time, the Map Nora deposits were discovered, together with many others. None of the subsequent mines were major operations, and most shut down in the early 1900's. However, a number were reworked from about 1930 to 1950, including Map Nora; some were again reopened about 1980. Complex metallurgy was said to have been a major factor limiting development.

In 1983, Phelps Dodge Corp. (PD) of the United States agreed with Falconbridge Ltd. of Canada, through their Botswana subsidiaries, to join and manage an ongoing exploration program on a concession that included numerous prospects. In June 1987, after drilling, bulk sampling, metallurgical tests, and some additional underground development at Map Nora, it was decided to start production. In December 1987, PD bought out Falconbridge's interest. The mining lease, covering 52 square kilometers and including 14 old gold workings, was apparently actually granted in March 1987 to Shashe, which at yearend 1988 was owned 85% by PD and 15% by the Government of Botswana. A second mine, Golden Eagle, was also being developed on the lease.

The Map Nora ore was described as being siliceous, associated with shear zones and sulfide mineralization, and occurring in veins typically 0.5- to 1.0-meter thick, dipping 65°, and of very variable width and grade. Ore was said often to be rich in arsenopyrite, usually to have moderate amounts of pyrrhotite and pyrite, and to contain erratic concentrations of antimony that needed blending to permit roasting. Mining by underhand open stoping was planned to deliver ore averaging 6 grams of gold per ton. Processing of the so-called refractory ore was designed to include comminution, froth flotation, fluid bed roasting, agitated leaching, carbon-in-pulp absorption, elution, and electrowinning. Overall recovery, in an 85% gold and 5% silver bullion, was expected to be about 88.5% of the gold in ore milled.

Cost of the mine, processing plant, and ancillary facilities reportedly totaled about $10 million, close to that budgeted. The original time schedule apparently was met. Planned employment of 275 people was said to be higher than optimal to accommodate expected high turnover. Processing of surface dump material and stockpiled development ore was to start in January 1989, and the plant was expected to be at design capacity treating stope ore by July 1989.

In other gold-silver mining activity in 1988, mining leases were applied for by Mecor (Pty.) Ltd. on the Tekwane deposit and by Mineral Holdings (Botswana) (Pty.) Ltd. on tailings; a mining lease was granted to Metore (Pty.) Ltd. from which production was due early in 1989; underground production by Morex Botswana (Pty.) Ltd. from the Rainbow deposit continued since startup in late 1987; underground production by Mineral Holdings (Botswana) (Pty.) Ltd., since before 1986; production from tailings by Golden sands, since before 1986; and production from tailings by Shamrock, since before 1986.

Nickel.—Nickel, one the country's leading exports, made headlines with new production records, new mines and new prospects. The granulated smelter matte produced by BCL Ltd. during 1988 was a company record of 47,258 tons for total contained nickel-copper-cobalt metal. During the year, 35,641 tons of contained metal were shipped to Falconbridge Ltd.'s refinery in Kristiansand, Norway; most of the 12,776 tons shipped to refiners in Zimbabwe went to Rio Tinto (Zimbabwe) Ltd. at Eiffel Flats, and some went to Anglo American Corp.-managed BSR Ltd. at Bindura. The BCL production facilities, about 350 kilometers northeast of Gaborone, consisted of the Selebi and Phikwe underground mines, and a processing complex 4 kilometers from the Phikwe shaft, which included a froth flotation concentrator facility and a coal-fired flash smelter and converter facility. BCL was reportedly owned by the Government of Botswana (15%) and Botswana RST Ltd. (85%). The latter's major shareholders apparently were AMAX Inc. of the United States and Anglo American Corp. (AAC) of South Africa each with 29.8% in 1987, the latest year for which ownership data were available.

Overall matte content for 1988 was near the considered typical average of about 40% each for nickel and copper with about 0.5% cobalt, under 20% sulfur, and under 1.5% iron. However, cobalt content had been lower for the previous several years. Apparently, sulfur content in some converter product was adjusted, from about 19% to 6%, to provide total metal content of about 78% to 93%, respectively, depending on the customer's needs. Smelter-converter recoveries appear to have averaged over 96% for nickel, over 91% for copper, and 21% for cobalt. The matte was obtained from a record 1.18 million tons of feed to the flash smelting furnace, which was overhauled in 1987 after a record 7-year campaign. The feed included carry-over concentrates from 1987, but the major portion came from 1988's new record of 3.33 million tons of ore milled. The mill-head grades were 0.78% nickel and 0.82% copper, which resulted in 742,684 tons of concentrate at 2.86% nickel and 3.44% copper for a recovery of 81.4% and 93.9%, respectively. However, production was not expected to set another record in 1989, especially since the concentrator was operating at maximum capacity. Concentrator expansion was considered because the smelter still had some excess capacity.

Ore production tonnage also was a record: Phikwe—2,529,984 tons at 0.83% nickel and 0.71% copper and Selebi—815,561 tons at 0.63% nickel and 1.16% copper. At Selebi, about 14 kilometers southwest of Phikwe, a shaft system to allow production below the 250-meter level was being developed. On the Selebi North deposit, midway between Selebi and Phikwe, detailed planning was in progress for mine development in 1989 and production in 1990. The planned 1,500 tons per day production by 200 employees was to replace some output from Phikwe where grades were expected to decline. Limited exploration drilling gathered more information on the Phikwe North and South zones. Mineral reserves were considered adequate for operating beyond the year 2000, based on geologic interpretations in 1982 that there was a very persistent folded ore horizon.

For Botswana RST (BRST), in 1988 as compared to 1987, the larger quantity of matte and the higher metal prices, plus a decline in value of local pula currency relative to the U.S. dollar, resulted in a more than tripled pula sales revenue, equivalent to $231.8 million. Even with local inflation, this produced a huge increase in operating profit, but after substantial allowances for deferred royalty and interest, and unrealized exchange losses, the result was a loss for the year. Nevertheless, substantial cash distributions reduced part of the large outstanding debt. Heavy debt, primarily to major shareholders, had been incurred since start of production in 1973, because of major plant modifications to improve metal recoveries, production rates, and environmental conditions, as well as other difficulties. One of the latter was continuing production in order to maintain employment, in face of low metal demand and prices. BRST stated it expected to repay all outstanding senior debt in 1989. AMAX apparently was no longer actively looking for a buyer of its interests, as it was in 1987.

Tati Nickel Mining Company (Pty.) Ltd. (Tati) was granted a mining lease on the Selkirk and Phoenix nickel-copper sulfide deposits, 25 kilometers east of Francistown. BCL entered into agreements to manage the operations and to toll smelt the output, which was to be trucked about 120 kilometers south to Phikwe. Reportedly, Selkirk reserves were 1.2 million tons at 2.4% nickel and 1.3% copper, and mine production was expected to be rich enough for direct charging into the BCL smelter. Phoenix reserves were said to be in excess of 2.9 million tons at 2% nickel and 0.8% copper. Production was to start at Selkirk in January 1989; planned rate was 60,000 tons of ore per year, about 5% of 1988's feed to BCL's smelter, which was not at capacity. A decision on starting the Phoenix was still being considered. Tati is reportedly owned 51% by a Swiss trading affiliate of RTZ Corp. identified as Centametall and 49% by a United Kingdom investment group identified as Morex. Apparently, the Government had not yet exercised its reportedly legal option on 15% to 25% ownership. Centametall was said to be involved in the ore purchasing and smelting-refining contracts as it also was on the 20% of BCL's matte refined by Rio Tinto in Zimbabwe.

Additional nickel sulfide occurrences were frequently reported in the platinum prospecting that continued in the Molopo Farm Complex, 200 to 400 kilometers west southwest of Gaborone.

Platinum.—Prospecting for platinum-group metals (PGM) continued in the Molopo Farms Complex. The Complex was astride the Molopo River border with the Republic of South Africa, 200 to 400 kilometers west-southwest of Gaborone. Reportedly the Botswana Geological Survey, with British Government assistance, found low grades of PGM in the Complex in the early 1980's. However, as far back as the mid-1970's, the complex had been seen to be similar to the Bushveld Igneous Complex, 400 kilometers or more to the east in the Republic of South Africa, and more recently was considered a possible outlier. The Bushveld Complex contained major platinum and chrome deposits.

Gold Fields of South Africa had reported in 1986 that substantial exploratory drilling was underway on a three-unit, 3,000-square-kilometer concession, and in 1987 that the search continued. In 1988, the company was reportedly on its second and last automatic time extension of a prospecting license issued in January 1984, and having to decide soon, was concentrating on one unit area.

Molopo Botswana, said to be a joint venture of Molopo Australia and Southern Prospecting International (SPI) of South Africa, was also reported active. Apparently, work was on a 2,000- or 3,000-square-kilometer concession, adjacent to Gold Fields', which in 1986 was reported to be held by SPI and, in 1987, by Molopo Australia. The latter was reportedly a company formed by SPI and Paringa Mining and Exploration to raise funds for the work.

***Industrial Minerals.*—Clays.**—Construction of a brick factory by Makoro Brick & Tile Ltd. began south of Palapye, about 250 kilometers northeast of Gaborone. Production was expected to start in April 1989, with a capacity of 14,000 bricks per hour. Employment was planned to total 111 employees. Botswana Development Corp., a parastatal, was a 30% shareholder. Construction was started on another brick plant, owned by Agro Industrial Products Ltd., with production slated for April 1989.

A mining lease on clay deposits near Lobatse, about 75 kilometers south of Gaborone, was issued to Kwena Concrete Products Ltd. Reports said an almost $10 million investment was expected to produce 24 million brick units per year, including bricks and floor and roof tiles.

Construction Materials.—Fourteen quarries or pits were in operation as follows: 10 for crushed stone, 2 for sand, and 2 for lime. Stone and sand output was up about 50% but lime was down about one-third.

Diamond.—Production of diamonds again increased in volume and value to new highs, and further increases in both were planned for 1989. Other sources said a plateau was expected in 1990 at about 16.5 million carats. The only producer of record, De Beers Botswana Mining Company (Pty.) Ltd. (Debswana), reported the sales value increase was helped by an average price increase of 14.5% from April 1988. This was the second in less than a year. However, the company reported a decrease in net profit, because of added income in 1987 from the sale of a large stockpile that had accumulated over a number of years.

The production was from three open pit mines operated by Debswana, which was owned equally by the Botswana Government and De Beers Consolidated Mines Ltd. (De Beers) of South Africa or its subsidiaries. Debswana held a 5% share in De Beers since a 1987 agreement that involved selling the large Debswana stockpile of diamonds to De Beers and included granting Debswana the right to two seats on De Beer's board of directors. The seats were initially filled in November 1988 by Government officials. Production for the mines in 1988 is reported in table 5.

Botswana's long drought continued to cause more than usual concern over the normally limited water supply in the arid area. Between Orapa, about 375 kilometers north of Gaborone, and Letlhakane, about 40 kilometers southeast of Orapa, additional water well fields were being established. These would supplement the seasonal Boteti River flow that did not reach the supply dam for Orapa, which then had to rely on existing well fields. At Letlhakane, pit dewatering wells provided sufficient water. Modification to the diamond treatment plant at Letlhakane was completed early in 1988 enabling a 20% increase in feed rate. At Jwaneng, about 125 kilometers west of Gaborone, construction of a new recrush facility, reported to cost $110 million, began in mid-1988. Startup is scheduled for 1990. It was planned to increase diamond production by 30%, treating lower grade ore and tailings to permit extracting mostly smaller diamonds that were not otherwise economically recoverable. The plant was designed with a new De Beers technology referred to as interparticle crushing.

TABLE 5

BOTSWANA: DIAMOND PRODUCTION IN 1988, BY MINE

Mine	Metric tons ore treated	Carats produced
Orapa	7,258,000	5,566,212
Letlhakane	2,949,000	733,637
Jwaneng	5,783,000	8,929,510

Debswana totaled over 4,700 employees at yearend. Usually satisfactory labor relations were strained somewhat during the year by a protracted dispute with the Mine Worker's Union over the minimum wage for unskilled employees. At yearend, the Union was not satisfied with the Government arbiter's decision and applied for review by the High Court of Botswana.

A kimberlite prospect called Gope 25, some 350 kilometers northwest of Gaborone in the Kalahari Desert, continued to be investigated by a joint venture of De Beers and Falconbridge Exploration Botswana. Falconbridge apparently did the original work from 1981 to 1987. Three other kimberlite discoveries were drilled and considered too low grade to be worked. At Gope 25, a 150-meter shaft was sunk, and a bulk sample was to be obtained for testing. The top of the ore horizon is covered by about 100 meters of sand overburden.

Areas reportedly being explored by other companies were southeast of Letlhakane, north of Orapa in the Makgadikgadi salt pans, and southwest of Jwaneng in the Molopo Farms igneous complex. Ampal, a local company, was in a joint venture with Australian companies Kalahari Exploration, a subsidiary of Taurus Resources and Molopo Farms Complex Exploration. All three companies were reportedly new to the search in Botswana and apparently were working in the Molopo area. Seltrust Botswana Exploration also was reported to be active in an unidentified area.

Gem Stones.—Based on number of exploration permits, gem stones other than diamond were an active field for exploration; however, value of production was not significant. Agate, of several varieties, was said to be the major product.

Soda Ash.—Annual production of 300,000 tons of soda ash and up to 650,000 tons of salt was scheduled within 2 years after startup in March 1991 at latest, of a plant to treat the underground natural brines of Sua Pan. Saltcake (sodium sulfate) and potash (potassium chloride) particularly were mentioned as potential byproducts. The plant was planned to be on a split of higher ground in the occasionally flooded Makgadikgadi Depression, an inland drainage basin that encloses the deposit about 450 kilometers north of Gaborone. For more than 40 years, various entities had been involved in investigating and/or attempting to commercialize the enormous deposit covering more than 900 square kilometers and contained in unconsolidated sands overlain by clays.

In November 1988, agreements in principle were concluded and a mining lease issued to Soda Ash Botswana (Pty.) Ltd., owned 52% by a South African consortium effectively led by AECI Ltd. and 48% by a consortium headed by the Government of Botswana. AECI's subsidiary AECI Chlor-Alkali Plastics Ltd. was reported to actually hold 26.5%; the other 25.5% was split equally between AAC and its affiliate De Beers. Substantial interests in AECI and its subsidiary were said to be held ultimately by AAC and by Imperial Chemical Industries Ltd. (ICI) of the United Kingdom. The Government was reportedly hoping to reduce its share to 24%; conceivably, this could be cut to as low as 15%, the apparent customary ownership retained by the Government in mining ventures, if announced discussions with international financing agencies, as well as local private sector investors, were successful.

Markets in southern Africa, mostly in South Africa, were expected to absorb the production. Press reports stated that South Africa's 1988 requirement for soda ash was roughly 260,000 tons. More than one-half of that was imported from the United States, which represented almost 10% of U.S. exports, but still there was some concern over the vulnerability to U.S. anti-apartheid sanctions. Related to the venture was AECI's decision to cancel a synthetic soda ash project to use salt and limestone in South Africa, and South Africa's agreement to a 10% duty on soda ash imports, if needed, to protect the new industry. Botswana officials expected production to boost total export earnings by 10%.

Prior to the November agreements, the American Natural Soda Ash Corp. (ANSAC), international marketing agency for the six U.S. producers, acted vigorously to protect their South African market, which reportedly approached $20 million at yearend 1988. The U.S. Government was pressed to reconsider aid to Botswana; ANSAC claimed the venture would not be competitive in delivered price and thus was basically uneconomic, and any restrictions, such as quota or duty, were a breach of trade agreements. Obviously, Botswana and South Africa considered the project's benefits, respectively, local employment and a secure supply of raw material, were more important.

The project was expected to cost about $400 million. Financing announced was 35% equity; 24% South Africa and Botswana bank loans, some of which were guaranteed by De Beers; 27% South African credits; the remaining 14% was not fully arranged, but said to include the Federal Republic of Germany and Japanese credits. Reportedly, the Botswana Government also was to provide an infrastructure costing about $80 million and covering town, water, power, and a $40 million, 165-kilometer railroad from Francistown. Employment was projected at 540, including initially, 110 expatriates.

The processing facilities were said to be based on Kerr-McGee technology used in California for brines having the same chemistry. The planned process was described as starting with wells about 35 meters deep to supply brine for concentration in solar evaporation ponds covering about 25 square kilometers where most of the sodium chloride would crystallize. According to reports, a chemical plant would subsequently complete separation and purification of sodium carbonate from the remaining brine by carbonation, crystallization, filtration, and calcination. A consortium consisting of Uhde, a chemical plant constructor from the Federal Republic of Germany, and LTA Ltd., a South African process engineering-construction affiliate of AAC, was reportedly appointed principal contractor. Babcock Engineering of South Africa was reportedly to supply two boilers to be fired by Botswana coal. Environmental protection was especially mentioned as being carefully considered during design and construction, based on a 1985 impact assessment.

***Mineral Fuels.*—Coal.**—The Morupule Mine, about 250 kilometers north-northwest of Gaborone and 15 kilometers west of Palapye, continued to expand production to meet increased power demand, as it has every year except 1983 and 1984, since startup in 1973. The operating company, Morupule Colliery Ltd., reportedly over 90% owned by AAC or affiliates, originally opened the mine to supply the smelter and power station at the Selebi-Phikwe nickel-copper mines. Soon afterward, Botswana Power Corp. began purchasing some output and eventually become the major customer. In 1988, substantial expansion plans were reported for supplying needs for power and heat at several new projects, including the Sua Pan soda ash and Jwaneng developments.

A shallow, underground stop adit operation, Morupule was the only mine exploiting Botswana's coal reserves which are reportedly the largest on the continent after South Africa.

Since coal was first reported before 1900, there have been numerous investigations, including fairly extensive field exploration programs. In the last decade, estimates have ranged from at least 3.5 billion tons of economically recoverable coal plus at least 13 billion tons indicated reserves, to 40 billion tons called identified resources. Although coal was reported over a large area, the apparently better coal was at Moropule and Mmamabula, about 130 kilometers south. Medium ash, medium calorie grades, were said to extend some 50 kilometers west from Morupule, with poor quality seams continuing southwesterly. Three seams were considered economically significant; the lowermost, Morupule Main, was about 9 meters thick where it was mined. The Mmamabula area coal was said to be lower grade than at Morupule and to have seams broken by faults.

Periodically, studies apparently found that the lack of abundant water needed for beneficiation as well as high transportation costs mitigated against developing an export market.

A campaign to increase utilization of coal as fuel in households as well as in industry and commerce was continued from 1987. This effort, supported by the Federal Republic of Germany, is particularly aimed at replacing the use of wood, which was becoming very scarce.

Petroleum.—The search continued into Botswana's oil and gas potential, which generally is considered to be in the western Kalahari. Oil seeps were long known to be across the border in Namibia. Aerial surveys, reportedly starting with magnetics funded by Canada in the 1970's, and subsequent ground and aerial work apparently continued to justify further exploration into 1989. In 1988, Petro Canada reportedly completed an encouraging program. This apparently was seismic work that started in 1986 and covered the Nossop, Ncojane, and Passarge Basins, three deep sedimentary basins (to 15,000 meters) previously outlined by studies as potential hydrocarbon sources. Two other firms, one from the Federal Republic of Germany and one from France or Belgium were reportedly also interpreting that data and/or previous data, and one firm reportedly was possibly doing ground work.

Early in 1989, a news release stated that Petro Canada International Assistance Corp. had confirmed it would drill a hole up to 4,000 meters deep, which other reports said was for stratigraphic information.

LESOTHO[4]

Since the closure of the Letseng-la-Terai mine in 1982, Lesotho's mineral production has consisted solely of sand and gravel for local use. The most significant new development in the Lesotho economy was the final approval of the Highlands Water Project. This $2 billion project will involve the construction of four dams, one of which, the Katse dam, reportedly will be the largest in sub-Saharan Africa. The purpose of the project is to provide water to the Republic of South Africa and electricity to both Lesotho and the Republic of South Africa.

Tenders began in 1988 for various phases of the project, including numerous roads into previously inaccessible regions of the country. Construction of some of these roads was in progress during the year. The Katse Dam was slated for completion by late 1995; the remaining three dams and two transfer tunnels would be completed over the following 25 years. The project's hydropower delivery was to be 100 megawatts at full capacity. Annual revenues from water sales to the Republic of South Africa are anticipated to be between $20 million and $50 million.[5] Large additional revenues were anticipated from recreational use of the project's reservoirs. Road and dam construction was expected to require a major increase in the country's production of sand and gravel and other construction materials.

A major factor in the economy continued to be the repatriated wages of the approximately 120,000 Basotho mineworkers in the Republic of South Africa. Of these, about 101,000 were employed in gold mines and 6,700 in coal mines. These mineworkers represented about 7% of Lesotho's population. Estimates of their wages in 1988 ranged from $295 million to $315 million, or about 40% of the country's GNP.

MALAWI[6]

The mining industry consisted mostly of coal, limestone for cement production, crushed stone for construction, and clays for brickmaking. Small quantities of gem stones were reported to have been mined at Chimwadzulu in central Malawi. Although Malawi has significant quantities of industrial minerals, little was known of the deposits other than estimates of geologic reserves. Exploration of these deposits was planned by the Malawi Geologic Survey with French technical

TABLE 6

LESOTHO: PRODUCTION OF MINERAL COMMODITIES[1]

Commodity		1984	1985	1986	1987[p]	1988[e]
LESOTHO[2]						
Stone[e]	cubic meters	25,000	25,000	25,000	25,000	50,000

[e]Estimated. [p]Preliminary.
[1]Includes data avaialble through Feb. 20, 1990.
[2]In addition to the commodity listed, modest quantities of unlisted varieties of crude construction materials (clays, sand and gravel) presumably are produced, but output is not reported quantitatively, and available information is inadequate to make reliable estimates of output levels.

TABLE 7

MALAWI: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]	1984	1985	1986	1987[p]	1988[e]
Cement, hydraulic	70,058	61,654	69,471	72,831	[3]65,597
Coal	2,000	[e]4,000	10,708	18,256	[3]39,376
Lime	2,005	1,923	2,735	2,160	3,000
Stone: Limestone for cement	[e]100,000	[e]100,000	103,037	107,040	105,000

[e] Estimated. [p] Preliminary.

[1] Includes data available through Feb. 20. 1990.

[2] In addition to the commodities listed, modest quantities of unlisted varieties of crude construction materials (clays, sand and gravel) presumably are produced, but output is not reported quantitatively, and available information is inadequate to make reliable estimates of output levels.

[3] Reported figure.

support.

The Malawian economy was predominately agricultural, and about 90% of the population lived in rural areas. Agriculture accounted for 40% of GDP and 90% of export revenues. The industrial base is small, and nearly all essential needs are imported.

There were very few metalliferous mineral deposits known in Malawi. The two most promising were the Kayelkera uranium deposit in the northern part and the Kanunghunde Hill rare-earth deposit in the southern part of Malawi. Both deposits were undergoing prefeasibility studies.

Malawi's Kaziwiziwi and Mchenga coal mines produced over 26,000 tons of subbituminous coal in 1988, over 60% of total demand. However, known reserves at these mines were considered only sufficient to last another 3 to 5 years. Consequently, French-sponsored exploration of coal occurrences in the southern region was increased. Mobil Oil Corp. and the Government were to enter into negotiations in 1989 regarding a long-term petroleum exploration program in the Lower Shire Valley and Lake Malawi area. Malawi imported all of its petroleum products.

MOZAMBIQUE[7]

The overall level of exploration activity in Mozambique increased in 1988, especially for gold, titanium sands, coal, and graphite. Several mines in Zambezia Province, which had once produced tantalum minerals and gem stones from pegmatites and had been overrun by insurgents in 1986, were secured by the Government in 1988 and were undergoing rehabilitation studies at yearend. Overall foreign investment in the mining sector increased from about $500,000 in 1986 to about $2 million in 1988 and was expected to reach $5 million in 1989 and about $12 million[8] in 1990.

Production of most mineral commodities decreased, although bauxite production increased significantly. Mining was the key sector in the Government's program to attract new foreign investment. Agreements were being negotiated with a number of foreign companies and governments for the exploration and mining of such commodities as coal, gold, bauxite, copper, titanium sands, graphite, clay, diatomite, tantalite, gem stones, petroleum, and natural gas. In addition, the Government received and was negotiating numerous loans and other assistance, largely related to the purchase of food and fuel, and the rehabilitation of the country's transportation infrastructure.

The continuing insurgency affected all sectors of the Mozambique economy, but had its greatest effects in the displacement of a large sector of the population and in the disruption of the country's transportation infrastructure. This in turn greatly affected Mozambique's agricultural output and its ability to transship goods from neighboring countries and to transport for export its own mining products, most notably coal. Rail traffic along certain routes increased owing to ongoing rehabilitation to the rail lines and the protection offered by the presence of foreign troops. The ports of Beira and Maputo were undergoing various forms of rehabilitation during the year, but shipping capacities at both remained well below levels reached in years before the onset of guerrilla attacks. The giant Cahora Bassa hydroelectric facility remained inoperative owing to insurgent attacks on the power transmission pylons.

In 1988, Mozambique's GDP increased 4% to about $1.6 billion; however, this was well below the $4.13 billion GDP in 1986. Mineral exports declined in value by 1% to about $1 million, which represented about 1% of the country's total exports. Mozambique's total imports increased 25% to about $765 million, of which fuel imports comprised about $70 million. Imports from the Republic of South Africa were in excess of $75 million. Although mining in Mozambique was only a small factor in the overall economy, it was the sector that was being most heavily promoted as having the greatest potential for significant expansion. Furthermore, a major proportion of the country's foreign exchange earnings was by the transshipment of goods, largely coal, ferrochrome, and copper, from the Republic of South Africa, Swaziland, Zimbabwe, and Zambia, and of fuel and other commodities into some of these countries. In addition, Mozambique benefited from an estimated $108 million in wages earned by its 47,000 workers employed in mines in the Republic of South Africa.[9]

Traditionally, a large proportion of Mozambique's revenues have been earned through the transshipment of goods to and from other countries in the region. In terms of distance, export via Mozambique ports is cheaper than exports through other countries such as the Republic of South Africa. It was estimated that Zimbabwe saved $35 million in 1988 using Mozambique ports. Regional exports through Mozambique were via four main rail lines: the so-called Limpopo Corridor connecting the Eastern Transvaal, Republic of South Africa, with Maputo; a rail line from Swaziland to Maputo; the so-called Beira Corridor, connecting Beira to Zimbabwe; and the rail line from Nacala to Malawi. All of these lines had been partly or completely interrupted by insurgent activity, and all came under attack in 1988. The Limpopo Corridor and Nacala route were inoperative during the year, but both the line to Swaziland and the Beira Corridor were operational, if only intermittently. All of the routes were undergoing rehabilitation during the year. In addition, a reported 10,000 Zimbabwean troops were guarding the vital Beira Corridor, and, to a lesser extent, the rehabilitation work on the Limpopo Corridor. A reported 600 Malawian troops were helping to secure the rail line to Nacala.

While overall revenues from domestic rail traffic increased, international transit revenues decreased, because of a 19% decrease in shipments from the Republic of South Africa. International shipments along the Beira Corridor increased, however, owing to both improvements in the line and the fact that Zambia shipped about 10% more copper than normal to Beira because of problems with shipments to Dar es Salaam, Tanzania. Overall traffic through the port of Beira increased 13% to 2.2 million tons.

Rehabilitation of the Beira Corridor was part of an ongoing $350 million project for which the Government continued to negotiate grants and loans. A number of regional and Western governments and financial institutions were involved with this project, as well as with less advanced projects on the other routes. Improvements to the port of Beira included harbor-dredging, funded by the Netherlands, that would allow ships of 60,000 tons displacement to dock and the construction of new loading facilities financed by Sweden. The Republic of South Africa was rehabilitating the coal-loading terminal at Maputo, while Norway financed the rehabilitation of the coastal shipping berth there. Canadian and Italian funding was being used to reroute, for security reasons, the Cahora Bassa transmission lines closer to the Beira Corridor.

Mozambique's bauxite production was restricted to a small operation in Manica Province close to the Zimbabwe border. Production of bauxite, grading 60% aluminum oxide, increased 28%. As in past years, the bauxite was exported to Zimbabwe. Bauxite reserves in the region were being delineated by the United Nations Development Program.

Guerrilla-inflicted damage to the railroad to the Moatize coal mines severely limited the ability of the mines to economically ship production, which consequently fell almost 45%. Total coal shipments, which were mostly by truck, were estimated to be approximately 107,000 tons; this amount was believed to include material in stockpile at yearend 1987. Coal exports were largely to Malawi. Brazil's parastatal mining company, Cia. Vale do Rio Doce, was exploring for coal in the Moatize region and was planning to assist in the rehabilitation of some of the coal mines.

Lonrho PLC of the United Kingdom continued its exploration efforts for lode and placer deposits in Manica Province, close to the company's gold mine at Penhalonga, Zimbabwe. Feasibility studies were expected to be carried out on several prospects in 1989. The company was also exploring for gold in the southwest part of the country. Mozambique reported the production of about 23,000 troy ounces of silver, presumably as a byproduct of the country's modest copper production.

Production of tantalum minerals ceased in 1986 when the producing mines in the Mocuba and Alto Ligonha region were overrun by insurgents. This area was secured by the Government in 1988, but the mines were discovered to have been severely damaged by the insurgents. The Government was seeking overseas investors to rehabilitate the mines. In recent years prior to the insurgent attacks, tantalum mineral production had been from the Morrua, Muiane, and Marropino Mines, for which the reported installed production capacities are given in table 9. Annual production in the 1980's was well below listed capacity, which in turn appeared to be below production levels of the 1970's.

More recent reports speculate that the tantalite output capacity of Morrua is 62.5 tons per year, with the possibility of being expanded to 153 tons per year.

Kenmare Resources Plc. of Ireland continued drill testing of its titanium sands deposit near Angoche. An independent consultant study of the project by Mineral Deposits Ltd. of Australia was begun late in the year and was expected to be completed by mid-1989. Preliminary results, based on a 2,000- to 2,500-ton-per-hour dredge-operation mine plan, gave proven reserves as 123 million tons grading 3.9% heavy minerals, up from the 1987 speculative reserves of 28 million tons grading 8% heavy minerals. The ilmenite-dominated deposit remained to be delineated at both ends and at depth. Kenmare was testing the deposit below the water table and predicted that the final reserves would be well in

TABLE 8

MOZAMBIQUE: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1984	1985	1986	1987[p]	1988[e]
Asbestos		[e]400	55	—	—	—
Bauxite		—	5,037	4,247	5,113	[3]6,548
Beryllium: Beryl concentrate, gross weight		7	6	1	—	—
Bismuth: Bismuth minerals	kilograms	1,047	1,052	80	—	—
Cement, hydraulic	thousand tons	[r]110	[r e]200	[r e]200	[r e]250	400
Clays:						
Bentonite		405	361	1,112	936	[3]986
Kaolin		[e]300	152	230	151	200
Coal, bituminous	thousand tons	107	20	4	43	[3]24
Copper, mine output, salable ore and concentrate:						
Gross weight		1,573	590	1,303	719	[3]660
Cu content		291	118	260	151	[3]139
Feldspar		[e]800	67	100	—	—
Gem stone:						
Cut stones, all types	carats	NA	NA	35,477	36,340	[3]26,551
Aquamarine	grams	2,400	3,600	568	—	—
Beryl, morganite	do.	96	50	7,303	—	—
Emerald	do.	4,200	5,000	[e]5,000	—	—
Garnet	kilograms	1,625	[r]2,000	11,024	13,240	[3]17,860
Tourmaline	grams	6,000	1,500	4,231	—	—
Lime, hydraulic[e]		10,000	10,000	10,000	10,000	10,000
Marble	cubic meters	575	715	1,137	1,140	[3]940
Mica, waste[e]		300	300	300	—	—
Monazite concentrate[e]	kilograms	4,000	4,000	2,649	—	—
Ornamental stones, rose quartz	do.	3,600	2,500	2,500	2,500	2,500
Petroleum refinery products:						
Gasoline	thousand 42-gallon barrels	140	—	—	—	—
Kerosene and jet fuel	do.	23	—	—	—	—
Distillate fuel oil	do.	160	—	—	—	—
Residual fuel oil	do.	487	—	—	—	—
Asphalt	do.	25	—	—	—	—
Total	**do.**	**835**	**—**	**—**	**—**	**—**
Salt, marine[e]		28,000	28,000	28,000	28,000	28,000
Tantalum ores and concentrates:						
Microlite	kilograms	9,900	6,283	2,649	—	—
Tantalite	do.	6,700	4,275	[r]5,373	—	—

[e] Estimated. [p] Preliminary. [r] Revised. NA Not available.
[1] Data availabe through Feb. 20, 1990.
[2] In addition to the commodities listed, modest quantities of unlisted varieties of crude construction materials (clays, sand and gravel, and stone) presumabley are produced, but output is not reported quantitatively, and available information is inadequate to make reliable estimates of output levels.
[3] Reported figure.

TABLE 9

MOZAMBIQUE: INSTALLED TANTALUM MINERAL PRODUCTION CAPACITY

(Production in metric tons, grade in percent Ta_2O_5)

Mine	Microlite		Tantalite	
	Production	Grade	Production	Grade
Morrua	31.3	65	29.3	50
Muiane	10.7	67	14.5	31
Marropino	19.3	55	8.8	27

Source: Exploration and mining activities report for 1984, Mozambique Ministry of Mineral Resources.

excess of those announced. Given satisfactory results of the 1989 drilling program, it was anticipated that mining would begin in mid-1991.

Edlow Resources, a Bermuda-registered American company, completed phase I drilling of its Pebane titanium sand concession immediately to the south of Kenmare's Angoche property. The drill program tested, at a reconnaissance level, approximately 120 kilometers of a 200-kilometer strip between the Riara and Moma Rivers. The drilling was by hand auger to a maximum depth of 20 meters and was conducted on lines extending 5 kilometers inland, spaced 10 kilometers apart. The results were particularly encouraging for the portion of the concession lying between the Morenja River and Pebane, although the preliminary reserve estimates were not available. The company planned to do intermediate-scale phase II infill drilling in this area in 1989. Toward yearend, Edlow was negotiating with the Government for exploration and mining rights to the Quelimane concession, which adjoins the south end of the Pebane concession.

The Ministry of Mineral Resources received a loan from the Italian Government for the expansion of existing marble quarries at Montepuez in Cabo Delgado Province and for setting up a cutting and polishing plant for production. The Italian company Technostone S.p.A. had the construction and technical contract for this project.

Geologic studies, begun in 1987, identified several deposits of graphite in gneisses in the Ancuabe area of Cabo Delgado Province. During 1988, further work was done on one of these deposits, resulting in the delineation of reserves of 20 million tons, grading 4.75% graphite. A preliminary feasibility study was prepared, and the Government was seeking private investors to develop the deposit.

Marwais Steel of the United States was studying the feasibility of assuming operation of the state-owned wire and rod mill near Maputo, which was operating at only about 10% capacity.

NAMIBIA[10]

The mining industry continued to be the major source of foreign exchange in 1988, accounting for about 85% of total exports. Production of most mineral commodities was up or similar to that for 1987, and interest in exploration increased. Implementation of an agreement among Angola, Cuba, and the Republic of South Africa began a process aimed at achieving national independence for Namibia.

The GDP was $1,538 million[11] in 1987, the latest year for which detailed statistics were available. Mining accounted for 24.9% of the GDP, compared with 22% for general Government, 12% for agriculture, 12% for wholesale and retail trade, and 7% for transport and communications. The mining sector made up almost 37% of total private sector contribution to the GDP. Total exports in 1987 were $889 million compared with $878 million in 1986, while the value of mineral exports was down by about 20% in that time period.

Government expenditures for the financial year ending March 31, 1989, were projected to be $860 million, an increase of 2.7% over 1988. The deficit was estimated at $343 million in that time period. The Republic of South Africa budgeted $136 million for Namibia's economy in 1988, and a similar amount was scheduled for 1989. No loans were made by the Government in 1986 and 1987, but such borrowing may constitute 5% of the GDP in future years. Combined direct taxes paid by mining companies, which were members of the Chamber of Mines (CM) in 1987, were $138 million or about 25% of total public revenue collected, and indirect taxes were $16 million. In 1987, the latest year available, the mining industry had capital expenditures of $46.4 million, and operating profit, minus depreciation, was $234.8 million, compared with $32.7 million and $343 million, respectively, in 1986.

Exploration expenditures in 1988 were a record $17 million, compared with $10 million in 1987. The Department of Economic Affairs issued 229 new prospecting licenses, compared with 197 in 1987. New claims registered jumped from 580 to 1,670, while there were 10 new prospecting grants compared with 29 in 1987. Of prime exploration interest were diamonds, precious and base metals, and granite and marble.

The total labor force of mines that were members of the CM was 13,073, compared with 12,905 in 1987. Remuneration to these workers, including cash and fringe benefits, was $110 million or 14.3% of total employee remuneration for the country. A total of 39 people were injured in mine accidents, giving a reportable injury rate of 2.98 per 1,000 workers. Total fatalities in the mining sector were 7, giving a fatality rate of 0.54 per 1,000 workers.

Gold Fields of South Africa Ltd. (GFSA) took over Newmont Mining Corp.'s 31% share of Tsumeb Corp. Ltd. (TCL) in early 1988. GFSA restructured its interests in Namibia by forming Gold Fields Namibia Ltd. (GFN), in Windhoek. GFSA held 69% of GFN; Seltrust Investments Ltd., 8.3%; BP Minerals Development Ltd., 3.5%; Southern Life Association Ltd., 6%; and General Mining Union Corp., 3.7%. GFN held 100% of Berg Aukas Ltd., Gold Fields Prospecting Co. (Pty.) Ltd., Namib Mines Ltd., Trekkopje Exploration and Mining Co. Ltd., TCL, and Tsumeb Exploration Co. Ltd. (TECO). In the 18-month period ending December 1988, GFN spent $3.4 million on exploration. The company also changed its financial yearend to December 31 from June 30.

Government Policies and Programs

Rossing Uranium Ltd., in cooperation with the Department of Water Affairs, was undertaking research to replenish underground water supplies through the intermittent damming of the perennial Khan River. Rossing obtained 90% of its water supply from the Kuiseb and Omaruru Rivers. Water availability was a major issue in certain areas of Namibia, and results of the $44,200 program may be viable elsewhere.

Production and Trade

Revenue accrued from Namibia's membership in the Southern African Customs Union was $193 million in 1987, the latest year available, compared with $154 million in 1986. Owing to overwhelming size of the economy of neighboring Republic of South Africa, Namibia's currency, manufacturing, and industrial base will continue to be dependent upon that country.

Several major well-established South African companies were investing $53 million in construction projects in Windhoek. Consolidated Mines (Pty.) Ltd. (CDM) opened its $13 million sorting and valuation facility in Windhoek under CSO Valuations Namibia (Valco). Output from Namibia had been shipped to the Republic of South Africa for sorting and valuation in Kimberley by a subsidiary of De Beers Consolidated Mines Ltd.

Commodity Review

Metals.—**Copper.**—As of January 1, 1988, TCL, the largest copper producer in Namibia, became a wholly owned subsidiary of GFN, and a portion of GFN's shares was listed on the Johannesburg Stock Exchange in October. In addition, TCL acquired all assets and liabilities of TECO. GFN's profits after taxes for the year ending December 31, 1988, were $25.4 million, compared with $10 million in 1987.

The Asis West section of the Kombat Mine, owned by GFN, was closed at yearend following flooding on November 8, 1988, that killed seven workers. The section was expected to remain closed in 1989. Work to repair flood damage included the installation of a concrete plug to seal the ruptured fissure, with total recovery cost estimated at $6.6 million. Mill activity was maintained at about one-third of capacity by treating surface dumps and some shallow ore, as well as expanding output from the Asis Est section of the mine to 10,000 tons per month. Output at the Tsumeb and Otjihase Mines was also to be expanded to make up for the shortfall from the Kombat Mine, using men and equipment from Kombat. Prior to the flooding, ore recovery at Kombat was 100% using cut-and-fill stoping. Total cemented backfill to the Tsumeb and Kombat Mines was 461,576 tons for a consumption of 23,294 tons of cement.

At the Tsumeb Mine, deep-level exploration was underway, as was evaluation of nearby deposits for extending mine life beyond the 7 years of reserves currently known.

At the Otjihase Mine, TCL encountered low efficiency and numerous maintenance problems from its recent implementation of an underground crushing and pumping system, with only about 300 tons per day of ore reaching the surface at high cost. TCL hoped to return to a system of ore passes and haulage to overcome the problem. In the Oblique block, site of most ore output, geological conditions and ore-body depth resulted in a denser rock-bolting pattern and larger support pillar size. Pillar reclamation amounted to 2% of total production. Mine development work was also being restricted by a lower availability of drill rigs and production also suffered because of high operator absenteeism for the roof-bolting rig.

Copper reserves for TCL, as of December 31, 1988, were 13.8 million tons averaging 2.75% copper. Of the company's total reserves, 3.2 million tons averaging 3.53% copper was at Tsumeb Mine; 3.3 million tons averaging 2.86% copper was at Kombat Mine; and 7.2 million tons averaging 2.35% copper was at Otjihase Mine.

Uncertainty in the political future of Namibia was believed to be responsible for a labor turnover of 14% in 1988, compared with 8% in 1987. At yearend, total employment was 3,996. The Mineworkers Union of Namibia (MUN) was granted an extended period of access to TCL's employees for further recruitment, while the South West Africa Mine Workers' Union gained recognition in June for the skilled category of workers at TCL's mines.

Gold.—Work on AAC's Navachab Mine continued with the awarding of a $2.5 million contract to Ovcon Civil Corp. for construction of a cement facility at the mine. Erongo Mining and Exploration Co., a subsidiary of AAC, was overseeing construction of the site and mine. It was to be an opencast mine with production of 14,000 tons of ore per week, and gold recovery would be by carbon-in-pulp and cyanidation. Site equipment would include a 1-kilometer-long conveyor feeding a

TABLE 10

NAMIBIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]	1984	1985	1986	1987[p]	1988[e]
METALS					
Antimony, Sb content of sodium antimonate	—	—	—	32	[3]98
Arsenic, white	2,504	2,471	2,208	1,864	[3]2,983
Cadmium metal, refined	40	58	61	51	[3]106
Columbium and tantalum: Tantalite concentrate, gross weight kilograms	[r]5,115	[r]3,113	8,186	13,809	15,000
Copper:					
Mine output, Cu content of concentrate	47,406	48,036	49,591	37,557	40,000
Metal, blister	46,436	43,295	45,688	35,488	[3]39,970
Gold, Au content of smelter products troy ounces	6,302	6,237	5,916	5,530	[3]6,269
Lead:					
Mine output, Pb content of concentrate	33,255	34,640	37,494	32,997	37,200
Metal, refined	28,930	38,511	40,047	40,634	[3]44,447
Silver, mine output, Ag content of concentrate thousand troy ounces	3,255	3,404	3,457	3,320	3,300
Tin, mine output, Sn content of concentrate	906	984	880	1,097	1,182
Uranium, U_3O_8 content of concentrate	4,400	4,400	3,990	4,175	4,100
Zinc, mine output, Zn content of concentrate	32,195	[r]30,332	35,371	39,650	36,000
INDUSTRIAL MINERALS					
Diamond:					
Gem[e] thousand carats	884	865	970	970	890
Industrial[e] do.	46	45	40	50	48
Total do.	**930**	**910**	**1,010**	**1,020**	**[3]938**
Granite	NA	NA	71	730	1,000
Limestone and marble	[r]23,464	[r]35,209	33,829	[e]32,000	35,000
Lithium minerals:					
Amblygonite	[r]58	[r]49	52	106	[3]147
Lepidolite	[r]18	[r]71	52	61	[3]18
Petalite	[r]829	[r]1,763	751	749	[3]1,477
Total	**[r]905**	**[r]1,873**	**855**	**916**	**[3]1,642**
Mica	[r]87	—	—	—	—
Quartz	20	300	851	2,273	[3]—
Salt	[r]88,376	[r]153,447	134,644	125,031	125,387
Semiprecious stones:					
Agate	41	65	87	100	100
Amethyst	105	21	37	189	200
Beryl	4	2	4	1	—
Chrysocolla kilograms	NA	NA	1,000	8,250	8,200
Dioptase do.	NA	NA	520	60	60
Rose quartz	369	299	172	365	370
Sodalite	—	140	NA	—	100
Tourmaline kilograms	306	745	2,878	1,709	1,700
Silica:					
High-purity	57	946	1,041	2,190	2,100
For flux	1,025	645	5,918	[e]6,000	6,000
Sulfur, S content of pyrite concentrate	104,454	107,718	133,824	74,354	75,000
Wollastonite	—	373	601	500	500

[e]Estimated. [p]Preliminary. [r]Revised. NA Not available.
[1]Table includes data through June 22, 1989.
[2]Data are compiled from the annual report of the Chamber of Mines of South West Africa-Namibia, and from operating company annual reports as follows: Tsumeb Corp. Ltd. (TCL), South African Iron and Steel Corp. Ltd., Gold Fields Namibia Ltd., De Beers Consolidated Mines Ltd., and others as available.
[3]Reported figure.

2,400-cubic-meter silo, a mill feed conveyor, a leach plant with seven leach tanks, an adsorption plant with seven tanks, an elution and regeneration area, and smelting facilities. Water supply would be from the Swakkoppoort Dam via an 85-kilometer-long pipeline. Total capital cost was $39.4 million, and mine life was about 13 years with initial ore reserves of 10.1 million tons averaging 0.07 troy ounce per ton. Total employment would be about 200. Initial output was planned for October 1989, and full production was planned for March 1990.

GFN has a gold prospect in the Ondundu area with an estimated 4.5 million tons of ore averaging 0.12 troy ounce per ton.

Remny Corp. of the United States signed a $1.5 million contract for gold mining rights in Rehoboth.

Lead.—Total refinery capacity was about 70,000 tons per year. Output of refined lead at TCL's smelter was 14,428 tons from TCL's mines and 30,019 tons from other sources. About 65,000 tons in concentrates was purchased from other sources, including Australia and Ireland.

Small ore bodies in the vicinity of the Kombat Mine, some mined previously, were being considered for exploitation. An abandoned mine near Gross Otavi, about 15 kilometers west of Kombat, was expected to produce 5,000 to 10,000 tons per year of ore for processing at Kombat.

Tantalum.—Severin Mining and Development Co. (Sevmin) of the Republic of South Africa was proceeding with plans to produce tantalum from a deposit 50 kilometers north of the Orange River in southern Namibia. The 40,000-acre site, which straddles both sides of the Orange River, was purchased by Sevmin from Utah Mining Co. of the United States in 1986.

Tin.—Imcor Tin (Pty.) Ltd., 100% owned by the Iron and Steel Corp. of South Africa (Iscor), had an $80,000 program underway to automate the tertiary crushing system at the Uis Mine. Implementation of the system will permit two crushers to replace the throughput capacity of the four crushers now used. The privatization of Iscor was expected to provide for the sale of Imcor shares to the public by about October 1989. Sale preference would be to company employees, including 550 self-employed Damara miners operating adjacent to the Uis Mine. About 90% of the tin required for electroplating at Iscor's Vanderbijlpark plant was obtained from the Uis Mine, where ore grade was about 0.139% tin.

GFN reported the discovery of about 1 million ton of ore grading 1.45% tin at Goantagab.

Zinc.—Imcor Zinc (Pty.) Ltd., which operates the Rosh Pinah Mine, was 51% owned by Iscor and 49% owned by Moly-Copper Co. About 70,000 tons per year of zinc concentrate was shipped to Zinc Corp. of South Africa Ltd. near

TABLE 11

NAMIBIA: GROSS WEIGHT AND ELEMENTAL CONTENT OF ORE AND CONCENTRATE PRODUCED IN 1988, BY MINE

(Metric tons unless otherwise specified)

Mine or mill	Gross weight	Elemental content				
		Copper	Lead	Zinc	Sulfur	Silver (troy ounces)
Kombat:						
Ore	350,689	10,833	3,629	—	NA	270,066
Concentrate:						
Copper	33,933	9,716	2,788	—	NA	245,889
Lead	1,701					
Otjihase:						
Ore	831,570	16,016	—	—	e154,200	149,372
Concentrate:						
Copper	55,789	15,148	—	—	e19,300	115,968
Pyrite	226,682		—	—	e115,200	—
Rosh Pinah:						
Ore[e]	NA	—	14,000	37,800	NA	NA
Concentrate:						
Lead	20,627	—	8,881	e950	NA	835,918
Zinc	65,281	—	e4,300	34,194	NA	e595,000
Slag mill:						
Ore (slag)	229,200	2,642	NA	—	NA	68,063
Concentrate	NA	1,100	403	—	NA	46,040
Tsumeb:						
Ore	620,906	17,228	19,189	e7,100	NA	2,168,082
Concentrate:						
Copper	e110,000	14,928	15,716	e2,500	NA	1,907,372
Lead						
Total:						
Ore	XX	46,719	36,818	44,900	e154,200	NA
Concentrate	XX	40,892	32,088	36,694	e134,500	3,746,187

eEstimated. NA Not available. XX Not applicable.

Springs, Republic of South Africa, for refining and shipping to Iscor's Vanderbijlpark plant. Milling capacity was about 600,000 tons per year, and mine life was about 15 years at current production levels.

Industrial Minerals.—**Diamond.**—CDM's capital expenditures and working cost for 1988 were estimated at $142.4 million, one-half of which flowed directly into the Namibian economy. CDM was responsible for about one-half of all direct taxes paid to the Government by the mining industry and 13% of all public revenue collected. Out of every 10 workers in the mining industry, 4 were employed by CDM earning about $35.4 million.

Average recovery grade continued to decline. CDM treated 16 million tons of ore, compared with 13 million in 1987. Ore grade was 5.8 carats per 100 tons, compared with 7.6 carats per 100 tons, respectively. Total overburden stripped was 42.8 million tons, compared with 32.2 million in 1987. This was attributed to a higher waste-to-ore ratio in the mining areas and the need to expose more ore for supplying the recommissioned No. 3 plant and the newly commissioned No. 4 plant's pretreatment facility. CDM's second bucket-wheel excavator was reactivated for meeting the higher waste and ore removal rates.

CDM had technical problems at the No. 1 plant in the recrushing of tailings and was unable to reach planned throughput. Although the pretreatment facility south of the No. 4 plant was commissioned, full production could not be achieved because higher than expected variations in the composition of feed material necessitated modifications, which were completed at yearend. CDM continued its trial dredging program for removal of overburden in the No. 4 plant area, and it completed construction of a floating screening plant to process dredged product. The process may afford successful processing of randomly distributed gravel lenses in the overburden, possibly leading to a larger scale operation.

In the No. 3 plant area, mining advanced 500 meters farther north. Despite heavy seas, the seawall was maintained 290 meters seaward of the highwater mark, with mining taking place at a depth of 5.5 meters below mean sea level. In the No. 2 plant area, mining covered over 700 meters of shore in two separate sections.

Positive results from prospecting supported the viability of another mining operation within Diamond Area No. 1 at Elizabeth Bay, about 30 kilometers south of Luderitz. Cost would be $60 million, and output would be 4 million tons per year of ore yielding 250,000 carats per year. Output would commence in 1991, and reserves were reported at 10 years at the planned production rate. Diamonds found at Elizabeth Bay are smaller than those found elsewhere in CDM's concessions, and final recovery from concentrates would take place at Oranjemund. The labor force was projected to be 350.

At Auchas, on the Orange River, CDM was proceeding with plans for a new $40 million mine, construction of which was to begin in 1989. Output at Auchas would be 1.2 million tons per year of ore following removal of 5.2 million tons per year of overburden. Yield would be 43,500 carats per year, with a recovery grade of about 3.6 carats per 100 tons, or about one-half CDM's average recovery for Namibia in 1987. Reserves were sufficient for 10 years of production at the projected rate, and output was to begin in late 1990. In addition to the Auchas site, nearby Arrisdrift and Daberas may also be opened.

CDM and MUN reached agreement on wages, overtime, shift and standby allowances, and annual leave. Wages in the lowest subgrade were to increase $44.35 per month, or 21.5%, and in the highest subgrade, $73.80 per month, or 20%. MUN originally sought a 35% increase in wages.

Fluorspar.—Okorusu Fluorspar (Pty.) Ltd. began crushing and milling of ore in September at the Okorusu Mine, north of Otjiwarongo. Production was estimated at 1,000 tons per week of fluorite, and reserves were about 3 million tons. The major shareholders were British, and Iscor, a minor shareholder, owned the concession. Capitalization for the project was $1.8 million, of which $800,000 was from the First National Development Corp. Exports were to Europe via Walvis Bay.

Mineral Fuels.—**Natural Gas.**—Results by South West Africa Oil and Exploration Corp. (Pty.) Ltd. (Swakor) from the latest drilling program were said to be positive. A French offshore drilling rig completed a 4,526-meter test well, intersecting 90 meters of gas-bearing sandstone.

The company planned a $797,000 seismic survey in the Kudu area to be conducted in February and March 1989. About 800 kilometers of seismic data would supplement the 360 kilometers surveyed in 1985. Swakor was to establish a library for the storage and maintenance of all reports, studies, and research data on oil and gas, and determine which would be available for sale to interested parties.

A joint venture involving United States and Taiwan interests was formed to investigate the onshore oil potential of an area near Etosha Pan.

Uranium.—RTZ Corp. fully regained its $164.3 million startup costs for the Rossing Mine, and with state-of-the-art processing technology has remained profitable despite nonrenewal of expiring long-term contracts. All uranium output was delivered under long-term contracts, which carried a higher price than either current contracts or spot market prices. Output was reported at 80% of capacity. Owing to the Comprehensive Anti-Apartheid Act of 1986, which embargoed uranium imports from the Republic of South Africa-Namibia, sales could not be made directly to the

United States. Exports were in 400-kilogram steel drums via Walvis Bay and were primarily to the United Kingdom and Europe. The labor force was about 2,000, and average take-home salary was about $657 per month. Rent, water, and electricity costs to the workers were nearly 100% subsidized by the company. The Rossing Mine provided about 35% of Namibia's export earnings and 17% of the GNP.

A $531,000 order was placed with Siemens Ltd. for extensions to the direct current electric overhead trolley system. The alternative power supply for Rossing Mine's 170-ton haul trucks will reduce fuel consumption from 24 liters per kilometer to less than 4 liters per kilometer and will allow twice the normal operating speed. About 50% of the equipment would be supplied from the Republic of South Africa and the remainder from the Federal Republic of Germany.

SWAZILAND[12]

Mining was a small but important factor in Swaziland's economy, accounting for about 4% of the country's GDP which was dominated by agriculture, particularly the production of sugar, citrus fruit, and wood pulp. Overall mining revenues decreased 0.3% to $19.12 million[13] in 1988, although in local currency terms the revenues increased by 12%. Asbestos continued to be the largest mining revenue earner, followed by diamonds, coal, and crushed stone. Swaziland's workforce included an estimated 92,000 wage earners, of whom about 2,100 worked in mines in Swaziland. In addition, about 17,000 Swazis worked in mines in the Republic of South Africa. It was estimated that about 13% of Swaziland's population was directly supported by mine wages, which totaled approximately $45 million in 1987.

About 90% of Swaziland's imports originated in or passed through the Republic of South Africa. In 1987, imports were $431.5 million, of which mineral fuels and lubricants, for which the country was entirely import-dependent, comprised almost $65 million. Swaziland's exports totaled almost $400 million. About 40% of the country's exports went to the Republic of South Africa. Trade with the United States was minor, consisting of about $19 million in exports to the United States and only about $4 million in imports. None of the trade with the United States was in mineral commodities.

Minerals in Swaziland were vested in the King, in trust for the Swazi nation. Mining matters were overseen by a Minerals Committee, which was completely restaffed in late 1987. At that time, a Minerals Negotiations Committee was formed to renegotiate certain existing mining leases. Higher royalty agreements were negotiated in late 1988 with Emaswati Coal (Pty.) Ltd. and with the operators of the Dvokolwako[14] Mine. The new agreement with the coal company provided for a production-related royalty of between 3% and 5%. The company was to pay 12.5% of gross revenues, instead of the 7% of net revenues paid previously. In both cases, the new royalties were to be applied retroactively to the commencement of mining.

Most mining ventures had state participation through Tibiyo Taka Ngwane (TTN), formed in 1968. Through its investments, this organization became self-supporting in 1976 and since that time, mine royalties have been diverted to another parastatal, Tisuka Taka Ngwane, for the support of housing and infrastructure development.

Asbestos was produced solely by the Havelock Asbestos Mine in the Makhonja Mountains in the northwest part of the country. The mine was operated by Turner & Newall Group PLC of the United Kingdom, in joint ownership with the Government. Production had suffered in recent years because of declining grades, increasingly difficult ground, and low world asbestos prices, which were partly related to health concerns. In addition, reserves were expected to be exhausted by 1990. Additional reserves had been outlined nearby in what was known as the Far West Area, but permission to mine there had been delayed by the Government, pending review of certain management, health, and environmental issues.

Asbestos fiber production declined 12% to about 23,000 tons, and revenues declined 16.4% to about $8.5 million. Total ore milled declined almost 18% to 600,500 tons. The grade, however, was slightly higher at 3.86% fiber.

Total asbestos sales in 1988 declined 19% to 22,820 tons, of which 22,570 tons were exports. Of these exports, 9,900 tons were to the Republic of South Africa, 3,870 tons were to Thailand, 3,100 tons were to France, and 2,740 tons were to Japan. All exports were through Barberton in the Republic of South Africa.

A revised mining plan was introduced in February, under which the staff at the Havelock Mine was reduced from 1,876 to 1,484 workers, and the production rate was cut 20% to 50,000 tons per month of ore. However, in February, the Government guaranteed a $4.4 million loan from Barclays Bank to the mine to keep the company solvent until operations could be transferred to the Far West Area. In April, an exclusive prospecting license was granted to the company for the Far West Area, and this was converted to a mining lease in December. Asbestos production from the new area was scheduled to start in early 1989, with full production expected by mid-1990.

Coal (anthracite) was produced at Mpaka by Emaswati Coal (Pty.) Ltd., which was managed by Trans-Natal Coal Corp., a subsidiary of General Mining Union Corp. of the Republic of South Africa. Coal production decreased slightly to 164,845 tons. Mine revenues decreased 4.6% to $3.1 million. Total sales increased 2.4% to 191,570 tons. Export sales increased

2% to 160,240 tons. Export revenues were $2.51 million, down slightly in dollar terms from 1987 of $2.6 million, but up 7.5% in terms of local currency. As in years past, the largest purchaser of Mpaka coal was the Bamburi Cement Works in Kenya, which took 130,690 tons in 1988. The Republic of Korea took 29,550 tons. Domestic sales were largely to various sugar estates. Coal exports were transported by rail largely to the port of Maputo in Mozambique. Transport by this route suffered from attacks in Mozambique by guerrilla forces, especially in the first half of the year and in November. At such times, coal shipments were rerouted to the export facilities at Richards Bay, Republic of South Africa. In 1988, some production at Mpaka was from a new production area to the south of the old workings. Modifications to some of the old underground workings were underway during the year. The processing facilities were planned to be upgraded during 1989. The coal mine employed 352 workers.

Diamonds were produced at the Dvokolwako Mine, operated and owned 50% by Trans Hex, a subsidiary of the Rembrandt Group, Republic of South Africa. The remaining 50% was owned by the Swazi nation. Reported production in 1988 was almost 73,000 carats, an apparent decrease from estimated 1987 production levels, but well in excess of earlier production. Mine revenues were $6.52 million, well above the 1987 revenues of $4.94 million and the 1986 revenues of approximately $2 million. Diamond sales were held in Europe, independent of De Beers' CSO, and overlapped the production years. The diamonds were described as being mostly industrials, but with some low-quality and a few high-quality gems. Sales and ex-mine revenues suggest that the Dvokolwako diamonds were fetching on average in excess of $70 per carat.

The Dvokolwako Mine was an open pit operation exploiting weathered kimberlite having a surface extent of almost 3 hectares. The deposit had been drill-proved to a depth of 80 meters, and the company was planning to test the deposit to a depth of at least 250 meters. The company expected to extend the open pit to 60 to 80 meters depth, and then to mine underground in fresh kimberlite below that depth. In 1988, the mine employed 149 workers.

There were two commercial stone quarries in operation throughout the year. Another quarry, near Lavumisa, was reopened during the first quarter to supply road metal for a local road-tarring project.

Total stone production increased 11.5% to 107,205 cubic meters. Revenues increased almost 21% to slightly more than $1 million. This increase was largely owing to a 34% increase, 91,025 cubic meters, which in turn reflected an increase in construction in the country from April.

Australian Overseas Mining Ltd. (AOM) announced that the Government had approved a high-carbon ferrochrome plant having an annual production capacity of 120,000 tons of ferrochrome. The plant was to use kiln reduction technology developed by Krupp Industrie of the Federal Republic of Germany to produce a 55% chromium ferrochrome product. The plant would use about 1,150 kilowatts electricity per ton of product, which was to be supplied through the Swaziland grid, but which would necessitate additional purchases of electricity from the Republic of South Africa. Negotiations between the Government and the Republic of South Africa over the price of this electricity were ongoing late in the year. The remainder of the plant's energy requirements were to be met with anthracite from the Mpaka Mine. The chromite was to be imported from the Dilikong Mine in Lebowa, Republic of South Africa.

The project was originally a joint venture among Australian companies AOM, 35%; German Mines Ltd., 20%; and Boulder Gold, through its subsidiary Chrome Corp. Interna-

TABLE 12

SWAZILAND: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1984	1985	1986	1987[p]	1988[e]
Asbestos, chrysotile		25,832	25,130	20,908	25,925	[3]22,804
Coal, anthracite		124,569	166,179	172,145	165,371	[3]164,845
Diamond	carats	16,837	21,128	39,144	[r e]80,00	[3]72,676
Stone: Quarry product	cubic meters	97,657	83,903	120,723	96,114	[3]107,205
Tin, mine output, Sn content		1	—	—	—	—

[e]Estimated. [p]Preliminary. [r]Revised.
[1]Includes data available through Feb. 20, 1990.
[2]In addition to the commodities listed, modest quantities of unlisted varieties of crude construction materials (clays, sand and gravel, and stone) presumably are produced, but output is not reported quantitatively, and available information is inadequate to make reliable estimates of output levels.
[3]Reported figure.

tional, 10%; Luxembourg companies International Metals S.A. and Luxembourg Alloys Co., 10% each; and the Swazi nation, 15%. Later in the year, TTN acquired the shares of Luxembourg Alloys and half the shares of International Metals. Toward yearend, the joint venture was seeking an operating partner. There was some doubt as to the economics of the project, especially given planned ferrochrome capacity increases at plants elsewhere in the world, most notably in the Republic of South Africa.

Swaziland was an important gold producer earlier in the century. While several companies were continuing to explore for gold in the Piggs Peak and Nhlangano areas, there was no commercial gold production in 1988. Swaziland's recoverable coal reserves were estimated to be in excess of 1 billion tons, and it was considered quite likely that a second coal mine would be established by the mid-1990's. Swaziland had significant resources of various industrial minerals and the Government was actively seeking foreign firms to test some of the deposits. The country had once had minor tin production, but the potential for developing new tin mining was considered minimal in light of low world tin prices. Swaziland had significant resources of low-grade iron mineralization, primarily near the old Ngwenya Iron Mine, which closed in 1977.

Tenders were sent to various French firms to study the feasibility of constructing a hydroelectric dam on the Komati River. The French Government and the World Bank were to finance the construction project, which was expected to cost at least $43 million. In order to reduce the country's dependence on imported fuel, the Government was strongly supporting a project to establish an ethanol production plant in Mhlume in the northern part of the country. The plant was to utilize the abundant molasses produced by the sugar plantations. Project Engineering Africa, of the Republic of South Africa, was conducting the feasibility study of the estimated $8.3 million project, which was envisioned as producing about 63,000 barrels of ethanol per year by 1990. A feasibility study completed in 1987 recommended that plans be dropped for the construction of a second, smaller plant in the eastern part of the country.

ZAMBIA[15]

Zambia's economy hinged on its mineral industry in 1988 as in previous years. The minerals sector provided about 15% of the GDP and about 90% of export earnings. Refined copper alone, of which Zambia continued to be among the top one-half dozen world producers, earned over $1 billion[16] or about 85% of export earnings. A strategic coproduct, cobalt, was also important. Zambia was outranked in world output only by Zaire and cobalt sales generated about $70 million. Precious and semiprecious gem stones, especially emeralds, and zinc were also significant in the world market. Cement, coal, lime, and nitrogen were important products locally. In addition to other mineral production, the potential for adding nickel and iron was being investigated.

Although the economy depended heavily on the mineral industry, reports indicated that the sector directly employed only 62,000 workers, compared with an estimated 350,000 formally employed in industry, commerce, and Government. Some estimates indicate that five or more other jobs were dependent on each worker employed in the mining sector. Furthermore, many small-scale miners undoubtedly escaped counting. About 2.5 million citizens were said to be economically active, and about 85% of these were in agriculture. Total population, having grown about 3.6% during the year, was about 7.75 million at yearend.

Training of personnel to upgrade skills continued to be a recognized need for the mineral industry, particularly by Zambia Consolidated Copper Mines Ltd. (ZCCM), which employed more than 85% of the mineral-sector workers, including 1,371 expatriates. Inhouse programs were used to train many employees at ZCCM, plus some 300 awards for study either locally or abroad.

In the work force area, ZCCM, through the Copper Mining Enterprises Trust (COMET) it established, reportedly allotted the equivalent of about $1 million to reopen the Kansanshi copper mine, about 250 kilometers west of Kitwe. Otherwise unneeded miners would be kept at work while training unemployed youths. COMET had operating workshops and a small zinc mine in the Kabwe Div.

In general, Zambia continued to face serious economic difficulties despite record-high copper prices and a bumper corn crop in 1988. These two positive developments only partially offset damage done by years of low copper prices, falling copper production, drought, high birth rate, and management problems in Government and parastatal firms. The latter companies dominated the industrial scene, accounting for more than 60% of GDP. The resulting conditions contributed to rising unemployment, severe constraints on imports, and growing foreign debt. The chronic shortage of foreign exchange restricted industrial growth, industrial diversification, and maintenance programs.

Among the economic reforms announced early in 1988, the Government scrapped the mineral export tax. It also granted ZCCM permission to retain up to 40% of its export earnings.

In November the Government devalued the kwacha from 8 to 10 per U.S. dollar, thus boosting export revenues, and, at yearend, appeared to be considering some kind of rapprochement with the IMF.

Zambia's GDP, according to data published by the IMF, was equivalent to $2,737 million in 1988, based on the annual average exchange rate. This was 24% higher than in 1987, even though on a kwacha basis it was only 15% higher. But in constant dollars the real growth was elsewhere reported to be only 2.7%. Consumer prices increased more than 55% during the year according to the IMF data.

The United Nations Revolving Fund for Mineral Exploration promised to help Zambia in setting up a trust bank presumably with emphasis on promoting small-scale mining. Donors were being sought. The World Bank was also reported to be involved.

The Ministry of Mines announced reexamination of all licenses of small-scale miners of gem stones because of evidence of failure to declare their production. This was in line with a campaign to cut the widespread smuggling and black-market operations, which were given prominent notice in several Government releases. Preventing any further theft of copper from rail shipments was also given attention by the Government.

Transportation problems, especially railcar and locomotive shortages on the Tanzania-Zambia Railway Authority (Tazara) railroad connecting the Copperbelt, Lusaka, and Dar es Salaam in Tanzania. Problems on the rail and road-rail routes between Lusaka and Beira in Mozambique also continued to be reported.

Austria, Australia, China, the Federal Republic of Germany, and the United Kingdom, as well as international organizations, pledged assistance to Tazara's 10-year development plan. The plan gave priority to telecommunications, locomotives, and railcars. Tazara raised rates 10% in July partly to finance the plan.

Road repair also received funding from the African Development Bank and bilateral donors as did the crude oil pipeline from Dar es Salaam to Zambia's Copperbelt refinery at Ndola. Pipeline rehabilitation began in July. Work on the 1,710-kilometer Tazama pipeline was being done by Snamprogetti S.p.A. of Italy and was being financed by an Italian Government loan. Repair of leaks was a major component of the project.

Production and Trade

The value of mineral production was higher in 1988 than in 1987. However, although revenues from copper, the key mineral commodity, increased due to higher market prices and reduction of the mineral export tax, the quantity produced declined. The chronic decline was due to a lack of spare parts, mismanagement, and transportation problems. Additionally, equipment and work force skills have deteriorated.

Cobalt and zinc production was up slightly as was gem stone production. Much of the emerald production was reported to be marketed through illegal channels, and the Government was making efforts to gain effective control of marketing.

The value of exports increased 31% in 1988 to the equivalent of $1,190 billion according to IMF data. Apparently due to the dominance of copper, Japan was the major destination by far for exports based on value. Other leading exports, ranked in order of value, were zinc, cobalt, lead, and tobacco. Zinc and cobalt were the two principal U.S. imports from Zambia. In recent years France, India, and Italy were consistently large buyers of copper; and smaller purchases were made by Greece and Thailand. All exports were hampered by transportation difficulties especially on the Tazara railroad to Dar es Salaam, which in 1986–88 was estimated to have been the route for 75% to 85% of the copper. The balance of copper went primarily through Beira in 1988. During 1988, the Ministry of Mines announced that copper shipments through the Republic of South Africa, a major route in earlier years, had ceased completely in March 1987.

Imports were equivalent to $834 million according to IMF data, essentially the same as in 1987 on a dollar basis. Principal items were machinery, electricity, mineral fuels, manufactures, and chemicals. Sources were mainly the Republic of South Africa, the United Kingdom, and Saudi Arabia (for crude oil). Crude petroleum was by far the major mineral import, and iron and steel and fertilizer were of less importance. Mining equipment was the major import from the United States. However, the shortage of foreign exchange severely limited the importation of items crucial to maintaining, much less increasing, industrial production.

Commodity Review

Metals.—**Cobalt.**—Cobalt production increased only slightly in the year ending March 31, 1989 (fiscal year 1988), according to late reports of ZCCM. In January, ZCCM, jointly with Gecamines in Zaire, announced a $0.50 per pound increase to $7.50 for the so-called producer price of cobalt. In November, the two producers also proposed a quality grading program and asked consumers to make suggestions.

Memaco Trading Ltd., sales agents for ZCCM's cobalt, started up a U.S. subsidiary in April with offices near Cleveland, Ohio, and a warehouse in New Jersey.

Copper.—ZCCM's output of refined copper dropped more than 10% in fiscal year 1988, ending March 31, 1989, but revenue increased and profits soared 500% due to higher prices, lower taxes, and the devalued kwacha. Late 1988 delays in export shipments prevented profits from being higher. The company repeated claims that continued production declines were due to a variety of operating problems. One problem was that open pit ore production was lost due to the need to complete overburden stripping. Other problems were: loss of expatriates resulting from the Zambianization program; lower equipment availability due to poor maintenance caused by lack of trained personnel and spare parts, the latter the result of inadequate alloca-

TABLE 13

ZAMBIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987[p]	1988[p]
METALS						
Beryllium: Beryl	kilograms	[e]100	482	723	1,131	1,343
Cobalt:[2]						
Mine output:						
Ore milled, gross weight	thousand tons	6,938	6,681	6,864	7,015	[e]7,000
Co content		8,652	10,445	8,656	11,198	[e]11,000
Concentrate:						
Gross weight		197,912	244,531	294,569	295,285	[e]295,000
Co content		4,344	6,674	5,682	7,315	[e]7,000
Metal:						
Materials treated, gross weight		261,226	230,649	281,189	286,024	[e]285,000
Co content		6,049	6,459	5,743	7,261	[e]7,000
Refined electrolytic cathode		3,654	4,565	4,160	4,694	4,871
Copper:[2]						
Mine output:						
Ore milled, gross weight	thousand tons	28,721	25,372	26,010	24,419	[3]23,517
Cu content		633,203	553,161	537,261	507,446	[3]632,607
Concentrate:						
Gross weight[4]		1,938,414	1,624,252	1,682,355	1,642,907	[e]1,500,000
Cu content[4]		510,840	429,450	423,397	403,450	[e]375,000
Electrowon cathode from tailings leachate		75,128	63,182	90,598	98,306	[e]100,000
Metal:						
Smelter:						
Blister anodes[5]		416,734	386,963	349,469	347,904	[e]315,000
Electrowon cathodes from copper ore tailings and concentrate leachate		105,861	81,877	113,252	117,246	[e]110,000
Electrowon cathodes from cobalt ore concentrate leachate		20,048	22,033	26,556	27,228	[e]30,000
Total		**542,643**	**490,873**	**489,277**	**492,383**	**[e]455,000**
Refined:						
Electro refined[6]		397,861	383,450	352,150	347,342	311,983
Shapes[7]		93,753	79,872	94,376	79,281	85,728
Electrowon[8]		38,696	33,193	51,068	69,638	51,848
Total		**530,310**	**496,515**	**497,594**	**496,261**	**449,559**
Gold[9]	troy ounces	12,185	7,909	1,865	11,253	8,423
Iron ore: Magnetite		595	984	637	910	445
Lead:						
Mine output, Pb content of ore		18,124	15,021	14,851	14,516	11,782
Metal, refined[10]		8,825	8,873	6,648	7,979	6,385
Manganese concentrate (77% Mn), gross weight		250	1,870	554	—	502
Selenium:						
Refinery muds, Se content[e]	kilograms	33,650	37,790	29,870	42,650	40,000
Metal, refined[10]	do.	19,490	15,405	22,150	26,819	[3]24,350
Silver[9]	thousand troy ounces	795	607	861	961	943
Tin concentrate, gross weight		4	22	3	24	2
Zinc:						
Mine output, Zn content of ore		41,128	31,956	33,017	35,443	33,895
Metal, smelter and refined		29,177	22,766	22,493	21,025	20,220

See footnotes at end of table.

TABLE 13—Continued

ZAMBIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987[p]	1988[p]
INDUSTRIAL MINERALS						
Cement, hydraulic	thousand tons	241	316	334	375	405
Clay: Brick		12,010	2,612	4,627	6,606	[e]5,000
Building, not further specified		209	2,290	4,627	3,096	1,000
China		331	642	515	315	367
Feldspar		184	185	214	45	120
Gem stones:						
Amethyst	kilograms	24,827	19,612	6,991	3,757	4,701
Aquamarine	do.	1	3	([11])	63	56
Emerald	do.	23	115	413	992	1,039
Lime, hydraulic and quicklime	thousand tons	232	256	243	235	239
Nitrogen: N content of ammonia		27,900	17,600	[r]24,700	[r]33,330	16,200
Pyrite concentrate, gross weight		18,172	28,288	19,187	45,447	67,487
Sand and gravel, construction	thousand tons	78	61	129	[e]75	[e]75
Stone:						
Limestone	do.	916	702	705	720	999
Phyllite	do.	17	13	19	22	25
Miscellaneous (building)	do.	73	108	134	130	1,536
Sulfur, byproduct:[e]						
S content of pyrite concentrate		7,800	11,900	8,000	19,400	27,300
S content of sulfuric acid from smelter gas		79,000	79,000	74,000	74,000	74,000
Total		**86,800**	**90,900**	**82,000**	**93,400**	**101,300**
Talc		367	[e]1,900	266	258	73
MINERAL FUELS AND RELATED MATERIALS						
Coal, bituminous	thousand tons	510	471	557	463	524
Petroleum, refinery products:[2]						
Liquified petroleum gas	thousand 42-gallon barrels	[r]72	[r]75	60	77	84
Gasoline	do.	[r]1,020	[r]873	916	972	1,149
Jet fuel	do.	[r]347	[r]291	361	416	520
Kerosene	do.	[r]216	[r]198	239	253	318
Distillate fuel oil	do.	[r]1,706	[r]1,604	2,078	2,041	2,149
Residual fuel oil	do.	[r]761	[r]670	624	615	564
Other, including refinery fuel and losses	do.	[r]374	[r]362	418	407	466
Total	**do.**	**[r]4,496**	**[r]4,073**	**4,696**	**[r]4,781**	**5,250**

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

[1] Table includes data available through Sept. 1, 1989.

[2] Data are for year beginning Apr. 1 of that stated.

[3] Data are for calendar year ending Dec. 31 of year stated.

[4] Includes cobalt concentrates as shown under cobalt entry above, all of which contain some copper that is recovered.

[5] Includes following quantity of blister anodes produced on toll from Zairean concentrates in metric tons: 1984-9,964, 1985-32,300; 1986-26,897; 1987-29,077; 1988-[e]26,000.

[6] Includes the following quantity of electrolytic refined cathodes produced on toll from Zairean concentrates processed into blister copper in metric tons: 1984-4,499; 1985-33,161; 1986-26,111; 1987-28,099; 1988-[e]25,000.

[7] Reported as "finished production, shapes" (wirebar and billets), presumably produced from furnace-refined lower grade electrowon cathodes and/or high-grade electrowon cathodes and some furnace-refined blister anodes.

[8] Reported as "finished production, leach cathodes," presumably sufficiently high-grade electrowon cathodes that required no further refining. In 1986 and 1987, apparently also included electrowon cathodes not further refined but not necessarily high-grade, produced on toll by one company for another, amounting to 501 tons in 1986 and 106 tons in 1987.

[9] Mostly from refinery muds.

[10] For practical purposes, Zambian outputs of crude and refined lead metal are regarded as equal.

[11] Less than 1/2 unit.

tion of foreign exchange; supply shortages due to transportation bottlenecks; low worker productivity and poor supervision; and, early in 1988, a shortage of sulfuric acid. No major improvements were expected for the immediate future, although about $9 million was set aside for training replacements for expatriates.

Ndana smelter was reportedly being overhauled early in 1988 and technology from Chile was to be introduced, according to ZCCM officials.

Plans to reopen the Kankola Shaft No. 3 were announced by ZCCM, and Chinese Trust & Investment Corp. officials were reportedly discussing with ZCCM the possible reopening of the Chambishi Mine, which was closed in 1986, as part of ZCCM's 5-year plan for reconstruction of the industry.

Reports of extensive fire damage to a sulfuric acid plant at ZCCM's Nkana Div. in September were quickly disclaimed by the company. Only small damage to an outlet duct without loss of production occurred.

ARA Inc., a Tamrock subsidiary, was awarded a 4-year contract to supply about 40 load-haul-dump vehicles and services to ZCCM. Reportedly worth $75 million, it was claimed to be one of the largest supply contracts ever given to an underground loader equipment company. The contract was expected to reduce the parts supply problems in addition to other benefits.

Interests in reopening the Mkushi copper mine and concentrator south of the Copperbelt was being promoted by a Zambian company late in the year. The operation was closed in 1975 by its Italian owner.

Gold.—Prospecting by French, British, and Italian companies was announced by the Minister of Mines late in 1988. ZCCM also was active, particularly at Matala, a former producer, 130 kilometers west of Lusaka, where resources of 30,000 ounces of fine gold were reported.

At yearend, ZCCM's Small Mines Development Unit was reportedly planning to reopen the Dunrobin operation in the same locality. Old tailings estimated to contain 58 kilograms of gold in 68,600 tons of tailings, would be processed in about 2 years using shovels, wheelbarrows, and cyanide leach tanks. The mine, operated from 1928 to 1932 until water inflow caused its closing, was also being considered for reopening. Twenty other deposits that were worked before World War II were also being considered for reopening. They are located in Mumbwa District, Central Province. Another 83 occurrences to be examined reportedly stretch 600 kilometers to the Petauke District in Eastern Province.

Iron and Steel.—Based on results of a feasibility study, the U.S.S.R. and Zambia were reported to have signed an agreement in December on establishing an iron and steel plant in Zambia. Agreement details were not announced, but such a plant was one of the major projects in Zambia's Fourth National Development Plan ending in 1993. It was to be based on local high-grade iron ore (containing up to 60% iron), coal, and limestone using a rotary-kiln direct-reduction process. Contracts for construction were expected to be signed by yearend 1989. During 1989, engineers from the U.S.S.R. were to further investigate the project's first phase, which was to provide a 100,000-ton-per-year steel capacity within 5 years.

Lead and Zinc.—Production of lead and zinc was reported to have been lower in fiscal year 1988 in line with recent trends caused by depletion of ore and the mining of lower grades.

The Finnish Development Agency and Outokumpu of Finland were considering support to a lead-zinc project in the Kabwe area, 75 kilometers north of Lusaka.

Nickel.—The Munali nickel deposit was being restudied by Apollo Mining Ltd. of Zambia, owner of the license for the site. The site was about 65 kilometers south of Lusaka and was outlined with 68 drill holes, some completed to depths of 800 meters.

***Industrial Minerals.*—Gem Stones.**—A new company, Kariba Minerals Ltd., was announced as a joint venture between Lonrho PLC and the Zambian Government to mine amethyst at Mapatizya in the Zambezi Valley. According to the report, the deposits had been worked in the 1960's and early 1970's.

Nitrogen.—A contract for revamping ammonia and other facilities of Nitrogen Chemicals of Zambia at Kafue was reported in March.

Sulfur.—Iron pyrite production of 28,843 tons hoisted broke the record in June at the Nampundwe Mine near Lusaka. The nominal 40% sulfur concentrates were trucked to acid plants on the Copperbelt to make acid for use in ZCCM's tailings leach plants.

***Mineral Fuels.*—Coal.**—Maamba Collieries of Zambia produced 500,000 tons of coal in 1988 and in fiscal year 1988, ending March 31, 1989, made more than $3.5 million profit, more than 11 times the previous year's profit. The company credits the improvement to the continuing rehabilitation program at the mine.

Petroleum.—Exploration.—According to Zambian news agencies, Placid Oil Co. of the United States, which had been prospecting in Western Province, had ceased operation and returned some equipment to the United States. Reason for the action was not known.

Pipeline.—European Investment Bank was reportedly planning to lend $16 million for rehabilitation of the Dar es Salaam to Ndola pipeline.

ZIMBABWE[17]

In 1988, the volume of crude mineral production declined slightly, but the value increased 20% in Zimbabwean dollars and 12% in U.S. dollars to $547 million.[18] Higher commodity prices worldwide were primarily responsible for the increase. Gold again had the highest value in terms of crude mineral production at $380 million. Nickel had the highest increase in value of any commodity. In terms of export value, ferrochromium was the highest foreign-exchange earner for the mineral industry at $399 million.

Revised data for the real GDP indicate that since independence in 1980 the economy has grown at an average rate of 3% per year, slightly above the rate of population growth. A minimum of about 5.5% real growth was necessary to absorb new employees and provide a reasonable increase in per-capita income. GDP in 1988 was $5.6 billion, and the actual growth was 4.9%. The budget deficit for 1988-89 was estimated at about $600 million and resulted primarily from spending on defense, education, and subsidies to parastatal corporations. Subsidies to the latter totaled $330 million and included the Zimbabwe Iron and Steel Co. (Zisco) and the National Railways of Zimbabwe (NRZ). The inflation rate was estimated at 15%, exacerbating the mining industry's shortage of foreign exchange, and was forecast to deteriorate further.

The mining industry was hampered by a severe shortage of foreign exchange. The Chamber of Mines requested $98 million in foreign exchange for the industry but received less than 50% of that asked. The inability to secure spare parts and equipment caused loss of production in some mines, and lost development and even exploration drilling at others. An estimated $28 million of exportable output was reportedly lost because of a foreign-exchange shortage.

The budget of the Ministry of Mines was $29 million. Allocation of a portion of this funding to cover losses by the Zimbabwe Mining Development Corp. (ZMDC) resulted in inadequate funding for mine inspections.

The Chamber of Mines reported severe shortages of metallurgists and geologists in the industry's skilled labor force. Total skilled labor was 2,224 workers and 180 vacancies were reported, primarily owing to new mine developments.

The Intermediate Technology Development Group, in conjunction with the British Geological Survey, planned to set up a custom milling and mining center in the Shamva area for small-scale mining operations. The objective was to improve the safety and efficiency of the increasing number of artisanal miners in the gold-mining districts. The ultimate goal was to establish profitable operations.

The death rate per 1,000 workers employed in the mining industry in 1987, the latest available, was 0.60 based on 35 deaths within a labor force of 58,464.

Government Policies and Programs

The Mines and Minerals Act, reflecting the new mining law of Zimbabwe, stated that a prospector must be a citizen of Zimbabwe, or employ a local agent. Prospecting was no longer permitted within 500 meters of any dwelling or on land actively being farmed. Unused farm land could be staked. A license, which required payment of a fee, and an examination were required of prospectors. Coal and uranium, which were considered strategic materials, required a special grant. For prospecting in areas of more than 100,000 hectares, an Exclusive Prospecting Order was required from the Mining Affairs Board. For mining permission, mining rights had a legal advantage over land rights.

The ZMDC undertook exploration for gold, copper, and industrial minerals. Activity centered on determining the economic viability of the Sanyati polymetallic deposit, which contained copper, lead, and zinc, as well as recoverable sulfur. ZMDC reported that 44 registered mining cooperatives joined during the year.

Production and Trade

Total mineral export earnings in 1988 were $753.3 million, compared with total exports of $1,595 million. Gold sales were $211.7 million. Total imports were $1,145 million. U.S. exports to Zimbabwe were $34.3 million and consisted primarily of aircraft, computers, equipment, and synthetic fiber. U.S. imports from Zimbabwe were $126.7 million and consisted primarily of ferrochromium, nickel, coffee, and sugar.

The Republic of South Africa was Zimbabwe's largest trading partner. About 60% of Zimbabwe's trade transits South Africa, down from 90% over the past 5-year period. Mineral sales, excluding gold, remained under the control of the Minerals Marketing Corp.

The NRZ indicated that it had sufficient supplies of railroad cars but a shortage of diesel locomotives. About 50% of the country's 250 locomotives were out of service owing to a shortage of spare parts.

Commodity Review

Metals.—**Chromite.**—Zimbabwe remained a major world producer of chromite, both from podiform and stratiform deposits. Output was all consumed domestically in the production of ferrochrome. The chief Government mining engineer reported that the long-term future of the chromite mining industry was dependent upon cooperatives. The concept had been developed previously, but it was not implemented. Most output was from two mines owned by Zimbabwe Mining and Smelting Co. (ZIMASCO) and Zimbabwe Alloys Ltd. (Zimalloys).

Copper.—Corsyn Consolidated Ltd.,

TABLE 14

ZIMBABWE: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987[p]	1988[e]
METALS						
Aluminum: Bauxite, gross weight		22,726	20,877	24,284	—	—
Antimony, mine output, concentrate, Sb content		256	194	175	153	150
Beryllium: Beryl concentrate, gross weight		19	38	103	83	80
Chromium: Chromite, gross weight		476,521	536,490	533,105	570,000	600,000
Cobalt:[2]						
Mine output, Co content[e]		78	100	76	110	126
Metal		78	92	76	110	[3]126
Columbium and tantalum: Tantalite concentrate:						
Gross weight	kilograms	59,000	40,000	33,000	37,000	[3]66,000
Cb content[e]	do.	8,850	6,000	[r]5,000	[r]2,600	9,900
Ta content[e]	do.	20,650	14,000	[r]11,600	[r]6,100	23,100
Copper:						
Mine output, concentrate, Cu content[e]		24,000	21,570	21,390	[r]19,800	16,900
Metal:						
Smelter output, blister/anode, primary[e 4]		23,000	20,670	20,500	19,000	16,116
Refinery output, refined/cathode, primary		22,687	20,389	20,423	18,819	[3]16,116
Gold	troy ounces	478,307	472,327	477,535	472,937	475,000
Iron and steel:						
Mine output, iron ore:						
Gross weight	thousand tons	927	1,100	1,110	1,328	1,020
Fe content[e]	do.	555	660	670	824	632
Metal:						
Pig iron[e]	do.	400	674	644	[r]575	600
Steel, crude	do.	391	[e]465	490	515	500
Ferroalloys:						
Ferrochromium		177,800	156,000	155,000	212,300	180,000
Ferrochromium-silicon		42,482	53,527	50,000	21,192	40,000
Ferromanganese		1,845	2,044	2,000	—	2,000
Total		**222,127**	**211,571**	**207,000**	**233,492**	**222,000**
Nickel:						
Mine output, concentrate, Ni content[e]		12,150	11,116	10,370	12,320	12,000
Refinery output, refined metal[5]		10,251	9,381	9,730	10,394	10,000
Platinum-group metals:						
Palladium	troy ounces	[r]1,222	[r]965	1,125	932	600
Platinum	do.	[r]772	[r]611	836	579	1,000
Total	**do.**	**1,994**	**1,576**	**1,961**	**1,511**	**1,600**
Silver	thousand troy ounces	893	799	841	815	[3]706
Tin:						
Mine output, Sn content[e]		1,670	1,670	1,470	1,410	1,500
Smelter output, metal		1,210	1,207	1,079	1,038	1,000

See footnotes at end of table.

TABLE 14—Continued

ZIMBABWE: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987[p]	1988[e]
METALS—Continued						
Tungsten, concentrate:						
Gross weight		55	14	2	1	1
W content[e]		29	10	1	1	1
INDUSTRIAL MINERALS						
Asbestos		165,385	173,580	163,989	193,925	190,000
Barite		700	400	298	191	200
Cement, hydraulic		[e]650,000	[e]700,000	[e]750,000	810,712	[3]775,736
Clays:						
Bentonite (montmorillonite)		[e]64,000	[e]68,000	71,987	116,802	113,157
Fire clay		8,900	9,747	12,591	16,022	16,000
Kaolin		1,350	1,104	901	780	95
Feldspar		1,399	2,300	2,026	2,962	2,500
Gem stones, precious and semiprecious: Emerald	kilograms	8	13	59	1,979	1,900
Graphite		12,334	10,450	15,000	13,530	13,000
Kyanite		—	—	1,851	—	1,850
Lithium minerals, gross weight		22,548	27,910	32,760	14,959	25,000
Magnesium compounds: Magnesite		21,642	19,385	22,649	28,991	30,000
Mica		911	582	1,340	800	800
Nitrogen: N content of ammonia		68,600	68,900	49,100	53,300	52,900
Phosphate rock, marketable concentrate	thousand tons	134	135	136	155	155
Pigments, iron oxide[e]		1,000	[r]1,000	[3]207	[r]200	200
Quartz[6]	thousand tons	32	103	145	41	50
Stone: Limestone	do.	1,152	1,323	1,407	1,537	1,600
Sulfur:						
Pyrite: Gross weight		56,986	57,392	62,506	46,606	50,000
S content[e]		25,000	25,000	25,000	25,000	25,000
Byproduct acid, metallurgical and coal process gas[e]		5,000	5,000	5,000	5,000	5,000
Total		**30,000**	**30,000**	**30,000**	**30,000**	**30,000**
Talc		285	437	797	516	500
MINERAL FUELS AND RELATED MATERIALS						
Coal, bituminous	thousand tons	3,110	3,120	4,047	4,848	4,900
Coke, metallurgical[e 7]	do.	200	200	200	[3]592	600

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

[1]Table includes data available through Oct. 20, 1989.

[2]"Mine output" figures are calculated from "metal" figures. "Metal" may include metal content of compounds/salts, and may include cobalt recovered from nickel-copper matte imported from Botswana for toll refining.

[3]Reported figure.

[4]Smelter copper includes impure cathodes produced by electrowinning in nickel processing.

[5]May include nickel content of nickel oxide.

[6]Includes rough and ground quartz as well as silica sand.

[7]Data represents output by the Wankie Colliery Co. Ltd. for years 1984-86 ending Aug. 31 of that stated; additional output by the Redcliff plant of Zisco Ltd. may total 250,000 metric tons per year of metallurgical coke and coke breeze.

TABLE 15

ZIMBABWE: APPARENT EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987	
			United States	Other (principal)
METALS				
Aluminum:				
Ore and concentrate	256	NA		
Metal including alloys:				
Unwrought	63	NA		
Semimanufactures	—	3	—	All to United Kingdom.
Antimony: Ore and concentrate	NA	168	—	All to Belgium-Luxembourg.
Beryllium: Ore and concentrate	NA	73	73	
Chromium:				
Ore and concentrate	2,156	69	—	All to Japan.
Oxides and hydroxides	NA	2,471	2,471	
Columbium and tantalum: Ash and residue containing columbium and tantalum	421	NA		
Copper:				
Matte and speiss including cement copper	602	NA		
Ash and residue containing copper	556	NA		
Metal including alloys:				
Scrap	NA	94	—	All to Belgium-Luxembourg.
Unwrought	[2]21,660	12,884	—	Italy 12,407.
Gold: Metal including alloys, unwrought and partly wrought value, thousands	$317	$168	—	All to Belgium-Luxembourg.
Iron and steel: Metal:				
Scrap	NA	2,173	—	Republic of Korea 1,979; Taiwan 176.
Pig iron, cast iron, related materials	[2]605	NA		
Ferroalloys:				
Ferrochromium	113,220	74,214	41,579	Italy 21,782; Belgium-Luxembourg 6,402.
Ferromanganese	93	120	—	All to Philippines.
Ferronickel	—	22	—	All to Spain.
Ferrosilicochromium	20,795	3,509	1,869	Spain 1,640.
Unspecified	113,125	41,867	—	Japan 29,520; United Kingdom 6,446.
Steel, primary forms	[2]58,255	106,929	—	Italy 42,820; Taiwan 41,101; Republic of Korea 13,222.
Semimanufactures:				
Bars, rods, angles, shapes, sections	[2]139,542	6,473	16	United Kingdom 6,457.
Universals, plates, sheets	3,473	1,858	1,848	Taiwan 10.
Hoop and strip	29	NA		
Rails and accessories	NA	78	—	All to United Kingdom.
Wire	[2]9,239	421	—	Belgium-Luxembourg 237; United Kingdom 164.
Tubes, pipes, fittings	404	1,872	—	Portugal 1,856.
Lead: Metal including alloys, unwrought	NA	25	—	All to Pakistan.

See footnotes at end of table.

TABLE 15—Continued

ZIMBABWE: APPARENT EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
METALS—Continued					
Lithium: Ore and concentrate		[2]22,837	7,672	7,672	
Nickel:					
Matte and speiss		275	NA		
Metal including alloys:					
Scrap	value, thousands	NA	$159	—	All to Japan.
Unwrought		NA	9,909	2,500	Japan 6,016; Spain 580.
Semimanufactures		NA	18	—	Japan 10; Republic of Korea 8.
Unspecified		[2]14,326	NA		
Platinum-group metals:					
Waste and sweepings	value, thousands	NA	$18	—	All to United Kingdom.
Metals including alloys, unwrought and partly wrought	do.	$51	$69	—	All to Switzerland.
Silver:					
Ore and concentrate	do.	$1	$96	—	All to United Kingdom.
Waste and sweepings	do.	$2,337	NA		
Tin: Metal including alloys:					
Unwrought		NA	237	35	Belgium-Luxembourg 169; Denmark 28.
Semimanufactures		—	9	—	All to Spain.
Unspecified		[2]1,322	NA		
Titanium: Metal including alloys, semimanufactures		—	1	—	All to United Kingdom.
Other:					
Ores and concentrates of precious metals	kilograms	NA	25	25	
Ashes and residues		28	16	—	Do.
Base metals including alloys, all forms		108	NA		
Precious metals including alloys, waste and scrap	value, thousands	[2]$816	NA		
INDUSTRIAL MINERALS					
Abrasives, n.e.s.: Natural: Corundum, emery, pumice, etc.	do.	$82	NA		
Asbestos, crude		[2]167,970	97,342	57	Japan 45,802; Spain 15,217; Republic of Korea 9,766.
Cement		[2]77,929	NA		
Clays, crude		NA	697	—	Denmark 662; Japan 35.
Diamond:					
Gem, not set or strung	value, thousands	[2]$4,201	NA		
Industrial stones	do.	$26	NA		
Feldspar, fluorspar, related materials		180	NA		
Fertilizer materials: Manufactured, phosphatic		3,168	NA		

See footnotes at end of table.

TABLE 15—Continued

ZIMBABWE: APPARENT EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
INDUSTRIAL MINERALS—Continued				
Graphite, natural	([2 3])	1,263	156	United Kingdom 679; Portugal 388.
Kyanite and related materials	18	662	—	All to Denmark.
Magnesium compounds: Magnesite, crude value, thousands	[2]$691	NA		
Mica: Crude including splittings and waste	657	NA		
Precious and semiprecious stones other than diamond:				
Natural value, thousands	$1,396	$1,643	$243	Switzerland $1,256; Italy $85.
Synthetic do.	$30	NA		
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked	NA	40,038	379	Japan 34,268; Italy 2,808; Canada 2,201.
Worked	—	12	11	Italy 1.
Quartz and quartzite	NA	258	—	Belgium-Luxembourg 151; United Kingdom 74.
Unspecified	[2]29,579	NA		
Talc, steatite, soapstone, pyrophyllite value, thousands	NA	$7	$7	
Other: Crude	4,516	3,611	—	All to Japan.
MINERAL FUELS AND RELATED MATERIALS				
Coal: All grades including briquets	[2]64,645	NA		
Coke and semicoke	[2]113,133	NA		

NA Not available.

[1] Table prepared by Virginia A. Woodson. Owing to a lack of official trade data published by Zimbabwe, this table should not be taken as a complete representation of this country's mineral exports. These data have been compiled from various sources, which include United Nations information, data published by trading partner countries, and partial official trade data of Zimbabwe. Unless otherwise specified, data are compiled from trade statistics of individual trading partners.

[2] Central Statistical Office, Harare, Zimbabwe. Quarterly Digest of Statistics. Dec. 1987.

[3] Unreported quantity valued at $7,024,000.

a subsidiary of Lonrho PLC, closed its Inyati Mine, which had a 3,000-ton-per-year metal capacity. They disposed of all the assets.

Gold.—Rio Tinto Zimbabwe (Riozim) planned to spend $15 million on a new treatment facility at Eiffel Flats. The plant would have fine-grind and thickener sections and would employ carbon-in-leach and column flotation for recovery. Throughput would be 700,000 tons per year and would consist primarily of tailings of the Cam and Motor Mines. Such tailings amounted to 5 million tons and averaged 0.04 troy ounce per ton. Commissioning was planned for late 1989. Gold output would be about 20,000 troy ounces annually, and recovery would improve from 30% to 70%. Riozim conducted geochemical exploration on six Exclusive Prospecting Orders and three other claim areas. Preliminary analysis was to be followed by drilling and metallurgical tests.

Gwalla International Ltd.'s 75%-owned Chase Minerals had an option to purchase an 80% interest in old mine workings that had a 10-kilometer strike length near Kwekwe. Resources were several hundred thousand tons, with about 0.039 troy ounce of gold per ton. Chase held title to 2.1 million tons of tailings from the Connemara Mine. These tailings had reported grade of about 0.032 troy ounce per ton. Additional resources were reported at the Hope Fountain project near Bulawayo, in which Chase had the option to obtain 60%.

Cluff Mineral Exploration (Zimba-

TABLE 16

ZIMBABWE: APPARENT IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987	
			United States	Other (principal)
METALS				
Aluminum:				
Oxides and hydroxides	1	1	1	
Metal including alloys:				
Scrap	—	22	—	All from Denmark.
Unwrought	303	1	—	All from United Kingdom.
Semimanufactures	([2] [3])	364	46	Switzerland 88; Egypt 81.
Arsenic: Oxides and acids	—	1	—	All from United Kingdom.
Chromium: Oxides and hydroxides	4	—		
Cobalt: Oxides and hydroxides	1	—		
Copper:				
Ash and residue containing copper	54	NA		
Metal including alloys:				
Unwrought	16	NA		
Semimanufactures	99	61	27	Italy 19; United Kingdom 6.
Iron and steel: Metal:				
Scrap	31	NA		
Pig iron, cast iron, related materials	46	1	—	All from United Kingdom.
Ferroalloys: Silicon metal	22	NA		
Steel, primary forms	—	1	—	Do.
Semimanufactures:				
Bars, rods, angles, shapes, sections	([3] [4])	199	—	United Kingdom 146; Italy 33.
Universals, plates, sheets	([3] [5])	617	132	Canada 259; United Kingdom 90.
Hoop and strip	360	247	—	Japan 205; Belgium-Luxembourg 39.
Wire	187	167	—	United Kingdom 92; Belgium-Luxembourg 50.
Tubes, pipes, fittings	([6])	135	1	United Kingdom 52; Italy 36; Japan 30.
Castings and forgings, rough	225	NA		
Lead:				
Oxides	—	10	—	All from United Kingdom.
Metal including alloys, semimanufactures	1	1	—	Do.
Lithium: Oxides and hydroxides	—	12	12	
Magnesium: Metal including alloys, semimanufactures	—	16	16	
Manganese:				
Ore and concentrate: Metallurgical-grade	209	52	—	All from Netherlands.
Oxides	18	36	—	All from Greece.
Molybdenum: Metal including alloys, all forms	2	—		
Nickel: Metal including alloys, semimanufactures	4	1	—	All from Italy.
Platinum-group metals: Metals including alloys, unwrought and partly wrought value, thousands	$7	NA		

See footnotes at end of table.

TABLE 16—Continued

ZIMBABWE: APPARENT IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS—Continued				
Silver: Metal including alloys, unwrought and partly wrought value, thousands	$97	$1	—	All from United Kingdom.
Tin: Metal including alloys:				
Unwrought	—	1	—	Do.
Semimanufactures	13	NA		
Titanium: Oxides	3	2	—	All from Denmark.
Vanadium:				
Oxides and hydroxides	—	1	1	
Pentoxides	8	—		
Zinc:				
Oxides	28	4	—	All from United Kingdom.
Metal including alloys, all forms value, thousands	[3]$3,793	NA		
Other: Base metals including alloys, all forms	3	—		
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	151	322	—	Turkey 260; Greece 39.
Grinding and polishing wheels and stones	[7]12	2	—	Japan 1; United Kingdom 1.
Asbestos, crude	NA	734	—	All from Ireland.
Boron materials: Oxides and acids	4	9	9	
Cement	NA	110	—	United Kingdom 74; Italy 36.
Chalk	38	11	—	All from United Kingdom.
Diamond:				
Gem, not set or strung value, thousands	$2	NA		
Industrial stones do.	$2	$1	—	All from Switzerland.
Fertilizer materials: Manufactured:				
Ammonia do.	[3]$9,996	NA		
Nitrogenous	9,683	31	—	Netherlands 20; Belgium-Luxembourg 11.
Potassic	18,414	NA		
Graphite, natural	5	—		
Gypsum and plaster	163	NA		
Lime value, thousands	[3]$3,013	NA		
Magnesium compounds: Other	1	1	1	
Mica:				
Crude including splittings and waste	1	—		
Worked including agglomerated splittings	—	4	—	All from United Kingdom.

See footnotes at end of table.

TABLE 16—Continued

ZIMBABWE: APPARENT IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987	
				United States	Other (principal)
INDUSTRIAL MINERALS—Continued					
Precious and semiprecious stones other than diamond:					
Natural	value, thousands	$125	$36	—	United Kingdom $23; Switzerland $13.
Synthetic	do.	NA	$5	—	All from Switzerland.
Salt and brine		7,542	323	—	All from United Kingdom.
Sodium compounds, n.e.s.: Carbonate, manufactured		72	NA		
Stone, sand and gravel: Dimension stone, crude and partly worked		NA	472	—	All from Ireland.
Sulfur: Elemental, colloidal, precipitated, sublimed		4	—		
Talc, steatite, soapstone, pyrophyllite		36	25	—	Republic of Korea 18; Denmark 7.
Other: Crude		11	—		
MINERAL FUELS AND RELATED MATERIALS					
Asphalt and bitumen, natural		1	159	—	All from Trinidad and Tobago.
Carbon black		55	13	—	All from United Kingdom.
Coal: All grades including briquets	value, thousands	[3]$15,743	NA		
Petroleum refinery products:					
Gasoline	42-gallon barrels	480	1,593	—	Australia 1,236; Netherlands 357.
Mineral jelly and wax	do.	9	181	—	Belgium-Luxembourg 87; United Kingdom 55.
Distillate fuel oil	do.	97	52	—	All from United Kingdom.
Lubricants	do.	10,476	14,749	224	United Kingdom 10,612; Netherlands 3,913.
Residual fuel oil	do.	NA	1,232	—	All from Belgium-Luxembourg.
Bitumen and other residues	do.	315	109	—	All from Italy.
Bituminous mixtures	do.	503	170	—	All from United Kingdom.

NA Not available.

[1] Table prepared by Virginia A. Woodson. Owing to a lack of official trade data published by Zimbabwe, this table should not be taken as a complete representation of this country's mineral imports. These data have been compiled from various sources, which include United Nations information, data published by trading partner countries, and partial trade data of Zimbabwe. Unless otherwise specified, data are compiled from trade statistics of individual trading partners.

[2] Unreported quantity valued at $8,622,000.

[3] Central Statistical Office, Harare, Zimbabwe. Quarterly Digest of Statistics. Dec. 1987.

[4] Unreported quantity valued at $6,561,000.

[5] Unreported quantity valued at $39,692,000.

[6] Unreported quantity valued at $3,895,000.

[7] Excludes unreported quantity exported by Canada valued at $20,000.

bwe) Ltd., a subsidiary of Cluff Resources PLC of the United Kingdom, reported production of 23,200 troy ounces from the Royal Family, Freda, and Rebecca Mines. Heap leaching has been employed at the Royal Family Mine since 1984. Annual output was 7,000 troy ounces. At full production, the Freda and Rebecca opencast mines, newly commissioned in 1988, would bring Cluff's total capacity to 80,000 troy ounces per year. The Freda Mine consisted of a 50,000-ton-per-month heap-leaching operation of an oxide ore capping, and the Rebecca Mine had a 60,000-ton-per-month flotation and cyanidation process using adjacent sulfide ore. Development cost of the Freda Mine was $4.3 million, including purchase of mineral rights, plus property and development cost. Operating costs were less than $200 per ounce. Estimated life of the Freda Mine was 2 to 3 years, and of the Rebecca Mine 7 to 8 years. At closure, about 46 million tons of rock would have been mined from both open pits. The waste dumps were to be recontoured and vegetated, and the pits were to be used as water reservoirs. The labor force of 128 was entirely Zimbabwean. Cluff was spending $1.6 million annually on exploration.

Lonrho PLC commenced a number of projects to expand gold production at its mines. Mill expansion at Shamva would increase the capacity to treat ore from 12,000 tons per month to 20,000 tons per month and would yield an additional 10,450 troy ounces of gold per year. Full commissioning was expected about June 1990. Expansion of the Athens Mine was completed, and gold production was increased from 965 to 1,610 troy ounces per month. Ore control problems prevented the full planned output of about 2,250 troy ounces per month. The Athens Mine had two carbon-in-pulp plants for treating surface ore and re-treating tailings, and a plant for treating underground ore. Plans for expanding output at the Redwing and Howe Mines were underway. Lonrho was exploring for large, low-grade gold deposits that would be amenable to heap leaching.

Delta Gold NL of Australia, through its subsidiary Masasa Mines, commenced assessment of the abandoned Pickstone Mine near Chegutu. Developed reserves were 240,000 tons grading 0.228 troy ounce per ton. Additional drilling was planned, and if successful, could lead to similar evaluation of the nearby Peerless Mine.

Union Carbide Corp. had three gold mines, Gaika, Camperdown, and Lennox, producing a total of 1,000 troy ounces per month, and had plans to triple output over a 5-year period. Heap leaching was conducted at Gaika Mine. Union Carbide reported that 25% of aftertax profits was repatriated, and 25% was placed in Government bonds.

Iron and Steel.—As a continuation of Zisco's modernization plan, bids were requested on an iron ore sinter plant with a 1.5-to-2-million-ton-per-year capacity to be built at or near the Redcliff facility. Ore feed would be mainly from the Ripple Creek Mine, where the mineralization was limonitic. Product from the sinter plant would provide a 70% to 100% sinter feed to the blast furnaces for production of 80,000 tons per month of metal.

Ferroalloys.—ZIMASCO placed its No. 2 electric furnace back into operation in February. The furnace had a 12.4-megavolt-ampere capacity, and the annual high-carbon ferrochromium output was 15,000 tons. A new 3-megavolt-ampere induction furnace to remelt chromite fines was constructed at yearend for the production of an additional 15,000 tons per year of high-carbon ferrochromium. Full operation of ZIMASCO's six electric furnaces and the new furnace would provide an annual output of 190,000 tons. Current operations include five 17-megawatt furnaces and one 12.4-megawatt furnace. Zimalloys accounted for the remainder of ferrochromium output. Zimbabwe was the fourth largest ferrochromium producer in the world.

Lead.—Lonrho proceeded with construction of a plant to recover lead concentrates at the Redwing gold mine. Concentrates would be sold locally for processing.

Nickel.—Riozim commenced test modification of its Empress nickel refinery to support the high copper matte feed, which was being toll refined for BCL Ltd. in Botswana. Capital expenditures for the test work were $2.5 million. Feed material from other sources in Botswana could also be accommodated at the refinery.

AAC's subsidiary, Bindura Nickel Corp., reported a profit of $54 million on sales of 11,014 tons of nickel for the year ending December 31, 1988. The company had a loss of $4.4 million in 1987.

Platinum-Group Metals.—Delta Gold NL completed a prefeasibility study of its Hartley platinum-group metals project, listing capital costs of about $180 million for a plant to process 2 million tons per year of ore over a 20-year period. Annual output from converter matte, which was to be toll refined in Europe or North America, was estimated at 100,000 troy ounces of platinum, 84,000 troy ounces of palladium, 8,000 troy ounces of rhodium, 10,000 troy ounces of gold, 2,700 tons of nickel, and 1,700 tons of copper. Based on drill-core data obtained from Union Carbide Corp.'s earlier drilling program of 177 drill holes, proven ore reserves were 28 million tons grading 0.09 troy ounce per ton of platinum, 0.064 troy ounce per ton of palladium, 0.016 troy ounce per ton of gold, 0.21% nickel, and 0.14% copper. Probable reserves were 34 million tons at 0.087 troy ounce of platinum per ton, and possible reserves were 58 million tons at 0.087 troy ounce per ton.

Riozim, in a joint venture with AAC and Robertson Group PLC of the

United Kingdom, was reevaluating and extending exploration on platinum claims held by it and AAC in the Hartley Complex of the Great Dyke. Mhondoro Mining Co., a subsidiary of Robertson, was to invest $2.8 million over 5 years, at which time it would earn a 24% interest in the project, and Riozim and AAC would earn 38% each. Its task was to correlate existing data, conceptualize the project for a drilling program, and if warranted, conduct a feasibility study on developing selected sites. Riozim had previously postponed attempts to develop the Hartley Complex for platinum-group metals and their byproducts. This decision was based both on its experience at the Zinca Mine and on Union Carbide Corp.'s experience at the Mimosa Mine. Both projects had developed technically successful mining and metallurgical processes, but neither was economically feasible.

***Industrial Minerals.*—Cement.**—Portland Holdings reported high demand for cement as the construction industry flourished. Profits were up $1.1 million in the 6-month period ending February 29, 1988. Prices were fixed by the Government, and the company reported that increasing costs were squeezing profits.

Lithium.—Corning Glass Works of the United States, which imports petalite from Bikita Minerals, reported some of the costs and logistics required to ship lithium minerals via an extensive and varied transport system in southern Africa. Costs per ton were reported as follows: ocean freight, $30; stevedoring, $18; and storage, handling, and trucking, $32. For transport, 1-ton units of ground petalite were loaded into polypropylene bags. These bags were then trucked 60 miles from the mine site at Bikita to the railhead at Masvingo, and were transferred to the NRZ and moved 1,230 miles to Durban, Republic of South Africa. Warehousing and transshipment was by Rennies Corp. Sea transport was by ocean charter 8,600 miles to Baltimore and Martinsburg, West Virginia, was the final destination. Because of the nature of petalite and its end uses, special precautions were required in order to prevent contamination, which was primarily from iron-bearing dust. The precautions included vacuuming of the bags prior to ocean transit.

Gem Stones.—The Sandawana emerald mine reportedly had an annual output of 20 to 30 kilograms of high-quality stones. The country's aquamarine output was estimated at about 100 kilograms of facet-grade material out of a total production of 1,000 kilograms annually. Cordierite output was about 5 kilograms per year.

Mineral Fuels.—Zimbabwe remained totally dependent upon imported petroleum. Refined products were imported primarily via pipeline from the petroleum terminal at Beira in Mozambique. Gasoline imported by Zimbabwe was blended with sugar-cane-derived ethanol in the ratio of 87% gasoline to 13% ethanol.

The Government announced the construction of a 300-megawatt extension to the Kariba South power station. Also under consideration was expansion of the coal-fired powerplant at Hwange, and a new $500 million hydroelectric station at Batoka Gorge on the Zambesi River. Discussion was underway with Mobil Oil Corp. for an exploration agreement for petroleum in the Zambesi valley.

Wankie Colliery Co. Ltd. had a project under negotiation to supply clean coke-oven gas to the Hwange Power Station as a substitute for imported oil. Additionally, participation with Zisco at Redcliff for construction of a plant for downstream processing of coal tar and benzol was planned.

Coal.—Wankie Colliery Co. Ltd.'s turnover was up 17% to $70.5 million for the year ending February 28, 1989. The increase was mainly due to a 13.5% price increase granted by the Government in October and to improved product mix with the greater availability of higher priced coke. Despite improved turnover, cash availability was inadequate to finance loan and interest payments of $17 million, as well as capital expenditures of $11 million. Negotiations were underway for a $6.7 million loan with a commercial bank. Coal sales were 4.32 million tons compared with sales of 4.58 million tons the previous fiscal year. The decline was attributed to lack of transportation to serve market demand, which was estimated at 4.8 million tons annually. Sales to the Hwange Power Station were 2.07 million tons, or about 176,000 tons below the previous fiscal year.

Output from the No. 3 underground colliery improved. However, travel distances to working faces were approaching the economic limit in the northern reserve area. A contract for delivery of load-haul-dump vehicles was canceled owing to faulty vehicle construction, thus delaying a mechanization trial planned for the area.

About 85% of output continued to be from the open pit mine, where production was 4.22 million tons. Spoil dumps were being rehabilitated and revegetated.

Riozim was granted mining title to 538 hectares in order to develop the coal reserves at Sengwa. It also had the right to continue prospecting in the area covered by an Exclusive Prospecting Order. Under the terms of the grant, Riozim was required to commence work in the area and produce 3,600 tons of coal per month. Production capacity of 100,000 tons per year was possible by 1990. Sengwa Colliery (Pvt.) Ltd. was formed on a joint-venture basis between Riozim and the Government. The grant was to last for 15 years, and the Government had the right to 51% share in Sengwa coal. The Government had under construction a road valued at $11.1 million between Gokwe and Siabuwa to gain access to the isolated coal reserve area. Riozim was required to supply coal, which would substitute for imported coal. Reserves were estimated at 200 million tons of low-sulfur and low-phosphorus coal with less than 20% ash.

Coke.—The newly refurbished coke ovens and byproducts plants were fully operational. Sales were 174,233 tons compared with 51,914 tons previously. Export markets temporarily lost during the refurbishing phase were reportedly regained.

Uranium.—Saarberg Interplan of the Federal Republic of Germany reported the existence of a small uranium deposit in the vicinity of Dande in northeastern Zimbabwe. Saarberg had been exploring in Zimbabwe for a number of years, and the discovery was part of a joint venture with a Japanese company. Grade was about 0.9% U_3O_8. A decision to build a pilot plant to determine process parameters and cost had yet to be made.

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[1] Prepared by Hendrik G. van Oss, physical scientist, Division of International Minerals.

[2] Prepared by Lloyd E. Antonides, physical scientist, Division of International Minerals.

[3] Values converted from Botswana pula (P) to U.S. dollars at the rate of P1.8159=US$1 for 1988; P1.6779 in 1987.

[4] Prepared by Hendrik G. van Oss, physical scientist, Division of International Minerals.

[5] Where necessary, values have been converted from Lesotho maloti (M) to U.S. dollars at the rate M2.26=US$1.00.

[6] Prepared by Harold R. Newman and Lloyd E. Antonides, physical scientists, Division of International Minerals.

[7] Prepared by Hendrik G. van Oss, physical scientist, Division of International Minerals.

[8] Where necessary, values have been converted from Mozambique meticais (M) to U.S. dollars at the rate of M525.00=US$1.00.

[9] An average of 44,084 Mozambique workers were employed in South African gold mines and 1,012 in coal mines. 1988 Annual Report, Chamber of Mines of South Africa.

[10] Prepared by George A. Morgan, physical scientist, Division of International Minerals.

[11] Where necessary, values have been converted from South African rands (R) to U.S. dollars at the rate of R2.04=US$1.00 for 1987 and R2.26=US$1.00 for 1988.

[12] Prepared by Hendrik G. van Oss, physical scientist, Division of International Minerals.

[13] Where necessary, values have been converted from Swazi emalangeni (E) to U.S. dollars at the rate of E2.28=US$1.00.

[14] This deposit has also been spelled Dokolwayoy and Dvokolwayo.

[15] Prepared by Lloyd E. Antonides, physical scientist, Division of International Minerals.

[16] Where necessary, Zambian kwachas (K), have been converted from K to U.S. dollars at the rate of K8.2237=US$1.00 for 1988 and K8.8889=US$1.00 for 1987.

[17] Prepared by George A. Morgan, physical scientist, Division of International Minerals.

[18] Where necessary, values have been converted from Zimbabwean dollars (ZD) to U.S. dollars at the rate of ZD1.66=US$1.00 for 1987 and ZD1.80=US$1.00 for 1988.

THE MINERAL INDUSTRIES OF

WEST AFRICA

By Hendrik G. van Oss and Bernadette Michalski

BENIN[1]

Benin's economy was hurt by low world prices for petroleum, the country's dominant mineral product. Benin also produced a modest amount of cement and a small amount of salt, as well as undocumented quantities of sand and gravel for local consumption. Early in 1988, operations began at the 62 megawatt hydroelectric plant at Nagbeto, at the Togolese border. It was expected that this development would significantly reduce the country's reliance on imported electricity, largely from Ghana.

Production of crude oil fell almost 10% in 1988. While 1988 export revenues for petroleum were not available, they amounted to $18.4 million[2] in 1987, approximately 28% of the country's total export revenues. Benin remained totally dependent upon imported petroleum products; these amounted to $25.6 million in 1987, equivalent to 21% of the country's total imports. This level of petroleum product imports, a 37% decline from 1986, reflected a resurgence of informal imports from Nigeria that resulted from the 1986 reopening of the Benin-Nigeria border. A significant portion of Benin's petroleum product imports were re-exported to neighboring countries. Approximately 14% of the 1987 imports were so traded.

At the end of April, Ashland Exploration of the United States signed a 2-year agreement with the Government to assume the operation of the Semé oilfield. The company announced that it would proceed with the existing Phase II plans for further developing the field. At least four new wells were to be drilled, and were expected to be on-line within 2 years. With production from the new wells, it was anticipated that output from the Séme oilfield would rise to 8,000 barrels per day. Funding for this drilling would be from existing World Bank and European Investment Bank loans that had been frozen in early 1986 pending resolution of management problems with the field's previous operators.

Trilogy Resources Co. of Canada was granted 100% interest in a 2.27 million acre onshore oil exploration concession, which was the first such concession to be granted since 1977. Exploration was planned for 1989. The Soviet Union was conducting petroleum exploration over a 6,000-square-kilometer area in the northwest part of the country.

In 1988, American entrepreneur John Moore, following the success of a similar venture set up in Togo in 1984, established a steel mill in Cotonou under the name Société Béninoise de Sidérurgie. The mill was to produce rebar, cotton-baling wire, and corrugated sheet roofing iron. The local market was estimated to be able to support an output of 7,000 tons per year, and there was considered to be some potential for exports to Nigeria and Burkina Faso. Production was expected toward yearend.

The Government was seeking private management for the three cement plants operated by the State-owned Société des Ciments d'Onigbolo. The plants had experienced losses resulting from continued production at levels well below capacity.

BURKINA FASO[3]

In 1988, the mineral industry of Burkina Faso continued to be largely underdeveloped, and was dominated by the production of gold. The country had reserves of several other commodities, notably manganese and base metals, but these remained undeveloped because of infrastructure and funding problems.

Much of the country's gold output was unreported artisanal production, new estimates of which suggest that the country's gold output in 1987 was almost triple earlier estimates, and further increased by about 50% in 1988. Legal sales of gold production were estimated to amount to about $45 million, or almost 20% of the country's total exports.[4] However, revenues from smuggled artisanal gold production were estimated to amount to an additional $80 to $90 million.

A railroad from Ougadougou to Kaya was under construction during the year. Kaya is the halfway point to the large manganese deposit at Tambao, development of which has been stymied by the lack of infrastructure.

Commodity Review

Metals.—**Gold.**—The largest single producer of gold in the country was the Poura gold mine, operated by the Société de Recherches et d'Exploitation Minières du Burkina (SOREMIB). SOREMIB was a joint venture of the Government (60%), the Islamic Development Bank (20%), and Compagnie Française des Mines (Coframines), a subsidiary of France's Bureau de Recherches Géologiques et Minières (BRGM). Production from the mine in 1988 was 73,882 troy ounces and sales were 74,815 ounces. Production was affected by a cave-in of the inclined shafts in early December. It was expected that this would lead to reduced gold production in 1989 and severe financial difficulties for the company. Coframines provided technical services to the mine during the year, but reportedly SOREMIB was seeking to reduce Coframines' involvement in these services.

Early in the year, the Société Minière Coréo-Burkinabé (SOMICOB) was reported to be producing about 1,600 troy ounces per month from a small placer operation at Sebba. However, owing to an inadequate sampling program prior to mining, reserves were exhausted within a few months. SOMICOB was a joint venture between the Government (60%) and North Korea.

Artisanal gold mining was widespread in Burkina Faso, and it was estimated that as many as 75,000 workers were employed on a seasonal basis in this activity. The bulk of the gold production was smuggled out of the country, largely to Côte d'Ivoire, Togo, and Mali. The Government, the sole legal channel for gold sales, was offering only about 50% of the world bullion price for the artisanal production and managed to purchase only about 32,000 troy ounces of this output. It was felt that this represented only about 15% of the total artisanal production.

Zinc.—Toward yearend, Boliden Mineral AB of Sweden met with the Bureau des Mines et de la Géologie du Burkina to discuss the possibility of Boliden evaluating the Perkoa zinc-silver deposit, believed to contain reserves of at least 5 million tons of ore grading in excess of 18% zinc and about 2 troy ounces per ton silver. The deposit is located about 30 kilometers from the rail line linking Ougadougou with Abidjan, Côte d'Ivoire.

CAPE VERDE ISLANDS[5]

The minerals industry of the Cape Verde Islands was limited to the production of small quantities of pozzolana, pumice, and salt, largely for domestic consumption. Some salt was exported. Plans for a 64,000-ton-per-year cement plant on Maio Island, initially approved in 1984, were shelved in 1988 by the Government because of low domestic demand and world prices for cement.

CÔTE D'IVOIRE[6]

Mineral production played a negligible role in the Côte d'Ivoire economy, which continued to be dominated by the production of cocoa and coffee. The country was a modest producer of petroleum and had minor artisanal production of diamonds and gold. There was, however, considerable exploration interest in gold.

Commodity Review

Metals.—**Gold.**—Gold mining in 1988 was restricted to artisanal production. Reported output fell to 178 troy ounces, but additional undocumented production was likely. As in years past, Côte d'Ivoire was an outlet for smuggled gold, largely from Burkina Faso. Estimates of the amount of gold smuggled through Côte d'Ivoire ranged as high as 6,500 troy ounces per week; however, gold exports were officially listed as 10,242 ounces for the year.

Côte d'Ivoire contains several Birrimian series greenstone belts. This geologic similarity to the country's gold-producing neighbors Burkina Faso, Ghana, and Mali, led to an increasing interest during the year in gold exploration. The parastatal Société pour le Développement Minier de la Côte d'Ivoire (SODEMI) conducted some of this exploration, commonly as a joint effort with foreign entities, notably the BRGM. The most advanced gold project continued to be the Ity deposit near the country's western border. The Ity deposit was undergoing final feasibility studies by Société des Mines d'Ity, owned 60% by SODEMI and 40% by Coframines. The deposit contained ore both within a laterite cap and in underlying clay-altered Birrimian rocks. Proven reserves were 700,000 tons of laterite ore grading 7 grams (0.23 ounce) of gold per ton and 1.2 million tons of argillaceous ore grading 9 grams (0.29 ounce) of gold per ton. Initial mining was planned to be by open pit extraction of the laterite ore, to produce 4.5 tons (145,000 ounces) of gold at a rate of 650 kilograms (21,000 ounces) of gold per year. Site preparation was expected to commence in late 1989.

Another advanced project was that of the Afema Syndicate, a joint venture of Eden Roc Mineral Corp. of Canada (49%) and SODEMI. The project was focused on the Asupiri shear zone near the southeast border with Ghana. In 1987, drilling to a depth of 262 meters had outlined probable reserves of about 2.35 million tons grading 6.2 grams (0.20 ounce) of gold per ton. Funding problems prevented further drill testing of the property in 1988, but these problems were resolved toward yearend, and it was expected that the testing would proceed in 1989.

Steel.—The Société Ivoirienne de Sidérurgie, a joint venture between U.S. investor John Moore (40%) and the Government (60%), was organized during the year under a World Bank export incentive program, to re-equip a bankrupt 20,000-ton-per-year, state-run steel mill. The company expected to produce steel fence posts for export to the United States and steel grinding balls for sale to gold mines in the region, particularly in Ghana, and to the Société Nationale Industrielle et Minière iron mines in Mauritania. Exports of both products were expected to begin in the second half of 1989.

Mineral Fuels.—Petroleum production fell significantly, owing to the progressive exhaustion of reserves at the country's two operating fields. In October, Phillips Petroleum announced that production from one of these, the Espoir Field, would cease at yearend.

THE GAMBIA[7]

There was no production of mineral commodities in The Gambia in 1988, except for limited undocumented quantities of clay and sand and gravel for local use. It was believed that the country's greatest potential for mineral resources development was in petroleum and in heavy minerals (titanium) sands. The Gambian titanium sand resource, an extension of a large deposit in Senegal, was estimated to contain 1 million tons of heavy minerals.

TABLE 1

WEST AFRICA: PRODUCTION OF MINERAL COMMODITIES

(Metric tons unless otherwise specified)

Country[1][2] and commodity[3]		1984	1985	1986	1987[p]	1988[e]
BENIN[4]						
Cement, hydraulic[e]		300,000	300,000	300,000	300,000	500,000
Petroleum, crude	thousand 42-gallon barrels	[r]2,600	[r]2,900	[r]2,800	[e]1,940	1,800
Salt, marine[e]		100	100	100	100	100
BURKINA FASO[4] (formerly Upper Volta)						
Gold[e]	troy ounces	[r]22,000	50,000	60,000	[5][r]220,000	[5]340,000
Phosphate rock[e]	thousand tons	3	3	3	3	3
Stone: Marble[e]	thousand tons	50	100	100	100	100
Pumice and related volcanic materials[e]		10,000	10,000	10,000	10,000	10,000
Salt		6,500	6,500	6,500	6,500	6,500
CAPE VERDE ISLANDS[4]						
Pumice and related volcanic rock materials[e]		10,000	10,000	10,000	10,000	10,000
Salt[e]		6,500	6,500	6,500	6,500	6,500
CÔTE D'IVOIRE[4]						
Cement[6]	thousand metric tons	536	679	776	653	[7]700
Diamond[e][8]	carats	25,000	20,000	[r]13,600	21,000	[7]11,157
Gold	troy ounces	—	—	[r]161	218	[7]178
Petroleum:						
Crude	thousand 42-gallon barrels	[9]9,960	[9]8,060	[9]6,600	[9]6,200	[7]4,721
Refinery products:[e]						
Motor gasoline	do.	2,196	2,190	2,190	2,555	2,562
Kerosene and jet fuel	do.	3,294	3,285	3,285	3,285	3,294
Distillate fuel oil	do.	3,294	3,650	3,650	3,650	3,660
Residual fuel oil	do.	3,660	3,650	3,650	3,650	3,660
Liquefied petroleum gas	do.	350	350	350	350	350
Other	do.	366	365	365	365	366
Total	**do.**	**13,160**	**13,490**	**13,490**	**13,490**	**13,892**
GHANA[10]						
Aluminum:						
Bauxite, gross weight		44,000	170,000	226,000	[7]230,000	[7]299,939
Metal, smelter, primary		NA	48,550	124,570	[7]150,000	[7]161,392
Cement, hydraulic[6]	thousand metric tons	229	363	219	[7]274	[7]477
Diamond:						
Gem[e]	thousand carats	35	60	[7]84	[7]65	[e]165
Industrial[e]	do.	311	572	[7]438	[7]400	[e]495
Total	**do.**	**[8]346**	**[8]632**	**[8]522**	**[8][7]465**	**[11][e]660**
Gold	thousand troy ounces	287	299	287	[7]328	[7]373
Iron and steel: Steel, crude[e]		5,400	5,400	5,000	5,000	5,000
Manganese:						
Ore and concentrate, gross weight		[r]251,019	[r]318,665	304,351	[7]274,451	[7]259,614
Mn content		[r]94,800	[r]118,100	110,300	[r]97,900	96,600

See footnotes at end of table.

TABLE 1—Continued

WEST AFRICA: PRODUCTION OF MINERAL COMMODITIES

(Metric tons unless otherwise specified)

Country[1] [2] and commodity[3]		1984	1985	1986	1987[p]	1988[e]
GHANA—Continued						
Petroleum:						
Crude[e]	thousand 42-gallon barrels	730	100	—	—	—
Refinery products:						
Gasoline	do.	1,460	[e]1,000	[e]1,000	[e]1,000	1,000
Jet fuel	do.	224	[e]200	[e]200	[e]200	200
Kerosene	do.	666	[e]600	[e]600	[e]600	600
Distillate fuel oil	do.	1,270	[e]1,000	[e]1,000	[e]1,000	1,000
Residual fuel oil	do.	2,120	[e]2,000	[e]2,000	[e]2,000	2,000
Other	do.	81	[e]80	[e]80	[e]80	80
Refinery fuel and losses	do.	216	[e]200	[e]200	[e]200	200
Total	**do.**	**6,037**	**[e]5,080**	**[e]5,080**	**[e]5,080**	**5,080**
Salt[e]		50,000	50,000	50,000	50,000	50,000
Silver, mine output, Ag content[e]	thousand troy ounces	14	14	14	16	18
GUINEA[12]						
Aluminum:						
Bauxite:						
Mine production:						
Wet basis	thousand metric tons	14,156	13,100	14,423	14,600	[7]16,868
Dry basis	do.	12,740	11,790	13,300	13,500	[7]15,619
Shipments (dry basis):						
Metallurgical-grade bauxite	do.	11,310	11,084	11,469	11,500	13,500
Calcined bauxite	do.	120	100	122	[7]138	[7]264
Alumina:						
Production	do.	578	572	556	556	[7]590
Shipments	do.	578	572	556	556	[7]590
Diamond:						
Gem	thousand carats	44	123	190	[7]163	136
Industrial	do.	3	9	14	[7]12	10
Total	**do.**	**47**	**132**	**204**	**175**	**[8]146**
Gold	troy ounces	—	—	—	—	[8] [13]42,500
LIBERIA[14]						
Cement, hydraulic	thousand metric tons	84	95	97	90	[7]106
Diamond:[e]						
Gem	thousand carats	108	66	63	60	67
Industrial	do.	132	72	189	190	100
Total	**do.**	**240**	**138**	**252**	**250**	**[8] [e]167**
Gold[e]	troy ounces	[15]10,500	[15]4,900	[15]20,100	15,000	[7] [8]21,753
Iron ore	thousand metric tons	15,100	15,318	15,295	13,742	[7]12,767
MALI[4]						
Cement, hydraulic		25,365	19,005	20,000	22,000	25,000
Gold, mine output, Au content[e] [16]	troy ounces	[r]16,000	[r]18,000	16,000	22,500	[7]85,200
Phosphate rock[e]		[r]3,460	[r]7,047	3,452	8,092	10,000
Salt[e]		4,500	4,500	4,500	4,500	4,500

See footnotes at end of table.

TABLE 1—Continued

WEST AFRICA: PRODUCTION OF MINERAL COMMODITIES

(Metric tons unless otherwise specified)

Country[1 2] and commodity[3]		1984	1985	1986	1987[p]	1988[e]
MALI—Continued						
Stone: Marble		758	769	750	200	155
Gypsum[e]		300	300	300	[5]600	[7]720
Silver[e 17]	troy ounces	1,000	1,100	1,000	1,100	1,600
MAURITANIA[18]						
Cement		—	—	—	80,000	90,000
Gypsum		800	5,470	18,060	19,402	20,000
Iron and steel:						
Iron ore:						
Gross weight[19]	thousand metric tons	9,527	9,333	8,929	9,000	10,004
Iron content[e]	do.	5,754	5,600	5,840	5,850	6,500
Metal: Semimanufactures		898	4,481	5,512	5,465	5,500
Petroleum refinery products	thousand 42-gallon barrels	—	—	—	300	3,000
NIGER[4]						
Cement, hydraulic[e]		38,000	38,000	38,000	40,000	[7]26,400
Coal		123,644	150,635	123,644	164,000	160,000
Gypsum[e]		3,000	3,000	3,000	3,000	3,000
Molybdenum concentrate, Mo content[e]		33	20	20	8.3	15
Phosphate rock		[r]1,426	[r]200	—	—	—
Salt[e]		3,000	3,000	3,000	3,000	3,000
Tin, mine output, Sn content		76	134	80	94	[7]119
Uranium, U_3O_8 content of concentrate		[r]3,854	[r]3,807	[r]3,662	3,493	[7]3,482
SENEGAL[4]						
Cement, hydraulic		384,821	406,890	360,000	372,000	[7]390,956
Clays: Fuller's earth (attapulgite)		115,498	95,957	81,857	111,048	[7]108,425
Petroleum refinery products:						
Gasoline	thousand 42-gallon barrels	546	[e]540	550	800	[7]951
Jet fuel and kerosene	do.	401	[e]400	400	576	[7]799
Distillate fuel oil	do.	675	[e]680	650	1,270	[7]1,564
Residual fuel oil	do.	786	[e]790	750	1,395	[7]1,815
Other	do.	23	[e]20	20	43	44
Refinery fuel and losses	do.	233	[e]230	230	213	227
Total	**do.**	**2,664**	**[e]2,660**	**2,660**	**4,297**	**5,400**
Phosphate rock and related products:						
Crude:						
Aluminum phosphate	thousand metric tons	279	355	131	191	[7]119
Calcium phosphate	do.	1,932	1,814	1,850	1,874	[7]2,326
Manufactured:						
Aluminum phosphate, dehydrated	do.	142	200	60	89	[7]61
Other[20]	do.	7	8	5	4	[7]1.5
Salt[e]		165,000	160,000	145,000	100,000	75,000
SIERRA LEONE[12]						
Aluminum: Bauxite, gross weight	thousand metric tons	1,040	1,184	1,242	[7]1,390	1,379
Diamond:[21]						
Gem[e]	thousand carats	240	243	215	214	12
Industrial[e]	do.	105	106	100	100	6
Total	**do.**	**345**	**349**	**315**	**314**	**[7]18**

See footnotes at end of table.

TABLE 1—Continued

WEST AFRICA: PRODUCTION OF MINERAL COMMODITIES

(Metric tons unless otherwise specified)

Country[1] [2] and commodity[3]		1984	1985	1986	1987[p]	1988[e]
SIERRA LEONE—Continued						
Gold[21]	troy ounces	18,223	19,004	8,740	[7]13,578	629
Gypsum[e]		4,000	4,000	4,000	4,000	4,000
Iron ore		355,000	[e]70,000	—	—	—
Petroleum refinery products:						
Gasoline	thousand 42-gallon barrels	238	287	[e]300	250	200
Jet fuel	do.	128	162	[e]170	150	100
Kerosene	do.	93	55	[e]50	50	35
Distillate fuel oil	do.	709	443	[e]450	450	400
Residual fuel oil	do.	433	379	[e]360	360	325
Liquefied petroleum gas	do.	9	9	[e]9	9	8
Other	do.	1	1	[e]1	1	1
Refinery fuel and losses	do.	64	60	[e]60	60	50
Total	**do.**	**1,675**	**1,396**	**[e]1,400**	**1,330**	**1,119**
Salt[e] [22]	thousand metric tons	200	200	200	200	200
Titanium:						
Rutile ore and concentrate 96% TiO_2, gross weight		91,300	80,611	97,100	[7]113,300	[7]126,000
Ilmenite ore and concentrate 60% TiO_2, gross weight		—	—	—	[7]5,600	[7]42,000
TOGO[4]						
Cement products:						
Clinker	thousand metric tons	154	—	—	—	—
Cement[23]	do.	243	284	348	370	[7]378
Iron and steel:						
Semimanufactures	do.	—	[7]7	[7]9	[7]12.1	14,000
Phosphate rock, beneficiated product	do.	2,400	2,450	[r]2,314	[r]2,644	[7]3,464
Stone: Marble, dimension	square meters	5,317	5,671	5,000	10,800	[7]27,000

[e] Estimated. [p] Preliminary. [r] Revised. NA Not available.
[1] Production data for Nigeria given in table 4.
[2] In addition to the countries listed, The Gambia and Guinea-Bissau, which are covered in the text of this chapter, presumably produced a variety of crude construction materials (clays, sand and gravel, and stone) but output is not reported quantitatively, and available information is inadequate to make reliable estimates of output levels.
[3] In addition to the commodities listed, most of these countries produce clay, sand and gravel for local construction purposes. Information is inadequate to make reliable estimates of output levels.
[4] Includes data available through Dec. 15, 1989.
[5] Approximately 60% of estimated production is smuggled out of the country.
[6] Output based entirely on imported clinker.
[7] Reported figure.
[8] Does not include artisanal production smuggled out of country.
[9] Data are for fiscal year ending July 30 of that stated.
[10] Includes data available through Oct. 1, 1989.
[11] Includes estimated 400,000 carats of smuggled artisanal production.
[12] Includes data available through Aug. 1, 1989.
[13] Figure includes reported mine production of 10,300 troy ounces. Remainder represents approximate sales to Government of artisanal production.
[14] Includes data available through June 1, 1989.
[15] Data are based on gold taxes for export, and may include gold produced outside of Liberia.
[16] Includes estimates of artisanal production from, and smuggled into, Mali. Kalana Mine accounted for about 67% of total output in 1984 and 1985, 50% of output in 1986 and 1987, and about 20% in 1988.
[17] Estimated output from Kalana Mine only.
[18] Includes data available through Sept. 1, 1989.
[19] Reported iron ore exports.
[20] Products marketed under the trade names "Balifos" and "Phospal."
[21] Data are based on official exports and do not reflect smuggled material.
[22] Data do not include output of salt refined from annual imports of 4,000 to 10,000 tons of crude marine salt.
[23] Output based entirely on imported clinker except for part of 1984 production.

GHANA[8]

The Ghanaian economy grew more than 6% in 1988, the fifth successive year of expansion under an economic rehabilitation program backed by the International Monetary Fund (IMF) and the World Bank. Economic prosperity was, however, hindered by the fact that more than 70% of export earnings went to debt reservicing. In addition, low world prices greatly reduced earnings from cocoa, traditionally Ghana's major source of export revenues.

The Ghanaian minerals sector provided about 22% of Ghana's foreign exchange revenues, second only to cocoa. Gold was the dominant mineral produced, accounting for about 85% of mineral exports, and was the focus of most of the major expansion of mineral exploration in the country. In 1984, the Government initiated policies designed to reverse many years of decline in mineral production and of deterioration of equipment and infrastructure. As a result of the new policies and increases in some world commodity prices, particularly gold, the Government was able to attract foreign investment in the minerals industry.

Loans from the World Bank and other international financial institutions were being used to rehabilitate and expand the facilities at the Government-owned mines and at Ashanti Mines. Numerous foreign companies were actively engaged in exploration. The first new gold mine in several decades began operations in 1988 and others were expected to commence operations in 1989 or 1990. In a continuing effort to privatize the country's industries, the Government began soliciting bids for its three wholly owned gold mines. In addition, the Government took steps to legalize and encourage the country's artisanal gold and diamond mining in order to channel this significant existing production through legal channels, increase total gold and diamond production, and increase the general level of employment.

The World Bank granted the Government a $40 million interest-free loan to rehabilitate state-owned mines. The Government-owned State Gold Mining Corp. (SGMC) was to receive $36 million of this, with a stipulation that the Government was to privatize the properties. The United Nations Development Program (UNDP) assisted the SGMC in drawing up prospectuses for these mines. The loan to the SGMC represented about one-third the estimated total cost to rehabilitate the gold mines. Financing for the remainder was being sought from the African Development Bank, the European Investment Bank, and France's Caisse Centrale de Cooperation Economique. The remainder of the World Bank loan went to Ghana Consolidated Diamonds Ltd. (GCD) and to Ghana National Manganese Corp. (GNMC).

Production and Trade

Ghanaian export earnings in 1988 increased about 5% to more than $868 million.[9] As in previous years, the export economy was dominated by sales of cocoa and cocoa products. Although cocoa sales volume was up slightly, sales revenues decreased by almost $100 million to about $400 million as a result of depressed world cocoa prices. Timber exports earned about $106 million.

Total mineral exports were about $193 million. Gold exports accounted for $164 million of this, which represented about 19% of Ghana's total exports and a 10.3% increase over 1987 sales. Gold production actually increased almost 14%, but world gold prices were slightly lower in 1988. Bauxite production increased about 30%, and aluminum production increased by almost 8%. Cement production increased dramatically. Production of manganese ore fell significantly, largely as a result of depletion of high grade oxide reserves. While table 1 shows a production increase for diamonds in 1988, this reflects the inclusion, for 1988 only, of the estimated artisanal production smuggled out of Ghana. Production from the country's only diamond mine fell almost 50% as the result of the continuing deterioration of equipment and a general lack of spare parts.

Commodity Review

Metals.—**Aluminum.**—As in years past, all of Ghana's bauxite production came from the Ghana Bauxite Co. (GBC) mine at Awaso. GBC was a joint venture between the Government (55%) and British Alcan Aluminium Ltd. (45%). The mine was producing well under capacity because of an inadequate railroad infrastructure to the exporting port of Takoradi. Ghana also has bauxite reserves at Kibi, and the Government had a long-term goal of using this bauxite to supply the Volta Aluminum Co. (VALCO) smelter at Tema. The main constraint was the cost of constructing the necessary infrastructure. The Soviet Union submitted a feasibility study on this project in 1988, but its conclusions had not been announced at yearend.

In recent years, aluminum production by VALCO had dropped because of decreased hydroelectric power supplies resulting from low water levels in Lake Volta. Continued low water levels as late as July 1987 led to fears about low production levels again in 1988, but heavy rains later in the year led to rapid water accumulation in the reservoir. As a result, VALCO restarted 40% of its fifth potline in early 1988, thus raising its aluminum production capacity by 10% at yearend to 176,000 tons per year. Production increased 8%, but fell short of capacity because of both the gradual nature of the potline restart and shortages of alumina.

Gold.—Ghana's recorded gold production of 372,979 troy ounces was its highest since 1978 and was an almost 14% increase above 1987 production. The increase was due to the opening of a new gold mine and to significant progress made in the rehabilitation and expansion programs at the existing gold mines. There were several advanced exploration projects ongoing at yearend; it was anticipated that some of these would become mines within the next few years. These favorable developments were results of the liberalized legal and financial conditions set forth in the 1986 Minerals and Mining Law. It was predicted that the country's gold production would reach 1 million troy ounces per year by the mid-1990's.

Gold smuggling remained a problem. The Government proposed setting up eight district centers in an attempt to regulate the activities of the small-scale mining sector. These centers were to be located at Akim Oda, Assin Fosu, Bibiani, Dunkwa, Enchi, Kibi, Konongo, and Tarkwa—all areas known to have much illegal small-scale mining. The Government hoped that by regulating small scale miners, revenues perhaps as high as $100 million annually would be forthcoming. The district offices would issue licenses, provide safety and technical training, and provide an official channel through which gold could be legally sold. The Government proposed granting the small-scale miners a tax holiday to encourage them to sell their gold through these new legal channels. Gold (and diamond) sales were to be to licensed Ghanaian buyers at prices fixed weekly. The official buying price was expected to be about 93% of the world price.

By far the largest gold producer was Ashanti Goldfields (Ghana) Corp. (AGC), a joint venture between the Government (55%) and Lonrho Plc (United Kingdom), which operated the Ashanti Mine at Obuasi. Gold production in 1988 increased 11.5% to 311,767 troy ounces, which was almost 84% of the country's total production. Gold sales increased 8.2% to $136.8 million, which represented about 16.5% of Ghana's total export revenues.

The expansion and rehabilitation program, begun in 1984, for the Ashanti Mine complex, continued. This $156 million program, partly financed by the International Finance Corp. (IFC)-World Bank ($45 million) and a European bank consortium ($26 million), had the goal of raising the Ashanti Mine's gold output to 400,000 ounces per year by 1990. The new 2,600-foot George Cappendell shaft was commissioned during the year and it was planned to effectively double its depth by sinking a winze. Work continued on the 5,200 foot Kwesi Mensah shaft, which was expected to be completed by 1991 for a cost of $27 million. An air-recirculation calcining furnace was added to the plant facilities, which was faster and cheaper to operate than its predecessor. To meet increased production goals, financing was being sought for a new processing plant to come on-line in 1995. In addition, AGC began reclaiming, using a newly commissioned $8 million plant, about 20 million tons of tailings at a rate of 2,000 tons per day (to be doubled by 1990). Encouraged by the recent application of heap-leach technology at the new Southern Cross Mine, AGC mined some surface portions of its ore body. Gold production capacity at known grades was 420,000 ounces per year, up from 320,000 ounces per year in 1987. The company expected to produce 348,000 ounces of gold in 1989, of which 36,000 ounces was to be from heap-leach recovery from surface workings.

AGC began a program to reactivate surface and underground mines and prospects at Sansu, 16 kilometers south of Obuasi. The total cost of this project was not announced, but the company was securing a $25 million loan from the World Bank for this. The remainder of the costs were to be borne by the company. The production plant for this site was expected to be completed in 1989 at a cost of $16 million. Mining was expected to commence in the last quarter of 1989 at a rate of 100,000 tons per month of low-grade, heap-leachable surface ores.

Total combined production from the Government-owned SGMC increased 4% to 50,295 troy ounces; sales were almost $22.5 million. SGMC produced gold from two underground mines (Prestea and Tarkwa) and from one dredging operation (Dunkwa). At yearend, SGMC had virtually completed negotiations for a loan for the second phase of its ongoing mine rehabilitation program. The $112 million loan was to be from the World Bank ($35 million), European Investment Bank ($18 million), African Development Bank ($35 million), Caisse Centrale of France ($10 million), and private and commercial loans ($14 million). As a result of the rehabilitation program, total SGMC production was expected to increase to more than 120,000 ounces per year by the early 1990's.

The Prestea Mine produced 23,471 ounces of gold from 214,000 tons of ore. This was an almost 20% increase in ore milled and was an indication of early benefits from the rehabilitation program. However, the gold production was only about 5% higher owing to lower ore grades and the fact that graphite in the ore adversely affected gold recovery in the mill. Tarkwa's production increased almost 10% to 20,053 ounces. The production from Dunkwa, however, fell almost 15% to 6,771 ounces, in contrast to the 61% production increase experienced in 1987. This decrease was largely due to the need for repair to several of the company's dredges.

As part of its ongoing efforts to privatize the Ghanaian economy, the Government began soliciting bids for the three SGMC operations toward yearend.

In May, Southern Cross Mining (SCM) opened a mine at Obenemase near Konongo. This was the first new gold mine to be opened in Ghana in more than 40 years. SCM was a joint venture between North Queensland Co. of Australia (70%) and SGMC. The joint-venture agreement was for a period of 30 years and covered a 126-square-kilometer concession. Production in 1988 was 10,853 ounces, which was one-third of the expected full-production output. There was a possibility that output would be expanded to 100,000 ounces per year in 1990. The mine was developed at relatively modest cost and was an open pit, heap-leach operation, mining oxide ore from Birimian metavolcanics and metasediments as well as processing old tailings. The company was not yet mining its sulfide ore reserves, which, it was recognized, would require more expensive processing. The mine's oxide and sulfide reserves were reported to be almost 1.9 million tons grading 5.85 grams (0.19 ounce) of gold per ton. Reported tailings reserves in the immediate area were about 1.8 million tons grading 0.97 grams (0.03 ounce) of gold per ton. The company had identified an additional 287,000 tons of oxide and sulfide ore reserves, grading 11.76 grams (0.38 ounce) of gold per ton, near the old SGMC Konongo Mine. Exploration was continuing and at yearend more than 4,000 samples of various types remained to be assayed. It was anticipated that the reserves would be increased once the results of these analyses became available.

As in 1987, there was a great deal of exploration for gold in Ghana during the year. Most projects involved either lode deposits in the Birimian and Tarwaian systems in the southwestern portion of the country, or placer deposits believed derived from these systems.

One of the most advanced exploration projects was that of Canadian Bogosu Resources Ltd. (CBR) on the Bogosu concession. Marlu Gold Mining Areas Ltd. produced 924,000 ounces of gold from 7.5 million short tons of ore from this area between 1936 and 1955. CBR started as a joint venture of Sikaman Gold Resources Ltd. of Canada (40.5%), Denison Mines of Canada (27%), Denison-affiliate Exall Resources Ltd. (13.5%), the Ghanaian Government (10%), and the IFC (9%). In early 1988, Billiton BV (Netherlands) purchased the 40.5% share held by Denison-Exall. Minproc Engineering (Australia) was the project engineer. Debt financing of the project was by the World Bank at an estimated capital cost of $45 million. The concession was believed to contain minable reserves of both oxide and sulfide ore as well as about 6 million tons of old dumps.

The ongoing project involved drill-testing 5 of at least 14 targets on a mineralized zone some 18 kilometers long. The exploration program involved about 40,300 feet of diamond core drilling (155 holes). Proven and probable open pit geological reserves based on this $9 million exploration and feasibility study program were reported to be about 924,000 ounces of gold within about 8 million short tons of ore. More than 65% of these reserves were considered as proven. Minable reserves were estimated at 6.5 million short tons grading 0.12 ounce of gold per ton. A treatment plant with an initial capacity of 825,000 short tons per year and a startup production rate in excess of 100,000 ounces per year was recommended. It was hoped to eventually increase that rate. Production costs were calculated to be $147 per ounce for the first 3 years and $181 per ounce for the life of the project. Total capital costs for the project were estimated to be $67.6 million, including 1989 preproduction costs, working capital, and interest during construction. The remaining targets were considered to have a potential for 3 to 5 million short tons of open pit reserves grading 0.12 ounce of gold per ton and more than 10 million short tons of underground reserves grading 0.12 to 0.30 ounce of gold per ton. Old dumps and tailings on the concession were reported to amount to 6.6 million tons containing 174,000 ounces of gold in proven reserves. Production was anticipated to start late in 1989.

Another advanced project was that of Teberebie Goldfields Ltd., which was a joint venture of Pioneer Group Inc. of the United States (63%), Glencar Explorations (United Kingdom) PLC (27%), and the Government (10%). The Teberebie project is 5 miles southwest of Tarkwa, in Tarkwaian conglomerate banket ores similar to those at the SGMC mine. Exploration in 1987, including detailed sampling of trenches and adits, delineated reserves of about 10 million tons grading 1.85 grams (0.06 ounce) per ton. A similar quantity of possible reserves were outlined immediately north of the original target. Diamond drilling continued in 1988. By yearend, proven reserves were about 6 million tons grading about 2 grams (0.064 ounce) per ton, and possible reserves of about 11 million tons at a similar grade had been identified along strike. A 30-year mining lease was signed with the Government in February. The project had some delays late in the year in finalizing equipment supply contracts, but open pit mining was expected to commence in late 1989 or early 1990. Total capital costs to bring the project into production had been estimated at about $27.5 million, but the project delays were expected to increase these costs. Gold production costs were estimated to be about $162 per ounce. Mining was to be at a rate of 4,600 tons per day, with an expected 75% gold recovery of about 60,000 ounces per year by heap leaching once full production is reached by mid-1990. However, the company was considering adding another work shift to increase eventual production to 100,000 ounces per year. In October, Teberebie Goldfields secured a $9 million loan from the Overseas Private Investment Corp. (United States) toward development of the mine.

Cluff Taywood Mining Co. (Cluff), a joint venture between Cluff (50%) and Taylor Woodrow Plc (50%) (both of the United Kingdom), was awarded licenses to explore various historic gold mines and prospects for minable targets similar to those operated by Cluff in Zimbabwe. At the Mpesetia property near Kumasi, 2,400 meters of trenching and resampling of surface workings and old adits confirmed the presence of several parallel gold-bearing shears. A 250-meter-long zone of continuous oxide mineralization was identified on one of these shears. It averaged 10 meters in width at a grade in excess of 6 grams (0.19 ounce) of gold per ton. Three nearby, but separate, zones were identified. They had similar strike lengths, widths of 20 to 60 meters, and grades averaging 1 to 3 grams (0.03 to 0.1 ounce) of gold per ton. Other prospects held by the company were at Bokitsi near Dunkwa, near Affo, and near Miradani.

Ghana-Australian Goldfields Ltd. (GAG), a joint venture between Golden Shamrock Mines of Australia (90%) and the Government (10%), was studying plans to develop a surface gold mine on its Iduapriem property 10 kilometers southwest of Tarkwa. The area has supported small mining operations for over a century. Trench sampling identified a resource of about 9 million tons grading 2.9 grams (0.09 ounce) of gold per ton. The ore was in conglomerate (banket) reefs over a strike length of 9 kilometers. Drilling commenced in May with encouraging results. Development costs were estimated to be $25 million, largely because the low grades would require a high degree of mechanized mining. It was estimated that the project could support a 1-million-ton-per-year operation producing between 85,000 and 110,000 ounces per year over a mine life of 8 to 10 years. Gold production costs were estimated to be $250 per ounce. A production decision was expected in March 1989.

Europa Minerals Ltd. (United Kingdom) was exploring for alluvial gold and diamonds as well as heavy minerals in beach sands at the mouth of the Pra River. The company had a large financial stake and management responsibility in the Dana Exploration Plc (Ireland) alluvial gold property on the Offin River. Bulk sampling and reconnaissance drilling there confirmed the continuity of two placer deposits—a high terrace area containing an estimated 80,000 cubic meters grading 0.4 gram (0.013 ounce) of gold per cubic meter and a low terrace area containing 1.32 million cubic meters grading 0.58 gram (0.019 ounce) of gold per cubic meter. These deposits were open. Reserves sufficient for a 2-year mining operation were delineated in the high terrace gravels where the overburden was thin. Pending approval by the Government, it was anticipated that mining could commence in late 1989. Work by Selection Trust in the 1930's suggested that the Offin River channel contained dredgeable reserves of 170,000 ounces of gold, and Europa Minerals Ltd. was considering diverting the river to gain access to these gravels when mining extended to the low terrace gravels.

The United Nations (U.N.) Revolving Fund for Natural Resources (UNRFNRE) reported that field operations had begun on a gold project on a 1.4-square-kilometer area near Prestea, between the SGMC lease and that held by CBR. The work was to include mapping, geophysical and geochemical surveys, and followup trenching and drilling as justified. Known reserves were more than 3 million tons grading 5 grams (0.16 ounce) of gold per ton. UNRFNRE was cosponsoring the project with the Agency for International Technical and Economic Cooperation (Sweden).

BHP-Utah International Inc. (Australia) commenced a reconnaissance exploration program over a large area south of Prestea and west of Tarkwa.

Manganese.—Ghana's manganese production continued to decline because of diminishing reserves of oxide ore and by problems at the loading facilities at Takoradi. Earlier problems with the railroad from the Nsuta Mine to the port had been partly alleviated. Extensive efforts to increase oxide reserves have reportedly led to delineation of about 5 million tons; however, it was still felt that the mine would exhaust its high-grade reserves in about 5 years. There were extensive reserves, perhaps 20 million tons, of carbonate ore. A calcining furnace built during the period 1979–82 remained uncommissioned at yearend. It was expected that the kiln would remain unused because the mine was able to sell all of the carbonate ore it produced to the Japanese and expected to continue to be able to do so.

GNMC entered into an agreement with Geomin (Romania) to explore the manganese reserves on the GNMC concession. Ghana received an offer from Bulgaria, Czechoslovakia, and Romania to purchase manganese ore.

***Industrial Minerals.*—Cement.**—Ghana's cement production increased 74% to 477,000 tons. This increase was due to the increased availability of foreign exchange, which allowed an increase in clinker imports.

Diamonds.—Ghana's official diamond production, which does not include estimates of smuggled production, was 244,881 carats in 1988; a significant decrease from 1987 and the third consecutive year of decline. However, newly available information has allowed the inclusion in table 1 of an estimate of smuggled artisanal production for 1988. The Akwatia Mine, operated by GCD, accounted for 225,200 carats of the total production, a 48% decline from the previous year. This decline was largely due to the continuing deterioration of equipment and a lack of spare parts.

In 1987, the focus of mining at Akwatia was shifted from the old high terrace gravel deposits, now largely exhausted, to channel gravels on the Birim River. The reserves in this area were delineated by the U.N. and could support an annual production of 1 million carats for at least 15 years. Equipment problems prevented the mine from approaching these output levels. In addition, the long ore haulage to the old plant contributed to the high cost of the operations.

As in previous years, smuggling of diamonds was a problem. The Government estimated that this smuggled production amounted to 450,000 to

600,000 carats annually, worth at least $10 million. In an effort to check smuggling in the Akwatia area, it was announced that GCD was now paying attractive rates for diamonds produced by artisanal miners.

In a further effort to reduce smuggling and to encourage the legitimate production of diamonds by small-scale miners, the Government announced that it would allocate mined-out areas of the GCD concessions to private companies. New equipment was commissioned at two small-scale mining companies, Cayco (Ghana) Ltd. and Ntboase Mining Co., in the West Akim District.

Mineral Fuels.—**Petroleum.**—It was announced in March that Libya had agreed to resume supplying crude oil to Ghana on favorable payment terms and to reschedule, without interest, the remaining debt for oil supplied to Ghana in 1983.

Amoco (Ghana) Production Co. signed an exploration agreement in 1987 for the offshore Ada concession. This 2,200-square-kilometer concession extended from the Accra area to the Togolese border. The company was committed to drilling one exploration hole by August; however, no results had been announced as of yearend.

Petro-Canada International Assistance Corp. (PCIAC) continued with its petroleum exploration assistance program begun in 1983. In 1988, PCIAC agreed to provide up to $8.1 million in goods and services to help the Ghana National Petroleum Corp. earn an interest in an undisclosed offshore block that was to be acquired by a consortium led by Atlantic Richfield Co. The Netherlands Government agreed to finance the cost of a drill ship for a multiwell program.

GUINEA[10]

Mining continued to be crucial to the Guinean economy, accounting in 1988 for about 22% of the country's gross domestic product (GDP) and 95% of its export revenues. Sales of bauxite and alumina accounted for only about 74% of Guinea's export revenues, compared with a traditional export reliance of more than 90%. This was due to diversification of the mining sector and the general economy in recent years, and not to a decrease in production of these commodities. The Government continued to encourage exploration and development of other mineral resources so as to broaden the country's mineral export base. Special attention was given to the development of gold and diamond production. At yearend, Guinea had one operating gold mine, one diamond mine, and a second diamond deposit in the advanced stages of exploration. There was also significant but undocumented production by artisanal miners of gold and diamonds, much of which was reportedly smuggled out of the country. In order to capture some of the foreign exchange earnings from undocumented gold sales, the Government in 1987 authorized commercial banks to purchase gold on its behalf from sellers who could remain anonymous. Up to one-half of the purchase price could be paid in hard currency. Purchases of gold were facilitated by the opening of commercial bank branch offices throughout the country. The Government reported purchasing more than a ton of gold in this manner in 1988.

An accord was reached during a visit by Guinean officials to Morocco for the two countries to form a joint company to prospect for gold, diamonds, and other minerals in Guinea's Mandiana Province. Morocco would finance the exploration, which would be capitalized or reimbursed upon the discovery and exploitation of minerals. The agreement also provided for the training of Guineans in Morocco in the sectors of geology, mines, and energy. Morocco was already involved in a uranium exploration consortium in Guinea.

A possible mineral exploration joint venture with the Government of Guinea-Bissau was discussed during the late November visit to Conakry by the Guinea-Bissau President. The joint venture's purpose would be the exploration and mining of bauxite in Gaoual Prefecture in Guinea and in the Madinaboué area of Guinea-Bissau and the joint exploitation of possible petroleum reserves along the common border.

Although it was announced in July that Yugoslavia would build an oil refinery in Guinea as a symbol of cooperation between the two countries, no date was given for the start of construction.

During a March visit to Guinea by the Romanian President, it was announced that there would be intensified cooperation between the two countries in several fields, including mining. A commitment was made for Romania to purchase 1 to 2 million tons of iron ore per year from the Mount Nimba deposit once it achieved production. However, no agreement resolving the iron ore project's myriad development problems had been reached at yearend, and production of iron ore in the near future was considered unlikely.

Production and Trade

Guinea remained the second largest producer of bauxite in the world. Production increased almost 16% to just under 17 million tons. Alumina production increased slightly. Bauxite exports increased about 17%; however, sales revenues fell about 10% to about $352 million as a result of a decrease in the world bauxite price.

Recorded production of diamonds fell 16%. This decrease was mitigated by higher world prices for gem diamonds and the continued production of a very high percentage of high-quality stones, including one large stone of extraordinary quality that sold for a world-record price. Recorded gold production increased, both as a result of the startup of a new placer mine, and the legal sale of at least a portion of the gold produced by artisanal miners.

Guinea imported all of its refined petroleum products needs, amounting to approximately 2.6 million barrels. Of this, about 1.25 million barrels was fuel oil. Imports of petroleum products from the U.S. consisted of about 8,000 barrels of lubricants and a small amount of asphalt.

Commodity Review

Metals.—**Bauxite and Alumina.**—Guinea's bauxite production increased by 15.5%, largely owing to an increase in production to about 11 million tons at the Sangáredi Mine of Compagnie des Bauxites de Guinée (CBG). Metallurgical-grade bauxite production was slightly more than 16 million tons and production of calcinated bauxite was about 264,000 tons. Production of alumina increased by 6% to 590,000 tons.

In February, an agreement was signed with the Central Fund for Economic Cooperation (France) whereby France granted a loan of 90 million francs ($15 million) for the financial reorganization of Friguia consortium, led by Pechiney (France), which mines bauxite for conversion to alumina for export. Later in the year, the European Community Mining Aid program (SYSMIN) approved a loan of 35 million European currency units (ECU) ($38.5 million) to Friguia, and it was announced that the European Investment Bank had plans to provide an additional 13 million ECU. The loans were to be used to upgrade Friguia's alumina plant, its bauxite mine, and road and port facilities. Emphasis was on reducing the alumina plant's energy consumption. These improvements were expected to restore alumina production capacity to 600,000 tons per year initially and to 670,000 tons per year by 1993. Production costs were expected to decrease almost 14% to about $114 per ton.

At yearend, the Guinean Government was studying the possibility of building an alumina plant for CBG, but recognized that this would require a large hydroelectric project. The feasibility of an aluminum smelter was also under study. Negotiations were underway with the Soviet Union for financial and technical assistance for these projects.

Gold.—Guinea's official gold production was 10,288 troy ounces. This did not include unrecorded artisanal production, estimated in the past to be about 60,000 ounces per year, most of which reportedly had been smuggled out of the country. Because of new purchasing arrangements started in 1987, some of the artisanal production began to be sold through legal channels. In 1988, these sales amounted to about 1 ton (approximately 32,000 ounces).

Almost all of the official gold production came from the Koron placer mine in the 23,000 square-kilometer Siguiri Concession. The mine was owned and operated by Société Aurifère de Guinée (SAG), which was a joint venture between the Government (49%) and Chevaning Mining and Exploration Co. (CMC) of the United States (51%). Union Minière S.A. (Belgium) acquired a 50.1% stake in CMC in 1987, with the remainder owned by Omnium Natural Resources (United Kingdom)—itself a subsidiary of Swiss merchant bank Société Financière Omnium (SFO). In May, Pancontinental Mining Ltd. (Australia) purchased the 25.45% SFO stake in SAG.

The initial mining plan for Koron was based on proven reserves of 9.2 million cubic meters of auriferous gravel grading 2 grams (0.06 ounce) of gold per cubic meter. Plant construction took place over a 12-month period. The engineering work was originally done by Wright Engineers (Canada), but this firm was replaced by Mechim, an engineering subsidiary of Union Minière, following the latter's acquisition of a majority interest in CMC in 1987. The pay zone gravels at Koron are confined to a narrow channel about 12 kilometers long, and the processing plant was moved periodically along this channel to avoid lengthy ore haulage. Plant processing capacity was designed to produce approximately 60,000 troy ounces of gold annually, but it was anticipated that this output could be increased to 90,000 ounces per year. Trial operations were underway early in 1988 and the first bullion was poured in July. It was expected that 875,000 cubic meters of gravel would be mined the first year to yield 55,000 ounces of gold; however, startup problems limited production to about 10,000 ounces. Revised estimates of future production were 45,000 ounces for 1989 and 60,000 ounces for 1990. Exploration was ongoing to increase the reserves. In addition, SAG was looking into the possibility of using a metal detector to recover nuggets larger than 1.25 inches, the maximum recoverable size for the existing processing plant. SAG had a second deposit, unmined in 1988, at Didi, with reserves of 3.5 million cubic meters of gravel grading 1.3 grams (0.04 ounce) of gold per cubic meter.

A gold-recovery circuit was added in 1987 at the Aredor diamond mine, but did not progress beyond the pilot stage because of low and irregular gold grades. Gold recovery in 1988 was only about 160 ounces.

France's BRGM and Kenor A.S. (Norway) were continuing their exploration and mine feasibility studies of the Matagania gold placer at Dinguiraye near Siguiri and of the old gold workings at Banora.

Iron Ore.—No agreement had been reached at yearend in the ongoing negotiations between the Liberian-American-Swedish Minerals Co. (LAMCO) in Liberia and various partners in the Société Minière de Fer de Guinée (Mifergui) consortium concerning the start of mining operations at the iron ore deposit at Mount Nimba near the Liberian border. The project hinged on the ability to connect the deposit by 17 kilometers of track to the railroad infrastructure in Liberia associated with LAMCO's iron mine at Yekepa. There were many problems associated with the project. The LAMCO infrastructure was deteriorating, and as the LAMCO mine was scheduled to close at yearend 1989, the timing of the startup of mining at Mount Nimba was crucial in terms of rail and port maintenance. LAMCO desired a role beyond merely leasing the infrastructure. There was concern on all sides that the original 12-member Mifergui consortium was unwieldy. It was felt that a new Mifergui, consisting of LAMCO plus three members (BRGM and the Governments of Guinea and Liberia) from the old Mifergui, was more workable, but difficult questions remained concerning the legal and financial concerns of the other partners in the original Mifergui. The Governments of Romania and Nigeria were committed to purchasing significant quantities of the ore, and one French partner in Mifergui expressed interest in both purchasing iron ore and helping with the project's financing. Nevertheless, overall agreement and financing remained very much in doubt at yearend, and announced forecasts of project startup in 1990–91 were considered optimistic.

Industrial Minerals.—**Diamonds.**—Diamonds were produced by one mine as well as by artisanal miners; all operations involved alluvial deposits. A separate exploration effort, that of Star Diamond Co. (United Kingdom), was ongoing at yearend, but was reported to be plagued by logistical problems.

As in 1987, all official diamond production in Guinea was from the Aredor Mine at Gbenko. Part of its 1988 production was from relatively low-grade zones on the boundaries of richer areas mined in 1987 and of those being prepared for mining in 1989. The mining of low-grade ore, together with some maintenance problems experienced toward yearend, resulted in a 16% decline in diamond yield to 146,439 carats. Aredor diamonds were sold for an average of $315 per carat, excluding very large stones. This 10.5% price increase greatly mitigated a sales volume decrease of almost 76% to about 118,600 carats. Diamond production averaged 93% gem quality, with an average stone size of 0.82 carat. Past production had included several large diamonds of extraordinary quality. In 1988, a 181.77 carat stone was found, which sold in November for almost $8.62 million. This price of more than $47,000 per carat was believed to be the highest ever paid for a rough diamond.

Exploration at Aredor during the year increased proven and probable reserves to 897,280 carats, which represented 5 to 6 years of production. Negotiations with the Government were ongoing at yearend to extend the Aredor lease to cover about 400 square kilometers of prospective ground adjacent to the existing concession.

GUINEA-BISSAU[11]

Production of mineral commodities in 1988 was limited to an undocumented quantity of building materials for local consumption. Towards yearend, the Governments of Guinea-Bissau and Guinea met in Conakry, Guinea, to discuss joint exploration for bauxite in the Madinaboué area of Guinea-Bissau, and in Gaoual Prefecture in Guinea. Joint exploration for petroleum was also discussed.

LIBERIA[12]

The Liberian economy was mixed in 1988, with the private sector showing strength, but with Government expenditures continuing to exceed revenues. The private sector export economy grew in response to higher world prices for iron ore, rubber, and hardwood lumber.

Liberian Government expenditures continued to exceed revenues, with financing of commitments being achieved through the increase of debt and the further issuance of newly minted Liberian coin. By yearend, the foreign debt had reached $1.7 billion, which was more than double the debt in 1981. The Government deficit was about $25 million at yearend, at which time Liberia's loans were some $670 million in arrears. In response to the lack of Governmental fiscal control, major donors such as the IMF, World Bank, and the African Development Bank continued to suspend disbursements to Liberia. For much the same reason, the United States continued to reduce aid to the country.

In late 1987, in an effort to restore U.S. foreign aid to Liberia, the Liberian President invited the United States Government to send a team of experts to manage the Liberian economy. This team arrived in January 1988, but left at yearend, having failed to in its efforts to convey the importance of fiscal restraint. One positive outcome, however, was Liberia's repayment during the year of $15 million in loans to the United States. This repayment was essential under U.S. law for continued U.S. assistance to Liberia.

In March, it was announced that a contract had been signed with a West German firm to assume total responsibility for operating, maintaining, and developing the port of Monrovia for a 3-year period. It was hoped that this would stimulate international trade by improving port services, security, and cargo handling capacity.

The Liberian private sector showed strength and resiliency during the year. In 1988, export levels for iron, rubber, and hardwood lumber increased in response to higher world prices for these commodities. Increased cutting of trees to meet export demands for lumber, with the attendant proliferation of small slash-and-burn farms, led to environmental questions concerning the destruction of the Liberian rain forest. Rubber and lumber were expected to assume an increasingly important role in the export economy, as iron ore

TABLE 2

LIBERIA: IRON ORE EXPORTS[1]

(Metric tons)

		LAMCO Joint Venture				
Destination	Product[2]	1984	1985	1986	1987	1988
Austria	wf	—	—	—	88,000	—
Belgium	wf	405,000	689,000	662,000	931,000	1,251,140
	wl	830,000	542,000	665,000	—	153,500
France	wf	795,000	761,000	441,000	759,000	689,030
	wl	185,000	336,000	183,000	142,000	155,110
	hg	—	—	—	255,000	—
German Democratic Republic	wf	—	—	—	—	36,750
	wl	68,000	72,000	—	37,000	—
Germany, Federal Republic of	wf	1,834,000	1,590,000	1,658,000	458,000	641,480
Italy	wf	1,077,000	937,000	852,000	828,000	1,000,290
	wf	—	—	—	—	12,290
Japan	c	312,000	173,000	305,000	72,000	297,860
Netherlands	wf	163,000	—	—	68,000	—
Nigeria	wl	335,000	297,000	—	116,000	153,980
Pakistan	wf	159,000	265,000	309,000	179,000	—
Poland	hg	62,000	—	—	—	—
Romania	wf	377,000	51,000	—	—	1,128,950
	wl	—	—	—	497,000	—
Spain	wl	394,000	554,000	719,000	785,000	660,430
	wf	—	—	—	28,000	15,000
Turkey	wf	250,000	128,000	32,000	—	—
United Kingdom	wf	—	—	—	60,000	—
United States	wf	1,636,000	2,067,000	1,738,000	896,000	128,000
Yugoslavia	wf	—	67,000	—	—	191,590
	hg	163,000	—	—	—	—
Total		**9,045,000**	**8,529,000**	**7,564,000**	**6,191,000**	**6,515,540**
		Bong Mining Co.				
Germany, Federal Republic of	sf	2,648,877	2,871,111	2,864,966	2,733,994	2,839,000
	pt	1,855,568	2,129,086	1,466,331	2,174,296	2,169,000
Italy	sf	1,169,622	1,488,150	1,359,240	1,350,423	1,146,000
	pt	960,707	1,087,909	1,232,890	1,052,859	1,033,000
Total		**6,634,774**	**7,576,256**	**6,923,427**	**7,311,572**	**7,187,000**

[1] Data do not include production from National Iron Ore Co. (NIOC) mine, which closed in 1985.
[2] wf = washed fines, wl = washed lumpy, hg = high = grade fines, c = concentrates, sf = sinter feed, pt = pellets

exports, traditionally accounting for about 50% of export revenues, were expected to decrease after the 1989 scheduled closure of the LAMCO Joint Venture (LJV) mine.

Production levels for mineral commodities were mixed, with increases reported for cement and gold production, but decreases reported for diamonds and iron ore.

Trade

Liberia's iron ore exports in 1988 increased by 1.4% to 13.7 million tons. The major buyers of Liberian iron ore, as in previous years, were European countries: the Federal Republic of Germany (41%), Italy (23%), Belgium (10%), and Romania (8%). In contrast, the United States purchased only about 1% of Liberia's production. Table 2 provides a breakdown by product type and purchasers of Liberia's iron ore exports for 1984 through 1988.

Commodity Review

Diamonds and Gold.—Reported production for diamonds fell by about one-third to 167,030 carats, of which, it was estimated, 40% were of gem quality. In contrast, reported gold production increased by about 45% to 21,753 troy ounces. Much of Liberia's gold and diamond production was by artisanal miners, and official records were not considered to be a reliable estimate of total production because of smuggling of both Liberian and neighboring countries' production through Liberia. Estimates of the value of this unreported trade in gold and diamonds ran as high as $240 million. In an attempt to reduce the smuggling of gold, the Government announced in May that the National Bank, rather than the previously licensed dealers, would handle all gold purchases. No mechanism to implement this had been set up by yearend.

Western Mining Corp. (Australia) was negotiating for land and financial concessions pertaining to a planned major exploration program for gold and diamonds. This program had strong support from the Liberian President, as it was seen as having major potential to help the Liberian economy at a time when projected iron ore revenues would be decreasing. A sticking point in the negotiations was the Liberian requirement that exporters surrender 25% of their foreign exchange earnings to the Government in exchange for Liberian dollars at the official rate, instead of the parallel exchange market rate.

Iron Ore.—The iron ore sector has been for the last quarter century the largest single factor in the Liberian economy, in recent years accounting for nearly 25% of the country's GDP and about one-half of the country's exports. In 1988, iron ore was produced by LJV and Bong Mining Co. (BMC). Negotiations were continuing with the Government of Guinea concerning the MIFERGUI-Nimba iron ore project; however, no agreement had been announced as of yearend. This $130 million project would connect the Guinean iron deposit at Mount Nimba with the LJV infrastructure by means of 17 kilometers of new track and would have the advantage to Liberia of keeping the LJV infrastructure in operation long after the LJV mine had exhausted its ore.

The most significant development in the iron ore sector was the announcement that the scheduled date for closure of the LJV mine at Yekepa had been advanced from mid-1990 to yearend 1989. The LJV explanation for this change was that the high-grade ore at Yekepa had been depleted more rapidly than expected. It was agreed that company benefits would continue to be paid to the workers in line with the original, mid-1990 closure announcement.

In contrast, BMC embarked on an expansion program that would allow mining of the ore in the Bong Peak area of its mining concession. Production from this area was predicted to keep BMC mining in Liberia until 2006. Because of the recent improvement in world iron ore prices, BMC finances improved after many years of losses. BMC conducted a program in 1988 to test the effect of semi-autogenous grinding on power consumption in the grinding cycle. It was recognized that the harder ores expected to be mined by 1995 would require an 85% increase in power consumption using the existing autogenous grinding cycle. The tests showed that semi-autogenous grinding would result in only a 17% power increase. As it was also found that an acceptable, if coarser, product could be had with the current softer ores using semi-autogenous grinding, it was decided to convert the existing grinding cycles to this mode. But the coarser product required more secondary and tertiary grinding, which negated about one-third of the power savings. Further tests were planned. Tests were also conducted in 1988 on removing alkali-bearing minerals from the harder ore mill feed.

Total Liberian iron ore production fell by 7.1% to 12.8 million tons. Production by LJV fell 14% to about 5.7 million tons. The BMC production fell only 0.5% to about 7.1 million tons. Recent production for the two companies is summarized in table 3. Figure 1 shows the workforce distribution between the mines for recent years.

Steel.—An $8 million secondary steel and gas production complex, having a capacity of 2,000 steel rods per day, began production in 1988. The complex is owned by a consortium of

TABLE 3

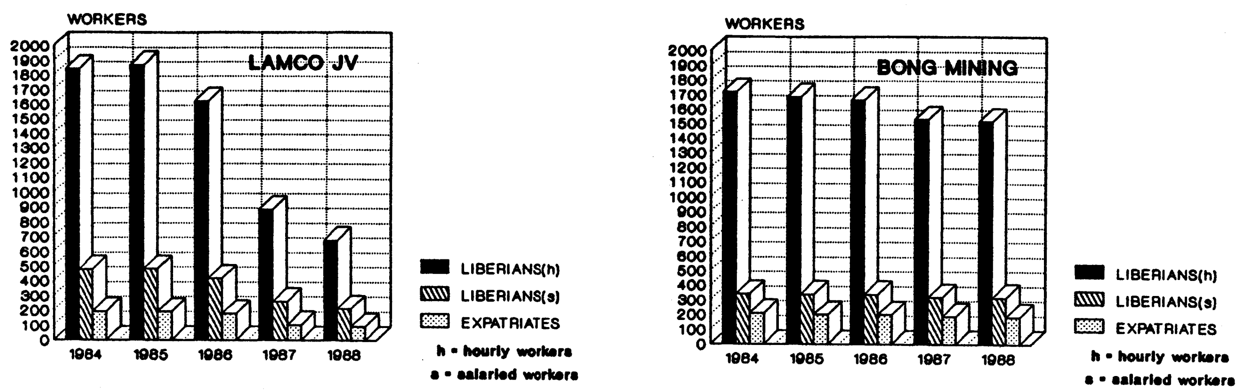
LIBERIA: IRON ORE MINE PRODUCTION

(Metric tons)

Product	1984	1985	1986	1987	1988
			LAMCO Joint Venture		
Concentrate	517,000	411,000	549,000	550,000	47,249
Washed lumpy	1,027,000	1,027,000	779,000	230,000	280,468
Washed fines	5,652,000	6,332,000	827,000	5,815,000	5,338,117
Total	**7,448,000**	**7,770,000**	**8,155,000**	**6,595,000**	**5,665,834**
			Bong Mining Co.		
Sinter feed	3,294,820	4,294,820	4,178,215	4,110,693	3,918,334
Pellets	2,994,617	3,032,840	2,961,775	3,036,671	3,182,751
Total	**6,994,617**	**7,327,660**	**7,139,990**	**7,147,364**	**7,101,085**

FIGURE 1

EMPLOYMENT TRENDS IN THE LIBERIAN IRON ORE INDUSTRY



three Liberian companies: Atlantic Oxygen Corp., which makes industrial gasses; Atlantic Steel Works Inc., which makes rods; and Atlantic Shipbreaking Inc., which uses scrap to make steel rods. The complex employs 100 Liberians and 10 expatriates.

MALI[13]

The production of gold continued to dominate the mining industry of Mali; gold export revenues in 1988 were about $37 million and made up about one-fifth of the country's total exports.[14] Gold was produced by one underground mine, and by numerous artisanal miners. Reported gold production increased significantly, but likely included gold smuggled in from neighboring countries. Some Malians worked as artisanal gold miners on a seasonal basis in Burkina Faso. The mining industry was otherwise characterized by the production of small quantities of cement, gypsum, marble, and salt.

There was significant gold exploration ongoing during the year, especially in the Kéniéba region, and, most notably, at Syama in the Bagoé region. At the latter, one company completed feasibility studies that were expected to lead to a favorable production decision in early 1989. Toward yearend, the French Government signed an agreement worth $2.65 million to help with gold exploration programs in the Kéniéba and Kangaba areas.

In August, the Soviet Union granted a $6.7 million commercial loan to rehabilitate the Socima cement factory at Diamou. Earlier in the year, a new company was formed to further exploit reserves of marble near Kayes.

Commodity Review

Metals.—**Gold.**—Mali's 1988 gold production was listed as about 85,200 troy ounces. About 16,000 ounces of this was from the Kalana Mine, the only official mine in operation. The remainder was from artisanal production in Mali and, probably, artisanal production smuggled into the country from Burkina Faso and Guinea.

The Kalana Mine continued to be the only large-scale operation in the country. The state-owned underground mine was run by the Société de Gestion et d'Exploitation des Mines d'Or de Kalana (SOGEMORK), with Soviet technical assistance. Gold production in 1988 increased almost 50% to about 16,000 troy ounces. The ore graded about 0.33 troy ounce per ton and had a gold-to-silver ratio ranging from 7 to 10. The gold is primarily within low-angle quartz veins penetrating both a pipe-like dioritic stock and the Birrimian-series country rocks. Some gold is also found associated with arsenopyrite and pyrite in the country rocks adjacent to the stock. Both the mine and the mill were undergoing expansion to provide for an increase in gold production to about 32,000 ounces per year starting in 1990. Mining was hampered by a high rate of water infiltration into the workings. A further problem was the high cost of diesel fuel needed for the mine's generators. The Soviet Union was financing the construction of powerlines to link the mine with the hydroelectric plant at the Sélingué Dam.

BHP-Utah International Inc. of Australia (BHP) continued exploration work on the Syama concession granted to it by the Government in mid-1987. The company had been attracted to the area based upon findings of a regional exploration program, conducted by the United Nations Development Program, which located a significant gold anomaly near 13th- to 15th-century gold workings. Work, begun by BHP in May 1987 and continued during 1988, consisted of detailed pitting and auger and diamond drilling of the Syama deposit, as well as reconnaissance mapping and sampling of other areas along the trend. Gold was found free and associated with iron sulfides in quartz veinlets and in their altered host rocks. The host rocks are steeply-dipping Birrimian-series basalts, tuffs, and fine-grained clastics. Oxide ore reserves included tailings and backfill from ancient gold workings. Sulfide ore was encountered at 35- to 40-meter depth and was drill-tested to a depth of 90 meters.

At yearend, reserves minable by open pit at the Syama deposit were reported to be 2.1 million tons grading 3.7 grams (0.12 ounce) of gold per ton of oxide ore (proven), and 2.5 million tons grading 5.5 grams (0.18 ounce) of gold per ton of mixed and sulfide ore (proven and probable). Preliminary mining feasibility studies were based on open pit mining of only the oxide ore. A production decision was expected to be made by early February 1989. The company was planning a drilling program for 1989 to prove underground minable sulfide reserves. At yearend 1988, indicated underground sulfide reserves were 4.5 million tons grading 7.2 grams (0.23 ounce) of gold per ton.

In April, Sikaman Gold Resources Ltd. of Canada announced that it had acquired from Victory Exploration Corp. Inc. of Canada an option to earn a 99% equity interest in a 517-square-kilometer gold concession in the Kéniéba area. Sikaman was involved in this effort on an earn-in, joint-venture basis with Billiton BV of the Netherlands (49.5%), Canadian Magnesite Mines Ltd. (10%), and Equatorial Gold Mines NV of the Netherlands (9.5%). Billiton was to be the project's operator and manager. A soil and rock sampling program over two target areas was carried out from May to September, but the assays showed erratic values and poor repeatability because of nugget effects. A rotary-percussion drilling program, totaling 1,500 meters, was conducted from July to December; the results were being evaluated at yearend. Additional drilling was planned for 1989.

In October, the Société Minière de Loulo (Somilo) was formed to exploit the Loulo deposit north of Kéniéba. The company was a joint venture between the BRGM-Coframines (49%) and the Government (51%). The decision to proceed with mining followed a 1987 feasibility study by Syndicat de Recherche de l'Or, a BRGM subsidiary, which showed recoverable gold reserves of about 225,000 troy ounces. Production was anticipated for the end of 1989, at an initial rate of about 12,800 ounces per year.

In July, Canadian Mali Gold Corp. signed an agreement with the Government to dredge alluvial gold on the Niger River in the Kangaba region.

Industrial Minerals.—**Marble.**—Mali-Marbre was formed to exploit a marble deposit at Sélinkégni in the Kayes region. The company was a joint venture between Institut Nationale Belge des Industries Extractives of Belgium and Torrence Ltd. of the United Kingdom (combined 51%), the Société Nationale de Recherche et d'Exploitation des Ressources Minières du Mali (20%), and miscellaneous Malian nationals (29%). Production of 5,000 tons per year of high quality marble was expected to commence in 1990.

MAURITANIA[15]

The depressed iron ore markets of the early 1980's and the recurrence of severe droughts adversely affected Mauritania's narrow resource-based economy. External debt service obligations substantially exceeded payment feasibility. To compensate, the Government adopted a comprehensive Economic and Financial Recovery Program for the 1985-88 period. The objectives were to create a foundation for sustained growth and to restore the balance of payments to a viable position. The program included a flexible exchange rate policy, a restrictive monetary and credit policy to curb the inflation rate, the rehabilitation of the public sector, investment priorities for productive sectors (fisheries and mining), and an incentive framework to promote private investment. These measures sustained promising results while the GDP annual growth rate was about 1.5% to 3.6% during the 1985-88 period compared with 0.8% in the 1981-84 period. The inflation rate was reduced to 6.3% in 1988 compared with 13.6% in 1985. The number of public servants was frozen, and public investment was cut from 22.7% of the GDP in 1985 to 13.9% in 1988 by limiting the program to economically justified, high-priority projects. Public and private investment programs focused on fisheries, iron ore mining, intensified hydrocarbon exploration, and infrastructure development for more effective use of existing assets.

The new economic plan covering the period 1989-91 projected a growth rate of 3.5% annually by essentially continuing the program started in 1985, which revitalized the economy.

To encourage exploration and development, a new petroleum code was adopted on November 11, 1988, updating and consolidating existing legislation. Included in the code was a guarantee that foreign companies holding a contract for hydrocarbon exploration and production may repatriate capital, dividends, and interests without the imposition of taxes on transferred funds.

Production and Trade

Iron ore continued to be Mauritania's principal mineral commodity with production and exports reported at 10 million tons valued at $144 million[16]. Mining commenced in 1963, and for two decades was by far the leading foreign exchange earner. More recently, sales of fish and fish products have become the nation's leading foreign exchange earner, with iron ore and small quantities of gypsum and plaster products accounting for about one-third of all export earnings. Mauritania enjoys a number of advantages over most iron ore exporters, including the proximity of the western European markets and the capacity of its port to accommodate larger ships of 120,000 to 150,000 deadweight tons. These limit the cost of ore transport to Europe to $3.00 per ton.

Petroleum products refined from Algerian crude oil piped to the Nouadhibou refinery were sufficient to meet most domestic requirements. Mauritania's expenditures on fuel and energy imports in 1988 were reported at $25 million reduced from $33 million in 1987 before refinery operations restarted.

Commodity Review

***Metals.*—Copper.**—Production at the Akjoujt Mine was scheduled for resumption by late 1989. The mine had been closed since 1978 due to technical problems and an uncertain investment climate driven by a prolonged period of low copper prices. Total investment for the reactivation was estimated at $40 million. The mine will be operated by the Société Arabe Minière D'Inchiri (Samin). The Mauritanian Government owns a 37.4% interest in the company; Jordan, 32.5%; Iraq, 12.5%; Libya, 10.1%; and the Arab Investment Co., 7.5%.

Mining operations will focus on the sulfide ore body remaining below the oxide ores extracted in earlier operations. Mine reserves were estimated at 100 million tons of ore averaging 2.25% copper and 1.17 grams of gold per ton. Initial output was anticipated at 65,000 tons annually of a 25% copper concentrate.

Gold.—Recovery of gold from 2.5 million tons of copper tailings from earlier mining operations at the Akjoujt Mine was scheduled to begin in 1989. The tailings contained 3 to 5 grams of gold per ton (0.08 to 0.15 troy ounce per short ton). When fully operational, gold extraction from old tailings as well as from new mining operations at the Akjoujt Mine should reach 1,000 kilograms annually.

Iron Ore.—Mining was conducted by the Société Nationale Industrielle et Minière-Société d'Economie Mixte (SNIM) in the Kedia d'Idjill deposit where additional reserves of 65% iron (Fe) content ores have been identified, which will permit extraction at current levels to continue through the mid-1990's. Earlier estimates called for reserve depletion by 1990, after which time all mine activity would shift to the lower iron content magnetite ores of the desert plains known as the Guelbs.

Phase 1 of the Guelbs project included the El Rhein open pit mine, which was inaugurated in mid-1984 with reserves estimated at 285 million tons of 37% Fe content ore. At full capacity, mine output was planned at 13.8 million tons per year using conventional mining methods employing 15-meter benches and a maximum 50° slope.

The ore beneficiation plant employed a dry enrichment process involving magnetic separation. Planned output for the plant was 6 million tons per year of a concentrate averaging 65% Fe content in the form of 1.2 million tons of magnetite sinter-plant feed, 2.6 million tons of oxidized sinter feed, and 2.2 million tons of fine-grained magnetite concentrate. The beneficiation plant operated well below capacity largely due to the rapid wear of the mills and a dust buildup. Output was estimated at 2 million tons.

In 1988, the African Development Bank, the Arab Fund for Economic and Social Development, Caisse Centrale de Coopération Economique, the European Development Bank, and the Kuwait Fund for Arab Economic Development financed a $70 million loan to solve beneficiation problems at the El Rhein plant and to improve rail line and port facilities. Plant modifications included replacement of materials to improve resistance to abrasion, installation alterations to improve material flow, and redesign to facilitate plant maintenance.

The second mine in the Guelbs project, Oumm Arwagen, originally was scheduled for operation in 1990 from a reserve base of 100 million tons. However, development was delayed by the identification of additional higher grade reserves at Kedia d'Idjill, the necessity of improving concentrating operations at El Rhein, and improving world iron ore market conditions. By 1988, the plan for phase 2 of the Guelb development project shifted away from the Oumm Arwagen deposit in favor of developing the Mhaoudat deposit about 30 kilometers to the northeast. It has proven reserves of 100 million tons of ore containing 64% to 68% iron, 0.003% phosphorus, 0.001% sulfur, 2% to 7% silica, and 0.57% alumina. SNIM reported that development cost was estimated between $70 and $100 million.

***Industrial Minerals.*—Gypsum.**—Production was derived from the N'Drahamcha quarry, 50 kilometers northeast of Nouakchott. The quarry was owned and operated by the Société Arabe des Industries Metallurgiques Maritano-Koweitiennes. Although annual capacity was reported at 120,000 tons, actual output dictated by the market demand was estimated at 20,000 tons.

Phosphate.—Discovered and evaluated by SNIM, BRGM (France), Geomin (Romania), and Compagnie Sénégalaise des Phosphates de Thiès, the Bofal deposit in southern Mauritania was estimated to contain 120 to 150 million tons of phosphate-bearing material averaging 20% P_2O_5. The remote location of the deposit required high infrastructure costs and financing was not yet secured.

Mineral Fuels.—**Petroleum.**—Exploration.—Exploration activities were conducted by Texaco and Amoco in the southern and central coastal waters. Following the completion of seismic surveys and geological analyses under a 1984 exploration agreement, Texaco prepared to drill an exploratory well in early 1989 in Block 8. By a second agreement signed in July, Texaco added the adjoining onshore Block 9 north of Rosso to its exploration concession. Amoco completed its investigation for hydrocarbon seepages as required by the terms of its exploration and production-sharing agreement signed in late 1987. A seismic survey was planned by Amoco in early 1989.

Refining.—Mauritania's sole refinery was owned by the Société Mauritanienne d'Industrie de Raffinage (SOMIR). The 20,000-barrel-per-day-capacity refinery, at Nouadhibou, was designed to process Algerian crude oil, and was closed from 1983–87 due to financial and technical difficulties. After completion of a $30 million renovation program funded by Algeria, and the signing of an agreement by the Mauritanian Government to purchase at world prices products that met domestic consumption requirements, the refinery reopened in September 1987 under the technical management of Naftal, an Algerian oil corporation. In 1988, the refinery operated at 57% capacity with a throughput averaging 11,400 barrels per day (bbl/d) of Algerian crude oil.

NIGER[17]

Niger's economy in 1988 was dominated by the minerals industry, notably uranium mining. Niger was the seventh largest producer of uranium in the world and reportedly had the fifth largest uranium reserves. Sales of uranium concentrate amounted to $255 million[18] and accounted for 69% of the country's total export revenues and almost 11% of the GDP. Niger also exported small quantities of molybdenum concentrate and tin (as cassiterite), and produced coal and salt for consumption by the uranium mining industry.

Uranium concentrate was produced by two companies, Société des Mines de l'Aïr (SOMAÏR) and Compagnie Minière d'Akouta (COMINAK), both of which operated mines near Arlit in the northern part of the country. Both companies were joint ventures between the Government and various French, Spanish, German, and Japanese firms. France's Compagnie Générale des Matières Nucléaires (COGEMA) was the dominant partner, holding 27% of SOMAÏR and 34% of COMINAK.

Reported total uranium production was essentially unchanged from that in 1987 and was about two-thirds of total rated capacity. Uranium sales were by long-term contracts to the joint venture partners. It was believed, however, that actual sales exceeded reported sales by a considerable amount. COGEMA was the major purchaser of uranium concentrate, reportedly at well in excess of world uranium prices. The Government was attempting to find additional markets for the country's uranium production in order to be able to increase the production at the existing mines and to develop additional deposits discovered during the 1970's. This effort was hindered by low world demand for uranium and the country's high uranium production costs, which were about double the world price for the commodity.

In late 1987, because of increased mining costs with increasing depth at the open pit mine at Arlit, SOMAÏR shifted part of its efforts to a new deposit 4 kilometers to the southwest. The new Tassa N'Taghalgué (TAZA) deposit was reported to have proven reserves of 21,000 tons of uranium metal. SOMAÏR suffered a miners' strike at Arlit at about the same time as the TAZA mine was opened, but, reportedly, the strike did not last beyond early 1988.

Electricity for the uranium mines was generated by a steam plant burning low-grade coal mined by Société Nigérienne de Charbon d'Anou Araren. Both the coal mine and the powerplant were operating well below capacity, as both had been designed to service uranium mines, planned in the 1970's, but never developed. Salt for the COMINAK uranium processing plant was produced by Société des Salines de Tidekelt, which became operational in 1988 under joint Government and Belgian management.

Niger had artisanal production of gold, largely from workings in the Tera sub prefecture near the Burkina Faso border. Production data were unavailable. Canadian-funded studies were underway in 1988 on the feasibility of larger scale exploitation of several of the deposits in this region. In 1987, a 6-month trial placer operation in this area, sponsored by the BRGM, reportedly recovered about 30 kilograms (960 troy ounces) of gold.

NIGERIA[19]

Although receipts from Nigeria's principal foreign exchange earner, petroleum, declined by nearly 10% to $6.4 billion,[20] the economy grew 4.1% largely because of the growth in agricultural output, in manufacturing, and in construction. The structural adjustment program launched in mid-1986 continued past its June 1988 closing date because the Government experienced a measure of success in restructuring the economy by diversification and reducing dependence on petroleum exports for foreign exchange earnings. Some aspects of the structural adjustment program included abolition of export controls, elimination of factory price controls, retention of all foreign exchange earnings by nonoil exporters, and reduction in petroleum product subsidies for individual but not commercial consumers. Since the program has been in effect, the nation's economic growth has reversed from a negative 2.1% in 1986 to a positive 1.0% the following year and was projected to continue a 4% growth in 1989.

Major problems included a $29 billion debt, high import requirements for many raw materials and finished products, and continued weak international oil prices. Petroleum accounted for 13% of real GDP, but represented 77% of all federally collectible revenues. Crude oil and products accounted for 89% of total export earnings, reduced from the 1986 level of 94%. In an attempt to partially offset weak crude oil prices that dropped from $16 to $12 per barrel, Nigeria's crude oil production exceeded the Organization of Petroleum Exporting Countries (OPEC) allotted quota of 1.355 million bbl/d.

In November, the Government launched a debt-conversion program reducing external debt and increasing direct investment in Nigeria.

By December, Nigeria commenced drawing on a $500 million balance-of-payment loan made available from the World Bank.

Major mineral developments during the year focused on conserving foreign exchange through import substitution. These included commissioning of the Onne Fertilizer Complex and construction of petrochemical facilities for carbon black and linear alkyl benzene production. Other developments included firming up markets for the export of liquefied natural gas and construction of pipelines for transport of associated gas to powerplants.

In December, an 11-member National Energy Commission was inaugurated with a mandate to evolve a comprehensive energy policy for the country.

Production and Trade

Production of crude oil, Nigeria's principal mineral commodity, averaged 1.45 million bbl/d in 1988. More than 80% of the crude oil or 1.2 million bbl/d were exported. More than one-half was destined for the United States and the remainder for Europe. Natural gas produced in association with petroleum averaged 1.8 billion cubic feet per day, most of which was flared. Production of low-grade iron ore commenced, but most remained in stockpile until required by the Ajaokuta Steel Complex. The ammonia and urea production units of the Onne Fertilizer Complex were completed prior to the construction of the mixed fertilizer unit. This provided Nigeria with exportable quantities of ammonia at an opportune time when ammonia exports from Persian Gulf nations were curtailed due to the Iran-Iraq war.

Commodity Review

Metals.—**Gold.**—The Nigerian Mining Corp. was the financial backer of the newly formed Nigerian Gold Mining Co. Ltd., producing gold concentrates at Ilesha, Oyo State. Mineral excavation in 1988 was planned at 78,000 cubic meters, but less than one-third of the plan was realized. Resulting gold production was reported as 38 troy ounces (about 1.2 kilograms) from 21,168 cubic meters of gravel.

Drilling and other sampling activities continued at the Iperinda Reef, confirming a reserve reported as 383,000 tons of ore containing about 128,000 troy ounces (about 4,000 kilograms) of gold in the 1-kilometer-long lode.

Iron and Steel.—Production of low-grade run-of-mine iron ore from the Itakpe Hill Mine was reported at 304,300 tons in 1988, an increase of 64,000 tons. Production was being stockpiled pending construction of a beneficiation plant, the Osara Dam power source, and the railroad line linking Itakpe to the Ajaokuta Steel Complex.

Civil engineering work on the Ajaokuta Steel Complex was halted in late 1987 when French construction contractors Dumey and Fougeralle sought to collect $190 million. By yearend 1988, the Nigerian Government agreed to make oil revenues available to service the debt, and construction was scheduled to resume in early 1989. The commissioning of the first phase of the integrated steelworks consisting of four rolling mills, an oxygen blast furnace, and ancillary facilities was projected for 1992. Only the powerplant, rolling mills, and general servicing units were operational in 1988. They used imported billets and blooms as feedstock for an output of 5,437 tons of steel products. The mill design capacity includes 100,000 tons of wire, 145,000 tons of bar, 275,000 tons of light structural products, and 560,000 tons of medium structural products.

Commissioned in 1982, the Delta Steel integrated steel plant, based on Midrex direct reduction of iron ore and electric arc steelmaking, operated at an estimated 20% of capacity. This was because the shortage of foreign exchange hampered the purchase of imported iron ore, ferroalloys, and other raw materials. Reported production included 58,200 tons of rolled products and 133,000 tons of billets.

In addition to the integrated steel plants, the Government owned three inland rolling mills each with capacities of 210,000 tons per year of wire and bar products. The mills were commissioned by the Nigerian Government as part of its industrial dispersion program. In addition, 17 privately owned rolling mills provided the country with an excess of capacity for wire products in contrast to a surge in demand for flat sheets and plates.

Tin.—The now totally Government-owned Makeri Smelting Co. was Nigeria's sole tin producer. In preparation for adapting to electric arc tin smelting, the company was upgrading the electricity supply of the smelter.

Tin production was considerably less than the 1,000-ton Nigerian quota allocated by the Association of Tin Producing Countries for 1988. Nigeria has mined most of the easily accessible cassiterite. Unless further investments in

TABLE 4

NIGERIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987[p]	1988[e]
METALS						
Columbium and tantalum concentrates, gross weight:						
Columbite		126	101	13	48	50
Tantalite		1	1	—	—	—
Iron and Steel:						
Iron ore, gross weight	thousand tons	—	—	—	240	304
Steel, crude	do.	187	254	200	184	192
Lead:						
Mine output, Pb content[e]		200	260	100	86	85
Metal, refined secondary		600	800	1,000	300	500
Tin:						
Mine output, cassiterite concentrate:						
Gross weight		1,808	1,500	630	844	432
Sn content		1,340	1,100	460	603	300
Metal, smelter		1,400	1,079	91	560	566
Zinc ore and concentrate, Zn content		(2)	1,000	(2)	(2)	(2)
INDUSTRIAL MINERALS						
Cement, hydraulic	thousand tons	3,600	3,600	3,860	[e]3,800	3,400
Clays:						
Kaolin		286	300	169	177	105
Unspecifed		20,000	20,000	15,000	15,000	15,000
Feldspar[e]		—	5,000	3,500	[3]485	190
Nitrogen:						
N content of Ammonia	thousand tons	—	—	—	225	300
N content of Urea	do.	—	—	—	200	260
Stone:						
Limestone	do.	1,890	1,800	1,850	2,627	1,712
Marble		1,200	1,200	1,482	6,900	5,445
Shale	thousand tons	127	120	104	88	86
MINERAL FUELS AND RELATED MATERIALS						
Coal	do.	76	140	144	110	150
Gas, natural:						
Gross	million cubic feet	583,000	618,000	642,000	643,000	660,700
Marketed	do.	97,000	108,000	116,000	117,000	120,000
Petroleum:						
Crude	thousand 42-gallon barrels	508,000	544,252	534,165	486,869	569,400
Refinery products:						
Gasoline	do.	22,000	23,000	18,600	19,000	21,000
Jet fuel	do.	400	400	400	490	500
Kerosene	do.	6,400	10,200	8,700	9,000	10,600
Distillate fuel oil	do.	14,547	17,500	12,400	12,500	15,000
Residual fuel oil	do.	9,990	11,300	15,330	14,000	13,600
Unspecified	do.	1,563	3,650	4,700	5,000	5,000
Total	**do.**	**54,900**	**66,050**	**60,130**	**59,990**	**65,700**

[e]Estimated. [p]Preliminary.
[1]Includes data available through June 15,1989.
[2]Less than 1/2 unit.
[3]Reported figure.

TABLE 5

NIGERIA: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
METALS			
Aluminum:			
Ore and concentrate	627	—	Ghana 600; Ivory Coast 17.
Metal including alloys, semimanufactures	48	—	Mali 46.
Columbium and tantalum: Ore and concentrate	126	—	All to Netherlands.
Copper:			
Ore and concentrate	80	—	All to China.
Metal including alloys, semimanufactures kilograms	200	—	All to Gabon.
Iron and steel:			
Iron ore and concentrate, unspecified	2,436	—	United Kingdom 2,032; Spain 404.
Metal:			
Scrap	4,792	—	Spain 2,934; West Germany 887.
Steel, primary forms	119	—	Ghana 113.
Semimanufactures:			
Bars, rods, angles, shapes, sections	2,287	—	Ghana 479; Spain 142; United Kingdom 119.
Universals, plates, sheets	485	—	All to Italy.
Tubes, pipes, fittings	2,433	—	Netherlands 2,432.
Tin:			
Ore and concentrate	155	—	All to Netherlands.
Metal including alloys:			
Unwrought	250	—	Do.
Semimanufactures	100	—	All to West Germany.
Zinc: Ore and concentrate	1,250	—	West Germany 1,000; United Kingdom 250.
Other: Ores and concentrates	2,208	—	West Germany 1,741; Netherlands 298.
INDUSTRIAL MINERALS			
Fertilizer materials: Manufactured:			
Ammonia	74,807	—	Hong Kong 16,000; Tunisia 16,000; Bermuda 8,007.
Nitrogenous	90,719	12,939	Bermuda 37,778; West Germany 31,002.
Salt and brine	2	2	
Sodium compounds, n.e.s.: Sulfate, manufactured	44	—	All to Benin.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	179	—	All to Liberia.
Petroleum:			
Crude thousand 42-gallon barrels	479,109	257,407	Netherlands 42,474; Canada 32,528.
Refinery products:			
Liquefied petroleum gas value, thousands	$84	—	Benin $47; Niger $21.
Gasoline:			
Aviation thousand 42-gallon barrels	4	—	All to Chad.
Motor do.	1,427	—	Chad 833; Niger 589.
Kerosene and jet fuel do.	2	—	Chad 1; Niger 1.
Distillate fuel oil do.	1,484	3	Niger 1,305; Chad 73.
Residual fuel oil do.	731	58	Ivory Coast 160; Greece 122.
Asphalt do.	1,226	—	Benin 1,187.

[1] Data not available for 1986. Table prepared by Virginia A. Woodson.

TABLE 6

NIGERIA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS			
Aluminum: Metal including alloys:			
Unwrought	11,306	72	United Kingdom 9,898; Spain 983.
Semimanufactures	6,500	146	Italy 1,491; West Germany 1,324; United Kingdom 1,140.
Copper: Metal including alloys:			
Unwrought	112	—	West Germany 85; Spain 26.
Semimanufactures	4,661	27	West Germany 2,279; United Kingdom 1,101.
Iron and steel:			
Iron ore and concentrate, unspecified	6,104	—	Romania 2,610; Liberia 1,900; West Germany 1,175.
Metal:			
Scrap	38	—	Italy 32; Ireland 4.
Pig iron, cast iron, related materials	9,008	37	Japan 5,603; China 1,965.
Ferroalloys:			
Ferromanganese	2,515	—	West Germany 1,481; Hong Kong 1,003.
Unspecified	457	—	Brazil 281; West Germany 176.
Steel, primary forms	175,402	28,397	France 45,721; Spain 32,544.
Semimanufactures:			
Bars, rods, angles, shapes, sections	97,830	653	West Germany 26,443; France 23,087; Italy 16,114.
Universals, plates, sheets	2,407,539	2,468	Japan 784,261; United Kingdom 272,659; West Germany 149,882.
Hoop and strip	20,451	2	China 7,253; United Kingdom 3,509; West Germany 2,977.
Rails and accessories	650	126	West Germany 470; United Kingdom 49.
Wire	56,127	44	West Germany 34,688; Brazil 8,072.
Tubes, pipes, fittings	636,870	60,817	Italy 126,967; France 115,834; West Germany 113,981.
Castings and forgings, rough	12,060	17	Italy 4,533; Belgium-Luxembourg 2,556; West Germany 1,705.
Lead: Metal including alloys:			
Unwrought	1,283	—	Belgium-Luxembourg 974; West Germany 260.
Semimanufactures	534	([2])	Belgium-Luxembourg 233; West Germany 183.
Nickel: Metal including alloys:			
Unwrought	13	—	All from Netherlands.
Semimanufactures	117	—	United Kingdom 35.
Tin: Metal including alloys:			
Unwrought	62	48	France 14.
Semimanufactures	2,766	1	Japan 1,346; France 687; Netherlands 248.

See footnotes at end of table.

TABLE 6—Continued

NIGERIA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS—Continued			
Uranium and thorium: Metals including alloys, all forms kilograms	7,811	—	West Germany 5,119; Belgium-Luxembourg 2,692.
Zinc: Metal including alloys:			
Unwrought	1,875	—	Belgium-Luxembourg 1,193; West Germany 366.
Semimanufactures	1,900	(2)	United Kingdom 1,305; Belgium-Luxembourg 394.
Other: Ores and concentrates	3,323	—	Netherlands 2,067; Romania 862.
INDUSTRIAL MINERALS			
Abrasives, n.e.s.: Natural: Corundum, emery, pumice, etc.	4,094	652	West Germany 1,935; Iceland 793.
Asbestos, crude	38,156	100	Canada 14,496; Brazil 9,990; Morocco 5,552.
Fertilizer materials:			
Crude, n.e.s.	178,768	—	Romania 83,756; Yugoslavia 46,121; Hungary 28,485.
Manufactured:			
Ammonia	2,486	9	France 1,862; West Germany 194.
Nitrogenous	779,292	20,503	Yugoslavia 539,162; Romania 178,523.
Phosphatic	234,583	—	Romania 217,581; Israel 14,000.
Potassic	1,519	—	Spain 564; United Kingdom 531; China 424.
Unspecified and mixed	13,522	422	Singapore 9,393; China 1,882.
Pigments, mineral: Iron oxides and hydroxides, processed	6,056	597	United Kingdom 2,603; West Germany 1,087.
Salt and brine	453,959	104	United Kingdom 90,324; Poland 74,791; Italy 70,121.
Sodium compounds, n.e.s.:			
Carbonate, manufactured	1,354	70	Italy 274; Poland 250; Romania 200.
Sulfate, manufactured	25,297	6,158	United Kingdom 5,399; West Germany 4,328.
Stone, sand and gravel	92,261	574	Spain 39,391; Greece 18,288; Italy 14,912.
Sulfur: Elemental, crude including native and byproduct	4,174	652	West Germany 1,935; Iceland 793.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	55,659	596	Morocco 16,216; United Kingdom 12,440; Turkey 7,085.
Coal: Anthracite and bituminous	1,357	21	U.S.S.R. 1,115.
Coke and semicoke	1,617	—	Taiwan 560; West Germany 397; United Kingdom 380.
Peat including briquets and litter	875	—	Denmark 840.
Petroleum refinery products:			
Liquefied petroleum gas value, thousands	$732	$296	United Kingdom $170; Italy $145.

See footnotes at end of table.

TABLE 6—Continued

NIGERIA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1987	Sources, 1987	
			United States	Other (principal)
MINERAL FUELS AND RELATED MATERIALS—Continued				
Petroleum refinery products—Continued				
Gasoline:				
Aviation	42-gallon barrels	26,923	17,133	NA.
Motor	do.	434,070	96	West Germany 285,235; United Kingdom 23,707.
Mineral jelly and wax	value, thousands	$6,329	$191	United Kingdom $2,493; West Germany $1,848.
Kerosene and jet fuel	42-gallon barrels	34,573	9,161	Belgium 25,335.
Distillate fuel oil	do.	3,112,678	22	West Germany 3,112,006.
Lubricants	do.	41,183	4,955	United Kingdom 16,390; West Germany 9,935.
Residual fuel oil	do.	23,290	853	France 11,661; Belgium-Luxembourg 4,502.
Asphalt	do.	20,180	4,842	United Kingdom 9,205; West Germany 2,527.

NA Not available.
[1] Data not available for 1986. Table prepared by Virginia A. Woodson.
[2] Less than 1/2 unit.

equipment and training are realized, production can only gradually decrease.

Industrial Minerals.—**Fertilizer and Fertilizer Materials.**—The National Fertilizer Co. of Nigeria commissioned the Onne Fertilizer Complex in February. The complex consisted of three plants: a 1,000-ton-per-day ammonia plant; an associated urea plant with a capacity of 1,500 tons per day; and a 1,000-ton-per-day nitrogen-phosphorus-potash (NPK) fertilizer plant. The latter was capable of producing various grades of fertilizers designed to accommodate Nigerian crop and soil conditions. Built by a five-company consortium led by M.W. Kellogg, the complex is expected to provide 70% of Nigeria's NPK fertilizer consumption requirements and 100% of its granular urea demand. This could save $100 million annually in foreign exchange. Natural gas feedstock for the complex was supplied via an 8.7-mile-long pipeline connecting the Alakiri Field with the complex.

The abundance of natural gas available as feedstock prompted a feasibility study by Scientific Design Co. (United Kingdom) for a second fertilizer complex at Onne. Phosphate rock deposits in Ogun State and potash deposits in Bono State were under investigation as possible substitutes for imported phosphoric acid and potash.

Mineral Fuels.—**Coal.**—The Nigeria Coal Corp. allocated over $200 million for development and expansion programs, including expansion of the Enugu underground mines in Anambra State as well as the expansion of the Okaba and Owukpa surface mines and the development of a new deposit at Ogbouoga in Benue State. The Nigerian Coal Corp. reported that the objective of the programs was to increase output to 3 million tons annually by 1991, of which two-thirds would be exported. About 300,000 tons would be utilized at the Ajaokuta Steel Mill for blending with imported coking coal and 700,000 tons would be used by the Nigerian Electric Power Authority.

Petroleum.—Exploration and Development.—The nationally owned Nigerian Producing Development Corp. was created in March by the Nigerian Government. The corporation was charged with developing crude oil and natural gas production in concessions owned solely by the Nigerian National Petroleum Corp. It was also responsible for exploration in the more remote inland areas of Nigeria, where equity partners are not active.

Shell Petroleum Development Co., Société Nationale Elf Aquitaine, AGIP Energy and Natural Resources, Texaco Inc., Nigerian Producing Development Corp., and Mobil Producing Nigeria Ltd. fielded a total of 9 to 12 seismic

TABLE 7

NIGERIA: IRON AND STEEL PLANTS IN 1988

(Million metric tons per year)

Plant	Description	Capacity: Liquid steel	Capacity: Rolled products	Remarks
Delta Steel Warri	Four 100-ton electric arc furnaces	1.00	0.32	Integrated Plant; Government owned. Includes Midrex DRI lines.
Ajaokuta Steel, Ajaokuta	Rolling mills	—	1.10	Dependent on imported billets at present. Government owned.
Integrated Ajaokuta Steel Plant (Expected completion 1992)	One blast furnace	1.30	—	Feed to be local iron ore and either imported coking coal or a blend with local coking coal, probably from Lafia. Government owned.
Jos Steel, Jos	Rolling mills	—	.21	Government owned.
Katsina Steel, Katsina	do.	—	.21	Dependent on Delta Steel for 120-millimeter-square billets. Government owned.
Oshogbo Steel, Oshogobo	do.	—	.21	Government owned.
Qua Steel, Eket	do.	—	.10	Cross Rivers State Govt. in partnership with Danieli of Italy. Dependent on imported billets.
Universal Steel, Lagos	One 8-ton and one 10-ton electric arc furnace.	1.05	.08	Furnace operated on scrap. Rolling mill augmented with imported billets.
CISCO Ltd., Ikeja	One 20-ton electric arc furnace	.06	.15	do.
Selsabeed Metals, Lagos	Rolling mills	—	.10	Dependent on imported billets.
Allied Steel, Onitsha	do.	—	NA	Plant mostly idle.
General Steel, Mills, Asaba	One 8-ton electric arc furnace	.02	.05	Very little activity. Dependent upon imported billets.
Nigerian Spanish, Kano	One 20-ton electric arc furnace	.08	.20	Very active plant. Recently invested in water-cooled panels and continuous casting machine, and built a new rolling mill.
Mayor Engineering, Lagos	Rolling mills	—	.01	Recently invested in new rolling mill.
Metcome (Nig.) Ltd., Owerri	do.	—	.03	Operational.
Kew Metals Lagos	One 5-ton fuel fired furnace	.01	.02	do.
Kwara Commercial, Ilorin	Rolling mills	—	.04	do.
Niger Steel, Emene	One 7-ton electric arc furnace	.02	.02	Plant idle.
Asiatic Mandarin	Rolling mills	—	.06	Operational.
Federal Steel Mills, Otta	One 12-ton electric arc furnace	.05	.14	do.
Alliance Steel Co. Ltd., Ibadan	Rolling mills	—	.02	do.
Ore Steel, Oro, Ilorin	do.	—	NA	Commissioned in 1985.
Union Steel, Ilorin	do.	—	NA	do.

NA Not available.

parties in each month of 1988. Most of the activity was focused in the Niger River Delta and its immediate offshore area.

Three discoveries, which could total an estimated 80 million barrels of oil and 250 billion cubic feet of natural gas, were reported by Shell in the Tunu-1, Benin Estuary-1, and Ososo-1 concessions. Other discoveries were reported by Mobil in the Inuen-1 and Iyak-3 concessions; by Chevron Corp. in Ajapa 1; by Texaco in Ekeh-1; and by Elf Aquitaine near Elele.

By yearend, development work, at a cost of $375 million, had neared completion on Agip's Agbara offshore field. Production was scheduled in early 1989. The Agbara Field was anticipated to flow at a plateau of 40,000 bbl/d from a reservoir with estimated recoverable reserves of 65 million barrels. Development cost was relatively high at $5.75 per barrel.

Mobil continued development work on the Edop Field 25 miles offshore from Qua Iboe. By yearend, one platform was in operation with three wells producing a total of 20,000 bbl/d. The installation of five additional platforms was planned for an eventual output in excess of 150,000 bbl/d.

Mobil also initiated the development of the Oso condensate field 18 miles offshore Eket by awarding a preliminary engineering study contract to Fluor Corp. Recoverable reserves were estimated at 445 million barrels of condensate ranging from 48° to 52° API gravity. Field development will include seven offshore platforms for drilling and processing, 120 miles of pipeline, and onshore loading and storage facilities at Qua Iboe terminal. Recovery methods will include high pressure gas re-injection systems. The Oso Field is expected to yield 100,000 bbl/d in the first 5 to 7 years of production. The life of the field is estimated at 25 years.

The Nigerian National Petroleum Corp. (NNPC) will own and provide financing for 60% of the Oso Field project in partnership with Mobil. Mobil will provide 40% of the financing and will have total responsibility for technical expertise. In addition to marketing its own 40% share of Oso Field production, Mobil will market one-half of NNPC's 60% share for 5 years following project commissioning, which was scheduled for 1991. The World Bank affiliated International Finance Corp. was financial coordinator for the $900 million development of the Oso condensate field. Interest in condensate field development was augmented by the fact that production was not subject, at least at this time, to OPEC quotas and could be exported in quantities limited only by production capabilities and market demand. Furthermore, development cost at $2 per barrel was particularly favorable.

Production.—Crude oil and condensates production averaged 1.39 million bbl/d in January, dropping to the year's lowest level in April at 1.32 million bbl/d when prices increased to $16.75 per barrel for Nigeria's Bonny Light crude stream and $16.60 per barrel for Forcados crude stream. By August, production was 1.50 million bbl/d, compensating for reduced spot market prices for Bonny Light at $15.10 per barrel and for Forcados crude at $14.90 per barrel. In October, the spot market price dropped to $12.55 per barrel for Bonny Light and $12.45 per barrel for Forcados, while production increased to 1.55 million bbl/d. In December, production averaged 1.65 million bbl/d with the spot market price at $15.45 per barrel for Bonny Light and $15.35 per barrel for Forcados. Bonny Light crude stream at 37° API led production output through September, but took second place to the Forcados crude oil stream at 31° API during the elevated fourth quarter production level.

The Bonny Light and Forcados crude accounted for one-half of Nigeria's crude oil output. The Escravos 36° API crude and Qua Iboe 37° API crude each accounted for 15% of production. Bonny medium 26° API crude and Brass Blends 40° API crude each accounted for 8% of output. Pennington and Anton, both 36° API crudes, contributed the remaining 4% of production.

Refining and Marketing.—In support of the Government program to increase petroleum product exports, particularly to West African markets, and to limit the Nigerian offshore refining arrangements, a fourth refinery neared completion and was scheduled to be commissioned in May 1989. Adjacent to Nigeria's oldest refinery at Alesa-Eleme near Port Harcourt, the fourth refinery was designed to have a crude distillation capacity of 150,000 bbl/d. Built by Spie Batignolles (France), Japan Gasoline Corp., and Marubeni Corp. (Japan), the refinery was largely financed with loans guaranteed by export credit agencies amounting to $320 million from France and $280 million from Japan. The refinery is planned to have a direct link with the Bonny export terminals and storage facilities by 1990. In the interim, products are to be transferred by tank trucks and pipeline to Nigeria's southern and central States.

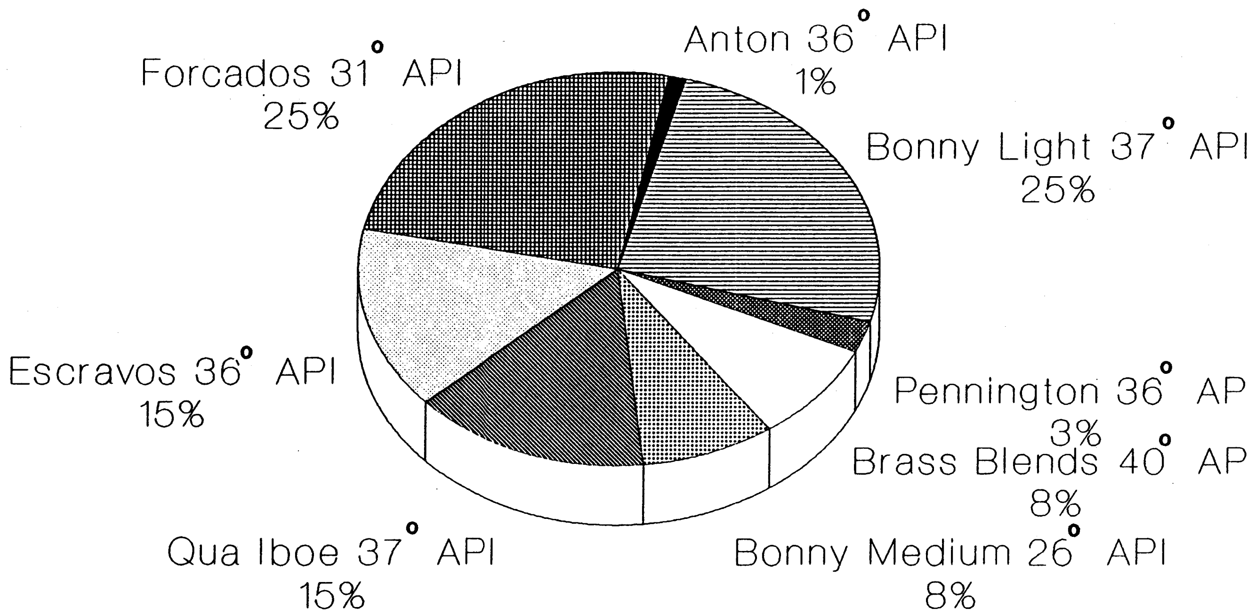
By yearend, expansion of the 100,000-bbl/d Warri refinery to a distillation capacity of 125,000-bbl/d was virtually completed. This raised Nigeria's total crude distillation capacity to 445,000 bbl/d, including the 110,000-bbl/d Kaduna refinery and both the 60,000-bbl/d original and the new 150,000-bbl/d Port Harcourt refineries. The Nigerian National Petroleum Corp. installed a 6,000-bbl/d Merox unit at the Kaduna refinery to increase production of liquefied petroleum gas (LPG) to 3,000 bbl/d, sufficient to meet domestic demands and release LPG production from the coastal refineries at Warri and Port Harcourt for export.

In 1988, Nigeria's three operating refineries averaged a total throughput of 175,000 bbl/d. The NNPC also assigned an estimated 45,000 bbl/d of crude oil for overseas processing under

FIGURE 2

NIGERIA—CRUDE PETROLEUM PRODUCTION IN 1988

(Total production = 1.45 million barrels per day)



Source: Nigerian Petroleum News.

contracts with Basic Resources (United States), Petrobras (Brazil), and Total S.A. (France). This included the return of light fraction products to the Nigerian market.

The NNCP negotiated at least six contracts involving an estimated total of 0.5 million bbl/d of crude oil sold to refiners in the United States and Spain based on a net-back formula determined by the market price of products. An integral component of the net-back agreements included discussions related to the Nigerian purchase of equity interest in the overseas refineries with payments in crude oil. For the first half of 1988, the net-back formula yielded a price $2 to $3 below the spot market sales. In the second half of 1988, the position of net-back contracts was reversed when spot market prices plummeted with the Middle East production in excess of OPEC quotas. Consequently, buyers demanded a review of the net-back formula.

Petrochemicals.—The NNPC petrochemical plants at Kaduna and Warri entered commercial production in March. This implemented Phase 1 of the petrochemical development program intended to promote import substitution and conserve foreign currency.

The Kaduna plant was designed to produce 30,000 tons of linear alkyl benzene annually and was reported operating near capacity. The Warri complex was designed to produce 18,000 tons of carbon black and 37,000 tons of polypropylene annually. The carbon black plant operated at 60% capacity. The price of Warri-produced carbon black was competitive with the landed price of imports. However, only three of the five hard grades of carbon black utilized in tire manufacture were produced at Warri. This required Michelin Nigeria Ltd. to continue importing some grades of carbon black. Nigeria cannot widen its range of carbon black without additional heavy investment. Increased sales of the existing grades should improve with construction of a tire manufacturing plant in neighboring Benin. The polypropylene production unit was nonoperational for most of 1988 due to a breakdown in the fluid catalytic cracking unit that provided a vital catalyst for polypropylene production.

Phase 2 of the petrochemical development program was scaled down from the $4 billion complex originally proposed in 1986 to an $800 million undertaking centered at Eleme with plant capacity designed to produce 250,000 tons of polypropylene and 80,000 tons of polyethylene annually based on natural gas as feedstock. Nigerian 1988 consumption levels for these chemicals would absorb about 60% of production with the remainder intended for export during a 5-year period. At the end of this period, Nigerian demand is projected to rise to absorb the total output.

Preliminary design contracts for the Phase 2 project were awarded to Spie Batignolles (France), Technimont (Italy), and Chiyoda and Kobe Steel (Japan). Technimont and Chiyoda and Kobe Steel are considering equity partnerships with the National Nigerian Petroleum Corp. in the Phase 2 project. Financing for 85% of the project will be raised by equity partners.

Natural Gas.—Production of natural gas averaged 2 billion cubic feet per day. Output ranged from nearly 1.8 billion cubic feet per day in April to 2.2 billion cubic feet per day in December, paralleling crude oil output. Natural gas utilization ranged from 20% to 31%. More gas was flared in September and October as less gas was used for reinjection and other oilfield operations during those months. About 70% to 80% of natural gas continued to be flared because of the prohibitive cost of the required infrastructure for utilization. In an effort at utilization, the Escravos-Warri-Lagos 228-mile, 36-inch-diameter natural gas pipeline was commissioned in September. Initial flow of 265 million cubic feet per day was supplied to the Egbin power station serving Lagos. Construction of the Utorugu gas treatment plant owned by NNPC (80%) in partnership with Shell Petroleum Development Co. of Nigeria (20%) was completed by yearend. Gas entered the plant at 3,919 pounds per square inch guage. Six process trains reduced pressure, cooled the gas, and extracted water and condensate. Treated gas was delivered to the Lagos pipeline. This main line included a spur connecting the Oben gas plant, which supplied gas through a 124-mile, 24-inch diameter pipeline, to the Ajaokuta Steel Co. for direct reduction of iron ore. The spur line assures that gas will be supplied to the steel mill when Oben Field is depleted.

Nigerian plans for nonassociated natural gas development and utilization focused on the liquified natural gas markets of Europe and the United States east coast. Construction of a $2 billion plant on Bonny Island, utilizing the Technip/Snamprogetti Tealarc liquifation process, was proposed by NNPC holding 60% equity with Shell Gas BV holding 20% and Elf Aquitaine and AGIP S.p.A. each holding 10%. Natural gas sources proposed for the project were onshore reservoirs in the East Niger River Delta. Gas production costs were projected to be relatively low because the gas contained few impurities and only shallow drilling would be required. The project group entered into contract negotiation with at least five major gas distribution companies during the year: Ruhrgas, BEB, and Thyssengas of the Federal Republic of Germany; Enagas of Spain; and Snam Gas of Italy. The group expected to complete negotiations with buyers and arrange finance in time to award construction contracts in early 1991, initial shipment of liquefied natural gas in 1995, and attainment of plateau shipments of 4 million tons of liquefied natural gas annually by 1997.

SENEGAL[21]

The production and export of phosphates continued to dominate Senegal's mineral industry. Export earnings in 1988 from phosphates and byproduct attapulgite and clinker increased 23% to about $81 million.[22] Fertilizer exports decreased 6% to $62 million. These exports cumulatively accounted for more than 18% of the country's total export revenues. Total phosphate production increased 22%, despite increased production costs and lower sales to certain countries resulting from concerns about the high level of cadmium in the phosphate. In addition to phosphates and related products, Senegal exported $4.8 million in salt and about $605,000 in cement.

Société Minière de Sabodala, a joint venture between the BRGM (52%) and the Government, was predicting the startup of gold production at the Sabodala deposit by 1991, assuming a favorable outcome of discussions between the partners. The company managed to increase the reserves slightly, but it was felt that additional reserves would be needed for a favorable production decision.

Senegal adopted a new mining code in mid-August. The new law was an effort to consolidate and modernize provisions of the existing laws that had remained virtually unchanged for 25 years. Liberalization of the financial and temporal aspects of exploration and mining agreements were features of the new law, which attempted to encourage mineral development both by local and international entities.

Toward yearend, the Government announced that it would host a major conference on hazardous wastes in late January 1989. The conference was to address the growing problem of foreign companies attempting to use West African countries as a dumping ground for such materials.

Commodity Review

Metals.—**Titanium.**—In October, E. I. du Pont de Nemours & Co. Inc. announced that they had signed an agreement with the Government covering exploration and potential mining of heavy minerals (ilmenite) beach sand deposits along the coast. The agreement, which had awaited the passage of Senegal's new mining law, provided for a 4-year exploration period with options for two renewals. Assuming that an ore deposit was found, the agreement granted Du Pont exclusive rights to mine the deposit for an initial 25-year period, renewable for another 25 years. The company stated that ilmenite production from Senegal would be sent to four of the company's TiO_2 plants in the United States and one in Mexico. The company expected to begin detailed sampling, at Pointe Sarene, south of Dakar, in January 1989. It was hoped that the deposit would be in production by the mid-1990's and that the output would be in excess of 100,000 tons of concentrate per year.

Industrial Minerals.—**Phosphates.**—Production of calcium phosphates by Compagnie Sénégalaise des Phosphates de Taïba (CSPT) increased 22% to 2.244 million tons. Exports increased almost 29% to 1.774 million tons, and export revenues increased 36% to $69.7 million. The main destinations of CSPT ore were the Philippines (31.4%), India (17.8%), the United Kingdom (10.3%), Greece (10.1%), and France and Spain (8.8% each). Overall sales to the European Community (EC) appeared to have been hurt by the high cadmium content (averaging 75 parts per million) of the ore, justifying concerns in the previous year for the future of such sales. Local sales of 551,000 tons, worth $13.4 million, were largely to Industries Chimiques du Sénégal (ICS), a fertilizer manufacturer.

Production of aluminum phosphate by Société Sénégalaise de Thiès (SSPT) decreased almost 38% to 119,300 tons. Exports, all to France, decreased about 8% to 42,370 tons, but export revenues fell almost 42% to $676,000. Clinker export revenues fell 31% to $3.55 million. In contrast, calcium phosphate production by SSPT more than doubled, to 81,580 tons. Exports, mostly to France and Greece, increased by two-thirds to about 78,000 tons, worth $1.9 million. The company also produced attapulgite, production of which fell slightly to 108,425 tons. Attapulgite export revenues fell 20%, to $4.66 million. Senegal was trying to expand its export market for aluminum phosphate and was especially interested in markets in Thailand, Pakistan, and China.

Export revenues for fertilizers produced by ICS decreased slightly to $62.1 million. Fertilizer sales were mostly to India, France, and Senegal's neighboring countries.

Mineral Fuels.—The Société Africaine de Raffinage, Senegal's sole refinery, increased its output 23% to 5.4 million barrels of crude oil. This amount was about 50% of capacity. The refinery processed about 20,000 barrels of liquid hydrocarbon distillate from the country's gasfields, in addition to the crude oil, which was imported from Nigeria (57%), Gabon (31%), and Angola (12%). Refinery output was affected by a 6-week shutdown for maintenance purposes and by reduced demand from customers Mali and Guinea-Bissau.

Following the completion of a high-resolution seismic survey in February, Ireland's Tullow Oil Plc. commenced a four gas well drilling program in an attempt to increase production from the Kabor and North Diam Niadio gasfields northeast of Dakar. The fields had been placed into production by France's Société Nationale Elf Aquitaine, but Elf had dropped its concession in 1980, at which time production ceased. Tullow expected to increase production from existing wells to 1 million cubic feet per day by yearend and hoped that the new wells would boost production to 3 to 5 million cubic feet per day. By yearend, two of the wells had been completed. Existing gas production of 500,000 cubic feet per day was burned in a power station 18 kilometers from Dakar and was transported to the power station by a pipeline that had been refurbished by Tullow and the Government, using World Bank funding.

SIERRA LEONE[23]

The production and export of mineral commodities had traditionally sustained Sierra Leone's economy. In recent years, heavy revenue losses attributed to illegal trading contributed to the country's balance of trade deficits in excess of 10% of the GDP. In an effort to reverse this situation a new mining policy was promulgated focusing on the gold and diamond industry. The main thrust of the policy limited license awards to miners with proven sufficient capital and expertise to effectively mine the property.

Under the new policy, the Ministry of Mines was empowered to periodically inspect production records and to determine the quantities and frequency of sales. Dealers were required to either export an average of $500,000 worth of gold or diamonds monthly or have their licenses revoked. Exporters were required to repatriate 60% of their hard currency earnings to the Central Bank of Sierra Leone. To encourage participation, the Government released and recommended for investment several promising gold and diamond mining properties throughout Sierra Leone. The success of the mining policy was yet to be determined but it at least provided a framework for curbing illicit trading and channeling the much needed additional funds to the Central Bank.

The large Government deficit was financed by money creation with the following results: the money supply virtually doubled in 1985, doubled again in 1986, and increased 50% in 1987 and the first three quarters of 1988 with the last quarter remaining constant. In January 1988, the Leone was valued at 45 to the dollar. In April, the Leone was devalued to 65 to the dollar; a rate closer to the 75 Leone to the dollar exchange of the black market and a further disincentive for illicit trading.

The Government, in collaboration with the World Bank, was engaged in developing a comprehensive mining investment code aimed at stimulating private investment in the Sierra Leone mining industry.

Production and Trade

The value of Sierra Leone's mineral exports was estimated at $80 million in 1988, equal to over 70% of total exports for the year.[24]

Rutile continued to be the nation's principal mineral export. The 1988 record production of 126,000 tons, which was valued at $43 million, was exported to Western Europe and the United States. Although diamond exports have traditionally ranked second as the nation's foreign exchange earner, the emergency measures adapted to curb illicit trading in late 1987 and 1988 temporarily reduced official exports to $4.3 million or 18,000 carats. Bauxite production and exports consequently ranked second, earning $22.4 million.

Commodity Review

***Metals.*—Bauxite.**—The Sierra Leone Ore and Metal Co., the nation's sole bauxite producer, completed the $2 million Mokanji Mine expansion program that began in 1987. A second bauxite operation and an alumina plant were planned for development at Port Loko.

Gold.—The illegal mining and consequent smuggling of gold prompted the Government to adopt emergency measures in November 1987, requiring that all gold be sold to the Central Bank of Sierra Leone, which was recognized as the sole legal exporter. Licenses to mine, trade, and export gold were withdrawn from 340 small-scale miners, 200 gold dealers, and 50 exporters. Licenses were issued only to investors with sufficient capital and expertise to conduct gold exploration, with emphasis on exploration in the Mototoka, Lake Sonfon, and Gori Hills regions.

Additional legislation was enacted in 1988 and modified in early 1989, which revoked the ban on mining and export licenses. Domestic gold-mining companies applying for licenses were required to hold working capital of $100,000 and companies with foreign shareholders were required to hold $125,000.

To create a climate for legal participation in Sierra Leone's gold-mining industry, the Government opened to local prospectors gold-mining areas in Pampana, Tane Chiefdom, Kalmaro, Kafe Simira, Sanda Loko, Bombali, Kunife, Valunia, and Simbaru. Licensees would be required to keep accurate production records, which would be subject to periodic inspection by the Ministry of Mines, and would be required to sell to exporters such quantities of gold as may be determined by the Ministry. Failure to comply with these sales requirements would result in loss of license.

Gold traders were required to purchase licenses annually at a cost of $5,000 for foreigners and $2,500 for nationals. Traders would be permitted to retain 40% of export earnings with 60% to be repatriated to the Central Bank of Sierra Leone at the official exchange rate. Performance standards were set at an average of $500,000 worth of gold exports monthly. Failure to meet this standard would result in loss of license. Gold exporters were also required to pay a royalty at the rate of 1.5% of the exported gold's value to cover administrative charges.

Iron Ore.—Production from the Marampa Mine ended in 1985 because of very poor world market conditions. However, the Ministry of Mines concluded an agreement in 1988 with two French firms to conduct a feasibility study of the mines and assess the potential and economic viability of the Marampa region, an area about 80 kilometers east of Freetown.

Titanium.—In 1988, rutile production from Sierra Rutile Ltd., which was a wholly owned subsidiary of Nord Resources Corp. of the United States, attained a record level of 126,000 tons containing 96% titanium dioxide. Byproduct ilmenite production from a new plant, which was commissioned in late 1987, totaled 42,000 metric tons containing 60% titanium dioxide. The sharp increase in production resulted from an expansion program and was at least partially attributable to the introduction of a Neumann bucket wheel secondary dredge. The bucket wheel was used as a reclaimer to recover dry mined material from outlying deposits and hauled to the dredge pond. It permitted selective mining in higher grade ore and also permitted the recovery of material that would not be minable by conventional dredging. In late 1989, Sierra Rutile Ltd. was to shift mining operations from the Bamba-Belebu deposit to the Pejebu ore body, which is 4 kilometers to the south. Ore reserves exposed in prospect pits and outlined by close-spaced drilling were 215 million tons averaging 1.5% rutile. In 1988, Sierra Rutile Ltd. and the Government began negotiations on a new concession agreement.

Interest in developing titanium dioxide bearing mineral deposits near Rotifunk, about 60 kilometers southeast of Freetown, was expressed by Intercontinental Gold and Minerals NL and MC Mining NL of Australia. Upon development, mining operations were expected to yield 56,000 tons of rutile, 83,000 tons of ilmenite, and 600 tons of zircon annually.

Industrial Minerals.—**Diamonds.**—In an effort to maximize Government earnings and to reduce the level of illicit trading, the Government adopted emergency measures in late 1987 calling for the withdrawal of all diamond export licenses and requiring producers to sell diamonds to the Government. By mid-1988, the Diamond Corp. of West Africa, a subsidiary of DeBeers' Central Selling Organization, reportedly ended its more than 30-year operation in Sierra Leone.

As the Government's diamond mining policy took form, additional legislation was enacted in 1988 and modified in early 1989. It revoked the ban on diamond export licenses, allowing traders to retain 40% of export earnings while requiring that 60% be repatriated to the Central Bank of Sierra Leone at the official rate. Licenses were to be granted to 25 dealers who were required to post a $500,000 performance bond. The dealers also were required to export an average of $500,000 worth of diamonds each month or risk losing their export license.

In accordance with the new policy, any applicant for a diamond mining license would have to provide proof of sufficient capital and expertise to effectively conduct the mining operation. Licensees would be required to keep accurate production records subject to periodic inspection by the Ministry of Mines. Licensees would be expected to sell to a dealer or exporter such quantities of diamonds as would be determined by the Minister of Mines. Failure to comply with these sales would result in loss of license. To protect the lease area of the state-owned National Diamond Mining Co. (NDMC), all diamond dealers in the area were obligated to engage in cooperative mining. Other specific mining areas have been released for alluvial diamond mining companies in Garrama Mande, Makpele, and Wando Nomo to create a climate for legal participation in the industry.

The National Diamond Mining Co., in a joint venture with Outokumpu Oy of Finland, scheduled mining operations to begin in 1989 on two pipes and numerous kimberlite dykes at Kono. Capital cost of the first phase of development was estimated at $30 million; the cost of the second stage was projected to be $40 million. Initial output was estimated at 54,000 carats annually and was expected to rise to 250,000 annually after 8 years of operation. Possible financial support for the project included the Kuwait Fund for Arab Economic Development and the Kuwait Investment Fund.

To improve existing diamond mining operations, the Ministry of Mines signed an agreement with Sumatu Raygreen Mining Co. (Sierra Leone), which obligated the latter to loan $4 million to NDMC to enable the national company to rehabilitate and modernize its mining equipment.

Mineral Fuels.—**Petroleum.**—The Sierra Leone Petroleum Refining Co. of Freetown operated a 10,000-bbl/d capacity refinery based on imported crudes. Crude suppliers have been Nigeria and Iran, but overdue obligations have prompted Sierra Leone to seek a new supplier. Libya signed an agreement in April supplying not only petroleum but also including investments in agriculture, mining, and fishing.

Petroleum product prices have been considerably lower in Sierra Leone and often were less than one-half the price the product commanded in neighboring countries. To discourage massive smuggling of fuel into these countries, petroleum product price increases were scheduled for mid-1989. Gasoline prices would be doubled from $.75 to $1.50 per gallon.

TOGO[25]

Togo's mineral industry continued to be dominated by the production and export of phosphates. Phosphate production increased significantly in 1988, and phosphate exports accounted for about 50% of the country's total export revenues. Cement and marble production increased, as did the production of steel.

In September, the Government approved a new environmental code prohibiting the importation, sale, storage, or transshipment of toxic wastes in the country.

Commodity Review

Metals.—**Steel.**—Togo's only steel company, the Société Togolaise de Sidérurgie, a producer of rebar since 1984, was undergoing a $2 million expansion of its product line to include electric power pylons, and galvanized steel frames for industrial buildings. Output of these new products was expected to reach 3,000 tons per year by 1990.

Industrial Minerals.—**Cement.**—Production by the country's sole cement producer, Les Ciments du Togo, increased slightly in 1988 to about 377,800 tons. Production relied entirely on imported clinker. Total reported cement sales were about 270,000 tons, of which, 39% was exported.

Marble.—Marble production by Nouvelle Société Togolaise de Marbrerie et de Matériaux more than doubled as a result of improvements made since the company was restructured in late 1986. However, production was still less than one-third the reported output capacity of 250 square meters per day.

Phosphates.—Phosphates remained Togo's main mineral resource. As predicted in 1987, environmental concerns over the high cadmium content, averaging 55 parts per million, of Togolese phosphate resulted in a loss of sales to certain traditional major buyers in the EC, notably the Netherlands. In this respect, the EC's share of Togolese phosphate exports fell from 90% in recent years to about 30% in 1988. However, Togo was able to more than offset this reduction by securing major contracts with new customers, with the result that phosphate production increased significantly to a record level of about 3.5 million tons. Phosphate export revenues were about $336 million.[26] The largest new long-term contract was to supply about 1 million tons per year to Esso's Redwater plant in Canada. Other new customers included Cyprus, India, the Philippines, and Poland. Togo also benefited from very high prices received for its phosphates.

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[1] Prepared by Hendrik G. van Oss, physical scientist, Division of International Minerals.

[2] Where necessary, values for Benin have been converted from Communauté Financière Africaine francs (CFAF) to U.S. dollars at the rate of CFAF298 = US$1.00. The conversion rate for 1987 was CFAF302 = US$1.00.

[3] Prepared by Hendrik G. van Oss, physical scientist, Division of International Minerals.

[4] Where necessary, values for Burkina Faso have been converted from Communauté Financière Africaine francs (CFAF) to U.S. dollars at the rate of CFAF298 = US$1.00.

[5] Prepared by Hendrik G. van Oss, physical scientist, Division of International Minerals.

[6] Prepared by Hendrik G. van Oss, physical scientist, Division of International Minerals.

[7] Prepared by Hendrik G. van Oss, physical scientist, Division of International Minerals.

[8] Prepared by Hendrik G. van Oss, physical scientist, Division of International Minerals.

[9] Where necessary, values have been converted from Ghanaian cedis (C) to U.S. dollars at a rate of C202.4 = US$1.00

[10] Prepared by Hendrik G. van Oss, physical scientist, Division of International Minerals.

[11] Prepared by Hendrik G. van Oss, physical scientist, Division of International Minerals.

[12] Prepared by Hendrik G. van Oss, physical scientist, Division of International Minerals.

[13] Prepared by Hendrik G. van Oss, physical scientist, Division of International Minerals.

[14] Where necessary, values for Mali have been converted from Communauté Financière Africaine francs (CFAF) to U.S. dollars at the rate of CFAF298 = US$1.00.

[15] Prepared by Bernadette Michalski, mineral specialist, Division of International Minerals.

[16] Where necessary, values have been converted from Mauritanian ouguiya (UM) to U.S. dollars at the exchange rate of UM76.0 = US$1.00.

[17] Prepared by Hendrik G. van Oss, physical scientist, Division of International Minerals.

[18] Where necessary, values for Niger have been converted from Communauté Financière Africaine francs (CFAF) to U.S. dollars at the rate of CFAF298 = US$1.00.

[19] Prepared by Bernadette Michalski, mineral specialist, Division of International Minerals.

[20] Where necessary, values have been converted from Nigerian nairas (N) to U.S. dollars at the rate of N5.03 = US$1.00 in 1988.

[21] Prepared by Hendrik G. van Oss, physical scientist, Division of International Minerals.

[22] Where necessary, values for Senegal have been converted from Communauté Financière Africaine francs (CFAF) to U.S. dollars at the rate of CFAF298 = US$1.00. The conversion rate for 1987 was CFAF302 = US$1.00.

[23] By Bernadette Michalski, mineral specialist, Division of International Minerals.

[24] Where necessary, values have been converted from leones (Le) to U.S. dollars at the rate of Le65 = US$1.00.

[25] Prepared by Hendrik G. van Oss, physical scientist, Division of International Minerals.

[26] Where necessary, values for Togo have been converted from Communauté Financière Africaine francs (CFAF) to U.S. dollars at the rate of CFAF298 = US$1.00.

THE MINERAL INDUSTRIES OF

CHINA, HONG KONG, MONGOLIA, AND TAIWAN

By E. Chin and John C. Wu

CHINA[1]

Under the seventh 5-year plan (1986–90), the Chinese Government continued to implement reform and to open the country further to the outside world in order to accelerate the growth of its national economy. As a result of expanded foreign economic exchanges and domestic achievements in education, science and technology, and cultural and public health undertakings, the national economy was strengthened. In 1988, there was impressive growth in the Chinese economy. The gross national product (GNP) grew by 11.2% reaching $373.4 billion;[2] the national income grew by 11.4% to $310.9 billion. The major problem in the Chinese economy was the imbalance between high demand and insufficient supply. Chronic shortages resulted in price increases and high inflation, which averaged 19% for China as a whole and about 30% in urban areas. Macroeconomic stability took precedence over market-oriented reform initiative. Because of rapidly growing inflation, the Government reimposed price controls and rationing in major cities in the fall of 1988.

China continued to be a major world producer of minerals, metals, and fuels. Output of the principal commodities continued to rise. The largest increase in production was salt which rose 24% in output in 1988; followed by sulfuric acid, 14%; cement, 12%; soda ash, 9%; caustic soda, 7%; and steel, 6%. For fossil fuels, the increase in output of natural gas was 14% in 1988; followed by coal, 3%; and crude oil, 2%. The output of electricity by thermal-fired powerplants rose by 9% while that for hydroelectric powerplants rose 7%. Although China's overall energy output has increased annually since 1980, the growth in demand continued to outstrip the supply.

An important economic development strategy was the Government's emphasis on creating export industries and the increased reliance on utilizing foreign investment in coastal areas. In addition to China's four special economic zones (Shantou, Shenzhou, Xiamen, and Zhuhai), Hainan was elevated to provincial status in 1987 and declared China's largest special economic zone in 1988 thereby enjoying the most liberal investment policy in China to date. The 14 coastal cities with economic and technological development zones to absorb foreign investment and technology were Beihai, Dalian, Fuzhou, Guangzhou, Lianyungang, Nantong, Ningbo, Qingdao, Qinhuangdao, Shanghai, Tianjin, Wenzhou, Yantai, and Zhanjiang. There were 478 cities and counties freely open to foreign investment and tourism.

The total value of agricultural and industrial output in 1988 was $639.3 billion. The output value of the agricultural sector grew by 3.2% to $151.4 billion; the output value of the industrial sector grew by 20.7% to $487.9 billion. The total industrial output value includes $78.7 billion contributed by village-run enterprises. By ownership, the output value of the state-owned sector increased by 12.7%; the collective sector by 28.8% (of which rural enterprises accounted for 35%); the private sector by 46%; and for Sino-foreign joint ventures, cooperative enterprises, and wholly owned foreign enterprises by 97%.

The output value of heavy industry increased 18.8%, reaching $246.6 billion in 1988. The processing sector grew more rapidly than the power and raw materials sectors, further aggravating the imbalance in the overall structure of industrial production capacity. The growth in output of selected, major industrial products was salt, 24.5%; sulfuric acid, 11.7%; soda ash, 9.6%; electricity, 9.2%; cement, 9.1%; rolled steel, 7.0%; fertilizers, 5.7%; coal, 4.5%; and crude oil, 2.2%. The major industrial commodities showing a decline in output included marine vessels, 20.7%; sugar, 10.0%; locomotives, 7.3%; and timber, 1.7%.

Profits of state-owned enterprises increased 17.4% to $41.9 billion in 1988, and per-capita productivity was up 9.3%. Overall energy consumption continued to decline, and the estimated energy saving was equivalent to 30 million tons of coal. There were 9,024 state enterprises that adopted the management responsibility system in 1988, and their profits collectively increased 20.8%. To raise investment capital, some enterprises experimented with stock issuance, such as in the case of the iron and steel complex at Anshan, Liaoning.

The country's aggregate investment in fixed assets increased 10.5% to $116.3 billion in 1988 composed as follows: state-owned enterprises, $72.6 billion (up 17.3%); collectively owned enterprises, $16.7 billion (up 13.5%); and private, $300 billion (up 25.4%). The estimated cost of all projects under construction was $350.4 billion, which the Government considered an unwieldy constraint on the national budget. There were 14,400 projects, with an estimated cost of $11.9 billion, that were either canceled or postponed for the remaining years of the current plan period.

Capital investment in construction with public ownership increased 14.9% to $41.6 billion of which $10.0 billion was for energy, $5.6 billion was for raw materials, $5.9 billion was for transportation and telecommunications, and the remainder was for construction projects in agriculture, light industry, and other sectors. In 1988, $27.8 billion was invested in capital construction of production projects. Nonproduction projects were allotted $13.7 billion, which excludes the large increase invested in office buildings, exhibition halls, and hotels.

In 1988, an investment of $11.3 billion was utilized by 203 key projects designated by the state. A total of 78 medium- to large-size projects and 138 small, individual projects were completed and placed in operation during the year. Newly added production capacities included 9.99 million kilowatts of power generating capacity, 30.8 million tons of coal, 115 million barrels of crude oil, 4 million barrels of ethylene, 2.46 million tons of cement, 7.92 million standard boxes of plate glass, 419 kilometers of railway, 820 kilometers of double-track railway, 1,487 kilometers of electrified railway, and 8.78 million tons of port cargo handling. The technological transformation of state-owned enterprises continued to advance, absorbing $25.7 billion in modernizing equipment. Included in this investment was $10.1 billion to expand production capacity, $3.6 billion to increase product diversification and variety, $1.3 billion to upgrade and improve product quality and specifications, and $0.8 billion to reduce energy consumption. Nearly 40,000 projects, which were either re-equipped or transformed, were completed, representing an investment of $17.1 billion in fixed assets.

Both passenger and cargo transportation continued to be overstrained, encumbering the development of the national economy. Although China's transport performance improved, it was not commensurate with industrial growth. The income by the railroad sector increased 6.9% and its labor productivity by 5%. The year's container transport by railway and waterway totaled 16.51 million tons, an increase of 8%. The performance of China's transport services in billion units is shown in the text table.

	1987	1988
Cargo, tons per kilometer		
Railway	946.9	987.6
Highway	262.2	287.1
Waterway	950.8	996.4
Air	.66	.74
Oil and gas pipeline	62.5	63.7
Total	**2,223.06**	**2,335.54**
Passenger, persons per kilometer		
Railway	284.2	326.0
Passenger, persons per kilometer—continued		
Highway	218.9	238.2
Waterway	19.9	20.4
Air	18.6	21.4
Total	**541.6**	**606.0**
Cargo volume handled at major seaports, tons	.396	.436

Commodity sales during the year rose steadily. The total value of the country's retail sales increased 27.8% to $200.5 billion. Retail sales of agricultural goods were $24.2 billion and of consumer goods, $176.3 billion. Retail sales by state-owned enterprises increased by 29.9%; cooperative rose by 27.9%; and collective, joint, and individual ownership increased by 21.2%, 27.7%, and 30%, respectively.

Retail prices rose sharply, and the average price level was 18.5% higher than in 1987. The average price increase in urban areas was 21.3% compared to 17.1% in the rural areas. The increased prices were attributed to demand-pulled inflation, arbitrary price hikes, and black-marketing.

In 1988, total exports were valued at $47.54 billion and imports, at $55.25 billion, which represented a trade deficit of $7.71 billion. After allowing for invisible trade transactions, the deficit was reduced to $3.09 billion. Nontrade foreign exchange income was up 22% to $6.61 billion, an income of $3.91 billion after allowance for the trade deficit. China utilized $9.84 billion in foreign capital, an increase of 16.4%. Direct investments by foreign businesses amounted to $2.62 billion, up 13.1%, and the remainder was posted as guarantees.

The business income from overseas projects and labor service was $1.2 billion, a slight decrease compared to that of the previous year. New contracts signed by China for overseas projects totaled $1.83 billion in 1988, an increase of 10.6%.

Curiosity about the sometime phoenix continued to soar. China received 31.69 million tourists and visitors from 168 countries, an increase of 17.8% over that of the previous year. Foreign exchange earnings through tourism were $2.22 billion in 1988, up 19.2%.

The State National Science Foundation approved 2,983 scientific research projects and appropriated $30.5 million for research and development in basic and applied scientific investigation. By the end of 1988, the state had standardized 132 weights and measures, established 261 specifications for new products, and standardized state specifications for various products of which 38.5% met international specifications. A total of 11,500 patents were issued, an increase of 68.8%. The number of technological contracts signed amounted to over 247,000 and represented a business value of $1.9 billion.

A total of 26,000 topographic maps of various scales were drawn from surveys by several agencies, and 307 maps were published representing a total printing of 74.4 million copies. In 1988, 281 geological surveys were conducted in order to delineate mineral formation. Verified reserves of 55 minerals were increased, which included 9.3 billion tons of coal, 760 million tons of iron ore, and a nonspecified amount for gold. The Government actively continued to survey both onshore and offshore areas for oil and natural gas exploration.

Per capita income for urban workers was $301 and for the agricultural sector, $147. By the end of 1988, nationwide employment was 135,730,000 and the total annual income was $61.9 billion. The birthrate in China was 20.78 per 1,000 and the mortality rate, 6.58 per 1,000. By yearend, the population grew by 15,410,000 to 1,096,140,000.

Production

China had a rich and diverse minerals resource base, and its mining industry ranked high in the world in terms of output. China ranks first in world production of barite, cement, coal, rare earths, and tungsten. It was the second largest producing country for magnesite, salt, and soda ash, and the third largest for beryllium, fluorspar, gypsum, iron ore, talc, and vanadium. Moreover, China was among the 10 leading producers of aluminum, bauxite, gold, ilmenite, iodine, lithium, manganese, mercury, nickel, petroleum, phosphate rock, steel, tin, titanium sponge, and zircon. The total value of China's mine output in 1988 was estimated at $30 billion, and the value of downstream processing and manufacturing was estimated at $250 billion.

Although China's production was of international significance, it had a very low per capita consumption of minerals and metals. The Government continued to give priority for investments to increase the production capacity for aluminum, cement, chemicals, and iron and steel in addition to fossil fuels. The overall output of heavy industry grew 16.4% in 1988, however, the growth in output of critical raw materials such as coal was only 5.4%; cement 12.2%; crude oil 2.1%; fertilizers 3.8%; and steel 7.0%;.

Production of minerals and metals in China was by a mix of Government and corporate identities. The major Government producing bodies were the Ministry of Metallurgical Industry for iron and steel, State Administration for Building Materials for cement, and the Ministry of Chemical Industry for fertilizers. The major corporate bodies for the production of minerals, metals, and fuels include China National Nonferrous Metals Industry Corp., China National Non-Metallic Minerals Industry Corp., and China National Offshore Oil Corp. In 1988, Government restructuring and organization continued and a new Ministry for Energy Resources was created from former ministries such as those for coal, and petroleum and natural gas. The new ministry was delegated to be in charge of planning and regulation as new corporate identities were created for the production of coal, petroleum and natural gas, and electric power generation. Since 1984, the Ministry of Geology and Minerals Resources has operated mines and production facilities, particularly those involving nonmetallic minerals. In addition to the large national entities, there were numerous provincial- and local-level companies and Government bodies involved with producing minerals, metals, and coal.

Trade

After nearly three decades of closed-door policy, China's acceptance into the international community can be measured by the growth in its total, external trade turnover. In the first year of the sixth 5-year plan (1981–85), China's trade turnover was $44,022 million. By the last year of the plan period, total trade reached $69,602 million. In the first year of the seventh 5-year plan, total trade was $73,846 million and reached $102,701 million in 1988. The expansion of China's trade in millions of dollars since 1981 was as shown in the text table:

Year	Exports	Imports	Trade Deficit (−) or Surplus (+)
1981	22,007	22,015	+8
1982	23,321	19,285	−4,036
1983	22,226	21,390	+836
1984	26,139	27,410	−1,271
1985	27,350	42,252	−14,902
1986	30,942	42,904	−11,962
1987	39,437	43,216	−3,779
1988	47,450	55,251	−7,711

In 1988, China's 10 largest trading partners were Xianggang and Aomen, which were commonly considered as transshipment points for Chinese shipments and receipts, followed by Japan, the United States, the Federal Republic of Germany, the U.S.S.R., Singapore, Italy, Canada, the United Kingdom, and France. China's trade with Xianggang and Aomen was $30,830 million, which accounted for 30% of its total trade. Exports to these ports increased by $4,500 million to $18,710 million in 1988, and imports increased by $3,570 million to $12,120 million. China's trade with Japan totaled $18,980 million, which accounted for 18.5% of its total trade. Exports to Japan were $7,920 million, up 23.8%, and imports were $11,060 million, an increase of 9.8%. The trade with the United States was valued at $10,010 million, or 9.7% of China's total trade turnover. China's exports to the United States were $3,380 million, an increase of 11.3%, and imports were up 37.3%, totaling $6,630 million.

The largest component of China's two-way trade was manufactures. The net import of manufactured goods was the largest contributor to China's trade deficit. The composition of China's trade in millions of dollars was as shown in the text table:

	1987	1988
Exports		
Primary products:		
Food and live animals, chiefly for food	4,781	5,891
Beverages and tobacco	175	236
Crude, inedible materials, except fuels	3,651	4,257
Mineral fuels and related materials	4,544	3,972
Animal and vegetable oils, fats, and waxes	81	74
Manufactures:		
Chemical and related products	2,235	2,897
Manufactured goods classified chiefly by material	8,570	10,491
Machinery and transport equipment	1,741	2,769
Miscellaneous manufactured articles	6,273	8,268
Commodities not elsewhere classified	7,387	8,681
Imports		
Primary products:		
Food and live animals, chiefly for food	2,443	3,476

Table continued on next page.

	1987	1988
Primary products—continued		
Beverages and tobacco	263	346
Crude, inedible materials, except fuels	3,320	5,090
Mineral fuels and related materials	539	787
Animal and vegetable oils, fats, and waxes	349	369
Manufactures:		
Chemical and related products	5,008	9,139
Manufactured goods classified chiefly by material	9,730	10,410
Machinery and transport equipment	14,607	16,673
Miscellaneous manufactured articles	1,877	1,983
Commodities not elsewhere classified	5,078	6,979

The major trading organizations of China's trade in minerals and metals were China Metallurgical Import and Export Corp., China National Metals & Minerals Import and Export Corp., China National Coal Import and Export Corp., China National Chemicals Import and Export Corp., and China National Building Material & Equipment Import and Export Corp.

The data given in tables 2 and 3 bear the caveat that the numeric information is not a complete presentation of China's commodity trade. The information given is compiled from trade data only from publicly disseminated customs declarations by China's major partners.

Commodity Review

Metals.—China produced a wide array of metals and output was significant in the context of world production. The largest metal-producing sectors were iron and steel followed by aluminum, which were each targeted in capacity expansion programs under the economic plan. Another important sector was gold, which was important to the national economy for its conversion to obtain hard foreign currency, rather than for its industrial use or much less for ornamental and fashion objects. The output of antimony, mercury, rare earths, tungsten, and to a much lesser degree for tin, was largely export oriented and met domestic needs as well as foreign demand.

Aluminum.—In 1988, mine output of bauxite was about 4 million tons, of which 80% was metallurgical grade and the remainder for abrasive, chemical, and refractory uses. Consumption of aluminum metal exceeded 900,000 tons, and domestic metal production provided close to 90% of the supply and imports the remainder. When full production capacity is on-stream in 1990 from plant expansion and/or new construction in Guangxi, Hebei, Qinghai, and Shaanxi, the national annual output capacity was expected to reach close to 1.3 million tons. China's primary aluminum plants were as shown in the text table.

Location	1988 Capacity (thousand tons per year)	1990 Capacity (thousand tons per year)
Anhui		
Hefei	25	25
Gansu		
Baiyin	50	50
Lanzhou	30	30
Guangxi		
Pingguo	40	100
Guizhou		
Guiyang	110	110
Hebei		
Handan	—	100
Henan		
Jiaozuo	30	30
Sanmenxia	30	30
Hubei		
Wuhan	35	35
Hunan		
Changsa	15	15
Xinxiang	—	[1]250
Jilin		
Changchun	15	15
Liaoning		
Fushun	100	100
Nei Monggol		
Baotou	20	20
Ningxia		
Qingtongxia	100	100
Yinchuan	30	30
Qinghai		
Xining	100	200
Shaanxi		
Tongchuan	10	10
Xi'an	—	200
Shandong		
Qingdao	15	15
Zibo	80	80
Shanxi		
Taiyuan	25	25
Yunnan		
Kunming	15	15
Total	**875**	**1,335** **[1]1,585**

[1]1995.

Antimony.—China was a major world producer and exporter of antimony. The major antimony operations in China in descending order were in Hunan, Guangxi, Guizhou, and Gansu. Mine output at Xihuangshan, Hunan, accounted for the largest percentage of the country's total export of antimony, perhaps as much as 50%. China was a major world purveyor of antimony in 1988, exporting over 29,000 tons, valued at $62 million. Antimony shipments to the United States alone included 13,436 tons of metal ($29.1 million), 3,697 tons of oxide ($7.8 million), 104 tons of sulfide ($14,508), and 71 tons of other antimony compounds ($158,880).

Copper.—China's annual metal production capacity was 565,000 tons. Concentrate from domestic mine production was about 90% of smelter feed, and the remainder was from imported material. Domestic supply in 1988 was from refinery output, supple-

TABLE 1

CHINA: ESTIMATED PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1984	1985	1986	1987	1988
METALS						
Aluminum:						
Bauxite, gross weight		1,600,000	1,650,000	1,650,000	2,400,000	3,200,000
Alumina, gross weight		800,000	825,000	825,000	1,200,000	2,200,000
Metal, refined, primary		400,000	410,000	410,000	615,000	800,000
Antimony, mine output, Sb content		15,000	15,000	15,000	15,000	15,000
Bismuth, mine output, Bi content		260	260	260	260	275
Cadmium, smelter		[r]450	[r]540	[r]650	[r]680	700
Copper:						
Mine output, Cu content		180,000	185,000	185,000	[r]250,000	300,000
Metal:						
Smelter, primary and secondary		210,000	225,000	225,000	300,000	300,000
Refined, primary and secondary		310,000	400,000	400,000	400,000	400,000
Gold, mine output, Au content	thousand troy ounces	1,900	1,950	2,100	2,300	2,500
Iron and steel:						
Iron ore, gross weight	thousand tons	75,000	66,000	90,000	100,000	105,000
Pig iron	do.	39,980	43,600	50,200	53,900	56,400
Ferroalloys	do.	900	900	1,020	1,150	1,200
Steel, crude	do.	43,370	46,700	52,100	56,000	59,000
Steel, rolled	do.	33,710	36,900	40,500	43,900	47,000
Lead:						
Mine output, Pb content		180,000	200,000	227,000	[r]267,000	250,000
Metal, refined, primary and secondary		195,000	210,000	240,000	[r]246,000	240,000
Magnesium metal, primary		7,000	7,000	7,000	7,000	7,000
Manganese ore, gross weight	thousand tons	1,600	1,600	1,600	1,600	1,600
Mercury, mine output, Hg content	76-pound flasks	20,000	20,000	20,000	20,000	20,000
Molybdenum, mine output, Mo content		2,000	2,000	2,000	2,000	2,000
Nickel:						
Mine		14,000	25,000	25,000	25,000	25,000
Smelter		14,000	22,500	22,500	22,500	25,000
Silver, mine output, Ag content	thousand troy ounces	2,500	2,500	3,000	3,000	3,500
Tin:						
Mine output, Sn content		15,000	15,000	15,000	[r]20,000	25,000
Metal, smelter		15,000	15,000	15,000	[r]20,000	25,000
Tungsten, mine output, W content		13,500	15,000	15,000	18,000	20,000
Zinc:						
Mine output, Zn content		160,000	300,000	396,000	[r]458,000	360,000
Refined, primary and secondary		185,000	275,000	336,000	[r]383,000	340,000
INDUSTRIAL MINERALS						
Asbestos		160,000	160,000	150,000	150,000	150,000
Barite	thousand tons	1,000	1,000	1,000	[r]1,250	1,500
Cement, hydraulic	do.	121,080	142,500	161,600	180,000	203,000

See footnotes at end of table.

TABLE 1—Continued

CHINA: ESTIMATED PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1984	1985	1986	1987	1988
INDUSTRIAL MINERALS—Continued						
Fluorspar		r750,000	r850,000	r900,000	r1,000,000	1,100,000
Graphite		185,000	185,000	185,000	185,000	200,000
Gypsum	thousand tons	4,800	5,000	6,500	7,200	8,100
Kyanite and related materials		2,500	2,500	2,500	2,500	2,500
Lithium minerals, all types		15,000	15,000	15,000	15,000	15,000
Magnesite	thousand tons	2,000	2,000	2,000	2,000	2,000
Nitrogen: N content of ammonia	do.	14,000	15,000	15,500	r16,000	16,200
Phosphate rock and apatite, P_2O_5 equivalent	do.	3,200	1,900	1,800	2,700	2,700
Potash, marketable, K_2O equivalent	do.	40	40	40	40	40
Salt	do.	16,000	14,450	17,300	18,000	22,000
Sodium compounds: Sodium carbonate, natural and synthetic	do.	1,880	2,000	2,100	r2,400	2,600
Sulfur:						
Native	do.	200	200	300	300	300
Content of pyrite	do.	2,300	2,300	2,500	r3,700	3,900
Byproduct, all sources	do.	350	350	300	r500	550
Total	**do.**	**2,850**	**2,850**	**3,100**	**r4,500**	**4,750**
Talc and related materials		950,000	950,000	1,000,000	1,000,000	1,000,000
MINERAL FUELS AND RELATED MATERIALS						
Coal:						
Anthracite	thousand tons	154,000	155,000	160,000	170,000	175,000
Bituminous and lignite	do.	618,000	695,400	710,000	750,000	770,000
Total	**do.**	**772,000**	**850,400**	**870,000**	**920,000**	**945,000**
Coke, all types	do.	35,000	39,000	41,400	45,000	47,000
Gas, natural:						
Gross	billion cubic feet	490	510	540	550	560
Marketed	do.	438	455	485	495	505
Petroleum:						
Crude (including crude from oil shale)	thousand 42-gallon barrels	836,069	873,500	953,500	978,200	999,200
Refinery products	do.	550,000	655,000	700,000	710,000	725,000

r Revised.

[1] Table includes data available through July 26, 1989.

[2] In addition to the commodities listed for which quantitative estimates of output have been made, China is known or believed to have produced other commodities for which no estimates have been prepared.

TABLE 2

CHINA: APPARENT EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987[p]	Destinations, 1987: United States	Destinations, 1987: Other (principal)
METALS				
Alkali and alkaline-earth metals	605	678	198	Japan 294; Philippines 75.
Aluminum:				
Ore and concentrate	600,219	559,408	309,126	Japan 59,907; Italy 30,892; Turkey 25,995.
Oxides and hydroxides	4,414	[2]5,185	265	Thailand 1,775; Pakistan 1,574; Hong Kong 848.
Metal including alloys:				
Scrap	249	3,136	([3])	Hong Kong 1,735; Japan 1,401.
Unwrought	523	54,548	1,206	Hong Kong 26,732; Japan 22,271.
Semimanufactures	5,149	10,562	48	Hong Kong 9,799; Japan 289.
Antimony:				
Ore and concentrate	2,295	3,200	1,966	Belgium-Luxembourg 956; Italy 126; Spain 84.
Oxides	5,044	4,392	3,088	Netherlands 796; United Kingdom 238; Spain 130.
Metal including alloys, all forms	10,402	7,576	6,244	Belgium-Luxembourg 713; United Kingdom 243.
Arsenic:				
Ore and concentrate	—	2	—	All to Spain.
Oxides and acids	155	763	233	Hong Kong 375; United Kingdom 136.
Metal including alloys, all forms	295	463	463	
Beryllium:				
Ore and concentrate	455	462	462	
Oxides and hydroxides	10	3	3	
Metal including alloys, all forms	10	—		
Bismuth: Metal including alloys, all forms	25	91	8	United Kingdom 72; Spain 8.
Cadmium: Metal including alloys, all forms	96	486	117	Belgium-Luxembourg 366.
Chromium:				
Oxides and hydroxides	1,843	1,239	342	Hong Kong 558; Japan 94.
Metal including alloys, all forms	903	1,091	791	Belgium-Luxembourg 153; United Kingdom 59.
Cobalt: Oxides and hydroxides	59	43	10	Hong Kong 14; Singapore 7.
Columbium and tantalum: Metal including alloys, all forms, tantalum kilograms	84	[4]5,000	5,000	
Copper:				
Matte including cement copper	—	20	20	All to Pakistan.
Oxides	1	18	—	All to Hong Kong.
Sulfate	360	83	—	Do.
Metal including alloys:				
Scrap	2,053	7,027	—	Hong Kong 6,844; Japan 162.
Unwrought	283	8,833	173	Hong Kong 6,714; Japan 1,931.
Semimanufactures	9,892	22,583	461	Hong Kong 20,818; Pakistan 663.
Gold:				
Ore and concentrate value, thousands	NA	$1,257	—	All to Canada.
Metal including alloys, unwrought and partly wrought troy ounces	359,756	[5]340,829	NA	Hong Kong 340,829.

See footnotes at end of table.

TABLE 2—Continued

CHINA: APPARENT EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987[p]	Destinations, 1987: United States	Destinations, 1987: Other (principal)
METALS—Continued				
Indium: Metal including alloys, all forms	8	—		
Iron and steel:				
Iron ore and concentrate excluding roasted pyrite	2,026	57,165	57,165	
Pyrite, roasted	—	50	—	All to Spain.
Metal:				
Scrap	2,899	111,693	508	Thailand 62,598; Hong Kong 35,433.
Pig iron, cast iron, related materials	5,733	318,695	—	Japan 268,415; Thailand 33,490.
Ferroalloys:				
Ferrochromium	134	—		
Ferromanganese	1,527	8,378	—	Pakistan 5,797; Japan 1,611; Singapore 500.
Ferromolybdenum	81	25	—	Netherlands 18; United Kingdom 5.
Ferrosilicon	—	38,045	—	Hong Kong 34,093; Belgium-Luxembourg 1,823.
Silicon metal	—	5,636	1,209	United Kingdom 2,425; Netherlands 1,463.
Unspecified	55,139	198,726	3,525	Japan 181,006; Pakistan 3,949.
Steel, primary forms	1,057	6,915	12	Thailand 6,124; Philippines 700.
Semimanufactures:				
Bars, rods, angles, shapes, sections	170,042	192,436	4,378	Hong Kong 173,616; Singapore 13,258.
Universals, plates, sheets	4,981	34,173	548	Hong Kong 15,262; Japan 7,868; Singapore 3,129.
Hoop and strip	6,907	10,198	—	Niger 7,253; Hong Kong 1,417.
Rails and accessories	1,929	48	—	All to Singapore.
Wire	53,393	61,626	6,848	Hong Kong 29,938; Singapore 10,458.
Tubes, pipes, fittings	46,032	72,149	14,327	Hong Kong 45,907; Singapore 4,771.
Castings and forgings, rough	4,983	2,736	16	Japan 1,387; United Kingdom 915.
Lead:				
Ore and concentrate	10,917	40,188	3,568	Japan 22,337; Italy 9,600; Belgium-Luxembourg 4,171.
Oxides	2,274	3,908	—	Japan 2,031; Algeria 875; Pakistan 508.
Metal including alloys:				
Scrap	167	117	—	Hong Kong 80; Pakistan 37.
Unwrought	925	18,756	547	Hong Kong 10,844; Japan 2,723.
Semimanufactures	45	148	—	Hong Kong 100; Singapore 44.
Lithium: Oxides and hydroxides	81	159	—	Spain 46; Italy 41; Netherlands 40.
Magnesium: Metal including alloys, all forms	—	126	—	Japan 114; Hong Kong 12.
Manganese:				
Ore and concentrate	4,330	6,584	—	Japan 5,897; Hong Kong 665.
Oxides	2,550	3,431	—	Hong Kong 1,875; Pakistan 591; Thailand 443.
Metal including alloys, all forms	322	1,549	—	Belgium-Luxembourg 531; United Kingdom 507; Netherlands 333.
Mercury 76-pound flasks	13,223	27,672	11,777	Hong Kong 7,358; Pakistan 2,379.

See footnotes at end of table.

TABLE 2—Continued

CHINA: APPARENT EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987[p]	Destinations, 1987: United States	Destinations, 1987: Other (principal)
METALS—Continued				
Molybdenum:				
Ore and concentrate	4,693	5,713	51	Belgium-Luxembourg 2,969; Netherlands 1,744.
Metal including alloys, all forms	72	77	44	Japan 17; Netherlands 10.
Nickel:				
Ore and concentrate	6	—		
Matte and speiss	1	—		
Oxides and hydroxides	18	5	—	All to Hong Kong.
Metal including alloys, all forms	2,247	9,090	3,066	Japan 5,075; Hong Kong 438.
Platinum-group metals: Metals including alloys, unwrought and partly wrought value, thousands	$5,689	$7,341	$1,477	United Kingdom $4,155; Hong Kong $1,402.
Rare-earth metals including alloys, all forms	89	31	7	Netherlands 22.
Selenium, elemental	—	3	—	All to United Kingdom.
Silicon, high-purity	—	133	—	Belgium-Luxembourg 86; Netherlands 47.
Silver:				
Ore and concentrate value, thousands	$636	$32	—	All to Thailand.
Waste and sweepings[6] do.	$756	$644	$425	United Kingdom $217.
Metal including alloys, unwrought and partly wrought do.	$8,022	$57	$20	Hong Kong $37.
Tin:				
Ore and concentrate	10,499	21,457	—	Singapore 10,788; Hong Kong 7,985.
Oxides	1,185	1,448	—	Japan 1,309; Thailand 139.
Metal including alloys:				
Scrap	27	109	99	Hong Kong 10.
Unwrought	7,633	17,359	8,680	Hong Kong 4,310; Japan 3,662.
Semimanufactures	330	366	2	Hong Kong 363.
Titanium:				
Oxides	4,183	7,412	1,119	Hong Kong 3,792; Netherlands 618.
Metal including alloys, all forms	67	262	81	United Kingdom 175; Italy 6.
Tungsten:				
Ore and concentrate	5,595	4,126	2,612	Hong Kong 1,082; Singapore 247.
Oxides and hydroxides	—	28	—	All to Belgium-Luxembourg.
Metal including alloys, all forms	144	288	178	Singapore 83; Netherlands 10.
Uranium and thorium:				
Oxides and other compounds	—	10	—	All to Hong Kong.
Metals including alloys, all forms value, thousands	$24	—		
Vanadium: Oxides and hydroxides	347	2,921	—	Belgium-Luxembourg 2,388; Netherlands 266.
Zinc:				
Ore and concentrate	99	14,973	([7])	Japan 10,505; Italy 4,468.
Oxides	3,775	3,814	—	Hong Kong 928; Japan 772; Algeria 395.
Blue powder	2	364	—	Spain 349; Philippines 10.
Metal including alloys, all forms	48,196	96,221	4,318	Hong Kong 61,335; Japan 13,295.

See footnotes at end of table.

TABLE 2—Continued

CHINA: APPARENT EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987[p]	Destinations, 1987: United States	Destinations, 1987: Other (principal)
METALS—Continued					
Other:					
Ores and concentrates		29,176	14,909	—	Japan 7,314; Hong Kong 4,835; Austria 1,598.
Oxides and hydroxides		343	1,198	—	Philippines 1,079; Canada 119.
Ashes and residues		6,400	6,730	237	Hong Kong 5,816; Japan 586.
Base metals including alloys, all forms:					
Quantity, reported		9,285	15,129	—	Hong Kong 8,792; Japan 5,560; Brazil 421.
Value only, reported	thousands	$425	$291	—	Canada $247; New Zealand $44.
INDUSTRIAL MINERALS					
Abrasives, n.e.s.:					
Natural: Corundum, emery, pumice, etc.		7,398	11,883	3	Hong Kong 10,306; Pakistan 460.
Artificial:					
Corundum		36,778	54,877	747	Japan 26,428; Hong Kong 25,717.
Silicon carbide		16,432	5,686	1,558	Hong Kong 4,000; United Kingdom 70.
Dust and powder of precious and semiprecious stones	value, thousands	—	$386	$370	Singapore $16.
Grinding and polishing wheels and stones		6,910	5,973	330	Pakistan 2,066; Hong Kong 1,908.
Asbestos, crude		553	158	—	Thailand 54; Hong Kong 35; Singapore 33.
Barite and witherite		492,528	729,258	577,274	Netherlands 74,850; Japan 68,958.
Boron materials:					
Crude natural borates		25	11	1	Netherlands 10.
Oxides and acids		2,274	1,536	—	Hong Kong 593; Pakistan 244; Netherlands 230.
Cement		160,079	154,453	—	Hong Kong 153,918; Japan 270.
Chalk		75	13	—	All to Pakistan.
Clays, crude		255,521	342,817	3,002	Hong Kong 188,507; Japan 134,667.
Cryolite and chiolite		51	1,055	1,055	
Diamond:					
Gem, not set or strung	value, thousands	$19,619	$16,233	$315	Belgium-Luxembourg $9,431; Hong Kong $4,682.
Industrial stones	do.	$3,771	$1,782	$21	Belgium-Luxembourg $931; Hong Kong $813.
Diatomite and other infusorial earth		239	127	—	Japan 97; Thailand 20.
Feldspar, fluorspar, related materials		90,382	509,024	38,377	Japan 390,195; Hong Kong 69,976.
Fertilizer materials:					
Crude, n.e.s.		106	994	1	Hong Kong 822; Singapore 141.
Manufactured:					
Ammonia		2,060	2,442	—	Hong Kong 2,395; Thailand 45.
Nitrogenous		4,909	3,537	244	Hong Kong 2,817; Japan 391.
Phosphatic		42,357	61,195	—	Japan 58,346; Hong Kong 1,560; Singapore 942.
Potassic		—	7,249	6,798	Niger 434; Japan 17.
Unspecified and mixed		3,769	4,910	100	Japan 2,312; Niger 1,882.
Graphite, natural		81,290	68,631	10,582	Japan 34,646; United Kingdom 8,656.
Gypsum and plaster		4,421	219,155	211,594	Hong Kong 3,539; Japan 3,103.
Kyanite and related materials		20	216	—	United Kingdom 116; Italy 100.

See footnotes at end of table.

TABLE 2—Continued

CHINA: APPARENT EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987[p]	Destinations, 1987: United States	Destinations, 1987: Other (principal)
INDUSTRIAL MINERALS—Continued				
Lime	44,150	44,264	—	Hong Kong 43,865; Singapore 399.
Magnesium compounds: Crude including calcined	524,567	[8]197,318	55,061	Netherlands 26,414; Hong Kong 27,201.
Mica:				
Crude including splittings and waste	3,039	[9]16,258	—	United Kingdom 10,045; Japan 5,972.
Worked including agglomerated splittings	60	85	—	Hong Kong 79.
Nitrates, crude	20	1,149	—	All to Hong Kong.
Phosphates, crude	1,610	10,274	—	Japan 6,661; Philippines 3,213; Hong Kong 350.
Phosphorus, elemental	—	154	30	Belgium-Luxembourg 124.
Pigments, mineral:				
Natural, crude	932	564	—	Hong Kong 514; Philippines 50.
Iron oxides and hydroxides, processed	8,708	12,781	110	Hong Kong 3,166; Egypt 2,852; Pakistan 2,541.
Precious and semiprecious stones other than diamond:				
Natural value, thousands	$4,822	$8,828	$599	Hong Kong $7,196; Japan $913.
Synthetic do.	$335	$167	$7	Hong Kong $96; Singapore $50.
Pyrite, unroasted	7,531	134,428	—	All to Japan.
Salt and brine	176,428	747,291	—	Japan 579,379; Hong Kong 118,469; Philippines 31,629.
Sodium compounds, n.e.s.:				
Carbonate, natural and manufactured	5,677	3,906	—	Hong Kong 3,365; Jordan 310; Singapore 200.
Sulfate, natural and manufactured[10]	102,008	94,074	—	Hong Kong 76,708; Philippines 11,557; Singapore 4,440.
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked	153,773	186,737	525	Japan 167,646; Hong Kong 13,886.
Worked	38,802	91,226	7,623	Japan 65,280; Hong Kong 8,425.
Dolomite, chiefly refractory-grade	—	9,823	—	Japan 9,313; Singapore 308.
Gravel and crushed rock	4,593,547	6,465,927	25	Hong Kong 6,461,037; Japan 3,568.
Limestone other than dimension	38,125	32,119	—	Hong Kong 32,118.
Quartz and quartzite	8,250	13,411	388	Japan 10,208; Hong Kong 2,493.
Sand other than metal-bearing	1,270,873	1,304,078	—	Hong Kong 1,258,658.
Sulfur:				
Elemental:				
Crude including native and byproduct	42,333	19,716	—	Thailand 13,798; Pakistan 2,351; Portugal 1,506.
Colloidal, precipitated, sublimed	3,801	669	—	Pakistan 417; Philippines 98; Hong Kong 76.
Sulfuric acid	6,473	7,332	([11])	Hong Kong 7,324; Pakistan 6.
Talc, steatite, soapstone, pyrophyllite	565,555	515,564	3,135	Japan 457,078; Hong Kong 29,404.
Vermiculite	5	3	—	All to Netherlands.
Other:				
Crude	35,966	63,056	330	Japan 39,703; Pakistan 7,477; Netherlands 4,121.
Slag and dross, not metal-bearing	8,935	7,667	—	Japan 7,010; United Kingdom 391.
Metalloids, unspecified[12]	2,511	19,698	—	Hong Kong 19,497; Netherlands 151.

See footnotes at end of table.

TABLE 2—Continued

CHINA: APPARENT EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987[p]	Destinations, 1987: United States	Destinations, 1987: Other (principal)
MINERAL FUELS AND RELATED MATERIALS					
Asphalt and bitumen, natural		523	20,196	—	All to Japan.
Carbon:					
Carbon black		3,469	3,284	—	Hong Kong 1,455; Thailand 690; Singapore 537.
Gas carbon		—	17	—	All to Italy.
Coal:					
Anthracite and bituminous	thousand tons	5,543	7,540	—	Japan 4,301; Hong Kong 1,963; Italy 308.
Lignite including briquets		1,040	10,992	—	Philippines 9,995; Japan 997.
Coke and semicoke		25,944	41,210	—	Japan 24,268; Thailand 14,162; Hong Kong 2,520.
Peat including briquets and litter		100	308	7	Japan 301.
Petroleum:					
Crude	thousand 42-gallon barrels	187,866	174,204	20,390	Japan 89,228; Singapore 34,553; Brazil 18,583.
Refinery products:					
Liquefied petroleum gas	do.	109	10	—	Mainly to Thailand.
Gasoline	do.	18,976	18,027	5,891	Japan 10,692; Singapore 1,084.
Naphtha including white spirit	do.	1,938	24	—	All to Hong Kong.
Mineral jelly and wax	do.	721	675	58	Hong Kong 223; Singapore 121.
Kerosene and jet fuel	do.	2,923	3,620	([11])	Japan 2,227; Hong Kong 1,393.
Distillate fuel oil	do.	12,352	[13]8,161	—	Hong Kong 3,990; Singapore 2,042; Japan 1,598.
Lubricants	do.	1,057	[14]1,176	404	Thailand 357; Hong Kong 224.
Residual fuel oil	do.	3,783	[15]5,368	142	Japan 3,364; Hong Kong 1,449.
Asphalt	do.	—	1	—	All to Niger.
Bitumen and other residues	do.	16	18	—	Hong Kong 10; Japan 8.
Petroleum coke	do.	773	352	—	Mainly to Japan.
Unspecified	do.	56	—		

[p] Preliminary. NA Not available.

[1] Table prepared by Audrey D. Wilkes. Owing to a lack of official trade data published by China, this table should not be taken as a complete presentation of this country's mineral exports. These data have been compiled from United Nations information and data published by the trading partner countries.

[2] Excludes unreported quantity imported by Japan valued at $443,000.

[3] Excludes unreported quantity valued at $6,000.

[4] Excludes unreported quantity imported by Japan valued at $1,000.

[5] Excludes unreported quantities imported by Italy and United States valued at $145,000 and $75,000, respectively.

[6] May include platinum-group metals.

[7] Unreported quantity imported by United States valued at $66,000.

[8] Excludes unreported quantity valued at $33,647,000.

[9] Excludes unreported quantity imported by New Zealand valued at $51,000.

[10] Includes hydrogen sulfate and pyrosulfate.

[11] Less than 1/2 unit.

[12] Reported under SITC item number as "selenium, tellurium, phosphorus, arsenic, etc."

[13] Excludes unreported quantity imported by New Zealand valued at $5,110,000.

[14] Excludes unreported quantity imported by Japan valued at $568,000.

[15] Excludes unreported quantity imported by Pakistan valued at $533,000.

TABLE 3

CHINA: APPARENT IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987[p]	Sources, 1987	
			United States	Other (principal)
METALS				
Alkali and alkaline-earth metals	1	344	—	Japan 286; Hong Kong 58.
Aluminum:				
Ore and concentrate	—	3,657	—	All from Ireland.
Oxides and hydroxides	107,787	15,732	22	Singapore 11,010; Japan 4,470.
Metal including alloys:				
Scrap	1,141	1,637	212	Hong Kong 1,425.
Unwrought	94,519	33,681	79	Australia 17,269; New Zealand 6,802.
Semimanufactures	44,311	47,456	1,439	Hong Kong 20,066; Japan 12,939; Belgium-Luxembourg 3,397.
Arsenic: Oxides and acids	216	—		
Beryllium: Metal including alloys, all forms value, thousands	—	$5	$5	
Bismuth: Metal including alloys, all forms	34	—		
Chromium:				
Ore and concentrate	145,573	13,498	—	Turkey 10,500; Ireland 2,998.
Oxides and hydroxides	287	3,924	556	Japan 1,964; Hong Kong 1,401.
Metal including alloys, all forms	—	3	—	All from United Kingdom.
Cobalt: Oxides and hydroxides kilograms	25	3,000	—	Netherlands 2,000; Japan 1,000.
Columbium and tantalum: Metal including alloys, all forms, tantalum value, thousands	$594	$393	$16	Japan $377.
Copper:				
Ore and concentrate	125,980	55,950	2,470	Philippines 27,608; Canada 25,861.
Matte and speiss including cement copper	—	8,907	—	Chile 8,900.
Oxides and hydroxides	147	219	—	All from Hong Kong.
Sulfate	2,016	64	—	Do.
Metal including alloys:				
Scrap	31,773	7,972	370	Hong Kong 7,602.
Unwrought	50,539	5,336	—	Canada 3,995; Belgium-Luxembourg 922.
Semimanufactures	34,547	37,375	225	Chile 18,200; Hong Kong 10,680; Japan 7,946.
Gold:				
Ore and concentrate value, thousands	$3,328	$2,310	—	All from Philippines.
Metal including alloys, unwrought and partly wrought troy ounces	616	83,151	—	All from Hong Kong.
Iron and steel:				
Iron ore and concentrate including roasted pyrite	8,734,496	7,892,928	—	All from Australia.
Metal:				
Scrap	649,371	431,508	227,591	Japan 138,079; Canada 41,013.
Pig iron, cast iron, related materials	815,169	526,708	18	Brazil 428,214; Pakistan 52,500; Turkey 45,327.
Ferroalloys:				
Ferromanganese	720	—		
Unspecified	31	93	54	Austria 33; Hong Kong 5.

See footnotes at end of table.

TABLE 3—Continued

CHINA: APPARENT IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987[p]	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS—Continued				
Iron and steel—Continued				
Metal—Continued				
Steel, primary forms	898,808	914,864	—	Japan 434,308; Brazil 360,638; Australia 55,051.
Semimanufactures:				
Bars, rods, angles, shapes, sections thousand tons	6,052	2,173	([2])	Japan 1,167; Spain 227; Turkey 190.
Universals, plates, sheets do.	4,096	3,415	11	Japan 3,013; Hong Kong 175.
Hoop and strip do.	206	201	([2])	Japan 162; Hong Kong 23; Turkey 11.
Rails and accessories do.	128	96	([3])	Japan 67; Australia 21.
Wire do.	87	[4]27	([2])	Hong Kong 18; Spain 6.
Tubes, pipes, fittings do.	1,676	794	1	Japan 630; Argentina 89; Hong Kong 32.
Castings and forgings, rough do.	2	1	([2])	Mainly from Belgium-Luxembourg and Austria.
Lead:				
Oxides	30	6	—	All from Japan.
Metal including alloys:				
Scrap	1,101	1,479	—	All from Hong Kong.
Unwrought	4,214	4,048	—	Hong Kong 2,994; Canada 499; Australia 294.
Semimanufactures	73	97	—	Hong Kong 73; Japan 24.
Magnesium: Metal including alloys, all forms	4,079	2,446	2,327	Hong Kong 56; Japan 41.
Manganese: Oxides	56	110	([5])	All from Hong Kong.
Mercury 76-pound flasks	—	90	—	Do.
Molybdenum:				
Ore and concentrate	—	15	—	All from Netherlands.
Metal including alloys, all forms	1	3	—	All from Japan.
Nickel:				
Matte and speiss	—	3	—	Do.
Metal including alloys, all forms	238	1,064	9	Hong Kong 751; Canada 196.
Platinum-group metals: Metals including alloys, unwrought and partly wrought value, thousands	$4,715	$14,175	$6,462	Hong Kong $3,967; United Kingdom $3,733.
Selenium, elemental	15	10	—	United Kingdom 7; Netherlands 3.
Silver:				
Ore and concentrate value, thousands	$6,018	$2,628	$133	Canada $2,495.
Waste and sweepings do.	$8	$51	$37	Hong Kong $14.
Metal including alloys, unwrought and partly wrought do.	—	$3,451	—	Hong Kong $1,973; Japan $1,297; United Kingdom $159.
Tin:				
Ore and concentrate	199	—		
Oxides kilograms	—	20	—	All from Hong Kong.
Metal including alloys, all forms	855	364	2	Hong Kong 346; Japan 13.

See footnotes at end of table.

TABLE 3—Continued

CHINA: APPARENT IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987[p]	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS—Continued				
Titanium:				
Oxides	8,448	8,761	2,321	Japan 4,770; Hong Kong 1,545.
Metal including alloys, all forms	399	11	—	Italy 10; United Kingdom 1.
Tungsten: Metal including alloys, all forms	6	25	([6])	Japan 23.
Uranium and thorium:				
Ore and concentrate	1	500	—	All from Singapore.
Oxides and other compounds kilograms	2,000	100	—	All from Hong Kong.
Zinc:				
Ore and concentrate	2,281	—		
Oxides	504	84	—	Hong Kong 67; Japan 12.
Blue powder	51	176	—	Hong Kong 154; Denmark 22.
Metal including alloys:				
Scrap	33	182	73	Hong Kong 109.
Unwrought	50,717	55,173	—	Hong Kong 12,894; Japan 12,294; Canada 10,482.
Semimanufactures	203	707	—	Canada 577; Hong Kong 111.
Zirconium: Ore and concentrate	—	150	—	All from United Kingdom.
Other:				
Ores and concentrates	12,979	1,943	—	Australia 1,715; Hong Kong 200.
Oxides and hydroxides	—	4	—	All from Philippines.
Ashes and residues	485	2,445	—	Canada 1,504; Hong Kong 913.
Base metals including alloys, all forms	885	4,030	313	Hong Kong 3,533; Japan 170.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	668	3,110	50	Hong Kong 3,051.
Artificial:				
Corundum	202	1,237	—	Japan 880; Hong Kong 335.
Silicon carbide	30	19	1	Hong Kong 18.
Dust and powder of precious and semiprecious stones including diamond value, thousands	$20	$106	$84	Japan $21.
Grinding and polishing wheels and stones	[7]717	801	6	Hong Kong 622; Japan 93; Italy 65.
Asbestos, crude	254	411	—	Canada 299; Italy 72; Hong Kong 36.
Barite and witherite	25	602	601	Australia 1.
Boron materials:				
Crude natural borates	—	144	—	All from Japan.
Oxides and acids	3	11,749	2,115	Hong Kong 9,334; Turkey 300.
Cement	1,234,365	480,634	—	Hong Kong 473,841; Singapore 3,766; Japan 3,003.

See footnotes at end of table.

TABLE 3—Continued

CHINA: APPARENT IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987[p]	Sources, 1987: United States	Sources, 1987: Other (principal)
INDUSTRIAL MINERALS—Continued					
Chalk		—	1	—	All from Switzerland.
Clays, crude		3,755	3,892	1,947	Hong Kong 1,288; Japan 387.
Diamond:					
Gem, not set or strung	value, thousands	$10,815	$22,549	$133	Belgium-Luxembourg $18,334; Hong Kong $2,563.
Industrial stones	do.	$10,257	$9,129	$891	Belgium-Luxembourg $4,832; Netherlands $2,429.
Diatomite and other infusorial earth		953	2,190	944	Hong Kong 608; Japan 549.
Feldspar, fluorspar, related materials		5,340	1,750	206	Hong Kong 1,544.
Fertilizer materials:					
Crude, n.e.s.		301	132	—	Hong Kong 130; Australia 2.
Manufactured:					
Ammonia		47	93	—	Hong Kong 90.
Nitrogenous	thousand tons	1,534	608	—	Indonesia 313; Canada 159; Turkey 61.
Phosphatic	do.	587	258	—	Philippines 163; Tunisia 96.
Potassic	do.	347	865	—	Canada 794; Spain 68.
Unspecified and mixed	do.	268	506	—	Philippines 158; Italy 92; Greece 80.
Graphite, natural		10	30	—	Hong Kong 29; Italy 1.
Gypsum and plaster		567	806	—	Hong Kong 775; Japan 31.
Iodine including bromine and fluorine		170	2	—	All from Hong Kong.
Kyanite and related materials		4	—		
Lime		132	256	—	Hong Kong 226; Australia 20.
Magnesium compounds: Crude including calcined		285	[8]11,247	—	Ireland 11,137; Hong Kong 110.
Mica:					
Crude including splittings and waste		—	4	—	All from Hong Kong.
Worked including agglomerated splittings		70	[9]209	—	Do.
Phosphates, crude		267,640	48,649	—	Algeria 48,609; Singapore 40.
Pigments, mineral:					
Natural, crude		18	37	—	All from Hong Kong.
Iron oxides and hydroxides, processed		923	1,440	88	Hong Kong 1,204; Japan 124.
Potassium salts, crude		188,302	301,500	—	All from Jordan.
Precious and semiprecious stones other than diamond:					
Natural	value, thousands	$12,082	$13,132	$11	Hong Kong $13,111.
Synthetic	do.	$219	$1,694	—	Australia $1,375; Canada $131.
Salt and brine		23,945	282	—	Hong Kong 248.
Sodium compounds, n.e.s.:					
Carbonate, natural and manufactured		773,315	452,331	282,759	Hong Kong 100,075; Japan 55,497.
Sulfate, natural and manufactured		141	1,595	—	All from Hong Kong.

See footnotes at end of table.

TABLE 3—Continued

CHINA: APPARENT IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987[p]	Sources, 1987: United States	Sources, 1987: Other (principal)
INDUSTRIAL MINERALS—Continued					
Stone, sand and gravel:					
Dimension stone:					
Crude and partly worked		50,704	811	—	Hong Kong 595; Ireland 101; Portugal 91.
Worked		10,292	14,475	130	Hong Kong 13,125; Italy 911.
Dolomite, chiefly refractory-grade		43	119	—	United Kingdom 65; Hong Kong 54.
Gravel and crushed rock		967	934	—	Hong Kong 928.
Limestone other than dimension		1,261	2,355	—	Hong Kong 2,341; Japan 14.
Quartz and quartzite		79	34	—	Hong Kong 30; Italy 4.
Sand other than metal-bearing		275	333	—	Hong Kong 275; Japan 40.
Sulfur:					
Elemental:					
Crude including native and byproduct		332	59	59	
Colloidal, precipitated, sublimed		9	12	—	All from Hong Kong.
Sulfuric acid		104	34,893	429	Japan 34,323; Hong Kong 138.
Talc, steatite, soapstone, pyrophyllite		678	1,130	396	Hong Kong 659; Italy 58.
Other:					
Crude		364	377	31	Hong Kong 256; Singapore 40.
Slag and dross, not metal-bearing		67	[10]712	—	All from Hong Kong.
Metalloids, unspecified[11]		NA	546	—	Do.
MINERAL FUELS AND RELATED MATERIALS					
Asphalt and bitumen, natural		21	3,004	—	Singapore 3,001.
Carbon:					
Carbon black		2,935	2,122	137	Australia 1,578; Hong Kong 194.
Gas carbon		—	46	—	All from United Kingdom.
Coal:					
Anthracite and bituminous		473,660	254,452	—	Australia 247,450; Ireland 7,000.
Lignite including briquets		139	—		
Coke and semicoke		—	5	—	All from Hong Kong.
Peat including briquets and litter		285	—		
Petroleum:					
Crude	42-gallon barrels	221,934	—		
Refinery products:					
Liquefied petroleum gas	do.	45,228	76,503	93	Hong Kong 67,106; Philippines 9,280.
Gasoline	do.	44,732	129,677	102	Singapore 83,011; Hong Kong 37,000.
Mineral jelly and wax	do.	5,579	11,435	110	Hong Kong 11,262.
Kerosene and jet fuel	do.	22,069	40,170	—	Hong Kong 40,000; Singapore 170.
Distillate fuel oil	do.	10,540,585	9,548,121	—	Singapore 7,706,568; Hong Kong 1,806,946.
Lubricants	do.	217,968	326,921	4,263	Hong Kong 266,533; Singapore 16,436.

See footnotes at end of table.

TABLE 3—Continued

CHINA: APPARENT IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987[p]	Sources, 1987 United States	Sources, 1987 Other (principal)
MINERAL FUELS AND RELATED MATERIALS—Continued					
Petroleum—Continued					
Refinery products—Continued					
Residual fuel oil	42-gallon barrels	4,044,305	1,592,401	294,692	Hong Kong 874,232; Singapore 362,504.
Bitumen and other residues	do.	7,926	28,720	—	Singapore 27,270; Hong Kong 1,402.
Bituminous mixtures	do.	352	154	—	Hong Kong 75; Italy 67.
Petroleum coke	do.	—	172,012	144,292	Japan 27,720.

[p] Preliminary. NA Not available.
[1] Table prepared by Audrey D. Wilkes. Owing to a lack of official trade data published by China, this table should not be taken as a complete presentation of this country's mineral imports. These data have been compiled from United Nations information and data published by the trading partner countries.
[2] Less than 1/2 unit.
[3] Unreported quantity valued at $2,000.
[4] Excludes unreported quantity exported by Japan valued at $24,112,000.
[5] Unreported quantity valued at $7,000.
[6] Unreported quantity valued at $8,000.
[7] Excludes unreported quantities exported by Canada and the United Kingdom valued at $85,000 and $1,000, respectively.
[8] Excludes unreported quantity exported by Japan valued at $470,000.
[9] Excludes unreported quantity exported by Japan valued at $8,000.
[10] Excludes unreported quantity exported by Canada valued at $210,000.
[11] Reported under SITC item number as "selenium, tellurium, phosphorus, arsenic, etc."

mented with imports of 84,000 tons and secondary recovery of perhaps as much as 100,000 tons. The Government's emphasis was on the expansion of the aluminum sector rather than copper. Aluminum electrical cables presumably were to supplement copper cables made available to the energy sector. By 1990, copper refinery capacity was to reach 665,000 tons compared to 1.3 million tons for aluminum.

China's copper producers were as shown in the text table.

	1988 Capacity (thousand tons per year)
Anhui:	
Tongling No. 1	30
Tongling No. 2	30
Gansu:	
Baiyin	110
Hezheng Xian	35
Wu Wei	35
Henan, Zhuzhou	10
Hubei, Daye	30
Jiangxi, Guixi	90
Liaoning, Shenyang	50
Shanghai	65
Shanxi, Taiyuan	35
Tianjin	[1] 100
Yunnan, Kunming	45
Total	**565** **[1] 665**

[1] 1990.

Gold.—While gold output increased 14% in 1986, the annual increases in 1987 and 1988 were only about 10% each year, thereby falling short of the state target of 15% annual growth. Since 1978, the Government has permitted small-scale gold mining by individuals and collectives. However, by 1988, the Government began to restrict small-scale operations as a result of land-use conflicts and despoiling of the environment. In addition, because of the lower prices the state paid for gold, there apparently was a marked increase in gold smuggled out of the country. The estimated gold output in 1988 was as follows:

	Thousand ounces
Shandong	665
Heilongjiang	200
Henan	145
Hebei	90
Jilin	90
Liaoning	90
Nei Monggol	90
Shanxi	25
Other areas	30
Individuals and collectives	1,400
Byproduct of refinery operations	75
Total	**2,900**

Iron and Steel.—During 1981-85, the average annual increase in steel production was 2 million tons to reach a crude steel output of 46.7 million tons in the last year of the plan period. During 1986-90, the average annual increase in production was targeted at about 3 million tons in order to produce more than 60 million tons in 1990. Notably, crude steel output was already 59.2 million tons by 1988. To reach the targeted output in 1995 of 80 million tons, the average annual output would require an annual increase of 4 million tons.

Between 1986-95, the known proposed expansion program and new capacity to be installed was 21.1 million tons, reaching close to 72 million tons for the country's overall annual capacity. The 1988 capacity and the proposed capacity for the following steel facilities were as shown in the text table.

Steel facility	Capacity 1988 (metric tons)	Proposed capacity (metric tons)
Anhui, Ma'anshan	2,300,000	3,200,000
Fujian, Meizhouwan	—	300,000
Guangdong:		
Guangzhou	—	300,000
Shenzhen	—	3,900,000
Guangxi, Beihai	—	300,000
Hainan, Haikou	—	1,000,000
Hebei, Xuanhua	600,000	1,050,000
Hubei, Wuhan	4,000,000	7,000,000
Jiangsu:		
Meishan	—	2,000,000
Liaoning:		
Anshan	7,000,000	10,000,000
Benxi	1,600,000	3,600,000
Shandong:		
Laiwu	160,000	800,000
Shijiusuo	—	3,000,000
Shanghai, Baoshan	3,700,000	6,700,000
Sichuan, Panzhihua	1,700,000	2,500,000
Zhejiang, Ningbo	—	3,000,000
Total	**21,060,000**	**44,650,000**

Because of the capital cost required for new construction, the projects proposed for Beihai, Guangzhou, Haikou, Meizhouwan, Ningbo, Shenzhen, and Shijiusuo, will probably be delayed.

The Government's projected low demand for steel in 1995 was 136.6 million tons, a short fall in production of 64.7 million. The crude steel consumption and forecast, in metric tons, were as shown in the text table.

	Consumption	Forecast		
		Low	Midrange	High
1950	1,036,800	—	—	—
1955	3,915,900	—	—	—
1960	16,039,900	—	—	—
1965	7,983,000	—	—	—
1970	18,793,500	—	—	—
1975	25,365,600	—	—	—
1980	40,663,900	—	—	—
1985	72,235,100	—	—	—
1986	75,165,800	—	—	—
1990	—	96,012,000	99,815,000	103,619,000
1995	—	136,581,000	141,132,200	145,683,000
2000	—	193,860,000	199,624,300	205,388,000

Either the growth forecasted for steel demand was too optimistic or the imbalance between production and demand was to be made from purchases of foreign steel.

To ensure a steady supply of high-grade iron ore for the expanding steel industry, China Metallurgical Import and Export Corp. (CMIEC) and Hamersley Iron Pty. Ltd. of Australia signed an agreement to develop jointly the Channar iron ore mine in the Pilbara region of Western Australia. China's equity interest in the joint venture was represented by a wholly owned subsidiary, CMIEC Channar Pty. Ltd. (40%), whereas its counterpart in Australia was Channar Mining Pty. Ltd. (60%). All of the iron ore produced at Channar was to be shipped to China, and the share owned by Hamersley was to be sold to China on a long-term contract basis. Mine construction began in early 1988, and mine production was due to start in 1990 at a rate of 3 million tons per year and increase progressively in annual increments to 10 million tons per year. The total capital expenditure of the project was $250 million. The cost for the use of Hamersley's existing facilities was to be charged to the joint venture on a tolling or service fee basis.

The configuration of China's scrap recovery was expected to change in the next century. As soon as the industry modernizes and gains up-to-date technology, home scrap generation in finishing was to diminish. When the domestic economy expands, there should be increased production and consumption of consumer durable goods and attendant growth in waste disposal and the collection of old scrap such as that from vehicular stock. Ferrous scrap recovery in 1988 was 6.9 million tons, an increase of 8% over that of the previous year. Moreover, China was to compete more aggressively in world shipbreaking activities. Because of lower labor cost, China could become the world's second largest shipbreaking nation attaining a deadweight breakage capacity of 5 million tons per year in the 1990's.

During the seventh 5-year plan, China

was to invest $11 billion in technical renovation and capital construction in the iron and steel industry to ensure a steel production target of 60 million tons in 1990 and 95 million tons in the year 2000. In addition to the domestic funding, foreign capital would be sought to upgrade the existing facilities at the Anshan Iron and Steel Complex in Liaoning and the Wuhan Iron and Steel Corp. in Hubei.

China's largest iron and steel works at Anshan had an annual production capacity of 7.5 million tons of steel and 6.6 million tons of pig iron. It produced 7.2 million tons of steel in 1988. Imported advanced technology was being sought to modernize the complex and to increase its capacity to 15 million tons of steel per year.

The second largest steel producer, Wuhan Iron and Steel Corp., produced 4.3 million tons of steel in 1988. A total investment of $1.9 billion was earmarked for this project whereby annual production capacity would be increased to 7 million tons in 1993. Of this investment $590 million would be available from state sources, the rest would be obtained from foreign investment.

The Baoshan Iron and Steel Complex in Shanghai turned out 2.5 million tons of steel in 1986, quadrupling the output of the previous year. In November 1985, the first phase of construction went into operation using imported technology and equipment from Japan and the Federal Republic of Germany at a cost of $2.5 billion. The second phase, which would have a new blast furnace to be designed and built by the Chinese, was expected to be completed by June 1991. At the completion of the second stage construction, annual output capacity would be more than 6.7 million tons of steel.

The future emphasis of China's iron and steel industry is to be placed upon quality, variety, and technological advancement, rather than upon quantity, in order to ensure sustained development in the coming years. Quality improvement of iron and steel products to meet the world standards is the main task of the industry. It was expected that 40% of the products manufactured by the domestic major steelmakers would match international standards by the end of 1990. China must import up to 20 million tons of steel a year, at a cost of $5 billion of mostly high-quality products in order to meet the huge domestic demand.

Lacking sufficient domestic funds, the Chinese must use foreign funds to boost the iron and steel industry. To absorb foreign investment, China plans to negotiate with Japan and the countries of western Europe to build or expand its existing iron and steel plants. Four major steel plants to use foreign capital were Laiwu, Shandong; Wuhan, Hubei; Meishan, Jiangsu; and Anshan and Benxi, Liaoning. The Wuhan project had an estimated cost of $2.2 billion. The Anshan Iron and Steel Works were expected to spend $849 million on technical renovations. The first phases of these projects were expected to be completed by 1993, and increased production would begin in 1995. In the first half of 1987, financing for the expansion and reconstruction to 3 million tons per year at a total cost of $810 million at the Panzhihua Iron and Steel Co. was completed by raising $210 million from 24 foreign banks. China's own investment funds would be raised by local governments and individual factories through issuing bonds. Seven key iron and steel companies planning to do so were Baoshan, Baotou, Benxi, Panzhihua, Shoudu, Tangshan, and Wuhan.

Lead and Zinc.—Although China was a net exporter of zinc metal in 1986 and 1987, it was a net importer of zinc in 1988. Trade of lead was not separately reported. China may possibly receive lead and zinc metal in barter or countertrade for Daqing crude oil, which was transported to North Korea by pipeline for refining at Anju. China's consumption of lead and zinc in 1988 was probably 250,000 tons and 400,000 tons, respectively. The capacities, in thousand metric tons, for China's smelter facilities at yearend 1988 were as shown in the text table.

	Lead	Zinc
Fujian		
Liancheng	10	15
Gansu		
Baiyan	50	100
Guangdong		
Shaoguan	15	30
Guangxi		
Changpo	5	20
Hunan		
Songbai	10	5
Zhuzhou	50	135
Liaoning		
Huludao	—	60
Shenyang	50	20
Shanghai	5	—
Yunnan		
Lanping	20	40
Unspecified	50	100
Total	**265**	**425**

Rare Earths.—China had purportedly the world's largest resources of rare earths, and reserves were equivalent to four times those in the rest of the world. The largest occurrence of rare earths was associated with the magnetite deposit at Bayan Obo, Nei Monggol. The ore was reduced to pig iron at Baotou, and the slag was treated for byproduct rare-earth recovery. Baotou was China's largest producer and accounted for 80% of its rare earths output. China exports high-purity rare earths and yttrium compounds, most notably to Japan. China was believed to equal or to exceed U.S. production of rare earths in 1988.

Tin.—China had rich tin resources, and its reserves may have accounted for as much as 20% of the total world resources. Although China was a major tin producer, it played a minor role in world commerce. Exports of tin decreased from 15,894 tons in 1987 to

10,717 tons, valued at \$71.04 million, in 1988. Close to 60% of China's export of tin metal in 1988 was to the United States.

Tin production in Guangxi and Yunnan accounted for about 80% of the national output. China's tin smelter capacity in 1988 was estimated as shown in the text table.

	Metric tons
Guangzhou, Guangdong	1,000
Dachang, Guangxi	5,000
Hengyang, Hunan	500
Ganzhou, Jiangxi	500
Gejiu, Yunnan	15,000
Undistributed	5,000
Total	**30,000**

Titanium.—China had abundant titanium resources with large quantities in beach sands in Guangdong, Guangxi, and Hainan. In addition, there were resources of titaniferous magnetite in Anhui and Sichuan. China's titanium reserves were estimated at 10 billion tons containing 800 million tons of titanium dioxide (TiO_2). For three plants, the annual production capacity for titanium sponge was only 3,000 tons. In comparison, the smallest plants worldwide had at least a 5,000-ton-per-year capacity for sponge, and the more efficient plants had an economy of scale of 10,000 tons. China was soliciting technology to treat the titaniferous slag produced at Ma'anshan, Anhui, and Panzhihua, Sichuan, for the production of pigment and metal.

Tungsten.—China had large resources of tungsten and was the world's largest producer. China continued to dominate the world market for tungsten; however, its exports were mainly concentrates, not value-added products. In 1988, China's exports of ore totaled 27,290 tons, valued at \$96.8 million, and 408 tons of metal with a value of \$3.2 million. Exports to the United States of ammonium paratungstate and tungstic acid were covered under a Sino-U.S. orderly marketing agreement. Chinese tungsten exports to the United States in 1988 were as shown in the text table.

	Quantity (kilograms)	Value
Ore	8,288,728	\$24,096,539
Ammonium paratungstate	382,418	2,615,342
Metal:		
Waste and scrap, less than 50% tungsten	18,400	92,298
Waste and scrap, more than 50% tungsten	653,033	3,632,583
Unwrought alloy	394	6,602
Wrought (wire)	76	6,717
Other, wrought	1,256	53,395
Tungsten carbide	31,441	467,346
Tungsten compounds	912,581	6,976,841

Industrial Minerals.—China was a major world producer of a variety of industrial minerals. The important producers were China National Nonmetallic Minerals Industry Corp., Ministry of Chemical Industry, Ministry of Metallurgical Industry, and the State Administration for Building Materials. Other producers included China National Nonferrous Metals Industry Corp., Ministry of Geology and Mineral Resources, and a host of provincial and lower level entities.

Barite.—China was the world's largest producer of barite. The annual output was at least twice that of the U.S.S.R., the world's second largest producer. Mine output in 1988 may well have been around 1.5 million tons, and Guangxi accounted for about two-thirds of the total. China exported 1.1 million tons of barite, valued at \$28.1 million, in 1988. During 1985-88, Chinese shipments accounted for close to 60% of U.S. imports of crude barite.

Cement.—China was the world's largest producer of cement and had an output of 203.4 million tons in 1988. However, because the output was still insufficient to meet the demands of national construction and reconstruction activities, many projects were forced to be postponed or canceled. China was a net importer of cement, importing 1,517,781 tons and exporting 152,190 tons in 1988.

Fluorspar.—China was probably the world's largest producer of fluorspar, outpacing production by Mexico and Mongolia. China's exports in 1988 totaled 911,976 tons, valued at \$65.2 million. Based on the order of magnitude of export shipments and the growth in domestic demand by the chemicals and metallurgical sectors, China's mine output may have exceeded 1.5 million tons per year. Fluorspar occurred in numerous provinces, but the largest reserves were believed to be in Nei Monggol followed by Jiangxi.

Fertilizer.—China was the third largest producer and user of fertilizer after the United States and the U.S.S.R. In 1988, production of chemical fertilizers totaled 17,670,000 tons, estimated to be comprised of 14,930,000 tons of the nitrogenous component (N), 2,700,000 tons phosphatic (P), and 40,000 tons potassic nutrients (K). There are about 1,900 plants producing fertilizers: 1,200 for N, 700 for P, and 2 for K. Based solely on domestic production, the nutrient ingredient of chemical fertilizers output was strongly skewed to nitrogen, resulting in an N to P to K ratio of 375:70:1. To supplement domestic production, China imported N and P ingredients and imported virtually all its requirements for K. Total imports of fertilizers in 1988 were 14,706,323 tons comprised of 8,570,753 tons for N and 6,135,570 tons for P and K (about 3,400,000 tons for P and about 2,700,000 tons for K).

Salt.—After the United States, China was the world's second largest producer of salt. Salt production from evaporites and rock deposits increased 24%, reaching 21,944,000 tons in 1988. China exported about 1.1 million tons of salt in both 1986 and 1987. However, because of the growing demand by the domestic chemicals sector, exports in 1988 were only about one-third of that in the prior years. China's major salt operations were in Anhui, Hainan, Jiangsu, Jiangxi, Liaoning, Nei Monggol, Qinghai, Sichuan, and Xinjiang.

Talc.—China was a major world producer of both industrial- and cosmetic-grade talc. The talc-producing bases were in Guangxi, Liaoning, and Shandong. Output was sufficient to meet domestic demand as well as provide substantial quantities for export. In 1988, China exported close to 750,000 tons of talc. Inasmuch as the three talc-producing bases were undergoing expansion, China was expected to be a major factor in world talc commerce by 1990.

Mineral Fuels.—China was a major producer of fossil fuels. In 1988, coal production increased 2.9% to 947,090,000 tons; crude oil production increased 2.0% to 999 million barrels; and natural gas production increased 3.4% to 487 billion cubic feet. Electric power generation increased 8.6% to 539 billion killowatt hours. About 80% of China's electric energy was generated by thermal-fired plants, and the remainder was from hydropower. Although there were annual increases in energy output during the seventh 5-year plan, China was experiencing an energy crisis inasmuch as the growth in demand for industrial energy consumption continued to outstrip the growth in energy production. Because of the energy shortage, most manufacturing units operated on a 6-day week in 1987 and on a 5-day week in 1988. Energy-intensive user-industries have been particularly affected such as the Guizhou aluminum smelter, which cut operating capacity by one-third. Steel facilities were facing suspended operations because of low coal stockpiles. The ratio of China's growth in energy consumption to the growth in energy production capacity was estimated at 3:1.

One of the principal deterrents to expanding China's energy sector was the lack of investment capital for development. Energy prices, especially coal prices, were not realistic and usually were below the level of production costs. Hence, production units were not profitable and could not generate reinvestment capital. Moreover, Government investment in the energy sector decreased from 7.3% of the state budget in 1984 to 4.2% in 1987. In addition, coal designated for key state projects was sometimes redirected to less-important projects, which paid up to five times the prices set at the coal mine site. The growth in demand for energy by the nonprocessing sector, e.g., air conditioning and refrigeration, was competing with the growth in demand by the overheated manufacturing sector.

In 1988, China exported close to 226 million barrels of crude oil and refinery products. Part of the foreign exchange earnings was used to import energy-consuming products, e.g., automobiles and trucks. Hence, China not only exported part of its tight energy supply but exacerbated the situation by importing additional demand.

To help alleviate the crisis, the Government concentrated on energy-saving methods and in the commercialization of the energy-producing sector. The latter involved the creation of energy corporations such as for coal, petroleum and natural gas, etc., whose survival was dependent on profitability. The former included reducing the power available to the residential users, decreasing energy exports, energy conservation through more-efficient industrial processes, and reducing investment in nonproduction projects.

In September 1988, the new Ministry of Energy Resources formulated an energy development plan for 1989–2000. Some of the proposals were: develop minesite power stations and install power transmission lines; construct thermopower plants with a total generating capacity of 10 million kilowatts within 5 years; construct hydropower stations with a total generating capacity of 10 million kilowatt within 5 years; replace small, inefficient generating units with high-efficiency units; increase coal production in large coal-consuming areas such as Huainan and Huaibei in Anhui, Jiling and Yanzhou in Shandong, Shenbei and Tiefa in Liaoning, and Kailuan in Hebei; and increase coal production in Shaanxi, Shanxi, and western Nei Monggol and install transportation infrastructure to move coal from the aforementioned.

In 1988, China National Nuclear Corp. was formed under a charter to widen China's foreign economic and technological cooperation in the nuclear field. The company's activities would include the export of uranium, rare earths, other metallurgical products, and chemical raw materials and processed materials. It would also include export of nuclear technology and labor services. Imports would center on obtaining investment funds and technology and the establishment of foreign-funded enterprises. The company was formulating the tasks and goals of China's nuclear industry and laying the blueprint for the construction of nuclear power stations, production of nuclear fuels, and for the prospecting, mining, and processing of uranium minerals. The company's earnings in 1988 included $38 million in exports of uranium, calcium metal, and minireactors.

China's plans for nuclear power generation were modest. Construction of a 900-megawatt reactor at Daya Bay in Guangdong was 90% complete. Thus far, an investment of $800 million was spent on the project. Preparations for the construction of a twin 900-megawatt reactor at Daya Bay project were underway. These preparations included invitations for feasibility studies, selection of the construction site, and procurement of information on foreign nuclear equipment. Completion of the twin reactors at Daya Bay was scheduled for 1992. China was also completing the construction of a 300-megawatt demonstration pilot plant at Qinshan, Zhejiang, in Hangzhou Bay.

The Ministry of Energy Resources proposed the utilization of solar energy in areas lacking electricity and other energy resources and in areas where conditions allowed the utilization of solar energy. The annual solar radiation for China's land mass is 0.8-2.0 million kilocalories per square meter of ground surface. Solar energy resources, however, could be utilized best in the northern and northwestern regions where there is little cloud cover or rain. The lack of funds has retarded the development of new technology. Only $8 million was designated for developing solar energy in the current 5-year plan. Lacking domestic funds, China had obtained foreign funding and technical cooperation for the following: a whole village solar energy project in Yihezhuang, Daxing County, Beijing Municipality, in cooperation with the Federal Republic of Germany; a wind power and solar energy generating project on Dachen Dao off the Zhejiang coast in cooperation with the European Community (EC); a solar battery project in Yuzhong, Gansu, in cooperation with Japan; a solar energy heating and cooling technology demonstration project in Yuzhong, Gansu, in cooperation with the United Nations (UN). Because of the infancy of the domestic program, China's effective use of solar energy was not expected until the ninth 5-year plan (1996-2000).

China's development plan for the energy sector was to emphasize expanding electricity generation by coal-fired powerplants. There were to be increased efforts in the exploration and development of oil and natural gas. Moreover, there was to be an increased emphasis on the development of hydropower and nuclear energy.

Based on an annual economic growth of 6% during 1989-2000, China's primary energy demand was to reach 1.43 billion tons of standard coal equivalence (SCE) by 2000. By sector, this energy need translated into 1.4 billion tons of coal, 1.5 billion barrels of crude oil, 1.1 trillion cubic feet of natural gas, hydropower amounting to 90 million tons SCE, nuclear energy equivalent to 12 million tons SCE, and the generation of an electricity output of 1,200 billion kilowatt hours. The proportion of coal to total primary energy was to decrease from 73% in 1988 to 70% in 2000. The proportion of coal converted to electric power was expected to rise from 27% to 33%.

Coal.—In 1988, China used more than $1.6 billion in foreign funds in the coal sector through borrowing and through compensation trade and comanagement arrangements. The projects undertaken included the development of two surface mines having a combined annual production capacity of 16 million tons and utilized Japanese loans. French export credit was used to purchase equipment for the Dongtan mine in Yanzhou, Shandong, which had an annual production capacity of 4 million tons. The Bailong mine in Shaanxi had an annual capacity of 1.2 million tons and was developed in cooperation with Romania through compensation trade arrangements. The surface mine at Antaibo, Shanxi, was developed in cooperation with the Occidental Oil Co. of the United States. A World Bank loan was used to develop the coal mine at Zhangshu, Shanxi, with an annual capacity of 4 million tons.

Between 1989-2000, the coal industry planned to focus on developing mine output in Shaanxi, Shanxi, and western Nei Monggol. Coal output, just from this area, was to reach 550-600 million tons by 2000, an increase of 300-350 million tons over the 1988 annual output. The added production from this area would afford shipment of 407-500 million tons of coal to other parts of China, an increase of 200-300 million tons over the 1988 shipment level.

The industry also planned to exploit the brown coal resources at Shenyang and Tiefa in Liaoning and at Huolinhe, Yiminhe, and Yuanbaoshan in eastern Nei Monggol. The industry was also to increase output from existing mines in Heilongjiang Province and at Hegang, Hunchun, Jixi, Qitaihe, and Shuangyashan in western Jilin.

In addition, the industry planned to develop new coalfields at Jining, Juye, Longkuo, Tengxian, Yanzhou, and Zaozhuang in southwestern Shandong Province. New fields were also to be exploited at Huaibei and Huainan in Anhui, Yongcheng in eastern Henan, and Yuxian, Hebei.

Other targets included expanding coal output of local and township mines so that their collective production would account for one-half of the national total by 2000. This would be the result of increasing the productivity of existing mines, increasing the output of quality coal through washing and dressing, and increasing the use of domestic and foreign funds for investment in coal mine construction.

Petroleum and Natural Gas.—In 1988, China National Petroleum and Natural Gas Corp. (CNPNGC) was chartered and given dominion over production and exploration and development of onshore oil and gas resources. In 1988, CNPNGC discovered new oil reserves totaling 3,950 million barrels, of which 2,900 million barrels were commercially recoverable, and 1.8 trillion cubic feet of natural gas, of which 1.1 trillion cubic feet were recoverable. The company estimated China's total onshore oil reserves to be as much as 470 billion barrels. Included in this total were 19 billion barrels in new discoveries which included six oil and natural gas-bearing formations in eastern Junggar Basin in Xinjiang, Chaluhe area of Jilin, south Kongdian areas of Dagang, Nanbao area in eastern Hebei, Erlian area of Nei Monggol, and Gaskule area of Qinghai. In addition, there were 12 new oil and natural gas-bearing formations discovered around Dagang, Daqing, Liaohe, Shengli, Xinjiang, Zhongyuan, and in oilfields elsewhere in north China.

The company planned to explore the beaches and very shallow areas in Bohai inasmuch as a trial well sunk in the 80-square-kilometer Chengbei formation yielded a daily gas output of 3,500 cubic feet of natural gas and another trial well resulted in the discovery of a 200-meter-thick oil-bearing formation with estimated oil reserves of over 780 million barrels.

China National Offshore Oil Corp. (CNOOC) is responsible for offshore oil exploration and development. China's offshore oil production increased 5.6%, reaching 5.5 million barrels in 1988. Close to 87% of the production was by two fields. The Chengbei oilfield in Bohai, a Sino-Japanese operation, produced 2.7 million barrels. The Wei 10-3 field in Beibu, a Sino-French venture, produced 2.1 million barrels. Offshore oil exploration activities in 1988 were as shown in the text table.

Formation name	Location	Expected initial production	Annual output
Oil:			
Bozhong 28-1	Bo Hai	1989	2.6 million barrels
Bozhong 34-2/4	do.	1990	2.9 million barrels
Huizhou 21-1	Zhujiang	1990	7.1 million barrels
Huizhou 26-1	do.	1991	10.2 million barrels
Sijiang 23-4	do.	1992	10.9 million barrels
Wei 1-4	Beibu Wan	1991	8.7 million barrels
Suizhong 36-1	Liaodong Wan	1992	7.3 million barrels
Natural gas:			
Jinzhou 20-2	do.	1991	17.7 billion cubic feet

There were 9 reported oil-gas discoveries in the 25 structures where drilling operations were conducted, which were as shown in the text table.

	CNOOC-foreign	CNOOC alone	Total
Seismic lines kilometers	2,000	24,000	26,000
Drilling:			
Test wells	15	10	25
Delineation wells	6	11	17

Offshore construction continued on the infrastructure for commercial production from eight fields, which were as shown in the text table.

Formation name	Location	Contractor
Huizhou 26-1	Zhujiang Kou	ACT Group.
Lufeng 13-2	do.	JHN Co.
Wenchang 9-2	do.	Esso Co.
Xijiang 30-2	do.	Phillips International Corp. and Pecten Orient Co.
Bozhong 29-3	Bo Hai	Japan-China Petroleum Development Co.
Wei 11-4	Beibu Wan	CNOOC.
Jinzhou 9-3	Liaodong Wan	Do.
Suizhong 36-1	do.	Do.
Beigaodian	do.	Do.

Feasibility studies and exploration studies were conducted in the following oilfields and gasfields: Bozhong 34, Jinzhou 9-3, Liuhua 11-1, Lufeng 13-1, Lufeng 13-2, Lufeng 22-1, Wei 6-1, Wei 11-4 North, and Wenchang 9-2.

CNOOC signed a development agreement with Amoco Inc. of the United States for the joint development of the Ya 13-1 gasfield in Yinggehai, Beibu Wan. Additional delineation wells were to be drilled in 1989 followed by construction. Initial production was expected in 1993.

HONG KONG[3]

Hong Kong was a well-established entrepot specializing in free trade and was also an important world financial market, active in foreign exchange dealings. Hong Kong was almost entirely dependent on imported materials in order to meet the needs of its population and the requirements of its light manufacturing industries. Because of its very limited domestic resources, Hong Kong had to import virtually all of its requirements, including food, consumer and capital goods, raw materials, fuels, and even water.

Production

Mineral production in Hong Kong is limited to clays, feldspar, and granite aggregate. At the end of 1988, there was only one mining lease in operation for the extraction of feldspar and kaolin. In 1988, five contract quarries supervised by the Geotechnical Control Office (GCO) of the Civil Engineering Services Department produced 10.7 million tons of granite aggregate. During the year, the domestic construction industry consumed almost 19 million tons of aggregate, crushed rock fines, and sand of which the shortfall in supply was imported from China. GCO was investigating the adjacent seabed to locate sand and gravel deposits suitable for use as fill material for land reclamation and for use as construction aggregate.

Hong Kong's largest industry was textiles and clothing, accounting for about 42% of industrial employment. The second largest industry was electronics, followed by watches and clocks, plastics, and electrical appliances. Other light manufactures included jewelry, optical and photographic goods, and travel goods. Hong Kong's heavy industry included ma-

TABLE 4

HONG KONG: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1984	1985	1986	1987	1988[p]
Cement, hydraulic	thousand tons	1,847	1,835	2,236	2,226	2,189
Clays:						
Kaolin		70	9,602	850	—	—
Other		92,293	82,446	68,737	92,504	61,888
Feldspar		23,101	26,777	35,208	22,853	11,050
Iron and steel: Metal: Steel, crude[e]		120,000	120,000	120,000	120,000	120,000
Quartz		34	116	33	—	—

[e]Estimated. [p]Preliminary.

[1]Table includes data available through Aug. 18, 1989.

[2]In addition to the commodities listed, crude construction materials such as sand and gravel and other varieties of stone presumably are produced, but available information is inadequate to make reliable estimates of output levels.

chinery manufacture to support local industry, ship and oil rig construction, servicing and repair, and aircraft maintenance and repair.

Trade

As of January 1, 1988, Hong Kong and a number of its trading partners adopted for use a new trade classification known as the Harmonized Commodity Coding and Description System (Harmonized System). The United States was to adopt and implement the Harmonized System effective January 1, 1989.

In 1988, total exports were valued at $63.17 billion, comprised of domestic exports, $27.89 billion, and reexports, $35.28 billion. Imports were valued at $63.90 billion.[4] The markets for domestic exports by major trading countries were: the United States, $9.34 billion; China, $4.88 billion; Federal Republic of Germany, $2.06 billion; United Kingdom, $1.99 billion; Japan, $1.46 billion; Canada, $0.77 billion; Singapore, $0.67 billion; the Netherlands, $0.63 billion; France $0.54 billion; and Australia $0.53 billion. The markets for reexports by major trading countries in 1988 were, in billion dollars, as shown in the text table.

	By major country of origin	By major country of destination
China	16.84	12.16
Japan	4.83	2.23
Taiwan	2.72	1.81
United States	2.45	6.34
Korea, Republic of	1.67	1.51
Germany, Federal Republic of	.54	1.11
Switzerland	.43	—
United Kingdom	.42	.82
France	.40	—
Singapore	.35	1.11
Australia	—	.57
Macao	—	.50

The suppliers of imports by major trading countries were: China, $19.94 billion; Japan, $11.91 billion; Taiwan, $5.68 billion; United States, $5.30 billion; Republic of Korea, $3.36 billion; Singapore, $2.37 billion; Federal Republic of Germany, $1.67 billion; United Kingdom, $1.66 billion; Switzerland, $1.17 billion; and Italy, $1.03 billion.

Clothing remains the largest component of domestic exports, valued at $8.62 billion. Exports of miscellaneous manufactured articles including jewelry and gold- and silver-smiths' ware, plastic toys, and plastic articles were $3.83 billion. Exports of photographic equipment and supplies, optical goods, and watches and clocks were valued at $2.47 billion. Exports of electrical equipment mainly of household type appliances and transistors and diodes were $2.24 billion. Domestic exports of telecommunications devices such as sound recording and reproducing equipment were valued at $2.22 billion. Other important exports included textiles, representing 7% of the total value of domestic exports, and office machines and automatic data processing equipment, 6%.

Imports of consumer goods in 1988 were valued at $21.06 billion, constituting 33% of total imports. Consumer goods consisted of: clothing; radios and television sets; diamonds; toys, games, and sporting goods; watches; travel goods; and household electrical appliances. Imports of capital goods, which included electrical, transport, and textile machinery and equipment, were valued at $9.90 billion. Other imports included foodstuffs valued at $4.11 billion and mineral fuels and related materials, $1.13 billion.

Hong Kong's trade surplus with the United States decreased from $11.6 bil-

TABLE 5

HONG KONG: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987 United States	Destinations, 1987 Other (principal)
METALS				
Alkali and alkaline-earth metals	—	109	2	China 58; Republic of Korea 28.
Aluminum:				
Ore and concentrate	19,987	25,971	—	Taiwan 16,970; Republic of Korea 4,991.
Oxides and hydroxides	681	1,193	—	Taiwan 750; Indonesia 400.
Metal including alloys:				
Scrap	22,080	27,656	40	Japan 25,155; China 1,425.
Unwrought	26,085	36,181	83	Republic of Korea 7,850; Thailand 6,788; Japan 5,392.
Semimanufactures	29,531	35,479	2,299	China 20,066; Taiwan 3,792.
Arsenic: Oxides and acids	308	441	36	India 105; Indonesia 102.
Beryllium: Metal including alloys, all forms value, thousands	—	$5	$3	Philippines $2.
Chromium: Oxides and hydroxides	387	1,858	—	China 1,401; Republic of Korea 179.
Cobalt: Oxides and hydroxides	31	21	—	Taiwan 9; Republic of Korea 7.
Copper:				
Oxides and hydroxides	150	219	—	All to China.
Sulfate	72	70	—	China 64; Republic of South Africa 5.
Metal including alloys:				
Scrap	27,947	36,954	—	Japan 22,935; China 7,602; Taiwan 4,495.
Unwrought	1,630	3,792	201	Japan 1,367; Republic of Korea 787.
Semimanufactures	9,576	17,756	47	China 10,680; Taiwan 3,808.
Gold:				
Waste and sweepings value, thousands	$23,919	$19,321	$2,370	United Kingdom $8,442; West Germany $4,776.
Metal including alloys, unwrought and partly wrought thousand troy ounces	1,542	508	1	Taiwan 206; China 83; West Germany 83.
Iron and steel: Metal:				
Scrap	275,389	345,259	—	Japan 94,453; Taiwan 73,514; Republic of Korea 61,326.
Pig iron, cast iron, related materials	133	421	—	China 286; Taiwan 83.
Ferroalloys:				
Ferromanganese	496	1,540	—	All to North Korea.
Ferrosilicon	3,483	30,135	—	Republic of Korea 17,730; Japan 6,639.
Unspecified	1,662	6,524	35	North Korea 4,524; Netherlands 1,040.
Steel, primary forms	24,842	13,174	—	Taiwan 13,144.
Semimanufactures:				
Bars, rods, angles, shapes, sections	456,109	181,751	33	Chile 137,318; Macau 23,510.
Universals, plates, sheets	187,525	203,006	4	China 175,883; Macau 4,142.
Hoop and strip	14,260	28,496	2	China 23,108.
Rails and accessories	231	40	—	China 20; Malaysia 20.
Wire	13,732	20,154	10	China 18,109; Macau 578.

See footnotes at end of table.

TABLE 5—Continued

HONG KONG: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
METALS—Continued					
Iron and steel: Metal—Continued					
Semimanufactures—Continued					
Tubes, pipes, fittings		42,906	37,616	19	China 31,678; Macau 2,485.
Castings and forgings, rough		11	3	—	All to Taiwan.
Lead:					
Ore and concentrate		—	194	—	All to Netherlands.
Oxides		54	266	—	Indonesia 160; Australia 75.
Metal including alloys:					
Scrap		2,502	3,523	—	Taiwan 1,817; China 1,479; Thailand 267.
Unwrought		435	11,561	189	Republic of Korea 5,648; China 2,994.
Semimanufactures		269	106	—	China 73; Macau 12.
Magnesium: Metal including alloys:					
Scrap		52	42	—	Japan 18; Italy 12.
Unwrought		366	50	—	All to China.
Semimanufactures	value, thousands	$65	$4	—	Do.
Manganese:					
Ore and concentrate		200	725	—	Republic of Korea 500; Indonesia 125; Taiwan 100.
Oxides		1,213	1,965	—	Republic of Korea 368; Turkey 310; Ethiopia 302.
Mercury	76-pound flasks	2,719	7,035	726	Netherlands 2,742; Indonesia 887.
Molybdenum: Metal including alloys, unwrought		—	6	5	West Germany 1.
Nickel:					
Oxides and hydroxides		162	76	—	Taiwan 66; Republic of Korea 3.
Metal including alloys:					
Scrap		387	956	4	Japan 513; Taiwan 416.
Unwrought		4,865	6,227	—	Taiwan 2,065; North Korea 1,888; China 703.
Semimanufactures		376	260	—	Republic of Korea 75; Taiwan 72; China 44.
Platinum-group metals:					
Waste and sweepings	value, thousands	$4,168	$9,054	$5,169	United Kingdom $3,821.
Metals including alloys, unwrought and partly wrought	troy ounces	19,905	84,928	29,991	China 20,332; Japan 14,111.
Silver:					
Waste and sweepings	value, thousands	$22,641	$45,222	$5	West Germany $29,429; United Kingdom $9,085.
Metal including alloys, unwrought and partly wrought	thousand troy ounces	1,284	1,148	—	Thailand 392; China 367; Taiwan 223.
Tin:					
Ore and concentrate		3,709	6,912	70	Singapore 3,842; Republic of Korea 1,339.
Oxides	kilograms	—	20	—	All to China.
Metal including alloys:					
Scrap		24	155	34	United Kingdom 113.
Unwrought		1,943	2,176	877	Japan 527; Taiwan 354.
Semimanufactures		747	1,196	(2)	Taiwan 474; China 327; Singapore 249.

See footnotes at end of table.

TABLE 5—Continued

HONG KONG: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987 United States	Destinations, 1987 Other (principal)
METALS—Continued				
Titanium: Oxides	2,840	4,784	512	China 1,545; Taiwan 345.
Tungsten:				
Ore and concentrate	2,013	3,692	713	Netherlands 1,881; North Korea 855.
Metal including alloys:				
Scrap	3	7	3	Netherlands 4.
Unwrought	2	4	1	China 2.
Uranium and/or thorium: Oxides and other compounds	8	19	([2])	Japan 16.
Zinc:				
Oxides	835	763	54	Republic of South Africa 164; Taiwan 80.
Blue powder	51	154	—	All to China.
Metal including alloys:				
Scrap	33	109	—	All to China.
Unwrought	31,245	68,391	4,697	Republic of Korea 30,655; China 12,894.
Semimanufactures	223	123	—	China 111; Indonesia 6.
Other:				
Ores and concentrates	9,389	6,373	204	Republic of Korea 4,168; Taiwan 587.
Metalloids, unspecified[3]	2,215	18,033	83	Republic of Korea 5,360; Japan 3,642.
Ashes and residues	473	1,888	—	China 913; Taiwan 697; Japan 195.
Base metals including alloys, all forms	5,495	11,067	896	China 3,533; Netherlands 2,337.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	2,773	10,783	—	China 3,051; Macau 2,754; Indonesia 914.
Artificial:				
Corundum	18,117	26,258	725	Republic of Korea 9,464; Taiwan 8,823.
Silicon carbide	1,919	4,319	512	Taiwan 1,778; Republic of Korea 1,339.
Dust and powder of precious and semiprecious stones including diamond value, thousands	$592	$329	$152	Republic of Korea $150.
Grinding and polishing wheels and stones	3,213	2,671	222	Indonesia 962; China 622.
Asbestos, crude	21	36	—	All to China.
Barite and witherite	120	2,396	—	Japan 1,223; Republic of Korea 785.
Boron materials:				
Crude natural borates	—	9	—	All to Republic of Korea.
Oxides and acids	312	9,503	—	China 9,334; North Korea 95.
Bromine including fluorine	22	—		
Cement thousand tons	902	1,064	—	Macau 571; China 474.
Clays, crude:				
Kaolin	73,866	176,647	—	Taiwan 134,944; Republic of Korea 27,132.
Unspecified	46,565	8,084	—	Taiwan 5,828; Republic of Korea 958; China 706.

See footnotes at end of table.

TABLE 5—Continued

HONG KONG: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
INDUSTRIAL MINERALS—Continued					
Diamond:					
Gem, not set or strung	carats	500,091	746,988	174,706	Belgium-Luxembourg 239,382; Thailand 89,470.
Industrial stones	do.	357,939	136,678	1,272	Netherlands 74,111; China 41,120.
Diatomite and other infusorial earth		442	624	—	China 608.
Feldspar, fluorspar, related materials		50,555	77,515	—	Taiwan 63,544; Indonesia 7,198; Republic of Korea 5,042.
Fertilizer materials:					
Crude, n.e.s.		800	590	—	Taiwan 246; China 130; Indonesia 100.
Manufactured:					
Ammonia		47	108	—	China 90; Macau 11.
Nitrogenous		2,448	23,288	—	China 21,786; Philippines 1,423.
Phosphatic		—	2,622	—	Singapore 1,329; Malaysia 1,162.
Potassic		—	10	—	All to China.
Unspecified and mixed		6,488	2,862	2	China 2,337; Japan 500.
Graphite, natural		3,036	3,781	—	Republic of Korea 2,769; Taiwan 573.
Gypsum and plaster		4,709	4,960	15	Macau 3,000; China 775.
Iodine	kilograms	1,703	2,475	—	China 2,000; North Korea 475.
Lime		47	226	—	All to China.
Magnesium compounds:					
Magnesite, crude		28,167	24,343	—	Taiwan 17,630; Indonesia 4,225; Republic of Korea 700.
Oxides and hydroxides		1,311	1,295	—	Republic of South Africa 600; Republic of Korea 360; China 110.
Mica:					
Crude including splittings and waste		6	172	—	Taiwan 153; Republic of South Africa 11.
Worked including agglomerated splittings		83	270	—	China 209; Indonesia 18.
Nitrates, crude		—	495	—	Republic of South Africa 184; Australia 110; Indonesia 80.
Phosphates, crude		—	550	—	All to Malaysia.
Pigments, mineral:					
Natural, crude		970	648	—	Indonesia 255; Japan 140; Egypt 103.
Iron oxides and hydroxides, processed		3,037	4,151	15	China 1,204; Indonesia 1,122.
Precious and semiprecious stones other than diamond:					
Natural	value, thousands	$106,213	$131,937	$33,183	Japan $44,176; China $13,111.
Synthetic	do.	$705	$920	$309	Thailand $101; Republic of Korea $90.
Salt and brine		947	614	—	China 248; Papua New Guinea 232.
Sodium compounds, n.e.s.:					
Carbonate, manufactured		378,118	100,819	—	China 100,075; Vietnam 227.
Sulfate, manufactured		12,729	47,274	—	Republic of Korea 19,843; Indonesia 13,471.

See footnotes at end of table.

TABLE 5—Continued

HONG KONG: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Destinations, 1987	
				United States	Other (principal)
INDUSTRIAL MINERALS—Continued					
Stone, sand and gravel:					
Dimension stone:					
Crude and partly worked		6,380	9,056	121	Taiwan 7,433; China 595.
Worked		10,989	16,454	629	China 13,125; Macau 1,022.
Dolomite, chiefly refractory-grade		36	66	—	China 54; Indonesia 12.
Gravel and crushed rock		1,413	1,704	—	China 928; Taiwan 585.
Limestone other than dimension		1,261	2,411	—	China 2,341.
Quartz and quartzite		1,183	935	—	Taiwan 713; Bangladesh 100.
Sand other than metal-bearing		639	537	—	China 275; Macau 115; Taiwan 105.
Sulfur:					
Elemental:					
Crude including native and byproduct		5,066	112	—	Indonesia 100.
Colloidal, precipitated, sublimed		96	88	—	Indonesia 75; China 12.
Sulfuric acid		64	155	—	China 138; Indonesia 9.
Talc, steatite, soapstone, pyrophyllite		29,250	25,204	—	Indonesia 12,590; Republic of Korea 6,280; Taiwan 4,978.
Other:					
Crude		1,441	849	—	Taiwan 589; China 256.
Slag and dross, not metal-bearing		359	964	—	China 712; Singapore 150; Macau 100.
MINERAL FUELS AND RELATED MATERIALS					
Asphalt and bitumen, natural		21	3	—	All to China.
Carbon black		3,446	1,649	—	North Korea 941; China 194; Indonesia 184.
Coal: Anthracite		10	—		
Coke and semicoke		500	635	—	Indonesia 600.
Petroleum refinery products:					
Liquefied petroleum gas	thousand 42-gallon barrels	118	154	—	Macau 86; China 67.
Gasoline	do.	151	165	—	Macau 128; China 37.
Mineral jelly and wax	do.	192	160	—	Singapore 85; Republic of South Africa 17; Indonesia 12.
Kerosene and jet fuel	do.	39	64	—	China 40; Macau 23.
Distillate fuel oil	do.	2,570	1,972	—	China 1,807; Macau 161.
Lubricants	do.	266	448	—	China 267; Taiwan 101.
Nonlubricating oils	do.	29	24	—	Indonesia 14; Taiwan 5.
Residual fuel oil	do.	2,728	2,001	(2)	Macau 997; China 874.
Bitumen and other residues	do.	8	5	—	Macau 3.
Bituminous mixtures	do.	(2)	(2)	—	NA.

NA Not available.
[1] Table prepared by Audrey D. Wilkes.
[2] Less than 1/2 unit.
[3] Reported under SITC item 522.120 as "selenium, tellurium, phosphorus, arsenic, silicon and boron."

TABLE 6

HONG KONG: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987 United States	Sources, 1987 Other (principal)
METALS				
Alkali and alkaline-earth metals	—	193	—	France 72; China 67; Belgium-Luxembourg 50.
Aluminum:				
Ore and concentrate	20,526	25,815	—	China 25,758.
Oxides and hydroxides	57	943	10	China 848; Japan 54.
Metal including alloys:				
Scrap	1,301	3,072	320	China 1,735; Macau 627.
Unwrought	46,950	70,480	590	China 26,732; Canada 19,177; Australia 9,894.
Semimanufactures	58,870	70,952	7,368	Taiwan 14,460; Australia 11,396; Japan 10,880.
Arsenic: Oxides and acids	116	375	—	All from China.
Beryllium: Metal including alloys, all forms value, thousands	$2	—		
Chromium: Oxides and hydroxides	747	2,987	426	West Germany 714; China 558.
Cobalt: Oxides and hydroxides	48	20	—	China 14; United Kingdom 6.
Copper:				
Ore and concentrate	—	5	—	All from Republic of South Africa.
Oxides and hydroxides	288	331	72	West Germany 108; Italy 90.
Sulfate	373	578	39	United Kingdom 146; Thailand 126.
Metal including alloys:				
Scrap	6,784	12,731	3,403	China 6,844; Singapore 1,495.
Unwrought	2,357	9,578	1,196	China 6,714; Chile 495.
Semimanufactures	70,247	97,771	4,185	Japan 36,423; China 20,188; Taiwan 10,994.
Gold:				
Waste and sweepings value, thousands	$587	$2,338	$14	China $1,446; Malaysia $561.
Metal including alloys, unwrought and partly wrought thousand troy ounces	1,648	5,056	34	Switzerland 2,386; Australia 870; United Kingdom 742.
Iron and steel: Metal:				
Scrap	33,669	43,600	2,406	China 35,433; Japan 2,602.
Pig iron, cast iron, related materials	4,316	7,523	165	China 6,022; North Korea 959.
Ferroalloys:				
Ferromanganese	1,998	2,442	—	Republic of South Africa 735; Netherlands 515; Norway 512.
Ferrosilicon	4,677	34,911	—	China 34,093.
Unspecified	3,220	7,770	1	Republic of South Africa 3,698; China 2,930.
Steel, primary forms	173,778	127,032	—	Republic of South Africa 58,948; Venezuela 39,600.
Semimanufactures:				
Bars, rods, angles, shapes, sections	1,533,955	1,321,524	101	Republic of South Africa 263,592; China 173,616; Japan 148,629.
Universals, plates, sheets	597,622	766,848	41,947	Japan 399,162; Republic of South Africa 64,516.
Hoop and strip	45,121	72,083	1,868	Japan 56,396; United Kingdom 2,631; France 2,618.
Rails and accessories[2]	3,633	5,419	—	United Kingdom 4,021; Belgium-Luxembourg 1,349.

See footnotes at end of table.

TABLE 6—Continued

HONG KONG: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS—Continued				
Iron and steel: Metal—Continued				
Semimanufactures—Continued				
Wire	57,319	69,180	176	China 29,938; Republic of Korea 13,627; Japan 12,431.
Tubes, pipes, fittings	205,374	205,322	355	Japan 58,433; China 45,907; Republic of South Africa 34,700.
Castings and forgings, rough	965	566	1	Taiwan 455; China 82.
Lead:				
Ore and concentrate	—	512	—	All from China.
Oxides	168	334	4	China 302.
Metal including alloys:				
Scrap	681	524	23	Singapore 244; China 80; Macau 78.
Unwrought	5,071	12,006	7	China 10,844; Malaysia 410.
Semimanufactures	213	295	—	Republic of South Africa 131; China 100.
Magnesium: Metal including alloys:				
Unwrought	396	112	39	France 51; China 12.
Semimanufactures value, thousands	$54	$7	$1	China $4.
Manganese:				
Ore and concentrate	341	665	—	All from China.
Oxides	1,455	2,297	—	China 1,875; Japan 336.
Mercury 76-pound flasks	3,586	7,367	—	China 7,358.
Molybdenum: Metal including alloys, all forms	([3])	[4]6	—	Mainly from China.
Nickel:				
Oxides and hydroxides	199	40	—	Canada 24; Australia 11.
Metal including alloys:				
Scrap	—	456	57	Taiwan 329.
Unwrought	7,053	6,220	59	Norway 2,241; Australia 1,509; Canada 904.
Semimanufactures	327	230	22	Norway 96; Australia 17.
Platinum-group metals:				
Waste and sweepings value, thousands	$8	$1,576	—	Republic of Korea $1,549.
Metals including alloys, unwrought and partly wrought troy ounces	18,895	54,129	1	United Kingdom 24,114; Republic of South Africa 16,397.
Silver:				
Waste and sweepings value, thousands	$39	$551	—	Philippines $304; West Germany $116.
Metal including alloys, unwrought and partly wrought thousand troy ounces	1,904	1,972	50	Australia 604; West Germany 494; United Kingdom 342.
Tin:				
Ore and concentrate	1,755	7,985	—	All from China.
Metal including alloys:				
Scrap	35	25	—	Malaysia 15; China 10.
Unwrought	3,568	4,655	11	China 4,310; Singapore 161.
Semimanufactures	634	835	4	China 363; Singapore 222; Japan 138.

See footnotes at end of table.

TABLE 6—Continued

HONG KONG: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS—Continued				
Titanium: Oxides	8,283	11,308	853	China 3,792; Australia 2,181.
Tungsten:				
Ore and concentrate	3,626	1,278	—	China 1,082; Singapore 196.
Metal including alloys:				
Scrap	1	3	([3])	Mainly from China.
Semimanufactures	7	9	1	China 5; Japan 2.
Uranium and thorium: Oxides and other compounds	22	43	([3])	France 26; China 10.
Zinc:				
Oxides	1,171	1,324	8	China 928; France 242.
Blue powder	17	187	—	Republic of Korea 102; Norway 70.
Metal including alloys:				
Scrap	539	599	21	Macau 380; China 158.
Unwrought	70,262	95,652	175	China 61,148; Australia 14,616; Belgium-Luxembourg 8,713.
Semimanufactures	710	714	—	West Germany 285; Belgium-Luxembourg 135; United Kingdom 94.
Other:				
Ores and concentrates	8,301	4,925	—	China 4,835.
Metalloids, unspecified[5]	2,597	19,718	14	China 19,497.
Ashes and residues	5,914	7,153	231	China 5,816; Singapore 712.
Base metals including alloys, all forms	7,026	12,998	2,883	China 8,792.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	27,672	60,956	254	Indonesia 44,630; China 10,306; Japan 3,859.
Artificial:				
Corundum	18,710	27,084	292	China 25,717; Japan 635.
Silicon carbide	1,765	4,040	—	China 4,000.
Dust and powder of precious and semiprecious stones including diamond value, thousands	$97	$81	$14	United Kingdom $30; Belgium-Luxembourg $12.
Grinding and polishing wheels and stones	4,062	3,991	148	China 1,908; Japan 960.
Asbestos, crude	82	78	—	China 35; Zimbabwe 30.
Barite and witherite	425	3,060	—	China 2,908; Thailand 72.
Boron materials:				
Crude natural borates	—	18	—	All from Turkey.
Oxides and acids	559	12,494	11,864	China 593.
Bromine including fluorine	44	5	—	Japan 4.
Cement thousand tons	4,131	4,453	—	Japan 1,688; Republic of Korea 1,242; Taiwan 1,163.

See footnotes at end of table.

TABLE 6—Continued

HONG KONG: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987 United States	Sources, 1987 Other (principal)
INDUSTRIAL MINERALS—Continued					
Clays, crude:					
Kaolin		82,336	197,422	737	China 173,421; Macau 21,800.
Unspecified		61,958	19,611	1,115	China 15,086; France 2,816.
Cryolite and chiolite		5	2	—	All from Denmark.
Diamond:					
Gem, not set or strung	thousand carats	2,091	2,573	195	India 1,061; Israel 692.
Industrial stones	do.	427	356	16	Netherlands 142; United Kingdom 132.
Diatomite and other infusorial earth		984	1,227	1,221	China 6.
Feldspar, fluorspar, related materials		37,396	69,976	—	All from China.
Fertilizer materials:					
Crude, n.e.s.		812	1,989	—	China 822; Netherlands 433; Canada 430.
Manufactured:					
Ammonia		2,045	2,493	1	China 2,395.
Nitrogenous		6,735	29,375	44	U.S.S.R. 21,466; China 2,817.
Phosphatic		—	1,560	—	All from China.
Unspecified and mixed		14,265	10,476	55	West Germany 8,800; China 501; Taiwan 436.
Graphite, natural		3,685	4,104	—	China 4,101.
Gypsum and plaster		110,865	152,552	292	Thailand 93,086; Japan 25,115.
Iodine	kilograms	1,500	2,426	1,350	United Kingdom 556.
Lime		44,588	43,893	—	China 43,865.
Magnesium compounds:					
Magnesite, crude		29,791	26,891	—	All from China.
Oxides and hydroxides		1,710	1,431	—	Japan 1,105; China 310.
Mica:					
Crude including splittings and waste		48	57	—	India 24; United Kingdom 24.
Worked including agglomerated splittings		1,022	1,408	2	Belgium-Luxembourg 585; Japan 444.
Nitrates, crude		—	1,420	96	China 1,149.
Phosphates, crude		—	350	—	All from China.
Pigments, mineral:					
Natural, crude		940	523	—	China 514.
Iron oxides and hydroxides, processed		5,288	6,587	1,050	China 3,166; Japan 988.
Precious and semiprecious stones other than diamond:					
Natural	value, thousands	$77,271	$122,615	$14,521	Thailand $37,324; India $13,164; Japan $9,755.
Synthetic	do.	$2,699	$2,276	$524	West Germany $414; Switzerland $314.
Salt and brine		130,537	129,938	10	China 118,469; West Germany 4,909.
Sodium compounds, n.e.s.:					
Carbonate, manufactured		414,020	189,064	144,470	East Germany 17,327; West Germany 9,826.
Sulfate, manufactured		45,878	78,682	5	China 76,708; Taiwan 1,920.

See footnotes at end of table.

TABLE 6—Continued

HONG KONG: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
INDUSTRIAL MINERALS—Continued				
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked	13,644	15,721	—	China 13,886; Taiwan 1,346.
Worked	35,084	58,191	7	Italy 38,441; China 8,425; Spain 5,361.
Dolomite, chiefly refractory-grade	201	136	—	United Kingdom 82; Norway 54.
Gravel and crushed rock thousand tons	4,849	6,520	(3)	China 6,461.
Limestone other than dimension	38,448	32,744	30	China 32,118.
Quartz and quartzite	8,243	2,698	—	China 2,493; Belgium-Luxembourg 167.
Sand other than metal-bearing thousand tons	1,273	1,261	(3)	China 1,259.
Sulfur:				
Elemental:				
Crude including native and byproduct	5,342	294	10	China 140; Thailand 72; West Germany 54.
Colloidal, precipitated, sublimed	294	434	—	Republic of Korea 270; China 76; West Germany 76.
Dioxide	19	—		
Sulfuric acid	6,613	7,505	40	China 7,324.
Talc, steatite, soapstone, pyrophyllite	32,707	30,312	289	China 29,404; Norway 301.
Other:				
Crude	6,997	3,185	673	China 1,973; Republic of South Africa 396.
Slag and dross, not metal-bearing	1,116	412	—	China 266; Thailand 138.
MINERAL FUELS AND RELATED MATERIALS				
Asphalt and bitumen, natural	59	50	35	United Kingdom 15.
Carbon black	3,281	2,376	146	China 1,455; Republic of Korea 200.
Coal: Anthracite and bituminous thousand tons	6,393	8,010	—	Australia 2,972; Republic of South Africa 2,559; China 1,963.
Coke and semicoke	3,860	3,544	—	China 2,520; Japan 698.
Petroleum refinery products:				
Liquefied petroleum gas thousand 42-gallon barrels	1,995	2,056	(3)	Singapore 1,027; Philippines 727.
Gasoline:				
Aviation do.	1	2	—	All from Australia.
Motor do.	1,701	1,839	—	Singapore 1,246; China 360.
Naphtha including white spirit do.	2,133	2,199	107	Singapore 2,062.
Mineral jelly and wax do.	266	239	4	China 223; Japan 10.
Kerosene and jet fuel do.	9,522	10,017	56	Singapore 8,151; China 1,393.
Distillate fuel oil do.	13,805	12,914	45	Singapore 7,556; China 3,990.
Lubricants do.	607	782	85	Singapore 284; China 175; Japan 68.
Nonlubricating oils do.	54	56	1	China 49.
Residual fuel oil do.	17,296	14,431	—	Singapore 10,425; China 1,449; Taiwan 909.
Bitumen and other residues do.	212	258	—	Taiwan 115; Singapore 107.
Bituminous mixtures do.	5	2	(3)	Japan 1.

[1] Table prepared by Audrey D. Wilkes.
[2] Excludes unreported quantities valued at $186,400 in 1986 and $972,000 in 1987.
[3] Less than 1/2 unit.
[4] Excludes unreported quantity valued at $18,000.
[5] Reported under SITC item 522.120 as "selenium, tellurium, phosphorus, arsenic, silicon and boron."

lion in 1987 to $8.2 billion in 1988. To help reduce its growing trade deficit, the U.S. Senate and the U.S. House of Representatives passed the Omnibus Trade and Competitiveness Act of 1988, which was signed into law by the President on August 23, 1988. In addition, Hong Kong, as well as the Republic of Korea, Singapore, and Taiwan were to be removed from the list of countries eligible for duty-free treatment under the U.S. Generalized System of Preferences as of January 2, 1989. About 16% of Hong Kong's exports to the United States benefited from the tariff preferences provided under this scheme.

MONGOLIA[5]

Mongolia was one of the world's leading producers of fluorspar, a significant producer and exporter of copper and molybdenum concentrate, and was becoming an important producer and exporter of tungsten concentrate in the centrally planned economy countries. Other minerals produced in Mongolia included gold, silver, tin, and zinc for export; and clay, coal, gypsum, limestone, salt, and construction materials for domestic consumption. Domestic requirements for petroleum products, iron and steel, nonferrous metals products, and fertilizer materials were met by imports, principally from the U.S.S.R. Mongolia also imported considerable amounts of cement and coal from the U.S.S.R. to meet the growing demand by the electrical power and construction industries.

In 1988, industrial output reportedly increased 5%, and the national income grew 4.3%. Mongolia's gross domestic product (GDP) was estimated at $1.9 billion,[6] and the output of the mining industry was estimated to contribute 19% to Mongolia's GDP. Production of copper, molybdenum, and tungsten reportedly continued to increase because of increased exports of metallic minerals to the U.S.S.R. and Eastern European members of the Council of Mutual Economic Assistance (CMEA). Production of coal, copper, fluorspar, molybdenum, and tungsten jointly accounted for 95% of the Mongolian minerals output. Exports of these minerals except coal, all in the form of ore and/or concentrate, accounted for 45% of Mongolia's exports in 1988.

According to the latest Government statistics, because of increased exports, Mongolia's trade deficit improved slightly to $334.1 million from $344.5 million in 1987. In 1988, exports increased 3.9% to $659.5 million and imports rose 1.5% to $993.6 million. Mongolia's two-way trade with CMEA countries declined slightly to $1,552.9 million, of which the U.S.S.R. accounted for 87%. However, two-way trade with the market economy countries surged 46% to $55 million, of which Japan and Switzerland accounted for 43% and 19%, respectively. Two-way trade with other centrally planned countries, including China, Laos, North Korea, and Yugoslavia, rose 10% to $44 million, of which China accounted for 44%.

In October, an agreement was signed between Mongolia and Poland for cooperation in exploration for minerals in the Gobi Desert. In November, the Ministry of Power, Mining Industry, and Geology of Mongolia and the Ministry of Geology of the U.S.S.R. reportedly formed the fourth joint geological survey of precious metals in the Tuyun Gol River Valley of the Dzaamar region. The joint expedition was financed equally by the two countries. As a result of the continuing joint Soviet-Mongolian geological expedition, a rich silver deposit reportedly was discovered in northwestern Mongolia near the Soviet border in 1988.

Commodity Review

Metals.—Production of copper and molybdenum by the Mongolian-Soviet Erdenet Mining and Concentrating Works from the Erdenet Mine in northern Mongolia continued to exceed its full capacity of 16 million tons per year since 1986.[7] About 95% of the concentrate was exported to the Urals region of the U.S.S.R. for smelting. The fifth-phase construction for expansion of ore production capacity to 20 million tons per year was undertaken by Mongolenergostroi, a Soviet construction company. Further expansion of capacity to 32 million tons per year by the year 2000 was planned. For the first time since Erdenet went into operation in 1979, Outokumpu Oy of Finland was involved in negotiation with Erdenet on a barter trade agreement. This agreement was to introduce new equipment and technology in order to upgrade and modernize Erdenet's treatment plant. In return, Outokumpu would receive from Erdenet 20,000 tons per year of copper concentrate for 10 years or 40,000 tons per year for 5 years.[8]

According to the Government of Mongolia, a significant copper and molybdenum deposit had been discovered in the early 1970's at Tsagaan-suvarga in Dornogovi Province of the eastern Gobi Desert. The deposit is 170 kilometers southwest of the railway station at Zuun-Bayan, 220 kilometers southwest of Saynshand, and 550 kilometers south of Ulaanbaatar. Ore reserves were estimated in 1982 to be 240 million tons. The deposit was estimated to have an average content of 0.53% copper and 0.018% molybdenum plus 0.084 gram of gold per ton, 0.39 gram of rhenium per ton, 8.3 grams of selenium per ton, 2.63 grams of silver per ton, and 12.8 grams of tellurium per ton. The copper ore reportedly contained little pyrite and could be concentrated easily.[9]

Tin was produced mainly from the open pit at Modoto in the Hentiy Province and as a byproduct of tungsten mining. Since 1974, tungsten had been produced mainly from the Burensogt Mine in Suhbaatar. In recent years, two small tungsten mines reportedly were

TABLE 7

MONGOLIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1984	1985	1986	1987	1988[p]
Cement, hydraulic	thousand tons	141	151	[e]200	[e]200	[e]200
Coal:						
Anthracite and bituminous	do.	458	480	[e]500	[e]500	[e]500
Lignite and brown	do.	4,973	6,038	[e]6,200	[e]6,300	[e]6,500
Total	**do.**	**5,431**	**6,518**	**[e]6,700**	**[e]6,800**	**[e]7,000**
Copper, mine output, Cu content[e]		118,000	128,000	136,000	[r]140,000	160,000
Fluorspar, all grades	thousand tons	747	787	[e]790	[e]800	[e]800
Gypsum[e]	do.	32	32	32	32	32
Lime, hydrated and quicklime[e]	do.	95	95	95	95	95
Molybdenum, mine output, Mo content[e]		1,000	1,000	1,100	1,100	1,100
Petroleum refinery products:[e]						
Kerosene	thousand 42-gallon barrels	23	23	23	23	23
Residual fuel oil	do.	20	20	20	20	20
Salt[e]		16,000	16,000	16,000	16,000	16,000
Tin, mine output, Sn content[e]		1,000	1,000	1,000	1,000	1,200
Tungsten, mine output, W content[e]		1,500	1,500	1,500	1,500	2,000

[e]Estimated. [p]Preliminary. [r]Revised.
[1]Table includes data available through Aug. 18, 1989.
[2]In addition to the commodities listed, crude construction materials such as sand and gravel and varieties of stone presumably are produced, but available information is inadequate to make reliable estimates of output levels.

developed and expanded at Kyzyltay and Kobdogol. In September, another tungsten mine was opened at Tsagaan-davaa, about 60 kilometers from Ulaanbaatar.

The Tsagaan-davaa Mine was developed by Wolframvest, a Hungarian company, under a bilateral agreement signed in 1984 between Mongolia and Hungary. The Wolframvest is a joint venture of the Central Development Institute for Mining of Budapest, the Mecsek Ores Mines of Pecs, and the Metal Alloys Factory of Salgotarjan. Construction of the mine and the concentrator took 3 years to complete and cost about $5.4 million. The Tsagaan-davaa tungsten mining and milling facilities were capable of processing 36,000 tons per year of ore and producing 3,000 tons per year of concentrate. The operation was expected to reach full capacity in spring 1989. Tungsten contained in concentrate was between

TABLE 8

MONGOLIA: APPARENT EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987[p]	Principal destinations, 1987
Aluminum: Metal including alloys, scrap		195	—	
Cement[2]		13,300	21,700	NA.
Chromium: Oxides and hydroxides		3	—	
Copper:				
Ore and concentrate		7,338	10,314	All to Finland.
Sulfate		17	—	
Graphite, natural		18	—	
Iron and steel: Metal: Semimanufactures:				
Universals, plates, sheets		92	25	All to Pakistan.
Mercury	76-pound flasks	—	406	Do.

[p]Preliminary. NA Not available.
[1]Table prepared by Audrey D. Wilkes. Owing to a lack of official trade data published by Mongolia, this table should not be taken as a complete presentation of this country's mineral exports. Unless otherwise specified, these data have been compiled from United Nations information and data published by the partner trade countries. The United States did not report any imports of mineral commodities from Mongolia in 1987.
[2]Statistical Yearbook of Members of the Council for Mutual Economic Assistance, Moscow, U.S.S.R.

60% and 65%. Under the agreement, 88% of the annual output would be exported to Hungary. As part of the mine development, a water supply and sewage system was also completed by the Hungarian company in 1988.[10]

According to a Soviet source,[11] two tin-tungsten deposits had been identified at Bayn-mod and Elstuin. They were reported to average between 300 grams and 800 grams of tin and between 60 grams and 650 grams of tungsten trioxide per cubic meter. Gold and zinc produced in north-central Mongolia were delivered for processing by the Yoroo Mining Enterprise in Selenge Province. A lead-zinc deposit was identified at Tumertyn-obo in Suhbaatar Province.

Industrial Minerals.—Production of metallurgical-grade fluorspar reportedly reached a peak in 1985-86 and began to level off in 1987-88. Mongolia continued to export almost all of the fluorspar production to the U.S.S.R. for consumption by the Soviet iron and steel industry. Production of fluorspar was by the Mongolian-Soviet joint enterprise, Mongolsovtsvetmet, from three underground mines at Berh and Dehgehrkhan in Hentiy Province and at Bor-ondor in Dornogovi Province as well as from three open pits at Har-Ayrag in Dornogovi Province, Chulutt-sagandel in Tov Province, and Dzunt-sagaandel in Hentiy Province. Proven reserves of fluorspar in Mongolia were estimated at 22 million tons and averaged between 35% and 45% CaF_2.[12]

Development of the Urandosh phosphorite deposit along the western shores of Hovsgol Lake in northern Mongolia, reportedly, has been postponed because of environmental concerns. However, the Government planned to develop another significant phosphorite deposit about 100 kilometers from Hovsgol Lake in the Burenhaan Valley area. Ore reserves at the Burenhaan deposit were estimated at 400 million tons, averaging 20% P_2O_5 in 1970.[13]

TABLE 9

MONGOLIA: APPARENT IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987[p]	Principal sources, 1987
Abrasives, n.e.s.: Grinding and polishing wheels and stones	4	[2]7	Italy 6; United Kingdom 1.
Aluminum: Metal including alloys, all forms	1	2	All from Italy.
Cement[3]	48,900	46,900	NA.
Coal: Anthracite and bituminous[3]	—	70,000	NA.
Copper: Metal including alloys, semimanufactures	—	([4])	All from Austria.
Fertilizer materials: Manufactured:			
Nitrogenous[3]	14,000	14,100	NA.
Phosphatic (P_2O_5 content)[3]	19,000	18,300	NA.
Gypsum and plaster	—	2	All from Italy.
Iron and steel: Metal: Semimanufactures:[2]			
Tubes, pipes, fittings	11,500	11,000	NA.
Unspecified	74,400	67,400	NA.
Petroleum refinery products[3] thousand 42-gallon barrels	6,077	6,483	NA.
Sodium compounds, n.e.s.: Carbonate, natural and manufactured[3]	1,700	2,400	NA.
Sulfur: Sulfuric acid[3]	1,400	1,400	NA.

[p] Preliminary. NA Not available.

[1] Table prepared by Audrey D. Wilkes. Owing to a lack of official trade data published by Mongolia, this table should not be taken as a complete presentation of this country's mineral imports. Unless otherwise specified, these data have been compiled from United Nations information and data published by the partner trade countries. The United States did not report any exports of mineral commodities to Mongolia during 1987.

[2] Excludes unreported quantity valued at $1,000 exported by Japan.

[3] Statistical Yearbook of Members of the Council for Mutual Economic Assistance, Moscow, U.S.S.R.

[4] Less than 1/2 unit.

Other industrial minerals produced in Mongolia included construction aggregate, cement, refractory clay, gypsum, salt, and volcanic slag. Despite active construction, cement production reportedly dropped in 1988 because of new environmental regulations imposed by the Government.

TAIWAN[14]

In terms of current dollars, Taiwan's GNP grew from $99.3 billion in 1987 to $119.9 billion in 1988.[15] In constant 1981 prices, the GNP in 1988 was $107.4 billion, representing a real growth of 7.3%. Based on a population of 19.9 million, the per capita GNP increased 19.2% to $6,022, the fourth highest in Asia after Japan, Hong Kong, and Singapore. The labor force totaled 8.1 million, composed of 5.0 million males and 3.1 million females. The unemployment rate was 1.6%, down from 1.9% in the previous year. Employment in the mining and quarrying sector decreased to 27,000, compared with 2.7 million for manufacturing, 1.5 million for commerce, 1.3 million for public administration and social services, and 1.1 million for agriculture. The value of output by the mining and quarrying sector was only 0.5% of the net domestic product

(NDP), dwarfed by the input of Taiwan's manufacturing industries of 38.1%. The input to the country's NDP by sector, in million current dollars, was as follows:

Sector	1986	1987	1988
Manufacturing	22,636	30,654	35,320
Commerce	8,783	11,772	14,508
Government services	6,638	8,512	10,477
Financial services	6,223	8,430	10,396
Agriculture	3,779	4,902	5,660
Social services	3,156	4,199	5,200
Transportation	3,180	4,211	5,135
Construction	2,626	3,579	4,578
Utilities	1,692	2,352	2,389
Mining and quarrying	314	408	484
Other	3,283	3,987	3,420
Total	**62,310**	**83,006**	**97,567**

Taiwan has a very weak minerals resource base. The value of the output of the mining sector is insignificant by world standards, and limited to small quantities of various, low-unit-value industrial minerals, mostly limestone, marble, and dolomite. The value of the mining sector is inflated by the small amount of coal and natural gas and associated condensate domestically produced. These minerals represented only 4.6% of Taiwan's total supply of energy, equivalent to a 17-day energy supply. Data on the mining sector were as follows:

	1986	1987	1988
Average annual employment	32,000	30,000	27,000
Average monthly working hours	179	180	178
Average monthly earnings dollars	459	563	686

Taiwan is a prominent member of the world's trading community. Its commerce is well served by a highly developed transportation infrastructure for both domestic and foreign receipts and discharges. Data on Taiwan's freight movement were as follows, in thousand-ton-kilometers:

	1986	1987	1988
Air:			
Domestic	2,352	2,787	3,072
International	2,535,145	2,941,783	3,215,428
Total	**2,537,497**	**2,944,571**	**3,218,500**
Highway	9,359,410	10,586,420	11,340,330
Railway:			
East Line	277,202	334,457	65,429
West Line	1,988,271	2,064,635	2,112,769
Other	99,987	91,122	99,845
Total	**2,365,460**	**2,490,214**	**2,278,043**

Kaohsiung, Taiwan's largest port, accounted for 57% of the country's harbor freight traffic. Harbor freight movement was as follows, in thousand tons:

	1986	1987	1989
Loading			
International:			
Kaohsiung	8,000	8,612	8,868
Keelung	4,569	5,449	5,012
Hualien	1,909	2,022	2,291
Taichung and Su-Ao	1,822	2,003	2,526
Domestic:			
Kaohsiung	3,969	4,363	5,034
Keelung	131	127	127
Hualien	1,312	1,034	1,381
Taichung and Su-Ao	139	48	126
Unloading			
International:			
Kaohsiung	47,616	54,480	63,851
Keelung	9,314	11,870	14,018
Hualien	872	1,014	1,381
Taichung and Su-Ao	7,963	9,892	11,085
Other	5,016	5,758	6,451
Domestic:			
Kaohsiung	1,140	915	1,034
Keelung	2,403	2,066	2,823
Hualien	378	358	260
Taichung and Su-Ao	1,529	1,751	2,203

Aside from containerized shipments, which were the largest single class, other bulk freight loaded and discharged included cement, fertilizers, iron and steel, machinery and metal parts, mineral ores, and vehicles and vehicular parts.

The United States was Taiwan's largest trading partner, its largest export market, and its second largest import supplier. Shipments to the United States were valued at $26.4 billion, accounting for 44% of total exports. Imports from the United States were valued at $8.5 billion, representing 22% of total receipts. The Government of Taiwan drafted a Trade Action Plan to reduce the country's large surplus with the United States. Proposals in the plan include tariff reductions and removal of nontariff barriers. Taiwan imported 190,119 kilograms of gold bullion from the United States, valued at $2.8 billion. The U.S. Government views the purchase of gold bullion as nonmerchandise trade. Hence, exclusion of the bullion purchase from the total U.S. shipments exacerbate Taiwan's large trade surplus with the United States.

Negotiations on a copyright agreement between the United States and Taiwan began in 1987. The remaining disputed issues of the agreement were expected to be resolved in 1989. A bilateral patent and trademark agreement also was under consideration. Significant legal and enforcement problems exist in

Taiwan, despite the Government's willingness to improve the protection of intellectual property rights.

Production

Because Taiwan has a very weak mineral resource base, the value of the output of the mining sector was only $464.8 million or 0.4% of the country's GNP. By value, the most important mine output was natural gas, followed by coal. The domestic output of mineral fuels was significant only in that it provided close to 5% of the nation's supply of energy. Mine production of metal ore, which was for copper, ended early in the decade. In terms of tonnage and value, the output of carbonate minerals, followed by clays, dominated the remainder of the output of the domestic mining industry. The value of Taiwan's mine output was as follows, in thousand dollars, in decreasing order:

Natural gas	248,764
Coal	108,689
Limestone	37,288
Marble	29,839
Kaolin	19,554
Dolomite	6,440
Serpentine	6,104
Salt	4,721
Fire clay	2,948
Feldspar	449
Total	**464,796**

At yearend 1987, the prospecting and mining rights registered with the Taiwan Provincial Bureau of Mines were as follows, by number of claims and area, in hectares:

	Prospecting		Mining	
	Claim	Area	Claim	Area
Chiayi County	—	—	1	75
Hsinchu County	2	116	1	117
Hualien County	23	2,772	5	271
Ilan County	2	252	2	965
Kaohsiung County	—	—	3	81
Kaohsiung Municipality	—	—	2	16
Miaoli County	2	71	4	179
Nantou County	1	29	1	83
Tainan County	—	—	2	277
Taipei County	2	141	1	30
Taitung County	12	1,023	3	211
Total	**44**	**4,404**	**23**	**2,305**

There are no mining claims in the counties of Taoyuan, Taichung, Pingtung, and Penghu, in Keelung City, and Taipei Municipality. By kind of minerals, there was mining-right registration for gold, quartz crystal, clays, carbonate minerals, coal, natural gas, gem stones, and geothermal steam. All of the registrations for prospecting and mining rights were to private parties.

The large mineral- and metal-producing companies in Taiwan are state-owned enterprises. These included China Petrochemical Development Corp., China Steel Corp., Chinese Petroleum Corp., Kaohsiung Ammonium Sulfate Corp. Ltd., Taiwan Aluminium Corp., Taiwan Cement Corp., Taiwan Fertilizer Corp., Taiwan Metal Mining Corp., Taiwan Salt Works, and Tang Eng Iron Works Co. Ltd.

The quantity and value of domestic shipments of selected mining and manufacturing products were as follows, in metric tons and thousand dollars except as otherwise indicated:

Trade

The value of Taiwan's total trade increased to $110.37 billion. Exports were valued at $60.56 billion and imports at $49.81 billion, resulting in a trade surplus of $10.75 billion. The largest export destination was the United States with shipments valued at $23.42 billion, followed by Japan, $8.76 billion; Hong Kong, $5.58 billion; the Federal Republic of Germany, $2.34 billion; the United Kingdom, $1.90 billion; Singapore, $1.68 billion; Canada, $1.58 billion; the Netherlands, $1.51 billion; Australia, $1.36 billion; and France, $0.94 billion. These countries collectively accounted for 81% of the total value of shipments from Taiwan. The largest supplier of Taiwan's imports was Japan, with receipts valued at $14.87 billion, followed by the United States, $13.04 billion; the Federal Republic of Germany, $2.14 billion; Hong Kong, $1.93 billion; Australia, $1.34 billion; Saudi Arabia, $1.24 billion; Switzerland, $1.03 billion; and Canada, $0.96 billion. These countries collectively accounted for 73% of Taiwan's total receipts.

The largest export class was machinery and transportation equipment valued at $22.33 billion or 36.8% of the value of total shipments, followed by textile, apparel, and related goods, valued at $10.83 billion, comprising 17.8% of total exports. The minerals and metals export categories included metal products, valued at $3.49 billion;

		Quantity	Value
Metals:			
Aluminum, sheet		12,027	38,722
Copper, electrolytic		34,446	90,284
Gold	troy ounces	31,674	16,285
Iron and steel:			
Pig iron[1]		20,550	3,295
Ferroalloys:			
Feromanganese		25,223	13,925
Ferrosilicon		23,756	27,518
Ferrosilicomanganese		28,908	16,947
Other		4,241	6,208

		Quantity	Value
Metals—Continued			
Iron and steel—Continued			
Steel ingot[1]		828,550	218,599
Silver	troy ounces	435,408	5,284
Industrial minerals:			
Cement		14,236,487	1,086,877
Clays:			
Fire clay		50,241	1,229
Kaolin		78,038	2,076
Dolomite		418,347	6,026
Feldspar		17,469	934
Fertilizer materials:			
Ammonia, anhydrous		74,635	20,882
Ammonium sulfate		426,284	77,493
Calcium superphosphate		273,780	24,240
Nitrochalk		16,529	2,370
Urea		268,480	46,141
Other		463,146	96,495
Limestone		794,075	2,195
Marble:			
Crude		2,381,576	6,408
Dimension	cubic meters	149,541	10,088
Salt:			
Crude		15,617	662
Refined		228,583	40,371
Serpentine		326,529	6,082
Sulfur		88,997	8,813
Fuels and related materials:			
Carbon black		55,007	30,823
Coal		1,227,620	108,897
Natural gas	thousand cubic meters	1,099,809	236,394

[1] Excludes China Steel Corp.

base metals, \$1.31 billion; chemicals, \$1.59 billion; chemical products, \$860 million; glass products, \$33 million; and cement, \$10 million. Altogether, these commodities accounted for 12.6% of the total value of exports. Imports of machinery and transportation equipment were valued at \$16.53 billion, or 33.1%, of total receipts. Mineral-related imports included base metals, valued at \$10.45 billion; metal products, \$36 million; chemicals, \$4.93 billion; chemical products, \$2.32 billion; industrial mineral products, \$31 million; and mineral ores, \$30 million. These receipts accounted for 37.4% of total imports. Imports of fuels were coal, valued at \$85 million, and crude oil, \$2.22 billion.

Commodity Review

Metals.—There were no domestic mining operations for metal-bearing ores in Taiwan. The country's only primary metals industry is limited to copper and iron and steel, both of which utilize imported ore.

Aluminum.—Primary aluminum metal production by Taiwan Aluminium Corp. (Talco), a state-owned enterprise, ceased in 1982. The Government transferred Talco to the state-owned Taiwan Power Co. (Taipower), which continued Talco's rolling operations to produce sheet and foil from imported ingot. Imports of unwrought aluminum totaled 136,553 tons. The principal suppliers were Australia, 67,192 tons; Canada, 14,745 tons; New Zealand, 11,318 tons; and the Republic of South Africa, 10,295 tons. U.S. shipments to Taiwan were 7,508 tons, valued at \$17.3 million. Imports of unwrought aluminum alloys were 56,851 tons, supplied principally by the United Arab Emirates, the Republic of South Africa, the United States, Australia, Bahrain, Canada, and New Zealand, in that order. U.S. shipments to Taiwan were 6,979 tons, valued at \$17.4 million.

Copper.—Taiwan Metal Mining Corp. (TMMC), a state-owned enterprise, had its 50,000-ton-per-year copper smelter-refinery at Juifang. Because of the insolvency of the operation, the facilities were transferred to Taipower in 1987, which was to continue the production of copper and byproduct gold and silver for the next 10 years. Taiwan imported 118,023 tons of copper concentrate, primarily from Canada, accounting for 62,292 tons, and the Philippines, 22,817 tons. The remainder of the imports was from Chile, Mexico, India, and Turkey, in that order.

Iron and Steel.—China Steel Corp. (CSC), a state-owned enterprise, operated the country's only integrated iron and steel complex at Kaohsiung. CSC's annual production capacity of crude steel was 5.65 million tons. Tang Eng Iron Works, Ltd. (Tang Eng) a state-owned enterprise, specialized in stainless steel production. Taiwan Nickel Refinery Co. (TaiNickel) supplies Tang Eng with nickel metal for stainless steel production. Prior to CSC's existence, Taiwan's steel industry was composed

TABLE 10

TAIWAN: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987	1988[p]
METALS						
Copper: Metal, refined		48,436	46,734	50,439	46,961	43,333
Gold, primary	troy ounces	37,794	30,633	29,270	17,152	7,584
Iron and steel: Metal:						
Pig iron	thousand tons	3,360	3,429	3,740	[e]3,900	5,675
Ferroalloys:						
Ferromanganese		19,803	18,508	20,040	17,026	25,744
Ferrosilicomanganese		23,082	22,688	20,933	18,944	20,420
Ferrosilicon		23,714	17,272	14,007	7,058	10,527
Steel, crude	thousand tons	5,224	5,326	5,679	5,949	8,313
Lead, refinery, secondary[e]		44,300	[r]48,700	[r]53,500	64,400	66,000
Nickel, refined		1,100	2,100	8,500	8,200	8,200
Silver, primary	troy ounces	364,274	366,078	405,521	315,382	268,416
INDUSTRIAL MINERALS						
Asbestos		1,355	625	—	—	—
Cement, hydraulic	thousand tons	14,234	14,418	14,806	15,663	17,281
Clays:						
Fire clay		52,479	63,446	64,652	76,005	131,370
Kaolin		79,411	76,605	63,228	67,525	81,879
Feldspar		15,452	11,055	26,290	28,116	19,101
Gypsum: Precipitated		1,882	2,199	2,247	1,378	2,438
Lime		117,496	105,132	109,690	105,005	105,701
Mica		304	114	774	787	4,387
Nitrogen: N content of ammonia		268,427	206,781	265,248	243,275	277,741
Pyrite, gross weight		—	8	10	—	—
Salt, marine		218,491	173,898	136,078	99,943	111,341
Sodium compounds, n.e.s.:						
Caustic soda		350,527	386,505	365,913	378,244	332,698
Carbonate (soda ash)		107,210	112,018	133,358	127,332	126,828
Stone:						
Dolomite	thousand tons	258	231	258	340	448
Limestone	do.	12,936	12,722	12,462	12,407	13,653
Marble	do.	9,542	10,259	10,603	11,062	11,615
Serpentine	do.	123	208	234	253	328
Sulfur:						
S content of pyrite		—	4	5	—	—
Byproduct, all sources		28,705	42,949	62,980	89,082	86,441
Total		**28,705**	**42,953**	**62,985**	**89,082**	**86,441**
Talc		18,680	17,560	21,552	22,102	21,603

See footnotes at end of table.

TABLE 10—Continued

TAIWAN: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987	1988[p]
MINERAL FUELS AND RELATED MATERIALS						
Carbon black		39,842	43,264	48,363	53,559	54,302
Coal, bituminous	thousand tons	2,011	1,858	1,725	1,499	1,225
Coke	do.	141	132	148	118	97
Gas, natural:						
Gross[e]	million cubic feet	49,000	44,000	40,000	41,000	45,000
Marketed	do.	44,698	39,731	36,111	37,325	41,087
Petroleum:						
Crude	thousand 42-gallon barrels	855	743	660	—	—
Refinery products:						
Gasoline	do.	17,518	25,408	18,128	24,480	[e]22,500
Kerosene	do.	61	282	956	547	[e]600
Distillate fuel oil	do.	21,972	23,852	19,480	25,581	[e]26,000
Residual fuel oil	do.	56,426	56,080	53,591	51,622	[e]52,000
Lubricants	do.	951	856	887	1,887	[e]2,000
Asphalt	do.	2,311	2,999	3,195	2,291	[e]2,300
Other[2]	do.	8,517	9,916	3,478	4,835	[e]4,800
Refinery fuel, losses and not reported[e 3]	do.	27,000	30,000	25,000	21,680	[e]22,000
Total	**do.**	**134,756**	**149,393**	**125,375**	**132,923**	**[e]132,200**

[e] Estimated. [p] Preliminary. [r] Revised.
[1] Includes data available through June 8, 1989.
[2] Naphtha, solvent oil, and base oil.
[3] Includes liquefied petroleum gas and jet fuel.

of numerous small operations utilizing scrap metal and ship plate generated by 140 shipbreaking companies in Kaohsiung Harbor. In 1986, Taiwan's shipbreaking reached a peak of 3.69 million light displacement tons of demolition. However, during that year, oil in a derelict tanker exploded in the scrapping yard as it was being cut, killing 14 workers and causing a huge fire. Lacking Government backing and encouragement, the industry has drastically contracted since that incident. At yearend, there were only 37 berths at Kaohsiung for breaking; on March 31, 1989, one of the shipbreaking sites at the Tajen zone was to close, leaving only a total of 13 shipbreaking berths at Kaohsiung. Consequently, the small steel operations were almost extinct, following the demise of the shipbreaking industry. CSC accounted for 71.4% of the country's total production of crude steel. The remainder of the output was by small operations such as Hai Kwang Steel Co., Lung Chin Steel Co., Li Chong Co., and Tung Ho Steel Enterprise Inc., all using electric furnaces.

CSC had planned a fourth-stage expansion at Kaohsiung to raise its annual production capacity to 8 million tons of crude steel. While the expansion is likely, it probably will be an overseas venture. There is a severe space constraint at Kaohsiung. Limited water is available for industrial use, and limited electric power is available to companies consuming more than 2,000 kilowatts. Air pollution was particularly bad in and around Kaohsiung. There is strong local opposition to CSC's expansion due to increased environmental degradation. The space being vacated by the shipbreaking operations was to be used to expand harbor facilities for containerized shipping. The company's in-house feasibility study considered the United States, Australia, Brazil, and the Republic of South Africa as possible host countries for CSC's added capacity.

Taiwan's steel industry was dependent on foreign sources for raw materials. Imports of iron ore totaled 8.5 million tons and were primarily from Australia, Brazil, and the Republic of South Africa, in that order. Receipts of manganese ore were 170,942 tons and were primarily from the Republic of South Africa, Australia, and Gabon, in order of tonnage. Imports of ferrous scrap metal were 1.3 million tons; principal suppliers were the United States,

TABLE 11

TAIWAN: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987 United States	Destinations, 1987 Other (principal)
METALS				
Aluminum:				
Ore and concentrate	—	2	—	Mainly to Hong Kong.
Oxides and hydroxides	6,384	3,721	—	Republic of Korea 1,330; Panama 1,250; Peru 800.
Metal including alloys:				
Scrap	3,096	7,969	5	Japan 7,926; Hong Kong 37.
Unwrought	12,504	17,254	56	Japan 13,445; Republic of Korea 2,526; Thailand 865.
Semimanufactures	18,247	23,682	1,609	Hong Kong 12,147; Japan 5,268; Singapore 2,780.
Antimony:				
Oxides	5	64	—	Netherlands 39; Japan 20; Hong Kong 3.
Metal including alloys, waste and scrap	—	3	3	
Arsenic: Oxides and acids	—	1	—	All to Philippines.
Beryllium: Metal including alloys, all forms	9	12	1	Japan 11.
Chromium: Oxides and hydroxides kilograms	—	717	—	Thailand 400; Indonesia 317.
Cobalt: Oxides and hydroxides do.	1,000	150	—	All to Malaysia.
Columbium and tantalum: Metal including alloys all forms: Tantalum	5	22	18	Japan 2.
Copper:				
Ore and concentrate	—	(2)	(2)	
Sulfate	270	250	—	Singapore 80; New Zealand 51; Malaysia 50.
Metal including alloys:				
Scrap	6,186	10,073	108	Japan 6,730; Republic of Korea 1,357.
Unwrought	49	665	9	Thailand 361; Hong Kong 168; Japan 90.
Semimanufactures	17,608	31,653	1,009	Hong Kong 9,044; Republic of Korea 8,845; Singapore 2,780.
Gold:				
Waste and sweepings value, thousands	$608	$65	$65	
Metal including alloys, unwrought and partly wrought troy ounces	(2)	3,858	3,858	
Iron and steel:				
Iron ore and concentrate excluding roasted pyrite	1	166	(2)	Hong Kong 108; Japan 37; Philippines 11.
Metal:				
Scrap	280,941	97,755	2,334	Thailand 50,711; Japan 43,372.
Pig iron, cast iron, related materials	4,766	2,877	913	Australia 543; Japan 398.
Ferroalloys:				
Ferrochromium	2	3	—	Philippines 2; Thailand 1.
Ferromanganese	60	100	—	All to Hong Kong.
Ferrosilicon	458	208	—	Japan 117; Republic of Korea 80.
Silicon metal	2	3	(2)	Hong Kong 1; India 1; Singapore 1.
Unspecified	915	1,448	29	Hong Kong 611; Japan 538; Republic of Korea 216.
Steel, primary forms	86,250	123,269	35	Japan 77,968; Philippines 17,391; West Germany 16,671.

See footnotes at end of table.

TABLE 11—Continued

TAIWAN: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
METALS—Continued					
Iron and steel—Continued					
Metal—Continued					
Semimanufactures:					
Bars, rods, angles, shapes, sections		739,827	272,058	59,204	Hong Kong 43,775; Sudan 31,762.
Universals, plates, sheets		401,274	439,269	53,528	Japan 217,940; Thailand 35,612.
Hoop and strip		2,571	3,804	NA	Japan 1,964; Thailand 506; Singapore 194.
Rails and accessories		593	1,245	328	Thailand 210; Canada 10.
Wire		39,343	39,627	2,771	Republic of Korea 18,545; Indonesia 7,488; Thailand 3,025.
Tubes, pipes, fittings		231,313	187,299	87,729	Saudi Arabia 44,177; Sudan 9,498.
Castings and forgings, rough		9,212	9,895	7,097	Hong Kong 990; Japan 595.
Lead:					
Ore and concentrate		—	(2)	—	All to Hong Kong.
Oxides		68	63	—	Thailand 40; Indonesia 18; Japan 5.
Metal including alloys:					
Scrap		100	1	—	All to Philippines.
Unwrought		23,473	16,031	121	Republic of Korea 5,399; Japan 4,456; Philippines 2,585.
Semimanufactures		182	345	47	Japan 222; Canada 16.
Magnesium: Metal including alloys:					
Scrap		525	522	7	Japan 410; Netherlands 104.
Unwrought		12	19	16	Hong Kong 1; Thailand 1.
Semimanufactures		35	52	52	
Manganese:					
Ore and concentrate: Metallurgical-grade		31	275	—	Republic of Korea 170; Hong Kong 100.
Oxides		29	82	1	Hong Kong 64; Philippines 17.
Molybdenum: Metal including alloys:					
Scrap	kilograms	—	188	—	All to West Germany.
Semimanufactures	do.	768	19,930	5,044	Saudi Arabia 14,836; Thailand 46.
Nickel:					
Matte and speiss		—	53	20	Japan 32.
Metal including alloys:					
Scrap		1,506	2,180	44	Japan 1,698; United Kingdom 236; Canada 165.
Unwrought		382	1,140	3	Japan 928; Australia 204.
Semimanufactures		26	19	6	Republic of Korea 7; Thailand 4.
Platinum-group metals: Metals including alloys, unwrought and partly wrought	troy ounces	77,515	26,974	7,459	Japan 9,935; Switzerland 3,729.
Selenium, elemental	kilograms	—	20	—	All to Indonesia.
Silicon, high-purity	do.	129	2,069	—	Republic of Korea 1,631; Singapore 360; Thailand 55.

See footnotes at end of table.

TABLE 11—Continued

TAIWAN: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
METALS—Continued				
Silver:				
Waste and sweepings[3] value, thousands	$1,079	$3,296	$2,178	Switzerland $457; Hong Kong $336.
Metal including alloys, unwrought and partly wrought troy ounces	39,995	17,490	96	Hong Kong 11,896; Singapore 5,305.
Tin: Metal including alloys:				
Scrap	(2)	16	—	All to Japan.
Unwrought	18	40	(2)	Saudi Arabia 10; United Kingdom 10; Philippines 9.
Semimanufactures	623	739	36	Hong Kong 345; Japan 163.
Titanium:				
Oxides	395	11	(2)	Nigeria 6; Indonesia 2; Australia 1.
Metal including alloys: Semimanufactures kilograms	—	43	—	All to Singapore.
Tungsten: Metal including alloys:				
Scrap	6	6	—	Japan 5; Netherlands 1.
Unwrought	—	3	—	All to Japan.
Semimanufactures	2	29	1	Republic of Korea 26.
Uranium and thorium: Metal including alloys, all forms	298	315	113	Belgium-Luxembourg 38; United Kingdom 27.
Zinc:				
Oxides	2,837	4,596	359	Japan 3,499; Thailand 263.
Blue powder	14	68	8	Philippines 60.
Metal including alloys:				
Scrap	79	40	3	Netherlands 18; Belgium-Luxembourg 11.
Unwrought	24	200	24	Japan 72; Singapore 40; Indonesia 27.
Semimanufactures	888	1,045	729	Jordan 60; Hong Kong 55.
Zirconium: Oxides kilograms	—	2	—	All to Hong Kong.
Other:				
Ores and concentrates	264	467	(2)	Republic of Korea 200; Japan 162; Thailand 91.
Ashes and residues	10,246	2,711	27	Japan 1,992; India 249; Netherlands 164.
Base metals including alloys, all forms	385	806	329	Japan 119; Belgium-Luxembourg 86.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	52	76	1	Thailand 26; Republic of South Africa 22.
Artificial: Corundum	390	275	—	Japan 256; Republic of South Africa 16; Hong Kong 2.
Dust and powder of precious and semiprecious stones including diamond	17	71	2	Singapore 64; New Zealand 3.
Grinding and polishing wheels and stones	3,182	4,378	1,610	Hong Kong 416; Thailand 334.
Asbestos, crude	(2)	27	—	Malaysia 26; Japan 1.

See footnotes at end of table.

TABLE 11—Continued

TAIWAN: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
INDUSTRIAL MINERALS—Continued					
Boron materials:					
Crude natural borates		—	2	—	All to Indonesia.
Oxides and acids	kilograms	500	200	—	Ivory Coast 100; Philippines 75; United Arab Emirates 25.
Cement	thousand tons	3,545	3,025	21	Hong Kong 1,154; Japan 1,118; Singapore 603.
Chalk		600	1,350	—	All to Indonesia.
Clays, crude:					
Bentonite		257	20	—	Hong Kong 19; Malaysia 1.
Fire clay		20	3	—	All to Indonesia.
Kaolin		1	331	—	Philippines 315; Hong Kong 9; Malaysia 5.
Unspecified		718	954	—	Philippines 584; Indonesia 100; Republic of Korea 62.
Diamond:					
Natural:					
Gem, not set or strung	thousand carats	12,340	29,660	22,735	Canada 4,795; Japan 995.
Industrial stones	do.	12,440	32,060	7,155	Spain 13,670; Hong Kong 5,315.
Synthetic:[4]					
Gem, not set or strung	do.	8,190	42,965	9,135	Saudi Arabia 25,125; United Kingdom 4,380.
Industrial stones	do.	328,180	656,260	800	Thailand 422,678; Republic of Korea 159,895; Austria 28,300.
Diatomite and other infusorial earth		34	731	—	Japan 535; Malaysia 178; Philippines 18.
Feldspar, fluorspar, related materials		166	203	([2])	Philippines 115; Indonesia 60; Malaysia 23.
Fertilizer materials:					
Crude, n.e.s.		393	887	—	Belgium-Luxembourg 532; Republic of South Africa 220; Japan 121.
Manufactured:					
Ammonia		17	93	—	Japan 67; Hong Kong 19; United Arab Emirates 7.
Nitrogenous		905	10,601	1	Philippines 10,000; Japan 600.
Phosphatic		4,129	4,108	—	Fiji 2,500; Malaysia 1,500; Japan 108.
Potassic		25,855	34,511	—	Japan 13,418; Hong Kong 11,718; Syria 3,700.
Unspecified and mixed		5,368	9,746	—	Japan 6,194; Thailand 3,100; Hong Kong 428.
Graphite, natural		204	178	—	Philippines 82; Republic of Korea 45; Indonesia 36.
Gypsum and plaster		726	741	15	Indonesia 504; India 100; Philippines 63.
Iodine	kilograms	1,400	3,350	—	Indonesia 2,000; Philippines 1,050.
Lime		13	27	([2])	Japan 18; Philippines 4; Republic of South Africa 2.
Magnesium compounds: Oxides and hydroxides		505	100	—	All to Indonesia.
Meerschaum, amber, jet		5	107	([2])	Malaysia 70; Japan 16; Singapore 6.
Mica:					
Crude including splittings and waste		198	394	—	New Zealand 179; Japan 156; United Kingdom 34.
Worked including agglomerated splittings		80	152	([2])	Japan 104; Hong Kong 18; United Kingdom 17.

See footnotes at end of table.

TABLE 11—Continued

TAIWAN: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Destinations, 1987	
				United States	Other (principal)
INDUSTRIAL MINERALS—Continued					
Pigments, mineral:					
Natural, crude		—	1	1	
Iron oxides and hydroxides, processed		35	134	10	Indonesia 81; Malaysia 20; Thailand 13.
Precious and semiprecious stones other than diamond:					
Natural	kilograms	131,696	405,230	34,023	Hong Kong 234,449; Thailand 49,145.
Synthetic	do.	43,708	53,876	17,975	Italy 9,881; Hong Kong 9,213.
Salt and brine		1,950	3,418	—	Mainly to Hong Kong.
Sodium compounds, n.e.s.:					
Carbonate, manufactured		259	3	—	Sri Lanka 2.
Sulfate, manufactured		23,984	20,670	—	Japan 9,847; Republic of Korea 5,000; Thailand 2,398.
Stone, sand and gravel:					
Dimension stone:					
Crude and partly worked		12,194	7,273	161	Japan 4,974; U.S. Trust Territory 1,261; Hong Kong 412.
Worked		30,434	24,561	3,363	Saudi Arabia 14,699; Japan 11,291.
Dolomite, chiefly refractory-grade		82,116	219,630	—	Japan 203,498; Saudi Arabia 14,870; Indonesia 1,262.
Gravel and crushed rock		170,932	252,098	23	Japan 240,116; Malaysia 8,370; Philippines 2,026.
Limestone other than dimension		9,094	3,764	—	Japan 3,262; Philippines 500.
Quartz and quartzite		13	13	—	Japan 10; Malaysia 3.
Sand other than metal-bearing		309,555	414,320	([2])	Japan 404,521; U.S.Trust Territory 6,576; Philippines 628.
Sulfur:					
Elemental:					
Crude including native and byproduct		1,192	599	—	Indonesia 295; Philippines 140; Thailand 84.
Colloidal, precipitated, sublimed		153	274	—	Philippines 180; Indonesia 48; Australia 26.
Sulfuric acid		104	216	12	Hong Kong 51; Republic of Korea 45; Japan 23.
Talc, steatite, soapstone, pyrophyllite		695	357	—	Indonesia 139; Republic of South Africa 73; Singapore 58.
Other:					
Crude		5,328	7,988	190	Philippines 3,745; Thailand 2,304; Singapore 292.
Slag and dross, not metal-bearing		80,572	141,974	NA	Philippines 55,507; Japan 53,521; Singapore 32,064.
MINERAL FUELS AND RELATED MATERIALS					
Asphalt and bitumen, natural		80	2	—	All to Singapore.
Carbon:					
Carbon black		9,746	13,735	—	Indonesia 8,735; Thailand 2,015; Malaysia 1,592
Gas carbon		277	6,363	—	Japan 4,648; Indonesia 1,100.

See footnotes at end of table.

TABLE 11—Continued

TAIWAN: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Destinations, 1987	
				United States	Other (principal)
MINERAL FUELS AND RELATED MATERIALS—Continued					
Coal, all grades including briquets		—	1	—	All to New Zealand.
Coke and semicoke		13,257	9,181	—	Japan 4,821; Indonesia 3,050; Malaysia 400.
Peat including briquets and litter		256	220	—	All to Japan.
Petroleum refinery products:					
Liquefied petroleum gas	42-gallon barrels	—	(2)	—	All to Panama.
Gasoline, motor	do.	9	23,630	—	Panama 3,060; unspecified 20,570.
Mineral jelly and wax	do.	39	787	(2)	Hong Kong 331; Japan 205; Philippines 126.
Kerosene and jet fuel	thousand 42-gallon barrels	9,785	6,750	411	Japan 7,338; Singapore 3,296; U.S. Trust Territory 1,529.
Distillate fuel oil	do.	8,246	5,643	—	Japan 223; Panama 55; Singapore 37.
Lubricants	do.	r776	839	329	Japan 137; United Arab Emirates 64.
Nonlubricating oils	do.	3	109	NA	Republic of Korea 50; Japan 38; India 12.
Residual fuel oil	do.	—	(2)	—	NA.
Bituminous mixtures	do.	1	(2)	—	Mainly to U.S. Trust Territory.
Petroleum coke	do.	908	727	2	Japan 492; Hong Kong 111; Indonesia 90.

r Revised. NA Not available.
1 Table prepared by G. Jacarepaqua and Audrey D. Wilkes.
2 Less than 1/2 unit.
3 May include other precious metals.
4 Data presented are as reported by the Inspectorate General of Customs of Taiwan, but the material listed is believed to be synthetic material other than diamond.

Japan, and Hong Kong. In addition, scrap metal was produced from shipbreaking. There were 167 vessels, weighing 1,026,763 tons, which were imported for scrapping. The principal suppliers were the United States, 50 vessels; Japan, 39; Spain, 13; and the Federal Republic of Germany, 10.

Industrial Minerals.—The production of industrial minerals in Taiwan is by Government-owned and privately owned operations for a limited array of minerals. Salt was produced from evaporation ponds, principally around Tainan; by the Taiwan Salt Works. This Government-owned enterprise, also operates facilities in Chiayi and Kaohsiung. Sulfur was recovered as a byproduct by China Petrochemical Development Corp. at its refineries in Ilan, Kaohsiung, and Taoyuan. All of the output of fine construction aggregate was by Government operations at Tainan and Taoyuan. A nearly equal quantity of dolomite was quarried by Government and private operations in Hualian and Taipei Counties. Most of the limestone and marble output was by private companies. Marble was quarried in Hualian and Ilan Counties, and limestone in Chiayi, Hualin, Hsinchu, Kaohsiung, Tainan, and Taitung. All of the output of china and fire clay, semiprecious gem stones, feldspar, mica, pyrite, quartz crystal, serpentine, and talc was by privately owned operations; the quantities produced of each are insignificant in terms of world standards. China clay was from mine operations in Hualien, Ilan, Keelung, Miaoli, Nantou, Taipei, and Taitung; fire clay in Hsinchu, Ilan, Keelung, Miaoli, Nantou, and Taipei; gem stones in Hualien and Taitung; feldspar in Hualien and Ilan; mica in Hualien, Ilan, and Taitung; pyrite in Taipei; quartz crystal in Hualien, Ilan, Miaoli, and Nantou; serpentine in Hualien and Taitung; and talc in Hualien and Ilan.

Mineral Fuels.—Taiwan has a very weak resource base for fossil fuels. Mine output of coal has declined annually since 1980 and was only 1.2 million tons in 1988. All coal production was by privately owned operations in Hsinchu, Keelung, Miaoli, and Taipei. Approximately 1.2 billion cubic meters of natural gas and approximately 879,000 42-gallon barrels of associated condensate were produced from wells in Hsinchu and Miaoli by the Chinese Petroleum Corp. Less than 25% of Taiwan's

TABLE 12

TAIWAN: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987	
			United States	Other (principal)
METALS				
Aluminum:				
Ore and concentrate	47,261	36,235	(2)	Malaysia 35,035; India 700; Japan 400.
Oxides and hydroxides	5,725	12,103	219	Japan 8,951; Australia 2,258.
Metal including alloys:				
Scrap	13,055	23,211	16,167	United Kingdom 1,204; Australia 804.
Unwrought	155,956	195,095	9,541	Australia 78,298; Republic of South Africa 29,181; Canada 26,011.
Semimanufactures	32,440	48,631	3,411	Japan 19,865; Australia 8,082; West Germany 3,947.
Antimony:				
Oxides	765	1,079	90	France 472; Japan 148; Malaysia 100.
Metal including alloys:				
Unwrought	74	415	(2)	Thailand 352; West Germany 28.
Waste and scrap	3	203	—	All from Australia.
Arsenic: Oxides and acids	563	665	—	France 631; Republic of Korea 34.
Beryllium: Metal including alloys, all forms	1	1	(2)	Mainly from Japan.
Cadmium: Oxides and hydroxides	476	340	—	Republic of Korea 272; Belgium-Luxembourg 67.
Chromium:				
Ore and concentrate	19,048	20,899	—	Republic of South Africa 20,819; Netherlands 80.
Oxides and hydroxides	2,881	3,256	347	Japan 1,534; West Germany 748.
Cobalt: Oxides and hydroxides	66	98	1	Belgium-Luxembourg 76; United Kingdom 13.
Columbium and tantalum: Metal including alloys, all forms: Tantalum kilograms	37	665	28	Japan 637.
Copper:				
Ore and concentrate	179,704	153,155	10,804	Mexico 47,197; Canada 47,047; Chile 24,883.
Matte and speiss including cement copper	28	7	—	Hong Kong 5; Japan 1.
Sulfate	480	666	15	Japan 548; Australia 43.
Metal including alloys:				
Scrap	42,508	49,693	26,630	Hong Kong 4,926; Japan 4,865.
Unwrought	109,476	166,902	2,862	Chile 48,004; Philippines 42,250; Japan 36,528.
Semimanufactures	58,075	81,080	4,767	Japan 54,826; Republic of Korea 5,789; West Germany 5,350.
Gold:				
Bullion thousand troy ounces	731	2,663	851	Republic of South Africa 726; United Kingdom 535.
Metal including alloys, unwrought and partly wrought do.	886	1,117	102	Japan 1,007.
Iron and steel:				
Iron ore and concentrate excluding roasted pyrite thousand tons	5,358	6,141	(2)	Australia 3,511; Brazil 2,237; Republic of South Africa 230.
Pyrite, roasted	9,460	3	—	All from Japan.

See footnotes at end of table.

TABLE 12—Continued

TAIWAN: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987	
			United States	Other (principal)
METALS—Continued				
Iron and steel—Continued				
Metal:				
Scrap	1,225,472	943,592	560,083	Japan 144,296; Netherlands 67,394.
Pig iron, cast iron, related materials	319,790	643,976	1,207	Brazil 566,276; Republic of South Africa 40,448; Japan 28,391.
Ferroalloys:				
Ferrochromium	29,886	15,904	32	Republic of South Africa 15,668; Japan 44.
Ferromanganese	8,936	18,865	—	Republic of South Africa 17,644; Japan 984; Italy 76.
Ferrosilicon	11,894	19,406	120	Republic of South Africa 8,644; Norway 5,993; Philippines 1,662.
Silicon metal	2,683	3,256	2	Norway 1,357; Canada 1,081; Japan 511.
Unspecified	824	887	13	United Kingdom 289; Japan 142; Brazil 106.
Steel, primary forms	[r]600,655	1,363,772	28,881	Japan 382,712; Republic of South Africa 361,195; Brazil 140,113.
Semimanufactures:				
Bars, rods, angles, shapes, sections	434,604	733,722	8,291	Japan 516,851; United Kingdom 42,316; Republic of Korea 30,946.
Universals, plates, sheets	1,286,764	1,690,949	38,830	Japan 1,320,067; Canada 115,392; Republic of South Africa 68,741.
Hoop and strip	42,041	44,329	2,522	Japan 37,415; West Germany 1,542.
Rails and accessories	22,103	28,530	10	Republic of South Africa 13,017; Australia 6,645; Republic of Korea 4,781.
Wire	26,749	33,305	1,581	Japan 17,595; Republic of Korea 9,171; Republic of South Africa 2,220.
Tubes, pipes, fittings	87,992	148,153	603	Japan 90,308; Republic of South Africa 22,685; West Germany 20,628.
Castings and forgings, rough	1,851	2,289	34	Japan 1,964; France 188; Republic of Korea 45.
Lead:				
Ore and concentrate	—	171	—	All from Indonesia.
Oxides	2,935	3,095	14	Australia 2,683; France 200; West Germany 152.
Metal including alloys:				
Scrap	89,536	79,652	20,299	Australia 15,605; Saudi Arabia 10,370.
Unwrought	16,154	20,947	2,982	Australia 9,114; Japan 2,793.
Semimanufactures	19	29	10	West Germany 10; Japan 5.
Magnesium: Metal including alloys:				
Unwrought	922	1,011	175	Norway 668; France 113.
Semimanufactures	29	77	69	West Germany 3; Canada 2.
Manganese:				
Ore and concentrate: Metallurgical-grade	119,241	131,704	—	Republic of South Africa 72,258; Australia 30,421; Gabon 28,685.

See footnotes at end of table.

TABLE 12—Continued

TAIWAN: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987	
				United States	Other (principal)
METALS—Continued					
Manganese—Continued					
Oxides		2,625	3,516	3	India 1,523; Japan 929; Republic of South Africa 528.
Metal including alloys, all forms		35	54	10	West Germany 17; United Kingdom 16.
Mercury	76-pound flasks	282	247	90	Japan 87; Spain 63.
Molybdenum: Metal including alloys:					
Scrap		—	2	1	Hong Kong 1.
Unwrought		—	1	1	Japan[2].
Semimanufactures		85	102	69	West Germany 22; Japan 9.
Nickel:					
Matte and speiss		11,514	11,256	—	All from Canada.
Metal including alloys:					
Scrap		1,223	383	259	Netherlands 105; West Germany 10.
Unwrought		6,535	6,364	5	Canada 3,939; Norway 1,621; Zimbabwe 274.
Semimanufactures		691	687	80	Canada 214; Japan 99; Australia 82.
Platinum-group metals: Metals including alloys, unwrought and partly wrought	thousand troy ounces	19	[3]3,884	9	Japan 3,859; Australia 11.
Rare-earth metals including alloys, all forms		62	81	1	Japan 75.
Selenium, elemental		27	47	([2])	Malaysia 30; United Kingdom 8; Japan 7.
Silicon, high-purity		[r]15	23	10	West Germany 7; Japan 6.
Silver:					
Ore and concentrate[4]	value, thousands	$78	$75	$8	United Kingdom $67.
Waste and sweepings[4]	do.	$61	$16	$10	Hong Kong $6.
Metal including alloys, unwrought and partly wrought	thousand troy ounces	2,403	3,200	341	Japan 714; Australia 713; West Germany 499.
Tin:					
Oxides		9	24	—	West Germany 14; Japan 5; United Kingdom 3.
Metal including alloys:					
Scrap		7	14	—	Singapore 9; Japan 4.
Unwrought		4,513	4,410	2	Malaysia 3,058; Indonesia 707; Thailand 319.
Semimanufactures		421	684	10	Hong Kong 497; Singapore 106; Japan 46.
Titanium:					
Oxides		13,187	14,481	621	Japan 6,369; West Germany 4,198; Australia 1,516.
Metal including alloys: Semimanufactures		26	26	1	United Kingdom 19; Japan 6.
Tungsten: Metal including alloys:					
Scrap		7	28	4	Japan 24.
Unwrought		—	([2])	([2])	
Semimanufactures		49	89	22	Japan 57; United Kingdom 4.
Uranium and thorium:					
Oxides and other compounds		38	70	24	France 26; Norway 11.
Metal including alloys, all forms	kilograms	18	82	—	Netherlands 77.

See footnotes at end of table.

TABLE 12—Continued

TAIWAN: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS—Continued				
Zinc:				
Ore and concentrate, value, thousands	—	$3	—	Mainly from Netherlands.
Oxides	326	488	55	Japan 224; Republic of Korea 94.
Blue powder	206	262	([2])	West Germany 145; Republic of Korea 54; Japan 26.
Metal including alloys:				
Scrap	69,369	110,814	80,215	West Germany 6,862; Canada 6,087.
Unwrought	79,000	84,118	524	Australia 34,677; Japan 13,498; Canada 11,805.
Semimanufactures	927	776	3	Japan 564; France 85; United Kingdom 51.
Zirconium: Oxides	1,519	464	38	Japan 117; France 84; Australia 80.
Other:				
Ores and concentrates	35,057	37,732	594	Australia 20,255; Malaysia 13,026; Republic of South Africa 2,109.
Ashes and residues	28,021	50,251	6,928	Japan 26,283; Australia 6,051.
Base metals including alloys, all forms	536	701	106	Hong Kong 187; Japan 145.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	4,533	21,389	720	Indonesia 16,590; Japan 1,369; Netherlands 1,114.
Artificial:				
Corundum	18,218	20,130	82	Japan 10,117; Hong Kong 7,169; Austria 1,085.
Silicon carbide including boron carbide	5,495	7,037	96	Japan 1,985; Hong Kong 1,674; Netherlands 1,224.
Dust and powder of precious and semiprecious stones including diamond, kilograms	891	1,417	227	Japan 660; Ireland 525.
Grinding and polishing wheels and stones	1,090	1,636	169	Japan 659; Italy 534.
Asbestos, crude	39,735	36,469	1,296	Canada 17,745; Republic of South Africa 11,955; Greece 2,000.
Barite and witherite	6,636	1,586	—	All from Thailand.
Boron materials:				
Crude natural borates	2,345	2,485	110	Japan 1,386; Switzerland 880.
Oxides and acids	2,019	2,342	1,975	Italy 328; Japan 38.
Bromine, kilograms	121	796	—	Israel 630; Japan 93; West Germany 57.
Cement	10,053	41,796	26	Indonesia 13,202; Hong Kong 9,550; Japan 9,179.
Clays, crude:				
Bentonite	18,624	20,051	16,361	India 1,400; Republic of South Africa 1,368.
Fire clay	632	2,693	—	India 1,000; Republic of South Africa 828; Japan 749.
Kaolin	120,134	156,723	62,789	Indonesia 33,586; Malaysia 16,709.
Unspecified	158,808	205,173	11,359	Hong Kong 121,327; Japan 34,102; India 23,727.
Cryolite and chiolite	108	68	—	Denmark 44; Japan 19; Australia 5.
Diamond:				
Natural:				
Gem, not set or strung, thousand carats	1,250	[5]25	—	France 15; Belgium-Luxembourg 10.
Industrial stones, do.	1,580	5,085	—	Japan 5,005; Belgium-Luxembourg 80.
Synthetic:				
Gem, not set or strung, do.	1,155	240	180	Ireland 55; Japan 5.
Industrial stones, do.	820	[6]560	50	Ireland 260; Japan 250.

See footnotes at end of table.

TABLE 12—Continued

TAIWAN: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987	
			United States	Other (principal)
INDUSTRIAL MINERALS—Continued				
Diatomite and other infusorial earth	4,296	4,623	3,399	West Germany 527; Japan 523.
Feldspar, fluorspar, related materials	158,131	224,733	854	Thailand 92,170; Hong Kong 57,603; Philippines 18,959.
Fertilizer materials:				
Crude, n.e.s.	1,732	181	14	Norway 79; France 42.
Manufactured:				
Ammonia	155,287	153,626	42,847	Indonesia 54,469; Qatar 18,125.
Nitrogenous	122,131	110,540	—	Saudi Arabia 74,641; Canada 18,958; Republic of Korea 5,493.
Phosphatic	110	202	2	Republic of South Africa 200.
Potassic	212,492	178,217	([2])	Canada 70,050; Jordan 54,570; Israel 41,549.
Unspecified and mixed	2,202	18,732	11,352	Japan 2,201; Republic of South Africa 2,044.
Graphite, natural	8,513	8,390	([2])	Republic of Korea 5,844; Zimbabwe 920; Sri Lanka 612.
Gypsum and plaster	401,118	185,846	714	Thailand 148,010; Japan 29,087; Australia 7,698.
Iodine	23	33	1	Japan 32.
Lime	20	17	—	Mainly from Japan.
Magnesium compounds: Oxides and hydroxides	37,215	38,113	234	India 15,295; Japan 9,816; Malaysia 7,280.
Meerschaum, amber, jet	3	43	—	Philippines 34; Hong Kong 5; Thailand 4.
Mica:				
Crude including splittings and waste	445	823	12	Malaysia 392; India 192; Thailand 150.
Worked including agglomerated splittings	192	268	14	Japan 187; Belgium-Luxembourg 32; India 30.
Phosphates, crude	330,763	361,188	—	Jordan 278,210; Morocco 49,563; Israel 23,480.
Phosphorus, elemental	2,899	2,677	209	Republic of South Africa 1,102; Japan 561; Netherlands 418.
Pigments, mineral:				
Natural, crude	5	38	2	Austria 36.
Iron oxides and hydroxides, processed	22,397	35,667	1,175	Japan 26,354; West Germany 1,951; Austria 1,602.
Potassium salts, crude	—	22	—	All from West Germany.
Precious and semiprecious stones other than diamond:				
Natural	7,616	6,527	89	Brazil 2,671; Republic of South Africa 2,372.
Synthetic	10	13	3	Japan 6; Belgium-Luxembourg 2.
Pyrite, unroasted	2	17	—	All from Japan.
Salt and brine	859,515	596,704	([2])	Australia 592,361; Japan 4,223.
Sodium compounds, n.e.s.:				
Carbonate, manufactured	31,100	49,846	43,820	Kenya 5,000; Australia 934.
Sulfate, manufactured	2,955	1,404	218	Thailand 920; West Germany 262.
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked	66,742	115,940	148	Republic of Korea 22,726; India 21,561: Spain 17,867.
Worked	432	1,320	3	Italy 800; Spain 292; Republic of South Africa 86.
Dolomite, chiefly refractory-grade	3,340	1,923	116	United Kingdom 1,617; Japan 76.

See footnotes at end of table.

TABLE 12—Continued

TAIWAN: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
INDUSTRIAL MINERALS—Continued				
Stone, sand and gravel—Continued				
Gravel and crushed rock	6,216	11,545	510	France 6,277; Italy 2,023; Philippines 768.
Limestone other than dimension	22,080	503,794	—	Japan 337,919; Philippines 165,875.
Quartz and quartzite	1,573	1,349	34	India 380; Republic of Korea 366; Japan 163.
Sand other than metal-bearing	10,726	29,391	147	Japan 13,388; Malaysia 12,438; Republic of Korea 1,800.
Sulfur:				
Elemental:				
Crude including native and byproduct	60,515	17,893	199	Canada 12,894; Japan 4,800.
Colloidal, precipitated, sublimed	261,370	153,152	9,345	Canada 122,838; Japan 20,850.
Dioxide	28	13	(2)	Mainly from West Germany.
Sulfuric acid	125,521	159,940	193	Japan 159,713; West Germany 34.
Talc, steatite, soapstone, pyrophyllite	12,230	22,726	2,465	Republic of Korea 12,667; Thailand 2,740.
Vermiculite	1,146	561	4	Republic of South Africa 270; India 211; Philippines 40.
Other:				
Crude	r111,989	132,584	1,625	Republic of Korea 107,269; Japan 12,443.
Slag and dross, not metal-bearing	14,460	4,089	—	Japan 3,586; Republic of South Africa 213; United Kingdom 121.
MINERAL FUELS AND RELATED MATERIALS				
Asphalt and bitumen, natural	98	170	165	Japan 5.
Carbon:				
Carbon black	r9,221	16,769	4,060	Australia 6,924; Japan 2,111.
Gas carbon	61	165	13	Japan 105; Republic of South Africa 36.
Coal, all grades including briquets thousand tons	11,003	13,382	4,253	Australia 5,843; Republic of South Africa 2,481.
Coke and semicoke	r157,705	214,172	62,652	Japan 144,303; Philippines 7,078.
Peat including briquets and litter	396	458	—	Netherlands 172; Finland 160; West Germany 70.
Petroleum:				
Crude thousand 42-gallon barrels	126,337	141,326	356	Saudi Arabia 46,761; Kuwait 38,921; Oman 20,968.
Refinery products:				
Liquefied petroleum gas do.	6,638	6,534	(2)	Saudi Arabia 5,080; Kuwait 492; United Arab Emirates 389.
Gasoline, motor do.	(2)	2,672	528	Singapore 619; Saudi Arabia 427.
Mineral jelly and wax do.	158	254	39	Japan 117; Indonesia 49.
Kerosene and jet fuel do.	(2)	(2)	(2)	
Distillate fuel oil do.	12,089	5,527	4,231	Kuwait 607; Singapore 590.
Lubricants do.	596	708	257	Japan 222; Singapore 72.
Nonlubricating oils do.	995	2,987	661	Saudi Arabia 862; Canada 400.
Residual fuel oil do.	(2)	(2)	(2)	
Bituminous mixtures do.	1	2	1	Netherlands 1.
Petroleum coke do.	557	149	146	Japan 2.

r Revised. NA Not available.
[1] Table prepared by G. Jacarepaqua and Audrey D. Wilkes.
[2] Less than 1/2 unit.
[3] As reported by the Inspectorate General of Customs, Taiwan; however, a very low unit value suggests an error in unit of measure as reported.
[4] May include other precious metals.
[5] Total excludes unreported quantity valued at $723,000.
[6] Total excludes unreported quantity valued at $31,000.

total supply of energy is provided from domestic sources. The configuration of primary commercial energy supply is as follows, in thousand 42-gallon barrels:

Energy supply	1985	1986	1987	1988
Domestic:				
Electric power:				
Nuclear	44,882	42,092	51,759	47,889
Hydroelectricity	10,822	11,591	11,122	9,614
Natural gas	8,345	7,604	7,691	8,772
Coal	8,050	7,475	6,496	5,310
Condensate	743	663	933	879
Total	**72,842**	**69,425**	**78,001**	**72,464**
Imports:				
Crude oil	118,482	118,496	127,263	134,187
Coal	45,987	48,661	63,754	79,515
Petroleum products	11,208	25,129	19,235	37,186
Total	**175,677**	**192,286**	**210,252**	**250,888**
Grand total	**248,519**	**261,711**	**288,253**	**323,352**

During 1979-88, the average annual growth in energy consumption was 62%. In 1988, the highest growth rates in consumption by sector were metal products, 29.5%; transportation, 12.7%; industrial minerals products, 11.3%; and chemicals, 10.6%. During 1979-88, the consumption of energy by the mining sector had an average annual decline of 1.1%. In 1988, the rate of decline was 3.8%. The configuration of commercial energy consumption by industrial sector was as follows, in thousand 42-gallon barrels:

Industrial sector	1985	1986	1987	1988
Transportation	27,886	30,187	33,421	37,655
Chemicals	20,836	24,721	26,835	29,687
Metal products	19,098	21,470	22,312	28,905
Industrial mineral products	19,065	19,317	20,182	22,462
Energy	14,621	15,146	14,903	15,338
Mining	1,042	764	621	597
Other	114,123	125,078	136,774	147,900
Total	**216,671**	**236,683**	**255,048**	**282,544**

The energy consumption by the "Other" category in 1988, in thousand 42-gallon barrels, was composed of miscellaneous manufacturing, 16,650; textiles, 16,567; forest products, 9,296; agriculture, 8,948; food, 6,560; and miscellaneous sectors, 89,879.

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[1] By E. Chin, physical scientist, Division of International Minerals.

[2] Where necessary, values have been converted from Chinese renminbi (RMB) to U.S. dollars at the rate of RMB3.72=US$1.00 for 1988.

[3] By E. Chin, physical scientist, Division of International Minerals.

[4] Where necessary, values have been converted from Hong Kong dollars (HK$) to U.S. dollars at the rate of HK$7.798=US$1.00 for 1987 and HK$7.806=US$1.00 for 1988.

[5] By John C. Wu, economist, Division of International Minerals.

[6] Where necessary, values have been converted from Mongolian turgriks (Tug) to U.S. dollars at the rate of Tug 3.36 turgriks=U.S.$1.00.

[7] U.S. Embassy, Beijing, China. State Dep. Telegram Beijing 27517, Sept. 15, 1988, p. 3.

[8] Mining Journal (London). V. 310, No. 7959, Mar. 11, 1988, p. 205.

[9] Government of Mongolia (Ulaanbaatar). Proposal for the Development of the Copper and Molybdenum Deposit of Tsagaan-Suvarga.

[10] BBC Monitoring (Reading, England). Summary of World Broadcasts (SWB). Far East Weekly Report, Aug. 24, 1988, pp. 12-13.

——. Sept. 14, 1988, p. 9.

[11] Mining Encyclopedia (Moscow). No. 3, K-O, Mongolia (in Russian), 1987, pp. 386-391.

[12] Work cited in footnote 11.

[13] The British Sulphur Corp. Ltd. (London). Phosphorus and Potassium, No. 118, Mar./Apr., 1982, p. 15.

[14] By E. Chin, physical scientist, Division of International Minerals.

[15] Where necessary, values have been converted from New Taiwan dollars (NT$) to U.S. dollars at the rate of NT$28.55=US$1.00 in 1987 and NT$28.56=US$1.00 in 1988.

THE MINERAL INDUSTRY OF

JAPAN

By John C. Wu[1]

Japan's mineral industry, benefiting from higher market prices and stronger demand for minerals and metals, improved its financial condition considerably in 1988. Most major minerals and metals producers reported higher earnings because of increased sales and higher market prices. Japan's mining sector, especially the nonferrous metals mining and coal mining industries, however, continued to shrink in 1988 because of increased imports of relatively inexpensive raw materials and continued cutbacks in domestic coal production under the Eighth National Coal Policy.

According to the Ministry of International Trade and Industry (MITI), output of the mining industry dropped by 5% because of fewer operating mines and further production cutbacks in 1988. As of April 1, 1988, the number of operating mines and employees in the metal mining industry declined to 29 and 2,865 from 34 and 3,579, respectively, in 1987. However, because of increased demand by the construction industry, the number of operating mines in the industrial mineral mining industry rose to 565 from 544 in 1987, but the number of employees declined to 13,946 from 14,088 in 1987. The number of major mines in the coal industry declined to 8 from 11 in 1987 and the number of employees dropped to 7,712 from 9,167 in 1987.[2]

Industrial and construction activity increased during 1988, and the iron and steel, nonferrous metals smelting, and cement industries reported significant improvements in sales and earnings. However, in 1988, Japan depended more than ever on imports to meet raw material requirements for its mineral processing and metal fabricating sectors. To meet domestic demand in 1988, Japan relied on imports for 90% to 100% of its aluminum, antimony, bauxite, chromium, cobalt, columbium, copper, crude petroleum, fluorspar, ilmenite, iron ore, lithium, manganese, molybdenum, natural gas, nickel, platinum-group metals, rare earths, rutile, strontium, tantalum, tin, and zirconium. Import dependency for aluminum, coal, copper, gold, lead, silver, tungsten, vanadium, and zinc was higher in 1988 than that of 1987 because of reduced domestic production and increased demand.

In 1988, Japan was the world's largest producer of indium metal, iodine, electrolytic manganese dioxide, pyrophyllite, selenium metal, and tellurium metal; the second largest producer of cadmium, gallium, and steel; the third largest producer of bismuth metal, cement, limestone, nickel metal, titanium sponge metal, and zinc metal; and one of the world's top five producers of bromine, refined copper, and lime. Japan was the world's largest importer of primary aluminum, coal, copper concentrate, iron ore, nickel ore, liquefied natural gas (LNG), phosphate rock, and industrial salt; the country was the second largest importer of crude petroleum. Japan remained the world's major supplier of steel, titanium sponge metal, and high-purity rare metal products.

Domestic demand for most mineral and metal products was higher than that of 1987, especially for the base metals, cement, coal, petroleum, and steel products. The rise in demand was generated by increased industrial production and continued increases in private housing, plant and equipment investments, and public works projects. Despite reduced exports of mineral and metal products, export earnings rose considerably because of higher market prices and further appreciation of the Japanese yen in 1988. Import cost for minerals and metal products also rose, however, because of higher import volume for most raw materials and processed products, especially for aluminum, cement, base metals, refined petroleum products, and iron and steel products.

According to Japan's Economic Planning Agency, the country's real gross national product (GNP) grew 5.7%, compared with 4.5% (revised) in 1987. Again, the expansion of domestic demand fueled Japan's robust economic growth in 1988. In domestic demand, private plant and equipment investment grew 15.9%, followed by private housing investment, 13.4%; Government fixed capital formation, 6.5%; and personal consumption expenditures, 5.7%.

In 1988, Japan's real GNP in 1980 constant dollars was $2,575.9 billion[3] and per-capita real GNP was $23,358, compared with $19,760 for the United States. Japan's per-capita real GNP had also exceeded that of the United States in 1987. Despite stronger yen value in 1988, Japan continued to enjoy a sizable merchandise trade surplus amounting to $75.6 billion, compared with a surplus of $79.7 billion in 1987.

GOVERNMENT POLICIES AND PROGRAMS

One goal of Japan's Eighth National Coal Policy has been to gradually reduce domestic production of steam coal to 10 million tons and to eliminate entirely the production of coking coal by fiscal year 1991. In this effort the Government spent $1,324 million to assist the coal industry in fiscal year 1987 (April 1, 1987–March 31, 1988). About $1.08 billion was used for 6-month, low-interest loans for industry to set up a private coal stockpile program and operation fund; $60 million went toward interest-free loans for streamlining mining operations and retrenching the industry's workforce, and $179 million was awarded in grants for coal mine moderization, coal mining safety, industry stablization, and interest payments on loans for the coal stockpiling program.

The Government raised import tariffs on crude petroleum and refined petroleum products by shifting the tax base to volume from value in April to provide a source of revenues to assist the coal industry and to finance a large national oil stockpile program. Japanese oil companies were encouraged to acquire productive oilfields and establish joint ventures for oil exploration and development overseas, especially in the United States. Incentives toward this goal were low-interest Government loans for up to 80% of total investments in oil exploration and development projects and up to 70% of production operating costs. The Government also allowed a 3.5% tax writeoff and a 15% depreciation allowance off the purchase price of overseas oilfields.

A similar fiscal incentive is to be provided to Japanese nonferrous mining companies for acquisition of productive nonferrous mines overseas beginning in April 1989, in order to secure raw materials supply sources for domestic nonferrous metal smelters. In its efforts to prevent a severe negative economic impact in the event of a supply disruption and to secure a short-term supply of rare metals vital to the iron and steel, chemical, electric, and electronic industries, Japan continued to build its stockpile of chromium, cobalt, manganese, molybdenum, nickel, tungsten, and vanadium.

In fiscal year 1987, the previous three-scheme stockpile program was changed to a two-scheme plan, Government stockpiles and private stockpiles. The joint Government-private program was abolished to save money and to allow more private companies to participate in the private stockpile. Because of reduced consumption of the seven rare metals between 1983 and 1986, the 1983 consumption base for deriving daily supply was replaced with the 1986 base. As a result of this recalculation using the 1986 base, the 31.4-day supply at the end of fiscal year 1987 was adjusted upward to a 44-day supply.

The Metal Mining Agency of Japan (MMAJ) was appointed once again in 1988 by the Government to administer the Government's program. The Japan Rare Metal Association continued to manage the private program. According to MMAJ, by fiscal year 1988 ending March 1989, stockpiles of the seven rare metals were to be raised to a 47-day supply, of which the Government program would have a 32.9-day supply and the private program a 14.1-day supply. The 60-day supply goal was expected to be achieved in fiscal year 1991.

MITI's Basic Industries Bureau, Nonferrous Metal Div. initiated a new program in April called the Metal Industry Engineering Research Vitalization Activity, or the MINERVA project. The objective of the project was to set up research and development programs for developing the metal technology of aluminum-lithium alloys, intermetallic compounds, superconductive materials, and rare-earth metals recycling. The Japan Research and Development Center for Metal was established in Tokyo in June to undertake research and development planning. The center reportedly was funded by MITI and approximately 50 private companies, mainly from the mining, mineral processing, and metal fabricating industries.[4]

PRODUCTION

Mine production of all nonferrous minerals, except tungsten and pyrite, was lower than that of 1987 because of the closure of the Yatani Mine, a copper-lead-zinc operation in Yamagata Prefecture, and a drastic production cutback at the Kamaishi Mine, a copper-iron operation in Iwate Prefecture. Despite higher domestic market prices for copper and zinc, a further rise in yen value resulted in lower levels of most domestic mine output and more imports of inexpensive nonferrous ores. Mine output of most industrial minerals, especially dolomite, fire clay, limestone, pyrophyllite, and silica stone, however, was higher than that of 1987 because of increased demand by the domestic construction industry.

Despite stronger demand for nonferrous metals in 1988, production of base metals, except slab zinc, was lower than that of 1987 because of insufficient domestic and imported raw materials. More refined metals of copper, lead, and zinc were imported as a result. Domestic production of primary aluminum dropped to the lowest level in 38 years, and almost all of the domestic demand for primary aluminum was met by imports. However, production of steel and titanium sponge metal rebounded to a new high since 1985. Metal production of cadmium, gold, indium, magnesium, electrolytic manganese dioxide, rare-earth oxides, and titanium dioxide pigment continued to move higher because of stronger domestic demand. Production of cement and fertilizer materials also recovered nicely owing to increased domestic demand.

In line with Japan's Eighth National Coal Policy, the domestic output of coal continued to decline as the remaining eight major coal mining companies streamlined operations and cut back production. Production of natural gas and crude petroleum remained insignificant, but the petroleum refining industry operated at a higher rate because of increased consumption of refined petroleum products by the industrial and transportation sectors of the Japanese economy.

TRADE

Japan remained a major power in world trade and continued to enjoy a substantial merchandise trade surplus in 1988. Despite Government efforts to open the Japanese market for foreign manufactured goods by reducing tariffs on many manufactured goods and reevaluating its currency upward, Japan's trade surplus remained high because of much higher exports in 1988. Japan's merchandise trade surplus declined slightly to $77.6 billion from $79.7 billion in 1987.

Overall merchandise exports rose to $264.9 billion from $229.2 billion in 1987; imports also rose to $187.4 billion from $149.5 billion in 1987. Among the major export commodities,

TABLE 1

JAPAN: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987	1988[p]
METALS						
Aluminum:						
Alumina, gross weight	thousand tons	1,172	978	607	358	415
Metal:						
Primary:						
Regular grades	do.	287	227	140	41	35
High-purity	do.	4	5	8	12	14
Secondary	do.	819	861	[r]872	894	954
Antimony:						
Oxide		9,698	8,243	9,677	9,805	10,661
Metal		253	296	194	196	185
Arsenic, white (equivalent of arsenic acid)[e]		500	500	500	500	500
Bismuth		563	642	640	546	524
Cadmium		2,423	2,535	2,489	2,450	2,593
Chromium:						
Chromite, gross weight		7,420	11,920	10,642	11,815	9,508
Metal		3,452	3,557	2,987	3,235	[e]3,600
Cobalt metal		905	1,277	1,338	124	109
Columbium and tantalum: Tantalum metal		[r]96	[r]77	[r]66	87	123
Copper:						
Mine output, Cu content		43,309	43,208	34,924	23,817	16,666
Metal:						
Blister and anode:						
Primary		821,100	802,300	827,700	871,000	854,600
Secondary		107,900	130,300	124,400	109,200	139,400
Total		**929,000**	**932,600**	**962,100**	**980,200**	**994,000**
Refined:						
Primary		821,064	802,341	827,657	870,994	854,599
Secondary		114,092	133,636	115,380	109,355	100,509
Total		**935,156**	**935,977**	**943,037**	**980,349**	**955,108**
Gallium metal:						
Primary		10	10	10	10	6
Secondary		7	10	[r]10	16	28
Germanium:						
Oxide		11	14	14	13	14
Metal		8	10	9	5	4
Gold:						
Mine output, Au content	thousand troy ounces	104	171	331	276	235
Metal	do.	1,342	1,383	1,575	1,802	2,959
Indium metal	do.	482	514	579	875	1,554

See footnotes at end of table.

TABLE 1—Continued

JAPAN: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987	1988^p
METALS—Continued						
Iron and steel:						
Iron ore and iron sand concentrate:						
Gross weight	thousand tons	324	338	r291	266	96
Fe content	do.	202	212	182	167	60
Roasted pyrite concentrate (50% or more Fe)	do.	225	218	205	210	214
Metal:						
Pig iron and blast furnace ferroalloys	do.	80,403	80,569	74,651	73,418	79,295
Electric-furnace ferroalloys:						
Ferrochrome		323,930	349,496	286,925	272,298	304,642
Ferromanganese		485,008	441,703	359,044	332,286	378,351
Ferronickel		217,053	227,043	200,311	203,143	242,276
Ferrosilicon		153,386	150,167	107,236	73,706	73,767
Silicomanganese		233,061	216,916	148,429	91,896	106,970
Ferrochromium-silicon[2]		6,451	9,463	6,377	8,310	9,236
Other:						
Calcium silicon		1,724	2,496	2,005	1,419	1,360
Ferrocolumbium		1,031	1,072	862	714	649
Ferromolybdenum		3,299	3,143	1,894	2,032	2,656
Ferrotungsten		144	114	122	96	91
Ferrovanadium		3,733	3,353	2,867	2,639	3,776
Unspecified		2,727	2,575	2,015	1,384	1,761
Total[3]		**1,431,547**	**1,407,541**	**1,118,087**	**989,923**	**1,125,535**
Steel, crude	thousand tons	105,586	105,279	98,275	98,513	105,681
Semimanufactures, hot-rolled:						
Of ordinary steels	do.	82,765	82,731	78,136	78,825	84,100
Of special steels	do.	16,070	16,802	15,004	14,871	16,396
Lead:						
Mine output, Pb content		48,735	49,951	40,327	27,870	22,889
Metal, refined:						
Primary		233,816	233,706	232,732	218,770	217,689
Secondary		129,179	133,257	r128,720	119,730	122,260
Magnesium metal:						
Primary		7,103	r8,448	8,116	8,180	10,019
Secondary		15,656	20,894	13,400	10,300	10,020
Manganese:						
Ore and concentrate:						
Gross weight		61,635	21,140	5,905	—	—
Mn content		16,679	5,562	1,535	—	—
Oxide		47,807	49,081	57,159	66,731	67,460
Metal		4,323	r4,864	3,854	3,753	e4,000

See footnotes at end of table.

TABLE 1—Continued

JAPAN: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987	1988[p]
METALS—Continued						
Molybdenum:						
Mo content of concentrate[e]		147	98	—	—	—
Metal		493	565	586	624	652
Nickel metal:						
Refined		23,356	23,257	[r]24,155	21,397	19,961
Ni content of nickel oxide sinter		15,150	15,200	[r]18,953	22,301	24,185
Ni content of ferronickel		50,842	[r]54,589	[r]49,630	49,405	57,556
Total		**89,348**	**[r]93,046**	**[r]92,738**	**93,103**	**101,702**
Platinum-group metals:						
Palladium metal	troy ounces	33,802	43,703	46,699	45,568	37,617
Platinum metal	do.	19,523	22,216	21,312	24,202	20,791
Rare-earth oxide[4]		—	—	—	3,053	3,750
Selenium, elemental		465	497	427	481	471
Silicon, high-purity		908	1,471	2,094	1,671	1,545
Silver:						
Mine output, Ag content	thousand troy ounces	10,403	10,915	11,294	9,035	8,101
Metal, primary	do.	50,952	52,817	55,448	59,328	59,070
Tellurium, elemental		65	[r]56	56	63	60
Tin:						
Mine output, Sn content		485	510	500	86	—
Metal, smelter		1,354	1,391	1,280	895	846
Titanium:						
Metal		15,368	21,897	14,481	10,083	16,408
Oxide		204,685	217,695	222,941	238,323	258,478
Tungsten:						
Mine output, W content		477	568	579	259	266
Metal		2,386	2,638	2,557	2,713	3,481
Uranium metal[e]	kilograms	4,000	5,000	5,000	5,000	5,000
Vanadium metal[5]		700	762	843	[e]840	313
Zinc:						
Mine output, Zn content		252,700	253,021	222,071	165,675	147,217
Oxide		72,794	72,832	68,277	73,434	83,312
Metal:						
Primary		644,360	629,504	626,489	591,516	601,082
Secondary		162,317	160,652	[r]127,247	116,865	124,702
Zirconium:						
Metal[e]		45	45	45	45	45
Oxide		[r]6,020	[e]6,700	[e]6,700	7,430	7,345
INDUSTRIAL MINERALS						
Asbestos		3,100	2,971	3,593	3,143	[e]3,000
Barite		66,018	[r]76,665	52,848	31,625	—

See footnotes at end of table.

TABLE 1—Continued

JAPAN: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987	1988[p]
INDUSTRIAL MINERALS—Continued						
Bromine, elemental[e]		12,000	12,000	15,000	15,000	15,000
Cement, hydraulic	thousand tons	78,859	72,845	71,261	71,551	77,554
Clays:						
Bentonite		410,079	461,530	408,864	415,806	455,137
Fire clay		1,423,235	1,148,196	1,004,150	907,342	961,354
Kaolin		224,614	221,996	203,653	158,973	157,771
Feldspar and related materials:						
Feldspar		35,526	30,895	32,063	33,754	29,465
Aplite		441,005	469,386	457,375	466,479	526,286
Gypsum[e]	thousand tons	6,050	6,300	6,400	6,000	6,000
Iodine, elemental		7,302	7,251	7,389	7,014	7,451
Lime: Quicklime	thousand tons	7,753	7,454	6,717	6,745	7,726
Nitrogen: N content of ammonia	do.	1,668	1,628	1,508	1,556	1,524
Perlite[e]		75,000	75,000	75,000	75,000	75,000
Salt, all types	thousand tons	955	1,200	1,370	1,397	1,363
Sodium compounds, n.e.s.:						
Carbonate		1,036,133	1,057,102	1,020,869	1,098,465	1,083,121
Sulfate		278,941	276,814	253,450	255,313	246,541
Stone, crushed and broken:						
Dolomite	thousand tons	4,268	4,329	3,953	3,834	5,423
Limestone	do.	169,825	164,156	162,358	165,957	182,468
Sulfur:						
S content of pyrite	do.	259	253	158	79	70
Byproduct:						
Of metallurgy	do.	1,191	1,201	1,228	[e]1,220	[e]1,200
Of petroleum	do.	1,142	1,044	985	[r e]1,012	[e]1,077
Talc and related materials:						
Talc		84,522	78,616	63,851	53,927	49,213a
Pyrophyllite		1,414,424	1,355,625	1,270,112	1,241,069	1,244,491
Vermiculite[e]		17,000	17,000	17,000	17,000	17,000
MINERAL FUELS AND RELATED MATERIALS						
Carbon black	thousand tons	602	632	616	629	720
Coal:						
Anthracite	do.	23	26	13	10	9
Bituminous[6]	do.	16,622	16,357	15,999	13,039	11,214
Total	**do.**	**16,645**	**16,383**	**16,012**	**13,049**	**11,223**
Coke including breeze:						
Metallurgical	do.	48,145	48,622	45,132	43,717	47,727
Gashouse including breeze	do.	3,130	3,120	3,006	2,716	2,907
Fuel briquets, all grades	do.	306	315	241	200	185

See footnotes at end of table.

TABLE 1—Continued

JAPAN: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987	1988[p]
MINERAL FUELS AND RELATED MATERIALS—Continued						
Gas, natural:						
Gross[7]	million cubic feet	75,293	78,562	74,351	76,553	74,050
Marketed	do.	75,329	80,122	77,989	83,000	80,617
Natural gas liquids:						
Natural gasoline	thousand 42-gallon barrels	53	57	56	57	56
Liquefied petroleum gas from natural gas (field plants only)[e]	do.	300	300	300	300	300
Peat[e]		60	60	60	60	60
Petroleum:						
Crude	thousand 42-gallon barrels	2,962	3,929	4,629	4,453	4,353
Refinery products:						
Gasoline:						
Aviation	do.	88	75	82	57	57
Other	do.	227,678	215,514	214,866	216,136	222,904
Jet fuel	do.	23,499	27,229	25,285	25,348	24,272
Kerosene	do.	168,774	152,477	151,484	126,003	132,300
Distillate fuel oil	do.	155,817	147,596	164,308	158,685	160,730
Residual fuel oil	do.	479,836	408,655	386,452	378,659	399,899
Lubricants	do.	12,032	12,133	11,730	12,271	12,743
Asphalt and bitumen	do.	30,719	29,814	33,418	34,436	35,758
Liquefied petroleum gas	do.	47,029	50,243	44,010	45,029	46,784
Naphtha	do.	73,175	65,093	60,822	55,250	55,061
Paraffin	do.	1,050	994	[e]980	[e]900	[e]1,000
Petroleum coke	do.	881	1,088	956	824	937
Unfinished oils	do.	48,243	39,525	40,928	43,161	47,677
Refinery fuel and losses[8]	do.	130,666	153,968	136,458	140,464	133,961
Total	**do.**	**1,399,487**	**1,304,404**	**[e]1,271,779**	**[e]1,237,223**	**[e]1,274,083**

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

[1] Table includes data available through September 5, 1989.

[2] For reasons not evident in sources, these figures are reported as negative numbers. (See also footnote 3.)

[3] Sum of listed detail as reported, but adding quantity cited in footnote 2 as positive numbers. Japanese sources provide the following totals for ferroalloy output in the years indicated, in metric tons: 1984, 1,418,645; 1985, 1,388,615; 1986, 1,105,333; 1987, 973,303, and 1988, 1,107,063. These totals represent the sum of listed detail using the quantities in footnote 2 as negative numbers, thereby not only omitting the footnoted numbers, but actually subtracting them from the sum of all other alloys. The reason for this procedure in source publications is not explained.

[4] Includes oxide of cerium, europium, gadolinium, lanthanum, neodymium, praseodymium, samarium, terbium, yttrium, and neodymium fluoride.

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

[6] Includes coking coal and steam coal.

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

[8] May include some additional unfinished oils.

machinery and equipment remained the most important commodity group, accounting for 74% of total exports, followed by metal products, 8%; and chemicals, 5%. Among the major import commodities, mineral fuels remained the largest, accounting for 20%; followed by foodstuffs, 16%; machinery and equipment, 14%; raw materials, including soybeans, wood, and pulp, 9%; chemicals, 8%; and metal ores and scrap, 5%.

The United States remained the single most important trading partner of Japan, accounting for 33.8% of Japan's exports and 22.4% of Japan's imports. Of the $89.6 billion of merchandise exported to the United States in 1988, $29.8 billion was for transportation machinery; $20.2 billion, general machinery; $19.3 billion, electronic and electric machinery; $4.7 billion, metal products; $4.6 billion, precision instruments; $2.3 billion, chemicals; and $8.7 billion, other. Of the $42.0 billion of merchandise imported from the United States, $12.5 billion was for machinery and equipment; $9.5 billion, foodstuffs; $5.6 billion, raw materials including soybeans, wood, and pulp; $4.6 billion, chemicals; $1.6 billion, mineral fuels; $1.2 billion, nonferrous metals; $1.1 billion, metal ores and scrap; and $5.9 billion, other.

In metal and mineral trade, Japan remained the world's major exporter of aluminum and copper mill products, electrolytic manganese dioxide, steel, titanium sponge metal, cement, and nitrogen fertilizer materials. Japan was the world's largest importer of primary aluminum, coal, copper concentrate, gold, natural gas, platinum-group metals, and rare-earth minerals and metals. Japan remained one of the leading importers of chromium ore, crude petroleum, lead and zinc ore, nickel ore, manganese ore, ferroalloys except ferromanganese, and zircon. Export earnings from steel in 1988 totaled $15.3 billion; metals, $4.3 billion; and processed industrial minerals, $2.9 billion. Imports of crude petroleum and refined products were $25.8 billion; coal, $5.4 billion; nonferrous ores, $4.1 billion; and iron ore, $2.9 billion.

Japan relied on the Middle East in 1988 for more than 67% of its crude petroleum imports, on Indonesia for 48% of its natural gas in the form of LNG imports, and on Australia for more than 48% of its coal imports. Australia was one of Japan's major suppliers of primary aluminum, copper ore, refined gold, ilmenite, iron ore, lead ore, primary lead, manganese ore, refined nickel, rutile, zinc ore, slab zinc, and zircon sand. The Republic of South Africa was Japan's dominant supplier of manganese ore, chromium ore, ferrochromium, acid-grade fluorspar, industrial diamonds, platinum-group metals, titanium slag, and vanadium. China was the single most important supplier of antimony, barite, fluorspar, graphite, mica, rare earths, and silicon. The United States was the dominant supplier of phosphate rock and molybdenum and one of the major suppliers of primary aluminum, coal, copper ore, refined copper, industrial diamonds, primary magnesium, rare-earths, silver, and vanadium.

COMMODITY REVIEW

Metals

Aluminum.—Japan was almost totally dependent on imports to meet its requirements for primary aluminum in 1988. The country's domestic primary production dropped to a new low since 1950, while domestic demand surged to a record high in 1988. A further increase in demand, coupled with lower tariffs on imports of primary aluminum and a higher value of the Japanese yen, resulted in record imports. In 1988, Japan's imports of primary aluminum accounted for about one-third of the primary aluminum traded in the world.

Production of primary aluminum by Nippon Light Metal Co. Ltd. at the Kanbara smelter in Shizuoka Prefecture was only 35,347 tons, or 55% of plant capacity. Since April 1987, Nippon Light Metal had been the sole producer of primary aluminum in Japan. Its output was equivalent to just 1.5% of Japan's demand for primary aluminum in 1988.

To meet domestic demand in 1988, Japan imported 1,622,484 tons of regular-grade ingots, 575,926 tons of alloyed ingots, and 93,586 tons of high-grade ingots. Major suppliers of regular-grade ingots were Australia, 30%; the United States, 16%; Brazil, 13%; New Zealand, 11%; Venezuela, 10%; Indonesia, 7%; and Canada, 5%. The principal sources of alloyed ingots were the United Arab Emirates, 15%; the U.S.S.R., 14%; Australia, 11%; Canada, 10%; and the United States, 9%. Major suppliers of high-grade ingots were Brazil, 29%; the United Arab Emirates, 22%; and New Zealand, 18%.

Despite steady increases in supply from overseas captive-import development projects to 560,000 tons and long-term contracts to 590,000 tons, imports from spot markets continued to rise. These imports reached 900,000 tons because of further cuts in the tariff on primary aluminum to 1% in April 1988. Since 1987, Japan's reliance on imports of primary aluminum has exceeded 98%, accompanied by declining domestic production and steady growth in domestic demand. In 1988, Japan became a dominant force in the world market; its imports represented more than 30% of the primary aluminum traded in the world market.

Increased Japanese influence on the world primary aluminum market led to an agreement in early September between the Government and the London Metal Exchange (LME) to establish LME aluminum warehouses in Japan once amendments to Japanese customs laws have been enacted by the Japanese Diet (parliament). The Government reportedly began allowing companies to

TABLE 2

JAPAN: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
METALS				
Alkali and alkaline-earth metals	231	752	3	China 296; India 263.
Aluminum:				
Ore and concentrate	429	637	—	Republic of Korea 616; Taiwan 20.
Oxides and hydroxides	384,473	197,845	6,373	Canada 58,620; Republic of Korea 40,041.
Metal including alloys:				
Scrap	1,914	8,715	—	Taiwan 7,746; Republic of Korea 840.
Unwrought	2,021	1,937	199	Thailand 730; Republic of Korea 532.
Semimanufactures	225,463	213,775	110,367	Taiwan 19,996; Republic of Korea 15,080.
Antimony: Metal including alloys, all forms	2	NA		
Beryllium: Metal including alloys, all forms kilograms	811	1,000	—	NA.
Bismuth: Metal including alloys, all forms	257	NA		
Cadmium: Metal including alloys, all forms	452	NA		
Chromium:				
Ore and concentrate	283	309	—	Singapore 214; Republic of Korea 75.
Oxides and hydroxides	3,990	5,804	410	China 1,964; Taiwan 1,483.
Cobalt: Oxides and hydroxides	24	21	([2])	Republic of Korea 5; Vietnam 5.
Columbium and tantalum: Metal including alloys, all forms, tantalum	11	18	13	Republic of Korea 1.
Copper:				
Ore and concentrate	1,684	—		
Sulfate	603	NA		
Metal including alloys:				
Scrap	65,944	5,381	17	Taiwan 3,747; Republic of Korea 1,292.
Unwrought	24,295	73,070	6,107	Taiwan 35,484; Republic of Korea 16,906.
Semimanufactures	209,191	228,694	48,470	Taiwan 53,283; Hong Kong 35,916.
Gold:				
Waste and sweepings value, thousands	$4	NA		
Metal including alloys, unwrought and partly wrought troy ounces	187,324	NA		
Iron and steel:				
Iron ore and concentrate:				
Excluding roasted pyrite	108	24	—	All to Taiwan.
Pyrite, roasted	5	NA		
Metal:				
Scrap	461,048	377,397	23	China 138,079; Taiwan 134,527.
Pig iron, cast iron, related materials	1,073,827	50,969	7,627	Taiwan 29,859; Thailand 4,601.
Ferroalloys:				
Ferrochromium	3,433	NA		
Ferromanganese	6,857	19,122	7,556	North Korea 5,000; Indonesia 2,130.
Ferronickel	7,100	NA		

See footnotes at end of table.

TABLE 2—Continued

JAPAN: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
METALS—Continued					
Iron and steel—Continued					
Metal—Continued					
Ferroalloys—Continued					
Ferrosilicomanganese		16	NA		
Ferrosilicon		1,091	NA		
Unspecified		3,246	12,901	1,611	Republic of Korea 3,490; North Korea 2,669.
Steel, primary forms	thousand tons	2,979	2,764	297	Republic of Korea 732; Taiwan 519.
Semimanufactures:					
Bars, rods, angles, shapes, sections	thousand tons	6,417	3,505	774	China 1,167; Thailand 361.
Universals, plates, sheets		11,870	12,352	2,014	China 3,013; Republic of Korea 1,013.
Hoop and strip		620	466	60	China 162; Hong Kong 44.
Rails and accessories		246	235	68	China 67; Canada 57.
Wire		302	([3])		
Tubes, pipes, fittings		5,692	4,010	618	U.S.S.R. 1,428; China 630.
Castings and forgings, rough		20	15	8	Singapore 2; Taiwan 1.
Lead:					
Oxides		55	80	—	Vietnam 30; Republic of Korea 29.
Metal including alloys:					
Scrap		2,893	18,201	—	Taiwan 10,620; Republic of Korea 6,703.
Unwrought		25,379	17,147	2,263	North Korea 6,556; Singapore 3,479.
Semimanufactures		489	243	15	Republic of Korea 47; Singapore 38.
Magnesium: Metal including alloys, all forms		1,007	165	3	Thailand 49; China 41.
Manganese:					
Ore and concentrate, metallurgical-grade		1,293	1,853	—	Philippines 918; Republic of Korea 265; Taiwan 156.
Oxides		35,527	44,722	14,889	U.S.S.R. 6,750; Indonesia 3,848.
Mercury	76-pound flasks	7,904	5,801	2,001	Netherlands 3,277.
Molybdenum: Metal including alloys, all forms		63	81	2	Republic of Korea 22; Hungary 14.
Nickel:					
Ore and concentrate		—	([4])	—	All to Republic of Korea.
Matte and speiss		—	275	—	India 252; Indonesia 12.
Metal including alloys:					
Scrap		51	67	26	United Kingdom 37.
Unwrought		181	236	98	India 72; Indonesia 48.
Semimanufactures		2,225	1,098	403	Republic of Korea 169; China 85.
Platinum-group metals:					
Waste and sweepings	value, thousands	$1	—		
Metals including alloys, unwrought and partly wrought	do.	$15,970	$13,251	$4,877	Taiwan $3,769; West Germany $1,425.

See footnotes at end of table.

TABLE 2—Continued

JAPAN: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
METALS—Continued				
Selenium, elemental	171	NA		
Silver:				
Ore and concentrate[5]	8,700	2,475	—	Mainly to Republic of Korea.
Waste and sweepings value, thousands	$82	$786	—	West Germany $696; United Kingdom $67.
Metal including alloys, unwrought and partly wrought do.	$9,523	$12,847	$264	Taiwan $5,009; Republic of Korea $2,388.
Tin:				
Oxides	15	NA		
Metal including alloys:				
Scrap	5	41	—	Netherlands 34; United Kingdom 7.
Unwrought	56	87	([2])	Republic of Korea 44; United Kingdom 17.
Semimanufactures	407	512	3	Singapore 106; Tanzania 75.
Titanium:				
Oxides	22,209	29,492	7,032	Taiwan 8,538; China 4,770.
Metal including alloys, all forms	6,143	NA		
Tungsten: Metal including alloys, all forms	261	269	46	West Germany 91; Taiwan 36.
Uranium and/or thorium: Oxides and other compounds	406	—		
Zinc:				
Oxides	762	1,134	160	Taiwan 219; Republic of Korea 155.
Metal including alloys:				
Scrap	1,880	3,233	—	Taiwan 2,354; Republic of Korea 879.
Unwrought	24,962	53,237	15,486	China 12,294; Republic of Korea 6,091.
Semimanufactures	1,997	1,420	40	Taiwan 767; Republic of Korea 142.
Other:				
Ores and concentrates	8,862	169	51	Taiwan 91; Republic of Korea 78.
Ashes and residues	4,141	8,600	61	Taiwan 6,109; United Kingdom 948.
Base metals including alloys, all forms	3,214	10,483	2,924	United Kingdom 2,009; France 1,237.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	11,624	16,814	1	Republic of Korea 9,783; Hong Kong 3,500.
Artificial:				
Corundum	20,904	30,190	1,277	Republic of Korea 14,909; Taiwan 4,354.
Silicon carbide	4,171	NA		
Dust and powder of precious and semiprecious stones including diamond value, thousands	$3,775	$5,303	$2,776	Republic of Korea $1,220; Belgium-Luxembourg $528.
Grinding and polishing wheels and stones	7,147	6,856	1,510	Republic of Korea 945; Hong Kong 737.
Asbestos, crude	163	129	—	Taiwan 61; Republic of Korea 57.

See footnotes at end of table.

TABLE 2—Continued

JAPAN: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Destinations, 1987	
				United States	Other (principal)
INDUSTRIAL MINERALS—Continued					
Boron materials:					
Crude natural borates		1,405	1,593	—	Taiwan 1,449; China 144.
Oxides and acids		159	316	—	Republic of Korea 299.
Cement	thousand tons	5,617	4,336	974	Hong Kong 1,749; Saudi Arabia 834.
Chalk		—	124	—	Republic of Korea 104; Taiwan 20.
Clays, crude		64,931	65,636	290	Taiwan 38,363; Republic of Korea 18,032.
Cryolite and chiolite		10	36	—	Republic of Korea 30; Vietnam 5.
Diamond:					
Gem, not set or strung	value, thousands	$547	$1,620	$13	Belgium-Luxembourg $1,217; Hong Kong $285.
Industrial stones	do.	$150	$89	—	Republic of Korea $68; Taiwan $17.
Diatomite and other infusorial earth		1,506	1,400	33	China 549; Thailand 344.
Feldspar, fluorspar, related materials		32,979	31,526	—	Taiwan 29,458; Republic of Korea 864.
Fertilizer materials:					
Crude, n.e.s.		557	136	—	All to Taiwan.
Manufactured:					
Ammonia		393	190	1	Thailand 95; Republic of Korea 25.
Nitrogenous		717,616	797,463	12,793	Thailand 276,445; Malaysia 116,718.
Phosphatic		30,050	53,326	—	Burma 33,906; Bangladesh 15,000.
Potassic		310	385	—	Philippines 336; Taiwan 43.
Unspecified and mixed		123,621	176,915	1,957	Thailand 65,075; Pakistan 22,223.
Graphite, natural		2,666	2,020	380	Republic of Korea 468; Taiwan 287.
Gypsum and plaster		4,837	5,032	—	Taiwan 1,412; Malaysia 1,194; Indonesia 759.
Iodine including bromine and fluorine		6,641	NA		
Kyanite and related materials		12,473	NA		
Lime		7,842	1,153	—	Papua New Guinea 450; Republic of South Africa 342.
Magnesium compounds: Oxides and hydroxides	value, thousands	$53,973	$45,389	$6,910	Republic of Korea $8,275; U.S.S.R. $5,175.
Mica:					
Crude including splittings and waste		366	320	23	Republic of Korea 195; West Germany 45.
Worked including agglomerated splittings		944	1,001	36	Hong Kong 433; Taiwan 252.
Phosphorus, elemental		167	NA		
Pigments, mineral:					
Natural, crude		51	—		
Iron oxides and hydroxides, processed		18,587	29,648	2,070	Taiwan 13,024; Republic of Korea 9,492.
Precious and semiprecious stones other than diamond:					
Natural	value, thousands	$1,045	$2,036	$117	India $378; Hong Kong $365.
Synthetic	do.	$27,262	$31,260	$5,815	Taiwan $6,656; Republic of Korea $5,931.

See footnotes at end of table.

TABLE 2—Continued

JAPAN: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
INDUSTRIAL MINERALS—Continued					
Pyrite, unroasted		402	200	—	All to Australia.
Salt and brine		1,182	727	61	North Korea 319; Republic of Korea 71.
Sodium compounds, n.e.s.:					
Carbonate, manufactured		81,968	137,201	19	China 55,497; Indonesia 42,750.
Sulfate, manufactured		5,593	NA		
Stone, sand and gravel:					
Dimension stone:					
Crude and partly worked		828	327	30	Republic of Korea 249.
Worked		1,506	1,217	(2)	Singapore 475; Republic of Korea 342.
Dolomite, chiefly refractory-grade		1,883	1,304	—	Indonesia 1,100; Republic of Korea 115.
Gravel and crushed rock		87,916	75,284	54	Australia 74,275; Kuwait 198.
Limestone other than dimension		1,153,077	1,396,929	491	Australia 932,338; Taiwan 358,048.
Quartz and quartzite		518	938	31	Malaysia 247; United Kingdom 234.
Sand other than metal-bearing		3,687	4,930	11	Taiwan 2,549; Republic of Korea 873.
Sulfur:					
Elemental:					
Crude including native and byproduct		77,815	138,133	593	Republic of Korea 110,926; Taiwan 25,389.
Colloidal, precipitated, sublimed		1,201	1,692	2	Canada 784; Republic of Korea 555.
Sulfuric acid		500,421	510,209	30,791	Taiwan 159,556; Republic of Korea 107,703.
Talc, steatite, soapstone, pyrophyllite		3,518	2,654	97	Taiwan 920; Republic of Korea 584.
Other:					
Crude		29,590	30,223	659	Republic of Korea 18,703; Taiwan 5,077.
Slag and dross, not metal-bearing		392,976	406,263	34,964	Singapore 200,471; Philippines 91,004.
MINERAL FUELS AND RELATED MATERIALS					
Asphalt and bitumen, natural		12	31	—	All to Philippines.
Carbon black		8,405	9,425	480	Republic of Korea 2,100; Taiwan 2,079.
Coal, all grades including briquets		1,167	1,288	—	Republic of Korea 805; Thailand 335.
Coke and semicoke	thousand tons	2,348	3,170	666	Brazil 685; Romania 499.
Peat including briquets and litter		272	—		
Petroleum:					
Crude	42-gallon barrels	—	51	22	Australia 22.
Refinery products:					
Liquefied petroleum gas	thousand 42-gallon barrels	184	93	88	Hong Kong 3.
Gasoline	do.	122	1,632	—	Republic of Korea 590; Malaysia 569j; Singapore 381.
Mineral jelly and wax	do.	516	424	60	Taiwan 91; Republic of Korea 80.
Kerosene and jet fuel	do.	1,356	1,900	—	Iran 1,239; Republic of Korea 408; Singapore 201.

See footnotes at end of table.

TABLE 2—Continued

JAPAN: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Destinations, 1987 United States	Destinations, 1987 Other (principal)
MINERAL FUELS AND RELATED MATERIALS—Continued					
Petroleum—Continued					
Refinery products—Continued					
Distillate fuel oil	do.	2,270	3,380	—	Republic of Korea 1,658; Iran 1,447; Singapore 274.
Lubricants	do.	1,531	[6]176	3	Republic of Korea 60; China 25.
Nonlubricating oils	do.	246	NA		
Residual fuel oil	do.	1,797	3,299	([2])	Republic of Korea 3,295.
Bitumen and other residues	do.	17	22	—	Thailand 7; Hong Kong 6.
Bituminous mixtures	do.	8	4	—	Taiwan 1; Thailand 1.
Petroleum coke	do.	582	540	263	U.S.S.R. 99; Netherlands 57.

NA Not available.
[1] Excludes exports under Japanese-United States Mutual Defense Agreement or for account of U.S. military forces. Table prepared by Audrey D. Wilkes.
[2] Less than 1/2 unit.
[3] Unreported quantity valued at $284,174,000.
[4] Unreported quantity valued at $2,000.
[5] May include other precious metals.
[6] Excludes unreported quantity valued at $104,378,000.

submit applications to establish LME warehouses in September 1988. However, LME aluminum warehouses in Japan were not to become operational unless such issues as duties and warehouse fees, among others, were resolved by the two parties before mid-1989.[5]

Domestic demand for primary aluminum rose in 1988 by 11% to 2.3 million tons, a record high. According to MITI, demand for primary aluminum was by manufacturers of aluminum mill products, 1,731,400 tons; secondary smelting, 258,280 tons; aluminum casting, 100,641 tons; aluminum electric wire, 65,363 tons; steel deoxidization, 35,605 tons; diecasting, 30,906 tons; and other, 62,666 tons.

Aluminum mill products such as plate, sheet, and strip products were consumed mainly for production of beverage cans, automobiles, and household appliances; foil, mainly for foodstuff packaging and household utensils; and extruded products, principally for production of sashes, verandas, and gates used by the building and construction industries. According to a Japanese industry source, the rapid increase in consumption of beer cans and the continued high rate of housing starts were motivating Japan's rolled aluminum mill products industry to expand its capacity.

Japan increased investments in 1988 in overseas aluminum smelting projects in Brazil, Canada, the United States, and Venezuela in order to secure long-term, stable supply souces of primary aluminum for its rapidly growing aluminum rolling sector. In early 1988, Mitsui & Co. Ltd., Toyo Sash Co. Ltd., and Yoshida Kogy K.K. acquired a 25% interest in two aluminum smelters from Alumax Inc. of the United States for $210 million. In return, Alumax was to deliver 25% of its annual output or 110,000 tons per year of primary aluminum to Japan starting in 1989.

Construction to double the smelter capacity of Aluminio Brasileiro Ltda. (ALBRAS) to 320,000 tons per year was started in May. Nippon Amazon Aluminium Co., a 33-member Japanese consortium, provided $73.5 million as a 49% equity partner for a portion of the $625 million expansion project. Japan has received 49% of ALBRAS's smelter output annually and was expected to receive the same percentage share upon completion of the expansion project in late 1991.[6]

A finance and supply agreement was signed in December between Marubeni Corp. of Japan and Industria Venezolana de Aluminio CA (Venalum) of Venezuela to expand Venalum's smelter capacity to 453,000 tons per year. The smelter capacity was expanded by 55,000 tons to 335,000 tons per year in mid-1988. Under the agreement, Marubeni was to provide $100 million for the expansion project. In return, Venalum was expected to deliver 400,000 tons per year of primary aluminum to Japan over the

TABLE 3

JAPAN: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987	
				United States	Other (principal)
METALS					
Alkali and alkaline-earth metals		1,186	640	141	China 294; France 141.
Aluminum:					
Ore and concentrate	thousand tons	2,307	1,872	(2)	Australia 1,119; Indonesia 495.
Oxides and hydroxides	value, thousands	$19,913	$21,513	$7,339	West Germany $8,426; France $1,926.
Metal including alloys:					
Scrap		358,813	430,642	246,827	Australia 29,362; United Kingdom 28,780.
Unwrought	thousand tons	1,366	1,835	239	Australia 398; Brazil 221.
Semimanufactures		35,595	55,325	10,646	Romania 7,074; Hungary 5,604.
Antimony:					
Ore and concentrate		6,400	NA		
Oxides		3,609	NA		
Metal including alloys, all forms		3,985	NA		
Arsenic: Oxides and acids		161	NA		
Beryllium:					
Oxides and hydroxides		100	NA		
Metal including alloys, all forms	value, thousands	$584	$602	$595	West Germany $5.
Chromium:					
Ore and concentrate		670,625	674,743	—	Republic of South Africa 454,757; Madagascar 81,227.
Oxides and hydroxides		2,300	2,407	928	West Germany 811; U.S.S.R. 282.
Cobalt:					
Oxides and hydroxides		460	432	24	Belgium-Luxembourg 289; Finland 68.
Metal including alloys, all forms		3,453	NA		
Columbium and tantalum:					
Ore and concentrate		1,717	NA		
Metal including alloys, all forms, tantalum		46	49	37	West Germany 8.
Copper:					
Ore and concentrate	thousand tons	3,037	2,981	390	Canada 976; Philippines 344.
Matte and speiss including cement copper		33	21	—	All from Taiwan.
Sulfate		650	NA		
Metal including alloys:					
Scrap		79,467	96,458	34,669	Hong Kong 21,117; Saudi Arabia 10,699.
Unwrought		303,034	380,425	5,991	Zambia 167,592; Chile 70,037.
Semimanufactures		21,134	26,287	2,447	Taiwan 15,459; Republic of Korea 5,852.
Germanium: Metal including alloys, all forms	kilograms	2,878	NA		
Gold:					
Waste and sweepings	do.	1,666	NA		
Metal including alloys, unwrought and partly wrought	thousand troy ounces	19,542	NA		

See footnotes at end of table.

TABLE 3—Continued

JAPAN: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS—Continued				
Indium: Metal including alloys, all forms kilograms	21,524	NA		
Iron and steel:				
Iron ore and concentrate, excluding roasted pyrite thousand tons	115,234	112,034	—	Australia 43,414; Brazil 26,831; India 20,255.
Metal:				
Scrap do.	3,224	2,358	929	U.S.S.R. 426; Australia 301.
Pig iron, cast iron, related materials do.	968	1,443	2	U.S.S.R. 371; Republic of South Africa 314.
Ferroalloys:				
Ferrochromium	372,513	NA		
Ferromanganese	7,125	27,425	—	Republic of South Africa 8,976; Brazil 6,059; Canada 5,476.
Ferromolybdenum	1,065	NA		
Ferronickel	38,700	NA		
Ferrosilicochromium	10,356	NA		
Ferrosilicomanganese	176,821	NA		
Ferrosilicon	350,069	NA		
Silicon metal	103,860	NA		
Unspecified	11,936	1,016,558	572	Republic of South Africa 308,937; China 181,006.
Steel, primary forms	1,743,567	2,537,197	32,805	Republic of Korea 930,838; Brazil 438,653.
Semimanufactures:				
Bars, rods, angles, shapes, sections[3]	142,810	541,817	1,081	Republic of Korea 241,897; Brazil 57,372.
Universals, plates, sheets[4]	1,230,439	1,606,737	9,199	Republic of Korea 683,840; Romania 292,114.
Hoop and strip[5]	3,937	14,909	308	Republic of Korea 11,059; Indonesia 1,002.
Rails and accessories	2,286	2,868	1	Republic of Korea 2,731; West Germany 69.
Wire[6]	27,104	32,890	149	Republic of Korea 31,447; China 299.
Tubes, pipes, fittings[7]	106,384	212,899	2,930	Republic of Korea 202,124; Saudi Arabia 1,569.
Castings and forgings, rough	3,512	2,252	59	China 1,387; Republic of Korea 573.
Lead:				
Ore and concentrate	273,829	294,734	2,140	Canada 101,327; Australia 80,474.
Oxides	12,070	19,720	6	Mexico 11,163; France 3,364.
Metal including alloys:				
Scrap	83	65	—	All from Papua New Guinea.
Unwrought	70,346	49,414	16	Australia 16,934; Republic of Korea 10,205.
Semimanufactures	43	51	35	Republic of Korea 11; France 4.
Lithium:				
Oxides and hydroxides	885	NA		
Metal including alloys, all forms	50	NA		

See footnotes at end of table.

TABLE 3—Continued

JAPAN: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987	
				United States	Other (principal)
METALS—Continued					
Magnesium: Metal including alloys:					
Scrap		472	495	—	Taiwan 386; Malaysia 69.
Unwrought		12,643	13,521	9,159	Norway 2,967; Canada 692.
Semimanufactures		398	489	409	Republic of Korea 66.
Manganese:					
Ore and concentrate, metallurgical-grade	thousand tons	1,807	1,581	—	Republic of South Africa 775; Australia 501.
Oxides		1,421	2,632	22	Belgium-Luxembourg 2,134; China 292.
Mercury	76-pound flasks	860	2,175	—	China 1,769; Algeria 203.
Molybdenum:					
Ore and concentrate		18,024	NA		
Oxides and hydroxides		414	NA		
Metal including alloys, all forms		290	380	163	West Germany 129; Austria 37.
Nickel:					
Ore and concentrate	thousand tons	2,886	2,927	—	Indonesia 1,179; New Caledonia 1,083; Philippines 664.
Matte and speiss		58,187	54,610	—	Indonesia 32,981; Australia 20,586.
Metal including alloys:					
Scrap	value, thousands	$6,114	$10,983	$5,683	Taiwan $2,552; Kuwait $885.
Unwrought		24,475	42,633	119	U.S.S.R. 10,643; Zimbabwe 6,016.
Semimanufactures		5,256	5,264	652	United Kingdom 2,558; Canada 1,080.
Platinum-group metals:					
Waste and sweepings	kilograms	3,179	NA		
Metals including alloys, unwrought and partly wrought	value, thousands	$736,003	$1,270,913	$95,550	Republic of South Africa $551,584; U.S.S.R. $394,719.
Rare-earth metals including alloys, all forms		132	NA		
Selenium, elemental		8	NA		
Silicon, high-purity		66	NA		
Silver:					
Ore and concentrate		1,907	24,024	19,456	Australia 4,019; Malaysia 525.
Waste and sweepings	kilograms	819	[8]8,027	2,259	Taiwan 4,896; Malaysia 840.
Metal including alloys, unwrought and partly wrought	value, thousands	$88,829	$143,001	$11,081	Mexico $77,161; Peru $29,950.
Tellurium, elemental		1	NA		
Tin:					
Ore and concentrate		2	NA		
Oxides		9	NA		
Metal including alloys:					
Scrap		4	15	—	Philippines 11; Republic of Korea 4.
Unwrought		32,311	33,598	5	Malaysia 17,049; Thailand 6,525.
Semimanufactures		278	72	6	Thailand 39.

See footnotes at end of table.

TABLE 3—Continued

JAPAN: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987	
				United States	Other (principal)
METALS—Continued					
Titanium:					
Ore and concentrate		670,436	NA		
Oxides		4,864	6,613	219	Republic of Korea 2,310; China 1,309.
Tungsten:					
Ore and concentrate		1,769	1,938	—	Portugal 702; Republic of Korea 378; Australia 350.
Metal including alloys, all forms		255	284	23	Republic of Korea 172; West Germany 59.
Uranium and/or thorium:					
Ore and concentrate	value, thousands	—	$10	—	Brazil $8; Niger $2.
Oxides and other compounds	kilograms	1,068	NA		
Metal including alloys, all forms	value, thousands	$37	$26	$26	
Vanadium:					
Ore and concentrate		68	NA		
Oxides and hydroxides		3,101	NA		
Zinc:					
Ore and concentrate		916,166	974,026	11,224	Australia 439,206; Peru 209,280.
Oxides		7,368	9,093	16	Republic of Korea 4,000; Taiwan 3,502.
Metal including alloys:					
Scrap		57	4	—	All from Singapore.
Unwrought		101,444	116,885	7	North Korea 36,487; Republic of Korea 24,495.
Semimanufactures		857	1,652	65	France 785; Norway 456.
Zirconium:					
Ore and concentrate		171,709	NA		
Metal including alloys, all forms		131	NA		
Other:					
Ores and concentrates		10,769	772,458	4,523	Australia 328,738; Malaysia 217,053.
Oxides and hydroxides		576	NA		
Ashes and residues		76,268	55,929	10,080	Australia 20,514; Taiwan 5,131.
Base metals including alloys, all forms		5,284	18,858	2,381	China 5,560; Republic of South Africa 4,800.
INDUSTRIAL MINERALS					
Abrasives, n.e.s.:					
Natural: Corundum, emery, pumice, etc.		6,820	7,260	1,243	India 4,616; Australia 755.
Artificial:					
Corundum		28,050	38,028	80	China 26,428; Hungary 5,745.
Silicon carbide		28,475	NA		
Dust and powder of precious and semiprecious stones including diamond	value, thousands	$87,971	$92,909	$23,732	Ireland $65,606.
Grinding and polishing wheels and stones		388	782	55	Taiwan 241; Austria 145; Italy 135.

See footnotes at end of table.

TABLE 3—Continued

JAPAN: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987	
				United States	Other (principal)
INDUSTRIAL MINERALS—Continued					
Asbestos, crude		255,732	277,277	12,356	Canada 91,432; Republic of South Africa 69,030.
Barite and witherite		30,962	69,014	18	China 68,958.
Boron materials:					
Crude natural borates		57,250	62,321	—	Turkey 61,140; U.S.S.R. 1,077.
Elemental[9]		44	NA		
Oxides and acids		25,236	26,195	19,558	Italy 5,615; Turkey 700.
Bromine and iodine		3,078	NA		
Cement		1,196,485	2,554,075	285	Republic of Korea 1,533,442; Taiwan 1,016,388.
Chalk		205	82	22	France 60.
Clays, crude	thousand tons	991	1,073	710	China 135; Brazil 68.
Cryolite and chiolite		357	340	—	Denmark 238; Greenland 102.
Diamond:					
Gem, not set or strung	value, thousands	$941,154	$1,428,315	$168,246	Belgium-Luxembourg $416,006; Israel $380,474.
Industrial stones	do.	$16,796	$18,389	$3,946	Zaire $2,153; Ghana $1,764.
Dust and powder	thousand carats	37,419	NA		
Diatomite and other infusorial earth		3,901	5,006	4,894	China 97.
Feldspar, fluorspar, related materials:					
Feldspar		6,766	NA		
Fluorspar		527,236	NA		
Unspecified		—	545,528	6	China 390,195; Thailand 63,652.
Fertilizer materials:					
Crude, n.e.s.		24,585	4,029	—	Indonesia 1,931; Philippines 1,339; France 318.
Manufactured:					
Ammonia		1	1	—	All from West Germany.
Nitrogenous		203,285	282,073	20,610	Qatar 93,226; Indonesia 45,701.
Phosphatic		107,919	140,396	58,397	China 58,346; Republic of Korea 22,190.
Potassic		1,199,454	1,439,824	175,346	Canada 707,222; U.S.S.R. 169,768.
Unspecified and mixed		374,144	571,107	396,376	Republic of Korea 143,752; Jordan 11,000.
Graphite, natural		58,645	94,268	236	Republic of Korea 48,886; China 34,646.
Gypsum and plaster		776,349	1,470,836	545	Thailand 1,290,670; Australia 86,471.
Kyanite and related materials		28,653	NA		
Lime		(2)	8	—	All from Taiwan.
Magnesium compounds:					
Magnesite, crude		33,613	NA		
Oxides and hydroxides		233,320	(10)		
Other		82	—		

See footnotes at end of table.

TABLE 3—Continued

JAPAN: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987	
				United States	Other (principal)
INDUSTRIAL MINERALS—Continued					
Mica:					
Crude including splittings and waste		15,143	17,282	290	China 5,972; India 5,096.
Worked including agglomerated splittings		166	251	([11])	India 154; Belgium-Luxembourg 90.
Nitrates, crude		—	818	—	All from Chile.
Phosphates, crude	thousand tons	2,076	2,160	1,202	Morocco 502; Jordan 293.
Phosphorus, elemental		25,119	NA		
Pigments, mineral:					
Natural, crude		847	NA		
Iron oxides and hydroxides, processed		8,552	10,815	3,675	West Germany 5,491; India 378.
Precious and semiprecious stones other than diamond:					
Natural	value, thousands	$219,778	$343,200	$3,425	Thailand $106,215; Colombia $64,978.
Synthetic	do.	$9,440	$11,806	$5,704	Malaysia $2,605; Switzerland $1,650.
Pyrite, unroasted		28,246	205,100	—	China 134,428; Australia 66,064.
Salt and brine	thousand tons	6,614	6,830	([2])	Australia 3,240; Mexico 3,010.
Sodium compounds, n.e.s.:					
Carbonate, natural and manufactured		4,283	335	—	Kenya 300; U.S.S.R. 35.
Sulfate, manufactured		95,856	NA		
Stone, sand and gravel:					
Dimension stone:					
Crude and partly worked		870,355	1,041,210	28,172	Republic of Korea 302,243; India 209,432.
Worked		148,296	258,893	431	Republic of Korea 118,161; China 65,280.
Dolomite, chiefly refractory-grade		520,560	767,672	2,252	Philippines 246,495; Taiwan 204,164.
Gravel and crushed rock		189,709	272,394	177	Taiwan 241,186.
Limestone other than dimension		15,721	34,459	3	Philippines 33,052.
Quartz and quartzite		120,638	121,876	1,198	India 71,627; Thailand 22,300.
Sand other than metal-bearing		1,227,223	1,648,395	1,013	Australia 899,900; Taiwan 424,058.
Sulfur:					
Elemental:					
Crude including native and byproduct		2,023	68	—	China 50; Republic of Korea 18.
Colloidal, precipitated, sublimed		58	99	6	China 73; France 17.
Sulfuric acid		13	58	2	Taiwan 54.
Talc, steatite, soapstone, pyrophyllite		614,422	579,171	20,778	China 457,078; Australia 84,701.
Other:					
Crude		245,979	378,238	7,126	Republic of Korea 158,463; Spain 121,958.
Slag and dross, not metal-bearing		435,323	432,765	442	Chile 132,003; Republic of South Africa 88,387.
MINERAL FUELS AND RELATED MATERIALS					
Asphalt and bitumen, natural		3,322	23,752	2,784	China 20,196.
Carbon black		10,846	16,979	11,411	Republic of Korea 1,687; Canada 1,096.

See footnotes at end of table.

TABLE 3—Continued

JAPAN: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987	
				United States	Other (principal)
MINERAL FUELS AND RELATED MATERIALS—Continued					
Coal:					
Anthracite and bituminous	thousand tons	91,347	92,554	9,256	Australia 47,126; Canada 16,845.
Lignite including briquets		25,415	42,541	951	U.S.S.R. 35,085; Australia 5,389.
Coke and semicoke		44,977	125,795	27,478	Australia 55,192; China 24,268.
Gas, natural: Liquefied	thousand tons	28,394	NA		
Peat including briquets and litter		31,577	38,818	635	Canada 34,492; U.S.S.R. 1,884.
Petroleum:					
Crude	thousand 42-gallon barrels	1,157,267	1,131,957	—	Saudi Arabia 249,411; United Arab Emirates 217,521; Indonesia 146,762.
Refinery products:					
Liquefied petroleum gas	do.	137,719	[12]484,613	10,836	Malaysia 70,840; Saudi Arabia 70,722.
Gasoline	do.	132,945	153,714	6,026	Saudi Arabia 43,888; Kuwait 17,624; Singapore 13,872.
Mineral jelly and wax	do.	174	96	39	China 21.
Kerosene and jet fuel	do.	32,859	57,886	2,574	Singapore 18,026; Saudi Arabia 16,209.
Distillate fuel oil	do.	9,836	28,404	2,729	Algeria 3,490; United Arab Emirates 2,512.
Lubricants	value, thousands	$69,531	$93,781	$43,608	Singapore $16,275; West Germany $9,808.
Residual fuel oil	thousand 42-gallon barrels	103,377	109,943	7,104	Indonesia 33,237; Singapore 17,199.
Bitumen and other residues	do.	250	384	208	Singapore 39.
Bituminous mixtures	do.	13	12	5	Republic of Korea 4.
Petroleum coke	do.	21,415	21,371	19,612	U.S.S.R. 643; China 352.

NA Not available.
[1] Excludes imports under Japanese-United States Mutual Defense Agreement or for account of U.S. military forces. Table prepared by Audrey D. Wilkes.
[2] Less than 1/2 unit.
[3] Excludes unreported quantities valued at $10,246,000 in 1986 and $12,002,000 in 1987.
[4] Excludes unreported quantities valued at $2,797,000 in 1986 and $4,880,000 in 1987.
[5] Excludes unreported quantities valued at $12,393,000 in 1986 and $2,675,000 in 1987.
[6] Excludes unreported quantities valued at $8,562,000 in 1986 and $16,992,000 in 1987.
[7] Excludes unreported quantities valued at $27,344,000 in 1986 and $27,118,000 in 1987.
[8] May include platinum-group metals.
[9] May include some arsenic.
[10] Unreported quantity including crude magnesite, valued at $40,427,000 imported mainly from China.
[11] Unreported quantity valued at $30,000.
[12] Includes liquefied natural gas.

next 8 years. Venalum was 20%-owned by a six-member Japanese consortium led by Showa Denko Co. Ltd.; Marubeni was one of the six member companies.[7]

A five-member Japanese consortium signed a memorandum of understanding in May with SGF, a Quebec Provincial government industrial holding company, to participate in building a $1 billion aluminum smelter with an initial capacity of 250,000 tons per year along the St. Lawrence Waterway in Quebec. The Japanese consortium consisted of Mitsubishi Corp., Mitsubishi Metal Corp., Kobe Steel Ltd., Toyo Sash Co. Ltd., and Yoshida Kogyo K.K.[8] Japanese overseas aluminum smelter operations in 1988 are shown in table 4.

Cadmium and Bismuth.—Japan was the second largest producer of cadmium and the third largest producer of bismuth in the world in 1988. Produc-

TABLE 4

JAPAN: OVERSEAS ALUMINUM SMELTING OPERATIONS

Company and country	Japanese equity participation (percent)	Annual capacity (metric tons)	Japanese share (metric tons)
Alcan Smelters and Chemical Ltd., Canada	50	90,000	45,000
Aluminio Brasileiro Ltda., Brazil	49	320,000	160,000
Industria Venezolana de Aluminio C.A., Venezuela	20	335,000	160,000
New Zealand Aluminium Smelters Ltd., New Zealand	21	244,000	50,000
P.T. Indonesia Asahan Aluminum, Indonesia	59	225,000	150,000[1]
Total	**XX**	**1,214,000**	**565,000**

XX Not applicable.
[1] Under a master agreement signed in the 1970's, the Japanese share equals 225,000 tons minus Indonesia domestic consumption. However, a new Japanese share was still under negotiation due to a change in capital structure and Indonesian demand in 1988.

Source: Ministry of International Trade and Industry (Tokyo). Metal Industry, 1988, p. 17.

tion of cadmium was recovered as a byproduct of zinc smelting; bismuth was recovered as a byproduct of lead smelting. The major producers of cadmium and bismuth and their output shares in 1987 are shown in table 5.

Despite Japan's significant share in world production of cadmium and bismuth, the raw material requirements for production of the two metals were dependent not only on domestic lead and zinc ore and other materials, but also to a larger extent on imports of lead and zinc ore and concentrates, mainly from Australia, Canada, and Peru. According to MITI, about 66% of Japan's raw material requirements for lead and zinc metal production in 1988 was met by imports. Because cadmium and bismuth were derived as byproducts of lead and zinc smelting, about two-thirds of Japan's raw material requirements for cadmium and bismuth were also dependent on imported ore.

TABLE 5

JAPAN: OUTPUT SHARE OF CADMIUM AND BISMUTH IN 1987, BY COMPANY

(Percent)

Company	Cadmium	Bismuth
Dowa Mining Co. Ltd.	15.3	37.4
Mitsubishi Metal Corp.	15.5	6.4
Mitsui Mining and Smelting Co. Ltd.	26.5	26.9
Nippon Mining Co. Ltd.	17.9	15.2
Sumitomo Metal Mining Co. Ltd.	10.6	6.4
Toho Zinc Co. Ltd.	13.7	7.7
Nisso Metals and Chemicals Co. Ltd.	.5	—
Total	**100.0**	**100.0**

Source: Japan Metal Journal (Tokyo). V. 18, No. 38, Sept. 19, 1988, pp. 1-2.

Although in past years, Japan had been 100% self-sufficient in cadmium and bismuth, the country became a net importer of these metals for the first time in 1988. Japan exported just 158 tons of cadmium and 68 tons of bismuth in 1988. Because of stronger cadmium demand for production of nickel-cadmium batteries and increased bismuth demand for ferrites, Japan imported 2,545 tons of cadmium and 326 tons of bismuth. The major suppliers of cadmium were the Republic of Korea, 25%; Belgium and China, 21% each; Australia, 11%; and Canada, 10%. The principal sources of bismuth were China, 56%, and the Republic of Korea, 33%.

About 78% of the cadmium was consumed in the manufacture of nickel-cadmium batteries in Japan. According to the Japan Mining Industry Association, demand for cadmium rose from 761 tons in 1982 to 1,443 tons in 1984 and then to 1,760 tons in 1987 because of rapid expansion of applications of nickel-cadmium batteries, especially for portable personal computers and cellular car telephones. In the past, nickel-cadmium batteries had been mainly for railroad crossing signal lighting, toys, video cassette recorders, and cordless telephones. Other end uses of cadmium included pigment, 197 tons; alloys, 76 tons; stabilizer of plastics, 72 tons; and other, 151 tons.

Consumption of bismuth totaled 481 tons, of which 54% was for ferrites; 18%, metallurgical additives; 11%, low-melting alloys; 3%, pharmaceuticals; and 14%, other. Demand for bismuth for ferrites grew from 72 tons in 1982 to 111 tons in 1984 and then to 261 tons in 1987.

Chromium.—Domestic chromium ore production by Nippon Chrome Industries Ltd. remained insignificant. Most domestic ore was used as refractory materials. Japan's metallurgical-grade chromium requirements for production of ferrochromium and chromium metal were totally met by imports. As a result of increased demand by the iron and steel industry, imports of chromium ore rose 45% to 976,168 tons and ferrochromium increased 11% to 473,707 tons in 1988.

The Republic of South Africa remained Japan's dominant chromium supplier in 1988, accounting for 60% of chromium ore imports and 56% of ferrochromium imports. Other major suppliers of chromium ore were India, 10%; Madagascar, 9%; Albania, 8%; and the U.S.S.R., 4%. Other principal suppliers of ferrochromium were India, 14%; Zimbabwe, 11%; and the Philippines, 9%.

Consumption of metallurgical-grade chromium ore by the ferroalloy industry for production of ferrochromium rose to 600,127 tons from 529,319 tons (revised) in 1987. Because of the continuing rise in demand for ferrochromium in Japan, NKK Corp. (formerly Nippon Kokan K.K.) reportedly reactivated one of the previously idled furnaces at its Toyama plant in Toyama Prefecture in October. Japan remained the third largest producer and the largest consumer of ferrochromium in the world in 1988. Consumption of ferrochromium by the specialty steel industry reached a record high of 790,000 tons, compared with 700,000 tons in 1987.

High-purity chromium metal (99.9% to 99.99% Cr) was produced by Tosoh Corp. (formerly Toyo Soda Manufacturing Co. Ltd.) at its Yamagata plant, with an annual capacity of 3,600 tons, using the electrolytic process. Nippon Denko Co. Ltd. produced the metal at its Tokushima plant, with an annual capacity of 700 tons, using the alumino thermic process. To meet increased demand for high-purity chromium metal in the Japanese market, Japan Metals and Chemical Co. Ltd. completed construction of a 60-ton-per-year plant at Oguni in Yamagata Prefecture in early 1988. Showa Denko Co. Ltd. reportedly was testing a new process to produce chromium metal with a 99.99% purity.

Japan imported 724 tons of chromium metal grading between 99.1% and 99.5% chromium in 1988 to meet domestic demand. Two major suppliers were the United Kingdom, 457 tons, and the United States, 175 tons. Japan exported 2,014 tons of chromium metal products, of which 863 tons went to the United States, 386 tons to the Netherlands, 156 tons to Belgium, 123 tons to the United Kingdom, 100 tons to the U.S.S.R., and the remainder to other European Community countries.

Japan's domestic demand was estimated at 1,600 tons, of which 60% was for superalloys, 20% for chromium-aluminum alloy, 17% for welding rods, and the remainder for electronic materials. Recently, Japan developed alloys of high-purity chromium metal with cobalt, copper, and nickel for magnetic materials used in the electronics industry.

Copper, Lead, and Zinc.—Despite higher domestic market prices, 1988 mine production of copper, lead, and zinc declined to a new low since 1946, 1954, and 1959, respectively. A further decline in domestic ore production was caused by continued streamlining of existing nonferrous metal mines through employment reductions and by closure of the Yatani Mine in Yamagata Prefecture. As a result, Japan's imports of copper, lead, and zinc ores rose by 15%, 8%, and 10%, respectively, in 1988.

The Yatani Mine, a copper-lead-zinc operation, was closed by Yatani Mining Co. Ltd. in March because of unprofitable operations in past years. The Kamaishi Mine in Iwate Prefecture, a copper-iron ore mine, was restructured to a small-scale mining operation from a major operation. Kamaishi Mining Co. Ltd. (formerly Shin-Kamaishi Mining Co. Ltd.) reduced the number of its workers to only 19 from 186 in 1987. According to MITI, as of April 1988, a number of major nonferrous metal mines remained in operation. The mines' output of copper, lead, and zinc in 1987 is shown in table 6.

Domestic production of copper, lead, and zinc ores was equivalent to only 1.7%, 8.5%, and 21.7%, respectively, of Japan's smelter requirements in 1988. In order to meet the raw material requirements for its nonferrous metal smelters, Japan imported 3,435,547 tons of copper ore and concentrate, 294,728 tons of lead ore and concentrate, and 1,068,407 tons of zinc ore and concentrate in 1988.

Major suppliers of copper ore to Japan in 1988 were Canada, 916,324 tons; the United States, 516,512 tons; the Philippines, 471,161 tons; Papua New Guinea, 385,335 tons; Chile, 304,779 tons; Indonesia, 280,919 tons; Australia, 202,206 tons; and Malaysia, 104,040 tons. Principal sources of lead and zinc ores were Australia, supplying 64,697 tons of lead ore and 518,615 tons of zinc ore; Canada, 94,901 tons of lead ore and 180,237 tons of zinc ore; and Peru, 32,030 tons of lead ore and 190,273 tons of zinc ore. Imports of lead and zinc ore from the United States were 6,290 tons and 29,282 tons, respectively.

In an effort to diversify its overseas supply sources of copper ore, Japanese Escondia Project, a consortium formed

TABLE 6

JAPAN: MINE PRODUCTION OF COPPER, LEAD, AND ZINC IN 1987

(Metric tons, metal content)

Company and location	Copper	Lead	Zinc
Hanaoka Mining Co. Ltd., Hanaoka, Akita	9,323	8,007	36,204
Kamioka Mining and Smelting Co. Ltd., Kamioka, Gifu	—	3,148	57,408
Shin-Kamaishi Mining Co. Ltd., Kamaishi, Iwate	([1])	—	—
Toyoha Mining Co. Ltd., Toyoha, Hokkaido	—	11,577	41,542
Uchinotai Mining Co. Ltd., Uchinotai, Akita	1,612	3,288	10,473
Other[2]	12,882	1,850	20,048
Total	**23,817**	**27,870**	**165,675**

[1] Included in other.

[2] Includes four small-scale nonferrous metal mines in Nurukawa, Aomori; Kamaishi, Iwate; Ashio, Tochigi; and Kuka, Yamaguchi.

Source: The Ministry of International Trade and Industry of Japan.

by Japanese smelters, signed a long-term purchase agreement in March with the Chilean Government and committed $350 million for the copper project. Commercial operation of La Escondia copper mine was scheduled to begin in 1991, with an annual capacity of 320,000 tons of copper in concentrate, of which a large portion was to be shipped to Japan. Ore reserves at La Escondia deposit were estimated at 662 million tons, averaging 2.1% copper.

A five-member official Japanese delegation was sent to Oman in July to sign a protocol agreement with the Government of Oman for a 2-year joint copper exploration project in the Hail Al Safil and Waka areas of the Batinah region in Oman. Japan reportedly was to provide $2 million for a geological survey, core drilling, mineralization tests, and an economic feasibility study. Ore reserves in the two areas were estimated at 4 million tons.[9]

Despite a higher domestic price and stronger demand for copper, production of refined copper decreased because of reduced refining capacity and insufficient raw materials. Furukawa Electric Co. Ltd. permanently shut down its 57,600-ton-per-year Nikko refinery in Tochigi Prefecture in March owing to inadequate raw material supplies and its disadvantageous inland location. As a result, copper refining capacity declined to 1,182,000 tons per year, with capacity utilization averaging 81% in 1988. In order to meet stronger domestic demand, imports of refined copper rose by 21% to 420,834 tons. Major suppliers were Zambia, 152,031 tons; Chile, 97,687 tons; the Philippines, 48,729 tons; the United States, 34,515 tons; Australia, 27,647 tons; and Peru, 21,710 tons.

In order to secure refined copper from an overseas captive-import project, Furukawa Co. Ltd., a major copper smelter, and Nissho Iwai Corp., a trading firm, jointly acquired a 40% interest in Electrolytic Refining & Smelting Co. of Australia, a leading Australian copper smelter, for $13 million in December. The two Japanese firms also agreed to invest $50.8 million, or 40% of the $127 million project, for renovating and expanding the smelter capacity at Port Kembla, south of Sydney in Australia, to 80,000 tons per year from 40,000 tons. Furukawa, which shut down the Ashio smelter and Nikko refinery in Tochigi Prefecture in March, was expected to receive 20,000 tons per year of refined copper when the expansion is completed in 1991.[10]

Mitsubishi Metal Corp., a major nonferrous metal producer, reportedly planned to build a $230 million copper smelter with an annual capacity of 120,000 tons per year in the United States. According to U.S. industry sources, the smelter is expected to be built in Texas City, south of Houston, Texas, for easy access to copper ore from Chile and other Latin American countries. Mitsubishi Metal, which acquired a 20% interest from Cox Creek Refining Co. of Baltimore, Maryland, in June 1987, reportedly planned to refine part of the anodes at Cox Creek Refining. Mitsubishi Metal reportedly had conducted a feasibility study and was expected to announce its decision in January 1989.[11]

Because of the continued rise in consumption by Japanese manufacturers of wire and cable, domestic demand for refined copper rose 4.7% to 1.5 million tons, of which 68% was for wire and cable, 30% for brass mills, and the remainder for copper alloys, coinage, powder, and other. Exports of refined copper dropped 54% to 28,262 tons, of which 46% went to Taiwan, 17% to the Republic of Korea, and the remainder to Indonesia and other countries. In anticipation of continued growth in demand, overall stocks of refined copper held by producers, fabricators, and dealers rose 18% to 111,012 tons at yearend.

Production of primary lead decreased slightly because of reduced domestic ore input. However, production of slab zinc rose slightly, resulting from increased zinc refining capacity.

Mitsubishi Metal expanded its electrolytic capacity at the Akita plant in Akita Prefecture in January by 8,400 tons to 105,600 tons per year. In May, Hachinohe Smelting Co. Ltd. also expanded its distillation capacity at the Hachinohe plant in Aomori Prefecture by 24,000 tons to 108,000 tons per year. As a result, the zinc refining capacity increased to 896,040 tons per year. Expansion of domestic zinc refining capacity took place in response to the continued rise in domestic demand by the galvanizing sector.

To meet stronger domestic demand for primary lead and slab zinc, imports rose 144% and 7% to 51,289 tons and 112,772 tons, respectively, in 1988. Primary lead was imported mainly from Mexico, 17,718 tons; Australia, 16,240 tons; China, 4,964 tons; Peru, 3,638 tons; and Taiwan, 3,215 tons. Slab zinc was imported principally from North Korea, 41,033 tons; the Republic of Korea, 28,912 tons; Canada, 13,756 tons; and Australia, 11,309 tons.

Consumption of primary lead rose 7% to 293,796 tons in 1988 because of a 10% increase in demand by the storage battery sector to 188,014 tons and a 7% rise in demand by the inorganic chemical sector to 65,624 tons. Consumption of slab zinc rose 3% to 760,215 tons owing to a 7% rise in demand to 475,632 tons by the galvanizing sector and a 15% increase in demand to 37,934 tons by the inorganic chemical sector. Exports of primary lead dropped sharply to 402 tons from 4,167 tons in 1987. Exports of slab zinc also declined to 21,129 tons from 51,854 tons in 1987. At yearend, overall stocks of primary lead rose 21% to 31,215 tons, overall stocks of slab zinc dropped 5% to 84,955 tons.

Gold and Silver.—Mine production of gold and silver continued to decline in 1988. The reduction was due to diminished output as byproducts (especially silver) from copper, lead, and zinc mines and reduced production from two major primary gold and silver mines in response to the lower gold prices in 1987–88. According to MITI, gold produced by Sumitomo Metal Mining Co. Ltd. from the Hishikari Mine declined to 203,160 troy ounces in 1987 from 249,264 troy ounces in 1986. Silver production declined to 106,033 troy ounces from 168,052 troy ounces. Gold produced by Mitsui Kushikino Mining Co. Ltd. from the Kushikino Mine also declined to 8,295 troy ounces in 1987 from 9,356 troy ounces in 1986; silver declined to 52,855 troy ounces from 58,257 troy ounces.

Although the Hishikari Mine was still in the exploration stage, ore production had been raised to 380 tons per day. The average ore grade, however, was lower in 1988 than that of previous years. According to Sumitomo Metal Mining, lower and medium-grade ores (between 4 and 10 grams of gold per ton of ore) were blended and sold in 1988 to Mitsui Mining and Smelting Co. Ltd. and Nippon Mining Co. Ltd. at the rate of 1,000 tons per month, each under a 6-month contract.

As a result of continued exploration, Sumitomo Metal Mining discovered another gold deposit nearby at Hishikari Yamada. Ore reserves at the Hishikari Yamada deposit were estimated at 2 million tons, averaging 20 grams to 25 grams of gold per ton, according to a Japanese source. Tunneling for further exploration was scheduled to begin in June 1990.[12]

Domestic metal production of gold rose sharply to a record high owing to processing of more imported gold-rich copper ore and increased refining capacity. Metal production of silver declined slightly, however, because of reduced input of domestic ore. Gold metal production by raw material sources was 14% from domestic ore, 75% from imported ore, and 11% from scrap and other. Silver metal production by source of raw material was 16% from domestic ore, 52% from imported ore, and 32% from scrap and other.

Mitsubishi Metal, Japan's largest precious metals producer, expanded its gold refining capacity at the Osaka plant to 60 tons per year in 1988. The company began construction of a $23 million precious metals refinery in Naoshima, Kagawa Prefecture, in September. With an annual capacity of 60 tons per year of precious metals, including gold, platinum, and palladium, the refinery was scheduled for completion in November 1989.

Japan's gold and silver metal production was equivalent to 21% and 57%, respectively, of gold and silver demand in 1988. Because of stronger demand for gold by the jewelry sector and for private hoarding, imports of gold metal rose 22% to 9.4 million troy ounces. Of this total, 40% was from Switzerland, 16% from Australia, 13% from Canada, 10% from the United Kingdom, 8% from the U.S.S.R., and the remainder from the United States and other countries. Imports of silver metal surged 52% to 30.8 million troy ounces owing to a 13% increase in silver consumption in 1988. Mexico and Peru remained the two principal sources, supplying 49% and 21%, respectively, in 1988.

Japan was a major world consumer of gold and silver. About 56% of gold demand was for private hoarding and jewelry, and 55% of silver demand was for photographic materials. According to

TABLE 7

JAPAN: DEMAND FOR GOLD AND SILVER

(Gold in kilograms, silver in metric tons)

Item	1986	1987	1988
Gold:			
Dental and medical	13,318	11,927	13,028
Electrical, electronic, and communications apparatus	32,736	34,420	35,602
Gold plating	22,880	19,111	18,895
Gilding	695	408	695
Jewelry	83,008	84,003	95,525
Decorations and badges	426	401	695
Pottery and porcelain	3,521	4,028	4,345
Fountain pens	320	421	550
Watches	1,192	914	728
Industrial arts and crafts	3,118	3,121	3,151
Private hoarding	146,711	131,847	149,734
Other	52,251	60,777	113,879
Total	**360,176**	**351,378**	**436,827**
Silver:			
Silver nitrate for photography	1,462	1,595	1,765
Silver nitrate for other uses	234	257	298
Electrical contacts	213	219	260
Brazing alloy	116	116	135
Electroplating	99	152	174
Rolled products	125	164	174
Jewelry and silverware	53	69	93
Other	478	293	331
Total	**2,780**	**2,865**	**3,230**

Source: Ministry of International Trade and Industry of Japan.

MITI and Japanese industry sources, demand for gold and silver by end user in 1986–88 is as shown in table 7.

Indium.—Japan was the world's largest producer of indium in 1988. The continued high level of indium prices and rapid growth in the application of indium-tin oxide for production of transparent electrodes motivated the four Japanese producers to produce a record-high quantity of indium metal. The amount of indium produced by Nippon Mining Co. Ltd. at its Saganoseki plant in Oita Prefecture was about 24 tons. Dowa Mining Co. Ltd. at its Kosaka plant in Akita Prefecture, Mitsui Mining and Smelting Co. Ltd. at its Takehara plant in Hiroshima Prefecture, and Sumitomo Metal Mining Co. Ltd. at its Harima plant in Hyogo Prefecture together produced about 24 tons. According to Japanese industry sources, between 18 and 20 tons of indium was recovered by recycling scrap of indium phosphate, compound semiconductors, and other scrap containing indium.

Despite higher import prices, imports of indium remained at a high level, but slightly less than that of 1987. In 1988, Japan imported 29.6 tons of indium, mainly from the United States, 8.7 tons; France, 6.7 tons; Italy, 5.6 tons; Canada, 4.8 tons; and China, 1.5 tons. The average import c.i.f. price was $309 per kilogram, compared with $192 per kilogram in 1987.

According to The Rare Metal News of Japan, total demand for indium in 1988 rose 22% to 59.6 tons. Estimated consumption by user in 1988 was as follows: indium-tin oxide for transparent electrodes, 16 tons; indium-boron oxide for fluorescents, 12 tons; semiconductors, 8 tons; and fusible alloy solder, 6.5 tons; dental amalgams and demisters, 3 tons each; electrical contact points, 2.6 tons; batteries, bearings, videcom tubes, and other, 11.1 tons.

Iron and Steel.—During 1988, the Kamaishi Mine in Iwate, the only major iron mine in Japan, and other major nonferrous metal mines cut back mine output. As a result, domestic production of iron ore and roasted pyrite dropped to a record low representing just 0.3% of Japan's iron ore requirements. Virtually all of Japan's iron ore requirements were met by imports.

Because of increased demand for iron ore by the blast furnace sector, imports of iron ore, including sinters, pellets, and iron sands rose by 10% to 123.4 million tons. Of this total, 42.5% was from Australia, 22.6% from Brazil, 17.6% from India, 4% each from Chile and the Republic of South Africa, and 9.3% from other countries. Among these major suppliers, imports from Australia increased by 9 million tons, accounting for 79% of increased iron ore imports in 1988. Japan also imported 311,388 tons of ferruginous manganese ore from the Republic of South Africa, 83.6%, and India, 16.4%.

Consumption of iron ore rose 8% to 129.4 million tons; production of pig iron, mostly by blast furnaces, also rose 8% to 79.3 million tons. About 99% of pig iron production was for steelmaking and 1% for foundry. Despite brisk demand, the iron and steel industry scrapped 2 of its 50 blast furnaces and scaled down its blast furnace capacity by 1 million tons to 101.9 million tons. Only 37 of 48 blast furnaces operated in 1988. Overall pig iron capacity was reduced by 1 million tons to 102 million tons per year in 1988. Blast furnace productivity, as measured by tons of pig iron output per cubic meter of blast furnace volume per day, rose to 1.89 from 1.76 in 1987.[13]

Japan had been importing more pig iron than ferrous scrap since 1987, because the world price of pig iron was lower than that of ferrous scrap. As a result, imports of pig iron rose by 102% to 2.9 million tons while imports of ferrous scrap declined by 24% to 1.8 million tons. Increased domestic supplies of steel scrap also resulted in a decline in imports of ferrous scrap. Japan's import reliance on ferrous scrap dropped to 4.3% from 5.7% in 1987. The United States provided 754,000 tons of ferrous scrap, accounting for 42% of Japan's ferrous scrap imports in 1988.

Japan remained the world's second largest crude steel producer, accounting for 13.6% of the world's production in 1988. Benefiting from the continued rise in domestic demand by the construction and manufacturing industries, crude steel production topped the 100-million-ton level for the first time in 3 years and reached a new record since 1980. Of the crude steel produced in 1988, 70.3% was processed by basic oxygen furnaces and 29.7% by electric furnaces. Japan remained the most efficient producer of rolled steel in the world, with a continuous casting ratio of 93.3%, compared with 59.8% in the United States and 16.1% in the U.S.S.R. in 1988.

The industry scrapped 7 of its 85 basic oxygen furnaces and 24 of its 514 electric furnace in 1988. As a result, the industry's crude steel capacity was scaled down to 143.3 million tons per year from 152.2 million tons per year in 1987. The number of continuous casting machines was also reduced to 149 from 151 in 1987, but capacity was raised to 87.5 million tons per year from 87.2 million tons in 1987.

According to the Japan Iron and Steel Federation, the continued rise in demand for steel by the construction and manufacturing industries generated an increase in Japan's apparent steel consumption in crude steel equivalence to 86.8 million tons from 75.8 million tons in 1987. Exports of steel in crude steel equivalence declined further, however, to 26.1 million tons from 28.0 million tons while imports rose to 7.3 million tons from 5.3 million tons owing to a higher yen value. In terms of per-capita apparent crude steel consumption, Japan ranked the world's top consumer at 620 kilograms, compared with 422 kilograms for the United States and 577 kilograms for the

U.S.S.R. in 1987.

According to MITI, domestic demand during 1987–88, for ordinary and specialty steel products by end use is as shown in table 8.

Exports of iron and steel products declined in 1988 for the third time since 1986 to 23.7 million tons from 25.7 million tons in 1987. Despite lower export volume, export earnings rebounded to $16.1 billion from $13.1 billion in 1987 because of higher export unit prices. Higher export unit prices in 1988 were attributed to further yen appreciation and a shift in export product mix to higher value added steel products such as electrical sheets, seamless pipe, and tubes, from long and flat-rolled products such as bars, wire rods, cold-rolled coils, and heavy plates.

Exports of iron and steel products in 1988 included 19.9 million tons of ordinary steel, 2.9 million tons of specialty steel, 572,000 tons of ordinary and specialty steel wire, 159,000 tons of slab and semimanufactured steel, and 122,000 tons of pig iron, ferroalloys, cast iron pipe, and clad steel sheets. Among the exported iron and steel products, only seamless pipe and tubes registered a 28% increase in volume because of increased shipments to China, the Middle East, the U.S.S.R., and the United States. Iron and steel products were exported mainly to China, 4.9 million tons; the United States, 4.3 million tons; Taiwan, 2.2 million tons; the Republic of Korea, 1.9 million tons; the U.S.S.R., 1.8 million tons; and Thailand, 1.3 million tons.

Imports of iron and steel products in 1988 rose by 49% to 11.1 million tons and topped the 10-million-ton level for the first time in history. Despite further yen appreciation, the total value of imports rose by 85% to $4.7 billion. The higher import value reflected a larger import volume and higher import unit prices.

Imports of iron and steel products included 6.2 million tons of ordinary steels, 2.9 million tons of pig iron, 1.3 million tons of ferroalloys, 559,000 tons of slab and semimanufactured steels, and 148,000 tons of specialty steels, processed steels, clad steels, and cast iron pipes. Among imported iron and steel products, pig iron rose 102% and two major steel products, wide strips and heavy and medium plates, had double-digit increases. Imports of pig iron were principally from China and accounted for 45% of pig iron imports. Imports of ordinary steels were mainly from the Republic of Korea and accounted for 44%; Brazil, 12%; and Taiwan, 7% respectively, of ordinary steel imports.

According to the Japan Iron and Steel Federation, the combined interim financial results of its 40 member companies for the 6 months ending in September 1988 showed a remarkable improvement in net profits over the same period in 1987. Stronger domestic demand, higher prices of steel products, lower costs of imported raw materials, and cost reductions due to restructuring programs all contributed to the higher profits in 1988, despite a lower volume of steel exports.

Financial results of the top five steelmakers for the 6 months ending in September 1988 included the following: Nippon Steel Corp. reported a $300 million profit, compared with a $40 million loss in the same period of 1987; NKK Corp. reported a $150 million profit, compared with a $19 million loss; Kawasaki Steel Corp. reported a $169 million profit, compared with a $15 million loss; Sumitomo Metal Industries Ltd. reported a $182 million profit, compared with a $29 million loss; and Kobe Steel Ltd. reported an elevenfold increase in profits to $76 million. According to the Japan Economic Journal, the combined pretax profits of the top six steelmakers, including Nisshin Steel Co. Ltd., for the 12 months ending in March 1989, were expected to reach $4 billion compared with $1 billion in the previous fiscal year.

In order to develop a new smelting process technology for the next generation, a joint R&D Task Force was formed in February by the top five

TABLE 8

JAPAN: DOMESTIC ORDER FOR ORDINARY AND SPECIALTY STEEL PRODUCTS, BY END USE

(Thousand metric tons)

End use	Ordinary		Specialty	
	1987	1988	1987	1988
Automobiles	9,499	10,833	2,147	2,454
Construction	14,110	15,529	523	547
Conversion and processing	2,975	3,495	3,400	3,805
Electric machinery	2,379	2,820	73	96
Home and office equipment	638	796	193	247
Industrial machinery	1,521	1,858	957	1,188
Rolling stock	37	47	21	28
Shipbuilding	1,770	1,935	45	60
Steel dealers	18,640	19,884	1,122	1,364
Tanks and containers	2,056	2,119	31	37
Other	273	325	65	70
Total	**53,898**	**59,641**	**8,577**	**9,896**

Source: The Japan Iron and Steel Federation.

steelmakers and three other major steel producers, including Nisshin Steel, Nakayama Steel Works, and Godo Steel Co. Ltd. The technology involves direct reduction of pig iron using powdered iron ore and powdered steam coal, without the process of sintering and coking, according to officials of the task force headquartered at the Japan Iron and Steel Federation in Tokyo. The 7-year R&D project reportedly was to cost between $77 million and $150 million, of which 70% was to be funded by MITI. The first year budget for the project in 1988 was about $7 million, of which $4.6 million was funded by MITI and the remainder by the eight participating steel producers.

According to an industry official, about $23 million was to be spent on the project between 1988 and 1990, using the research facilities of Kawasaki Steel's Chiba Works. Nippon Steel was to conduct experiments for designing a pilot plant to scale up daily capacity to 50 tons from 5 tons. During 1991-94, several pilot plants were to be built for experimentation and to gather additional data for the feasibility studies. The technology was expected to reduce as much as 20% of the building costs of the reduction furnaces and up to 20% of the production cost. The technology also could provide operational flexibility for easy shutdown or restart to cope with market conditions.[14]

Lithium.—Japan was a major world consumer of lithium in 1988. All of Japan's raw material requirements for lithium compound and lithium metal was met by imports. Imports of raw materials included mainly lithium carbonate, lithium hydroxide, and lithium metal. Because of increased demand for cathode materials used in lithium batteries and lower import prices in the past 2 years, imports of lithium rose substantially.

During 1986-88, imports of lithium carbonate rose to 3,318 tons from 2,431 tons, lithium hydroxide to 935 tons from 885 tons, and lithium metal to 95.2 tons from 49.7 tons. Major suppliers in 1988 were the United States, 1,827 tons, and Chile, 1,261 tons, for lithium carbonate; the United States, 831 tons, and China, 70 tons, for lithium hydroxide; and the United States, 59 tons, and the United Kingdom, 28 tons, for lithium metal.

Lithium sheet for batteries in Japan had been produced since 1981 by Asahi Higashi Kinzoku Kogy Co., a subsidiary of Honjo Chemical Co., using imported lithium metal. Because of increased demand for lithium metal by the lithium batteries manufacturer, Asian Lithium Corp., a joint venture firm of Honjo Chemical and Lithium Corp. of America, planned to build a $4 million lithium metal production plant with an annual capacity of 100 tons of lithium metal in Naoshima, Kagawa Prefecture. Lithium metal production was scheduled to begin in July 1989. Asian Lithium began production of organic lithium compound in 1986 using the technology of Lithium Corp. of America.

Yahagi Iron Co., a ferroalloy producer, reportedly began production in March of lithium metal with a purity of 99.9% lithium at its Nagoya plant. Using the vacuum evaporation process, the plant was capable of producing 5 to 6 tons per year of high-purity lithium metal. The high-purity lithium metal produced by this process was able to be used to manufacture lithium batteries and lithium alloy since it contained little natorium and nitrogen.[15] Other lithium metal producers in Japan included Mitsui Mining and Smelting Co. Ltd. and Honjo Metal Co. Ltd.

According to Honjo Chemical, which had a 70% lithium market share in Japan, demand for lithium metal for production of lithium batteries was expected to grow rapidly and to reach 129 tons in 1989. Japan's demand for lithium metal was estimated at 100 tons in 1988, of which 70 tons was for lithium batteries and 30 tons for organic lithium compounds used as a catalyst for soluble polymer polybutadiene, styrene butadiene rubber, and thermoplastic resins.

Magnesium.—Production of primary magnesium reached a new high since 1979; industry capacity was expanded by 5,000 tons per year to 19,500 tons per year in July. A sharp increase in domestic demand for magnesium by the manufacturers of aluminum alloy and nodular cast iron also contributed to the rise in production. In 1988, 67% of Japan's magnesium requirement was met by imports.

Primary magnesium was produced by Furukawa Magnesium Co. Ltd., with an annual capacity of 7,000 tons per year in Oyama, Tochigi Prefecture; Ube Industries Ltd., with an annual capacity of 7,500 tons per year in Ube, Yamaguchi Prefecture; and Nichiju M.A. Co. Ltd., with an annual capacity of 5,000 tons per year in Takaoka, Toyama Prefecture. In late 1988, Furukawa Magnesium announced that it planned to cease magnesium production at the end of March 1989 because of its outdated production facilities and continued yen appreciation, which had made imported magnesium more competitive. Nichiju M.A., a joint venture of Japan Metals & Chemical Co. Ltd. and Kanematsu Gosho Ltd., completed its primary magnesium plant and commenced operation in July at an initial rate of 150 tons per month. Nichiju reportedly used the magnetherm process.

Imports of primary magnesium rose from 13,521 tons in 1987 to 15,305 tons in 1988. Principal suppliers were the United States, 63%; Norway, 18%; and the U.S.S.R., 7%. The average import c.i.f. price per ton rose to $3,243 from $2,801 in 1987. Exports of primary magnesium declined from 65.3 tons to just 37.5 tons, of which 15.8 tons went to Thailand, 10 tons to India, 9.7 tons to Indonesia, and 2 tons to Taiwan.

According to MITI, domestic demand for primary magnesium rose to 22,896 tons from 21,431 tons in 1987. Stronger demand by the manufacturers of aluminum alloy and nodular cast iron accounted for most of the increased consumption. In 1988, primary magnesium was consumed mainly for light metal rolling, accounting for 58%; aluminum alloys, 12%; and nodular cast iron, 11%. Other uses included light metal casting and die casting, powder, and magnesium galvanic anodes.

Manganese.—Japan continued to rely on imports for all of its manganese requirements in 1988. Because of increased demand by the iron and steel industry, imports of manganese ore and concentrate rose 30% to 1,610,725 tons, of which 40,200 tons was high-grade manganese dioxide ore and concentrate; 1,364,261 tons, metallurgical-grade manganese ore containing more than 39% manganese, and the remainder containing less than 39% manganese. Major suppliers of manganese dioxide ore in 1988, were the Republic of South Africa, 23,526 tons; Australia, 6,289 tons; Congo, 5,000 tons; and China, 2,988 tons. Principal suppliers of metallurgical-grade manganese ore were the Republic of South Africa, 785,537 tons; Australia, 531,310 tons; Brazil, 107,460 tons; and Canada, 86,616 tons.

According to MITI, consumption of manganese ore by the iron and steel industry rose 28% to 1.2 million tons, of which 707,594 tons was for production of ferromanganese and the remainder for production of pig iron, crude steel, metallic manganese, electrolytic manganese dioxide (EMD), and other uses.

Metallic manganese was produced by Tosoh Corp., with an annual capacity of 6,000 tons, and Chuo Denki Kogyo Co. Ltd., 1,800 tons.[16] Because of stronger demand by the makers of specialty steel and nonferrous alloys, production of metallic manganese rebounded to the 4,000-ton level.

Japan was the world's largest producer of EMD in 1988, accounting for more than 50% of world production. According to Japanese industry sources, EMD was produced by four companies with four plants in Japan and two plants overseas. Production capacity by company and location at the end of 1988 is shown in table 9.

Production of EMD moved higher during 1988, because of increased demand by manufacturers of dry-cell batteries in the domestic and overseas markets. According to the Japan Association of Dry Battery Manufacturers, domestic consumption of EMD increased from 22,269 tons in 1986 to 24,167 tons in 1987 and then to 25,201 tons in 1988. Exports of EMD rose from 35,118 tons in 1986 to 44,074 tons in 1987 and then to 45,218 tons in 1988. Exports of EMD to the United States also increased from 8,053 tons in 1986 to 14,657 tons in 1987 and then to 14,828 tons in 1988. According to the Japanese Ministry of Finance, the average export price to the United States f.o.b. Japan declined from $1,252.35 per ton in 1986 to $1,191.70 per ton in 1987 and then to $1,115.88 per ton in 1988.

TABLE 9

JAPAN: ELECTROLYTIC MANGANESE DIOXIDE PRODUCTION CAPACITY IN 1988

(Metric tons)

Company and location	Annual capacity
Domestic:	
Mitsui Mining & Smelting Co. Ltd., Takehara, Toyama Prefecture	25,000
Tosoh Corp., Hyuga, Miyazaki Prefecture	24,000
Japan Metals & Chemical Co. Ltd., Takaoka, Toyama Prefecture	18,000
Daiichi Carbon Co. Ltd., Yokohama, Kanagawa Prefecture	3,000
Subtotal	**70,000**
Overseas:	
Mitsui Mining & Smelting Co. Ltd., Ireland	12,000
Tosoh Corp., Greece	12,000
Subtotal	**24,000**
Total	**94,000**

Source: The Rare Metal News (Tokyo). No. 1504, July 1, 1989, p. 3.

An antidumping petition was filed in April 1988 by Cemetals Inc. and Kerr-McGee Chemical Corp. of the United States against Japanese producers. The petition alleged that imported electrolytic manganese dioxide from Greece, Ireland, and Japan had been sold in the United States at less than fair market value and that the U.S. industry was being injured or being threatened with injury.

According to the preliminary investigation by the U.S. Department of Commerce (DOC) in November, dumping margins found on imports from Japan were 78.62% from Mitsui Mining & Smelting, 72.02% from Tosoh Corp., and 73.57% from all others. The dumping margin on imports from Greece was 34.03%, which covered all companies including Tosoh's operation in Greece. No dumping was found from Ireland. A final dumping determination by the DOC was scheduled to be released in February 1989. A final ruling by the U.S. International Trade Commission (ITC) was to follow within 45 days on whether the U.S. industry was being injured or threatened with injury by the imports. If the ITC ruling was affirmative, antidumping duties were to be imposed.

Molybdenum.—All of Japan's raw material requirements for molybdenum were met by imports in 1988. Because of increased demand by the ferroalloy and chemical industries, imports of roasted molybdenum concentrate increased from 17,115 tons in 1987 to 22,927 tons, of which 31.1% was from Chile, 30.8% from the United States, 28.3% from Canada, and 7.2% from the Netherlands.

According to MITI, consumption of molybdenum concentrate increased from 8,136 tons in 1987 to 9,514 tons, of which 2,801 tons was for production of ferromolybdenum, 2,399 tons for molybdenum briquets, 1,839 tons for inorganic chemicals, 665 tons for molybdenum metal, and 1,810 tons for other.

Production of both ferromolybdenum and molybdenum metal increased owing to stronger demand by makers of specialty steel and magnetic materials. To meet domestic demand, Japan also imported 1,486 tons of ferromolybdenum, principally from Austria, 469 tons; China, 401 tons; and Chile, 335 tons. Imports of molybdenum metal, including ingots and powder, increased sharply from 152 tons in 1987 to 525 tons. The United States provided 253 tons and the Federal Republic of Germany 215 tons.

Consumption of molybdenum metal increased from 1,569 tons in 1987 to 1,694 tons, of which 619 tons was for production of steel wire, sheet, and bar; 461 tons for specialty steel; 2 tons for magnetic materials; and 612 tons for other. The end users of molybdenum metal included nuclear powerplants and makers of electrical machinery and equipment, aircraft parts, magnets, and alloy powder.

Nickel.—Japan continued to rely on imports for all of its raw material requirements for nickel in 1988. The country remained the world's third largest producer of nickel metal, including ferronickel, nickel oxide, and refined nickel. Despite a higher nickel price in the world market, imports of nickel ore and nickel matte continued to increase owing to increased demand by the stainless steel industry.

Imports of nickel ore rose to a new high since 1981, amounting to 3.3 million tons. Of this amount, 42% was from New Caledonia, 34% from Indonesia, and 24% from the Philippines. Consumption of nickel ore increased to 2.5 million tons from 2 million tons in 1987. Production of ferronickel by Pacific Metal Co. Ltd., Sumitomo Metal Mining Co. Ltd., and Nippon Yakin Kogyo Co. Ltd. rose to a new high since 1981. Japan also imported a record amount of ferronickel, totaling 48,664 tons in 1988, to meet increased demand by the stainless steel industry. The major suppliers of ferronickel were New Caledonia, 25,043 tons; the Dominican Republic, 10,319 tons; Indonesia, 8,479 tons; and Colombia, 4,081 tons.

Imports of nickel matte increased 9.7% to 58,756 tons in 1988. Indonesia provided 63% and Australia provided 37%. Production of nickel oxide increased, while production of refined nickel declined. In 1988, refined nickel was produced mainly by Sumitomo Metal Mining at its 21,600-ton-per-year Niihama plant. Nickel oxide was produced by Tokyo Nickel Co. Ltd. at its 36,000-ton-per-year Matsuzaka plant and by Nippon Nickel Co. Ltd. at its 8,000-ton-per-year Tsuruga plant.

Nippon Nickel was liquidated in June because of the termination of its toll smelting agreement with Tokyo Nickel and the lack of raw materials. Nippon Nickel was established in 1968 as a joint-venture company of SLN of New Caledonia (34%), the raw material supplier, and three Japanese companies, Nippon Yakin (26%), Nippon Mining (24%), and Pacific Metal (16%). In 1983, SLN sold its interest to Nippon Yakin because of low nickel prices. Since 1984, Nippon Nickel had been operated under a toll agreement with Tokyo Nickel, using raw materials imported from Indonesia.

In order to meet increased demand by the specialty steel and battery industries, Japan imported 39,350 tons of refined nickel during 1988, including flakes, foil, and powder. Major suppliers of refined nickel were Canada, 11,535 tons; the U.S.S.R., 5,851 tons; Norway, 5,262 tons; Zimbabwe, 5,192 tons; China, 2,674 tons; and Australia, 2,064 tons.

As a result of the continued tight supply in the world market and increased world demand for nickel, the average monthly price per pound of the metal on the London Metal Exchange rose from $3.64 in January to $8.17 in April. It then gradually declined to $5.24, but rose again to $7.68 in December. According to the Ministry of Finance, Japan's import c.i.f. price averaged $5.14 per pound, compared with $2.07 per pound in 1987, despite a 12.3% appreciation in the yen in 1988. The extremely tight nickel market situation in Japan during 1987–88 did not warrant release of nickel from the stockpile since the situation was not a supply disruption, according to the Metal Mining Agency of Japan.

In order to secure a long-term supply of nickel, Sumitomo Metal Mining acquired from Inco Ltd. of Canada a 20% equity interest in Inco's subsidiary, P.T. International Nickel Indonesia (P.T. Inco), of Soroako, Indonesia, for $100 million in July. P.T. Inco has shipped annually about 7,000 tons of nickel matte containing 78% nickel to Sumitomo Metal Mining. By 1990, P.T. Inco was expected to expand its smelting capacity to 48,000 tons per year from 35,000 tons per year. Sumitomo Metal Mining was to have the right to purchase 20% of the smelter's output or 9,600 tons per year beginning in 1990.

According to MITI, consumption of refined nickel increased 8.2% to 62,662 tons. Although there was a reduction in demand by makers of magnetic materials, nonferrous alloys, and mill products, demand for nickel by the specialty steel, plating, storage battery, and coinage industries rose substantially. Of the total demand in 1988, 42,528 tons was for production of specialty steel, 6,255 tons for plating, 3,437 tons for nonferrous alloys, 2,896 tons for storage batteries, 2,860 tons for magnetic materials, 1,222 tons for coinage, 774 tons for mill products, 437 tons for catalysts, and 2,253 tons for other. Exports of refined nickel rose from 351 tons in 1987 to 593 tons. Most nickel exports went to China in 1988.

By the end of 1988, the overall stock of refined nickel held by producers, distributors, and consumers declined to 11,934 tons from 15,250 tons in 1987. The decline in stock was caused by increased demand, reduced imports, and lower nickel production.

Rare Earths.—Because of increased demand in 1988 for rare earths, especially lanthanum oxide, neodymium oxide, samarium oxide, and yttrium oxide, imports of crude rare earths and rare-earth products rose substantially. Domestic production of rare-earth products also moved higher.

Imports of crude rare earths rose from 3,751 tons in 1987 to 5,254 tons, of which 1,548 tons was from China, 1,151 tons from the United States, 897 tons from Malaysia, 890 tons from India, 729 tons from Brazil, and the remainder from France and the United Kingdom. Imports of major rare-earth products in 1988 were yttrium oxide, 688 tons compared with 391 tons in 1987; cerium oxide, 481 tons compared with 258 tons; lanthanum oxide, 196 tons compared with 102 tons; rare-earth metals, 468 tons compared with 278 tons; and rare-earth compounds, 5,328 tons compared with 4,430 tons. In 1988, imports of ferrocerium, including pyrophoric alloys, and other cerium compounds rose sharply to 427 tons and 2,608 tons from 53 tons and 1.6 tons, respectively, in 1987.

According to aggregated rare-earth import statistics, the following countries were major suppliers of rare earths to Japan in 1988: China, 40.5%; France, 29.2%; the United States, 15.2%; Malaysia, 5.0%; the U.S.S.R., 3.5%; India, 1.2%, and other countries, 5.4%. Among the three major suppliers, China's share rose to 34.0% in 1987 from 26.4% in 1984, France's share declined to 34.3% from 37.2%, and the U.S. share declined to 16.3% from 27.4%.[17]

Consumption of rare-earth products in Japan during 1986–88 is shown in table 10.

TABLE 10

JAPAN: DEMAND FOR RARE-EARTH PRODUCTS

(Metric tons)

Products	1986	1987	1988
Cerium oxide and catalysts	3,150	3,150	3,100
Europium oxide	9	10	11
Lanthanum oxide	350	380	400
Misch metal	300	250	230
Rare-earth fluoride	60	60	50
Samarium oxide	350	350	370
Yttrium oxide	230	240	270
Other rare earths[1]	350	450	610
Total	**4,799**	**4,890**	**5,041**

[1] Includes gadolinium oxide, terbium, neodymium oxide, and praesodymium. In 1988, about 550 tons of other rare earths was neodymium oxide.

Source: The Rare Metal News (Tokyo). No. 1495, Apr. 24, 1989, p.4.

In order to secure a long-term supply of rare earths, Japan signed a bilateral agreement with China in May to exchange information on rare-earths demand, trade, extraction, processing, and development of new applications. A 2-day joint conference was held by Japan and China in Tokyo in October to exchange information on technological development of rare-earth extraction and applications, supply and demand for rare earths, and to promote rare-earths trade between the two countries. During the conference, provisions for establishing specific joint-venture projects were also discussed.

In the fall of 1988, a small rare-earths processing plant was brought onstream in Niihama, Ehime Prefecture by Nippon Rare Earths Co. Ltd. Established in July 1986, Nippon Rare Earths was a joint venture of Sumitomo Metal Mining (59%) and Rhone-Poulenc (41%) of France. The new plant reportedly processed rare-earth elements from imported lanthanide series and yttrium concentrate. Nippon Rare Earths also marketed imported rare earths products produced elsewhere by Rhone-Poulenc.

Tantalum.—Japan was a major world consumer of tantalum in 1988. The country's tantalum requirements in the forms of ore, potassium-tantalum-fluorite (K_2TaF_7), metal powder, and fabricated products were met by imports. Because of tight market conditions and increased demand, imports of tantalum in all forms rose sharply, despite higher prices in 1988. Imports of tantalum ore increased by 363% to 162 tons, potassium-tantalum-fluorite by 90% to 365 tons, metal powder by 98% to 49 tons, and fabricated products by 52% to 60 tons in 1988. Principal suppliers of tantalum ore in 1988 were Malaysia and Zaire, accounting for 62% and 16%, respectively. The United States was the single largest supplier of potassium-tantalum-fluorite, metal powder, and fabricated products to Japan, accounting for 89%, 85%, and 82%, respectively, in 1988.

Tantalum ore was imported for production of tantalum oxide and carbide by Mitsui Mining and Smelting and Dowa Mining Co. Ltd. Tantalum oxide was used as an additive for the manufacture of optical lenses and ceramics. Tantalum carbide was used as an additive for the manufacture of ultrahard carbide tools. Imported potassium-tantalum-fluorite was used in production of tantalum metal powder by Showa Cabot Supermetals Co. Ltd., a joint venture of Showa Denko Co. Ltd. and Cabot Corp. of the United States, and V Tech-Fansteel Inc., a joint venture of V Tech Corp. and Fansteel Inc. of the United States. Tantalum powder was used mainly for the manufacture of capacitors. Imported and domestically produced tantalum fabricated products, mainly by Kobe Steel Ltd., were used for structural material in the chemical and nuclear power industries and for making tantalum condenser wire and dental material.

According to the Japan Society of Newer Metals, consumption of tantalum byproduct is as shown in table 11.

Titanium.—Japan remained the third largest producer of titanium sponge metal and one of the major producers of titanium dioxide pigment in the world in 1988. Japan continued to import all of its rutile requirements

TABLE 11

JAPAN: DEMAND FOR TANTALUM

(Kilograms)

Product	1986	1987	1988
Powder	85,120	109,125	158,652
Of which:			
Imported	19,150	22,448	35,438
Compounds	50,320	48,320	55,340
Of which:			
Imported	14,300	14,500	17,000
Fabricated products	34,554	42,034	78,732
Of which:			
Imported	14,748	20,890	46,007
Total demand	**169,994**	**199,479**	**292,724**
Of which:			
Imported	48,198	57,838	98,445

Source: The Rare Metal News (Tokyo). No. 1495, Apr. 24, 1988, p. 8.

TABLE 12

JAPAN: PRODUCTION CAPACITY OF TITANIUM SPONGE IN 1988

(Metric tons)

Company and location	Annual Capacity	
	Installed	Actual
Osaka Titanium Co. Ltd., Amagasaki, Hyogo Prefecture	13,200	11,400
Showa Titanium Co. Ltd., Toyama, Toyama Prefecture	2,500	2,500
Toho Titanium Co. Ltd., Chigasaki, Kanagawa Prefecture	12,000	9,000
Total	**27,700**	**22,900**

Source: The Rare Metal News (Tokyo). No. 1500, June 1, 1989, p.3.

from Australia for sponge production. It also imported ilmenite, principally from Malaysia (37%), Australia (27%), and Canada (19%), as well as titanium slag, mainly from the Republic of South Africa (99%), for dioxide pigment production. Production of titanium sponge rebounded after 2 years of decline because of increased domestic demand. Production of titanium dioxide pigment continued to move higher owing to stronger demand by the paper, printing ink, and pigment industries.

Titanium sponge metal was produced in 1988 by Osaka Titanium Co. Ltd., Showa Titanium Co. Ltd., and Toho Titanium Co. Ltd. Because of the depressed market in 1986-87, Nippon Soda Co. Ltd. shut down indefinitely its 2,400-ton-per-year-capacity plant at Nohongi, Niigata Prefecture in October 1986. Japan's titanium sponge production capacity in 1988 is shown in table 12.

Because of a higher price and lower inventory resulting from tight supply and demand situation, Osaka Titanium reportedly boosted its monthly sponge production in the second one-half of 1988 to 700 tons from 500 tons. Showa Titanium raised its production to 200 tons from 140 tons, while Toho Titanium kept its monthly output between 580 tons and 600 tons.

According to the Japan Titanium Society, total shipments of titanium sponge surged 63% owing mainly to increased domestic demand in 1988. Domestic demand for titanium sponge, including in-house consumption by sponge producers, rose 48% to 14,164 tons, while exports increased 3% to 4,365 tons. According to the Ministry of Finance, titanium sponge was exported mainly to the United Kingdom, 1,973 tons; France, 1,148 tons; the United States, 820 tons; and the Federal Republic of Germany, 323 tons. Japan also exported 2,902 tons of titanium powder and flakes, principally to the United States, 1,975 tons; the United Kingdom, 453 tons; and the Federal Republic of Germany, 215 tons.

Japan's titanium dioxide industry has expanded considerably since 1984 as domestic demand has continued to show steady growth. In 1988, titanium dioxide pigment was produced by seven companies operating eight plants in Japan, as shown in table 13. In addition, a 36,000-ton-per-year titanium dioxide plant to be operated by ISK Singapore Pte. Ltd., a wholly owned subsidiary of Ishihara Sangyo Co. Ltd., was expected to become operational in Singapore in April 1989.

The continued rise in demand for titanium dioxide by the paint, printing ink, and paper industries boosted total domestic demand to 198,113 tons from 173,437 tons in 1987. The Japan Titanium Dioxide Industry Association's assessment of Japan's supply and demand for titanium dioxide is shown in table 14.

Vanadium.—Imports of vanadium reached a record high in 1988 because of increased demand by the makers of speciality steel. Japan's raw material requirements for vanadium were met primarily by imports, mainly from the

TABLE 13

JAPAN: PRODUCTION CAPACITY OF TITANIUM DIOXIDE IN 1988

(Metric tons)

Company and location	Annual capacity
Ishihara Sangyo Co. Ltd., Yokkaichi, Mie Prefecture	92,400[1]
Do.	45,000[2]
Tekoku Kako Co. Ltd., Saidaiji, Okayama Prefecture	43,800
Sakai Chemical Industry Co. Ltd., Onahama, Fukushima Prefecture	43,200
Furukawa Mining Co. Ltd., Osaka, Osaka Prefecture	18,000
Tohoku Chemical Industry Co. Ltd., Akita, Akita Prefecture	18,000[3]
Fuji Titanium Industry Co. Ltd.[4] Kobe, Hyogo Prefecture	16,200
Titan Kogyo Co. Ltd., Ube, Yamaguchi Prefecture	15,600
Total	**292,200**

[1] Will be increased to 96,000 tons by 1990.
[2] The chloride processing plant will be increased to 50,400 tons by 1990.
[3] A second plant with 12,000 tons per year by Mar. 1990.
[4] 24.8% owned by Ishihara Sangyo.

Sources: The Rare Metal News (Tokyo). No. 1468, Oct. 1, 1988, p. 5; Japan Chemical Week (Tokyo). V. 30, No. 1514, Apr. 20, 1989, p. 2; No. 1517, May 11, 1989, p. 2. Industrial Minerals (London). No. 251, Aug. 1988, pp. 25, 29.

TABLE 14

JAPAN: SUPPLY AND DEMAND FOR TITANIUM DIOXIDE

(Metric tons)

Item	1986	1987	1988
Production	224,012	239,401	259,875
Imports	40,034	45,677	45,953
Domestic demand:			
Ceramic condensers	2,141	2,528	2,810
Chemical fibers	4,742	4,717	4,704
Paint	83,932	89,604	99,622
Paper	11,738	13,147	15,915
Printing ink	26,428	30,070	34,858
Rubber	3,763	3,833	3,848
Synthetic resin	14,069	15,138	16,868
Other	13,840	14,400	19,488
Exports	62,930	66,727	62,265
Producer stocks	10,599	9,836	9,333

Source: Japan Titanium Dioxide Industry Association.

Republic of South Africa. Taiyo Mining and Industry Co. Ltd. and Shinko Chemical Co. Ltd. reportedly recovered about 1,500 tons of vanadium pentoxide from petroleum residues, ashes, and spent catalysts. However, according to Japan Chemical Week, only 558 tons of vanadium pentoxide was recovered in 1988. Most vanadium pentoxide was used for production of ferrovanadium.

Imports of vanadium pentoxide rose 93% to 5,339 tons, of which 4,106 tons was from the Republic of South Africa, 832 tons from China, 278 tons from the Netherlands, and 123 tons from the United States and other countries. Consumption of vanadium pentoxide by the ferroalloy industry increased 43% to 4,846 tons. To meet demand by specialty steel producers, Japan also imported 595 tons of ferrovanadium—principally from Austria, 284 tons, and the Federal Republic of Germany, 109 tons.

Ferrovanadium was produced in 1988 by Awamura Metal Industry Co. Ltd. at the Uji plant in Kyoto Prefecture, Japan Metal and Chemical Co. Ltd. at the Oguni plant in Yamagata Prefecture, Nippon Denko Co. Ltd. at the Hokuriku plant in Toyama Prefecture, NKK Corp. at the Toyama plant in Toyama Prefecture, and Taiyo Mining and Industry Co. Ltd. at the Akou plant in Hyogo Prefecture. The industry produced two types of ferrovanadium; one contained 75% to 85% vanadium and the other 45% to 55% vanadium.

Industrial Minerals

Cement.—Japan was the world's third largest producer of cement in 1988 following China and the U.S.S.R. The cement industry, benefiting from the domestic construction boom, enjoyed a good year. Despite higher imports, strong demand by the public works and private development projects boosted the output of cement to its highest level in 4 years.

The cement industry's annual kiln production capacity was 97 million tons, with 23 cement companies operating 41 plants in 1988, according to the Cement Association of Japan. In an effort to be more competitive with the Republic of Korea and Taiwan, the industry began its third restructuring program to reduce annual capacity by 10 million tons. The industry became eligible for Government assistance in 1988 under the temporary provisions for industries severely affected by the yen appreciation of recent years.

Because of strong demand by the construction industry, especially in the greater Tokyo area, imports of cement rose 40% to 3.5 million tons in 1988. The Republic of Korea and Taiwan remained the two principal suppliers, providing 1.8 million tons and 1.7 million tons, respectively. According to an industry estimate, the price gap between Japanese cement and cement imported from the Republic of Korea and Taiwan was between $7.50 and $8.00 per ton in 1988. Increasing labor costs and the rising value of currency in those two countries have led some industry analysts to believe the price gap would be narrowed in the next few years.

Exports of cement rose by 13% to 5.1 million tons. Hong Kong, Singapore, and the United States were major buyers of Japanese cement in 1988. A new export market for Japanese cement was created in Australia, which took about 130,000 tons in 1988. Exports of cement to the United States rose from 837,966 tons in 1986 to 1,725,478 tons, of which about 50% reportedly was from Onoda Cement Co. Ltd.

To expand its cement business in the United States, Onoda Cement reportedly established a joint venture in January with Long Star Industries Inc. in Alaska, Oregon, and Washington. Onoda agreed in July to purchase California Portland Cement Co. (CAPC) from its parent company CalMat Co. of California for $310 million. CAPC's cement capacity was 3 million tons per year. Mitsubishi Mining and Cement Co. Ltd. also acquired from Kaiser Cement Corp. its 1.6-million-ton-per-year Lucerne, California, plant for $195 million in April. In 1988, Onoda Cement reportedly also agreed to form a joint venture with the Chinese Raw Materials Corp. to build a 1.2 million-ton-per-year cement plant in Dairen, China. Construction of this plant was scheduled to start in mid-1989 and to be fully operational by early 1992.

Diamond.—Japan was a major importer and consumer of natural (gem) diamond and one of the top two producers and consumers of synthetic diamond in the world. All requirements for natural diamond were met by imports, mainly from Belgium-Luxembourg, India, and Israel. Because of the stronger yen, lower prices, and increased investment in gem diamond, imports of gem diamond rose from 1.6 million carats in 1986 to 2 million carats in 1987 and reached 3 million carats in 1988. In the Japanese market, large sizes (1 carat and larger) and better quality diamonds reportedly have become more popular and attracted greater interest in recent years.

Japan was one of the world's leading producers of synthetic diamond. Major producers were Showa Denko K.K., Sumitomo Electric Co. Ltd., and Tomi Co. Ltd. Tomi was the world's largest producer of polycrystal diamond. In 1985, Sumitomo Electric reportedly had developed successfully a mass production technique to manufacture large-size synthetic diamond.

Japan's annual consumption of industrial diamonds, excluding gem diamonds, was estimated at 70 million carats, of which 95% were synthetic diamonds. To meet domestic demand, Japan imported more than 730,000 carats of industrial stones, mainly from the Republic of South Africa, the United States, and Zaire, as well as more than 37 million carats of dusts and powders, mainly from Ireland, the United States, and Zaire.

Fluorspar.—Japan remained the world's third largest consumer of fluorspar in 1988 and continued to import all of its fluorspar requirements. Because of increased demand for fluorspar by the iron and steel and chemical industries, imports of metallurgical- and acid-grade fluorspar reached record highs in 1988. The imported metallurgical-grade for steelmaking normally contained less than 97% calcium fluoride (CaF_2). Acid-grade, for manufacture of chemical products such as fluorocarbon gas and fluorinated resins, contained more than 97% CaF_2.

Imports of fluorspar rose 15% to 609,113 tons, of which 304,351 tons was metallurgical-grade and 304,762 tons was acid-grade. China remained the dominant supplier, providing 455,331 tons, of which 48% was metallugical-grade and 52% was acid-grade. Other suppliers of metallurgical-grade included 73,426 tons from Thailand and 10,465 tons from Mexico. Other acid-grade suppliers included the Republic of South Africa, 57,550 tons, and Kenya, 10,341 tons. Because of tight market conditions, the import c.i.f, price of acid-grade fluorspar from China rose 21.5% to $110 per ton, while metallurgical-grade prices remained between $105 and $108 per ton in 1988.

According to an industry source, consumption of fluorspar rose from 376,000 tons in 1987 to 420,000 tons. Demand for metallurgical-grade by the iron and steel industry rose from 208,000 tons in 1987 to 228,000 tons. Demand for acid-grade by the chemical and aluminium industries also rose from 168,000 tons in 1987 to 192,000 tons.

Pyropyllite.—Japan has abundant reserves of pyrophyllite and was the top producer of pyrophyllite in the world. Pyrophyllite, known in Japan as Roseki or waxy stone, was produced mainly in the Mitshuishi and Ohira areas of Okayama Prefecture, the Shokozan area of Hiroshima Prefecture in western Honshu, and on Goto Island off Northwest Kyushu. Production of pyrophyllite peaked at 1.7 million tons in 1969. Production has declined since 1986 to less than 1 million tons, resulting in reduced consumption as a refractory material by the iron and steel industry. Japan also produced pyrophyllite clay, which peaked at 460,000 tons in 1970 and declined by 1988 to less than 300,000 tons. The drop occurred owing to switching from the use of pyrophyllite clay to imported talc as a paper filler by the paper manufacturing industry.

Major producers of pyrophyllite were Goto Kozan Co. Ltd. on Goto Island in Nagasaki Prefecture, Nihon-Shoko Kogyo Co. Ltd. at Nihon-Shokozan in Hiroshima Prefecture, Ohira Kozan Co. Ltd. at Ohira in Okayama Prefecture, Sankin Kogyo Co. Ltd. at Otsue in Hiroshima Prefecture, Shinagawa Shirorenga Co. Ltd. at Mitshuishi in Okayama Prefecture, Shokozan Kogyosho Co. Ltd. at Yano-Shokozan in Hiroshima Prefecture, and Showa Kogyo Co. Ltd. at Showa Shokozan in Hiroshima Prefecture. Most major pyrophyllite mining operations in Japan used the open pit bench cut method, with a monthly capacity ranging from 17,000 tons at the Goto Mine to 5,000 tons at the Showa Shokozan Mine. MITI's official statistics on pyrophyllite production normally included production of sericite.

According to MITI, domestic demand in 1988 for pyropyllite and pyrophyllite clay was 843,577 tons and 295,814 tons, respectively. Pyrophyllite in Japan was consumed, in decreasing order of volume, mainly for production of refractories, pottery, agricultural chemicals, tile, cement, and construction materials. Pyrophyllite clay was consumed, in decreasing order of volume, mainly for production of agricultural chemicals, soda glass, paper, construction materials, refractories, building materials, inorganic chemicals, and rubber. To meet domestic demand by the paper and cosmetic industries, Japan imported between 400,000 tons and 600,000 tons of talc and pyropyllite annually during 1986–88.

Mineral Fuels

Coal.—In line with Japan's Eighth National Coal Policy, the country's coal industry cut its production by 1.8

million tons to 11.2 million tons and reduced its employment by 1,455 to 7,712 with Government assistance in 1988. In the meantime, Japan's imports of both coking and steam coal reached record highs in 1988 because of decreased supplies of domestic coal and increased demand for coal by the iron and steel and utilities industries.

To assist the coal industry in reducing its capacity and employment under the Eighth National Coal Policy for fiscal year 1987 ending in March 1988, the Government reportedly provided $60 million of 8-year, interest-free loans for streamlining coal mining operations and retrenching the industry's workforce; $255 million of 6-month, low-interest loans for company operating funds; and $830 million of 6-month, low-interest loans for private coal stockpiles. In addition, the Government provided $45 million in grants for coal mine modernization, $80 million for coal industry stabilization, $38 million for underground mine safety improvement, and $16 million for interest payments on loans for private coal stockpiles.[18] The number of major coal mines in Japan was reduced to eight in 1988. Coal production by company during fiscal years 1985-87 is shown in table 15.

In 1988, domestic production of coking coal was cut by 536,000 tons to 1 million tons, while anthracite and other bituminous coal was reduced by 1.3 million tons to 10.2 million. Of the total coal produced, 60% was from the Hokkaido area and 40% from the Kyushu and Honshu areas. The average heating value declined to 5,959 kilocalories per kilogram (kcal/kg) from 6,030 kcal/kg in 1987. The industry's employment at yearend declined to 7,712 from 9,167 in 1987. As a result of an increase in number of working days and a reduced number of miners, labor productivity rose to 113 tons per month per miner from 100 tons per month per miner in 1987. Because of reduced domestic production and increased demand, Japan's reliance on imported coal rose to 90.2% from 87.5% in 1987.

To meet higher requirements for coal in 1988, Japan imported 101.2 million tons of coking coal, 71 million tons of steam coal, and 1.6 million tons of anthracite. Australia, Canada, and the United States remained the major suppliers of coking coal, accounting for 41%, 26%, and 18%, respectively. Australia alone provided 70% of the steam coal imported by Japan. Because of Japan's policy of trade restrictions against the Republic of South Africa, imports of low-priced coal from that country were reduced to 6.2 million tons from 7.3 million tons in 1987. Japan's coal imports by source is shown in table 16.

In 1988, Japan planned to diversify portions of its steam coal from Australia and the Republic of South Africa because of the high risk associated with heavy dependence on Australian steam coal and the Government's import restrictions policy against the Republic of

TABLE 15

JAPAN: COAL PRODUCTION, BY COMPANY[1]

(Thousand metric tons)

Company and coal mine	1985	1986	1987
Hokutan Mayachi Coal Mining Co. Ltd., Mayachi, Hokkaido[2]	700	640	e300
Hokutan Horonai Coal Mining Co. Ltd., Horonai, Hokkaido	1,240	1,100	1,230
Hokutan Sorachi Coal Mining Co. Ltd., Sorachi, Hokkaido	920	890	780
Mitsubishi Coal Mining Co. Ltd., Minami-Oyubari, Hokkaido	830	1,180	730
Takashima, Kyushu[3]	580	e300	—
Mitsui Coal Mining Co. Ltd., Ashibetsu, Hokkaido	980	960	770
Miike, Kyushu	4,530	4,140	3,530
Sunagawa, Hokkaido[4]	940	600	e200
Mitsui-Matsushima Coal Mining Co. Ltd., Ikeshima, Kyushu	1,530	1,430	1,350
Sumitomo Akabira Coal Mining Co. Ltd., Akabira, Hokkaido	1,000	890	670
Taiheiyo Coal Mining Co. Ltd., Taiheiyo, Hokkaido	2,490	2,290	2,240
Other	714	780	775
Total	**16,454**	**15,200**	**12,575**

e Estimated.
[1] Fiscal years beginning in April and ending in March of the following year.
[2] Closed in Oct. 1987.
[3] Closed in Nov. 1986.
[4] Closed in July 1987.
Source: The Japan Economic Journal (Tokyo). Japan Economic Almanac, 1987-89, p. 187.

TABLE 16

JAPAN: COAL IMPORTS IN 1988, BY SOURCE

(Thousand metric tons)

Source	Anthracite	Bituminous	
		Coking	Steam
Australia	117	28,909	19,944
Canada	—	18,441	1,341
China	557	1,258	2,260
Colombia	—	155	182
Indonesia	—	90	274
Korea, North	488	—	—
New Zealand	—	230	—
South Africa, the Republic of	219	3,984	1,949
United States	—	12,833	619
U.S.S.R.	130	5,174	1,921
Vietnam	88	—	—
Total	**1,599**	**71,074**	**28,490**

Source: The Ministry of Finance of Japan.

South Africa. Japanese importers, including the utilities industry, reportedly were considering Canada, Colombia, and the United States as potential alternative sources.

In an effort to increase imports from the United States, Chugoku Electric Power Co. Inc. trial-imported steam coal for testing from Nerco Coal Corp.'s Spring Creek coal mine in the Powder River Basin of Montana. As a result of a satisfactory test, Chugoku Electric and Kyushu Electric Power Co. Inc. reportedly planned to import U.S. steam coal beginning in 1989. Other Japanese utility companies that planned to import coal from the United States included Hokkaido Electric Power Co. Inc. and Tokyo Electric Power Co. Inc. Japan's utilities industry consumed 24 million tons of steam coal, of which imports accounted for 9.5 million tons in 1988.

According to MITI, increased consumption of coking coal by the iron and steel industry and steam coal by the utility industry resulted in a 10% rise in overall demand for coal to 113.9 million tons. Of this total, 72.4 million tons was coking coal, 39.9 million tons steam coal, and 1.6 million tons anthracite. Japan's coal consumption by end use is shown in table 17.

TABLE 17

JAPAN: COAL CONSUMPTION IN 1988, BY END USE

(Metric tons)

End use	Anthracite	Bituminous		Total
		Coking	Steam	
Briquets:				
Domestic	—	—	9,778	9,778
Imported	142,582	—	4,736	147,318
Cement and ceramics:				
Domestic	—	—	454,768	454,768
Imported	654,576	13,518	6,716,819	7,384,913
Chemicals:				
Domestic	—	—	117,157	117,157
Imported	92,385	65,912	3,677,021	3,835,318
City gas:				
Domestic	—	289,598	8,660	298,258
Imported	15,445	553,613	—	569,058
Coke:				
Domestic	—	271,127	1,030	272,157
Imported	1,777	5,007,156	16,322	5,025,255
Electric power:				
Domestic	—	—	9,537,072	9,537,072
Imported	—	—	14,380,356	14,380,356
Iron and steel:				
Domestic	—	782,844	507	783,351
Imported	644,847	65,371,833	371,970	66,388,650
Paper and pulp:				
Domestic	—	—	127,729	127,729
Imported	—	—	2,245,957	2,245,957
Other:				
Domestic	—	10,882	1,204,741	1,215,623
Imported	61,284	60,659	1,055,448	1,177,391
Total	**1,612,896**	**72,427,142**	**39,930,071**	**113,970,109**
Of which:				
Domestic	—	1,354,451	11,461,442	12,815,893
Imported	1,612,896	71,072,691	28,468,629	101,154,216

Source: The Ministry of International Trade and Industry of Japan.

Petroleum and Natural Gas.—Japan remained one of the top consumers and the largest importer of crude petroleum and natural gas in the world. Domestic production of petroleum and natural gas remained insignificant, despite Government efforts to double domestic output by the end of fiscal year 1990 ending in March 1991. Increased industrial activity resulting from strong economic growth in 1988 boosted demand for petroleum products to an 8-year high and natural gas to an alltime high. As a result, imports of crude petroleum reversed the 4-year downward trend and rose 4.3% from that of 1987, while imports of natural gas in the form of LNG also rose 5.3% in 1988.

Domestic production of crude petroleum dropped to an average of 11,925 barrels per day from 12,183 barrels per day in 1987. Production of natural gas also dropped to an average of 203 million cubic feet per day from 210 million cubic feet per day in 1987. In 1988, practically all crude petroleum requirements for oil refining and about 95% of natural gas requirements were met by imports. Japan imported record amounts of refined petroleum products in 1988 to meet stronger demand for petroleum products. Imports as a percent of total demand for refined petroleum products rose to 23.9% from 22.6% in 1987 and 16.9% in 1986, the first year the import bans on gasoline, kerosene, and fuel oil were lifted.

Japan imported 1,219.3 million barrels of crude petroleum in 1988 of which 67.6% was from the Middle East, 25.9% from Asia, including China, and 6.5% from other areas. The top five crude petroleum suppliers were United Arab Emirates, 19.5%; Saudi Arabia, 14.4%; Indonesia, 13.6%; Oman, 8.8%; and China, 8.1%. According to Japan Petroleum and Energy Consultants Ltd., the Organization of Petroleum Exporting Countries accounted for 72.2% of Japan's imports of crude petroleum, compared with 71.7% in 1987.

Because of a broad increase in demand for refined petroleum products, consumption of crude petroleum by the oil refinery industry rose 3% to 3 million barrels per day. Industry capacity utilization was raised in 1988 to 64.7% from 60.8% (revised), resulting from increased input and a 3% reduction in capacity. According to MITI, the industry's refining capacity was reduced from 4,725,610 barrels per day in September 1987 to 4,551,610 barrels per day in August 1988.

Domestic demand for refined products, including gasoline, naphtha, jet fuel, kerosene, diesel fuel, and heavy fuel oil (types A, B, and C) totaled 1,272 million barrels, of which 304.2 million barrels was imported. Domestic consumption and imports of refined products are shown in table 18.

TABLE 18

JAPAN: CONSUMPTION AND IMPORTS OF REFINED PRODUCTS

(Thousand barrels per day)

Refined products	Consumption		Imports	
	1987	1988	1987	1988
Diesel fuel	498.0	542.6	69.6	110.3
Gasoline	657.3	680.6	72.2	67.1
Heavy fuel oil, A	375.3	424.0	31.1	29.7
Heavy fuel oil, B	32.3	25.6	—	—
Heavy fuel oil, C	701.8	742.3	106.9	106.7
Jet fuel	55.1	57.0	—	—
Kerosene	437.1	488.6	103.6	128.4
Naphtha	473.3	513.9	345.4	389.0
Total	**3,230.2**	**3,474.6**	**728.8**	**831.2**

Source: Japan Petroleum & Energy Trends. V. 24, No. 3, Feb. 3, 1989, p. 12.

Among the major imported refined products in 1988, naphtha came principally from Saudi Arabia, 28%; Kuwait, 15%; United Arab Emirates, 11%; Indonesia and Singapore, 10% each; and Bahrain, 8%. Kerosene was imported mainly from Saudi Arabia, 28%; Singapore, 26%; Kuwait, 10%; and United Arab Emirates, 8%. Diesel fuel was imported mainly from Saudi Arabia, 38%; Algeria, 22%; the United States, 10%; and Kuwait, 8%. Gasoline was imported mainly from Singapore, 31%; the United States, 12%; United Arab Emirates, 11%; Kuwait, 9%; and Saudi Arabia, 8%.

Japan's Ministry of Finance began implementing new tariffs in 1988 on crude petroleum and refined products, based on volume rather than *ad valorem*, and reduced tariffs on crude petroleum and heavy fuel oil, types A, B, and C, in August. The new tariffs, effective August 1, 1988, through March 31, 1989, were $0.63 per barrel on crude petroleum and heavy fuel oil, types A, B, and C; $2.90 per barrel on aviation gasoline; $0.97 per barrel on kerosene; and $1.81 per barrel on diesel fuel. There was no tariff on either LNG or liquefied petroleum gas (LPG). Crude petroleum imported for the manufacture of petrochemicals was exempted from tariff. Gasoline and naphtha imported for manufacture of petrochemical products and ammonia was taxed at $0.05 per barrel, for power generation at $1.02 per barrel, and for other uses at $2.05 per barrel.[19]

Imports of natural gas in the form of LNG reached 30.7 million tons or 1,625.1 billion cubic feet in 1988. Suppliers were Indonesia, 48%; Malaysia, 20%; Brunei, 17%; United Arab Emirates, 7%; Bahrain, 5%; and the United States, 3%. Consumption of LNG was 76% by the electric power industry, 22% by the city gas industry, and 2% for industrial use. Japan also imported about 12.6 million tons of LPG equivalent to 75% of consumption, principally from Saudi Arabia, 44%; United Arab Emirates, 22%; Kuwait, 10%; and Australia, 8%. LPG in Japan was consumed mainly by the manufacturing industry as fuel and for chemical raw materials, by the city gas industry for distribution for home heating and cooking, and by automobiles as fuel.

Imports of crude petroleum supplied from 90 oilfields leased or owned by Japanese oil companies in 20 foreign countries were about 10% of imports in 1988. The Government has been pursuing a policy to diversify sources of supply and to raise the import share of Japanese producers in foreign countries from 10% to 30% in the next 10 years. Through its state-owned Japan National Oil Corp. (JNOC), the Government began providing financial and fiscal incentives to Japanese oil companies to encourage oil exploration, development, and production, either by establishing joint ventures or by direct acquisition of oilfields overseas.

The incentives included low-interest (5.4%) financing up to 80% of total investments in overseas exploration by JNOC, funding up to 80% of total development costs by the Export-Import Bank of Japan, and funding up to 70% of operating costs by the Japan Development Bank. All loans were guaranteed by JNOC. The fiscal incentives included a 3.5% writeoff of the purchase price of foreign oilfields and a 15% depreciation allowance off the purchase price.[20]

As a result of the incentive programs and further strengthening of the Japanese yen, several joint ventures and acquisitions were made by major Japanese oil companies in Australia, Egypt, Norway, and the United States. Important joint ventures were JNOC with Texaco Inc. and Chevron Corp. for exploration in Alaska, and Nippon Mining with Conoco Inc. of the United States for exploration and development in seven countries. Important acquisitions included Idenmitsu Kosan Co. Ltd.'s new interests in drilling areas in Australia, Egypt, and Norway; Mitsui Oil Exploration Co. Ltd. and Japan's Arabian Oil Co. Ltd.'s new interests in developed oilfields in the North Sea owned by Norway; and Japan Petroleum Exploration Co. Ltd.'s new interests in 14 productive oilfields in the Gulf of Mexico off the U.S. coast.

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[1] Economist, Division of International Minerals.

[2] The Ministry of International Trade and Industry (Tokyo). Mining Handbook, 1989, pp. 10–11.

[3] Where appropriate, values have been converted from Japanese yen (Y) to U.S. dollars at the rates of Y144.62 = US$1.00 for 1987 and Y128.15 = US$1.00 for 1988.

[4] Japan Chemical Week (Tokyo). V. 29, No. 1462, Apr. 7, 1988, p. 1.

[5] IBA Rev. V. 14, No. 2, Sept./Dec. 1988, p. 13.

[6] American Metal Market. V. 96, No. 101, May 24, 1988, p. 2.

[7] ———. V. 96, No. 252, Dec. 29, 1988, p. 1.

[8] Metals Week. V. 59, No. 20, May 16, 1988, p. 2; No. 22, May 30, 1988, p. 7.

[9] American Metal Market. V. 96, No. 54, Mar. 18, 1988, p. 2; No. 169, Aug. 29, 1988, p. 4.

[10] ———. V. 96, No. 251, Dec. 28, 1988, p. 5.

[11] ———. V. 96, No. 210, Oct. 26, 1988, p. 1; No. 241, Dec. 13, 1988, p. 2.

[12] Japan Metal Rev. (Tokyo). No. 782, Nov. 24, 1988, p. 2.

[13] The Japan Iron and Steel Federation (Tokyo). The Steel Industry of Japan 1989, p. 18.

[14] American Metal Market. V. 95, No. 30, Feb. 12, 1988, p. 4; V. 96, No. 231, Nov. 29, 1988, p. 8; V. 97, No. 31, Feb. 14, 1989, p. 2.

[15] ———. V. 96, No. 38, Feb. 25, 1988, p. 5.

[16] The Rare Metal News (Tokyo). No. 1499, May 24, 1989, p. 8.

[17] ———. No. 1490, Mar. 16, 1989, p. 6.

[18] U.S. Embassy, Tokyo, Japan. State Dep. Telegram 18225, Sept. 29, 1988, p. 2.

[19] Japan Petroleum & Energy Trends (Tokyo). V. 24, No. 1, Jan. 6, 1989, p. 3.

[20] Petroleum News (Hong Kong). Jan./Feb. 1989, p. 31.

THE MINERAL INDUSTRIES OF

NORTH KOREA AND THE REPUBLIC OF KOREA

By Chin S. Kuo[1]

NORTH KOREA

North Korea has been in an isolate state diplomatically and economically with the outside world except for the Centrally Planned Economy countries. In 1988, however, the country seemed to be losing ground with these allies including China, Hungary, Poland, the U.S.S.R., and Yugoslavia. These countries began to look elsewhere to establish economic relations, in particular, the booming Republic of Korea. The Soviets and South Koreans signed a memorandum of understanding between their trade associations in October. Trade between China and the Republic of Korea, mostly via Hong Kong and Japan, was estimated to amount to $3 billion[2] in 1988, whereas that between China and North Korea was only $519 million[3] for 1987. Hungary and the Republic of Korea also agreed to exchange trade missions in September. These allies claimed, however, that they were not deserting North Korea.

Nevertheless, under the philosophy of Juche (self-reliance), the country began to invite much needed foreign exchange to buy modern technology for economic development. The effort to attract foreign investment through joint ventures has been considered mostly unsuccessful since 1984. Another problem with foreign exchange was the default on $900 million in loans from more than 100 Western banks with interest unpaid since 1984. The creditor banks, hoping to get paid one way or another, began trying to attach North Korean ships that docked in Asian ports and tap the value of the country's gold exports. North Korea relies on developing countries such as African and Latin American nations for goods delivery.

North Korea's economy has been growing rather slowly. Labor-intensive light industries were built on the basis of a backsliding agricultural sector. The country is endowed with an abundance of mineral resources such as anthracite coal, graphite, iron ore, lead and zinc, magnesite, and tungsten. The country needs to develop its mineral resources and export mineral commodities in exchange for hard currency to establish basic industries and improve its economic development.

Trade with the Republic of Korea could grow from nothing to $1 billion within 1 year including shipment of coal, if economic ties were established. A trade protocol between North Korea and Albania was signed in October for Albania to export chromium ore, copper, and other unnamed metals in exchange for North Korea's sheet iron, steel, and zinc. Trade with Iran has involved 80,000 tons per year of lead concentrate and 250,000 tons per year of zinc concentrate to North Korea in return for 200,000 tons of North Korean steel products and joint cooperation in the exploration and extraction of bauxite, phosphate, and other minerals in Iran. Burkina Faso, a country in West Africa, and North Korea signed a trade agreement to supply Burkina cotton and mining products in return for North Korean agricultural machinery, fertilizer, and manufactured goods. Century Metals and Mining N.L. of Australia signed an agreement with Daehung Corp. of Pyongyang to access to 36.6 million tons of North Korean gold tailings at Suan for extracting gold. Century Metals will hold a 50% interest in this joint venture.

There are three large mining complexes in the country, namely, Anju, Komdok, and Musan that operate coal and iron ore mines. In the nonferrous sector, high-grade ore deposits have been discovered in the Districts of Huchang, Munrakyyong, Pungsan, Ryongam, and Sinpa in the northern highlands. The Chonghwa smelter of the Nakyon Mine was commissioned in August to produce various nonferrous metals. The Chongpyong Mine, a new nonferrous mineral production base, was being developed during the year. Output of nonferrous metals in 1988 was estimated to be 800,000 tons.

In the iron and steel sector, iron ore deposits of good quality have also been found in the Munrakyyong and Pungsan areas. Six major projects have been completed at the Kim Chaek iron and steel complex in North Hamgyong Province, the largest integrated steel plant in the country, as part of its second stage expansion program to increase production capacities of pig iron, steel, rolled steel, and cold-rolled sheet. At the Hwanghae iron and steel complex, automation, robotization, and computerization in various processes of production operations have been implemented. A 6,000-cubic-meter oxygen plant has also been installed. At the Musan mining complex, which is a leading iron ore producer, an underground mine began operation. Current capacity of the complex was 6.5 million tons per year of iron ore concentrates. At the Toksong Mine, an ore dressing plant has been built to extract iron from iron sulfide ore. The country's iron ore production for 1988 was 10 million tons. The project to expand iron ore production from 10 million to 15 million tons was underway. Steel production increased slightly from 4.5 million tons in 1987 to 4.7 million tons in 1988.

North Korea is the largest producer of magnesite in the world. The expansion of the Taehung Mine and the construction of an ore dressing plant with a throughput of 1.25 million tons per year of magnesite ore at the Ryongyang Mine were planned to enable North Korea to raise its output and quality of magnesia clinker by the Tanchon magnesia plant in South Hamgyong Province. At the Sunchon vinalon complex, the construction of a modern 250,000-ton-per-year caustic soda (sodium hydroxide) plant was begun. A new soda ash (sodium carbonate) plant was being built in the Namhung area. A superphosphate plant was to be built in Haeju, South Hwanghae Province.

Cement in North Korea is produced by large and small cement-producing complexes such as Chonnaeri, Haeju, Puraesan, Pusanri, Sunchon, and Sunghori. The Sunchon cement com-

TABLE 1

NORTH KOREA: ESTIMATED PRODUCTION OF MINERAL COMMODITIES[1] [2]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987	1988p
Aluminum metal ingot, primary		10,000	10,000	10,000	10,000	10,000
Cadmium metal, smelter		100	100	100	100	100
Cement, hydraulic	thousand tons	8,000	8,000	8,000	9,000	12,000
Coal:						
Anthracite	do.	r41,000	r44,000	r48,000	r55,000	62,000
Lignite	do.	12,000	13,000	14,000	15,000	18,000
Total	**do.**	**53,000**	**57,000**	**62,000**	**70,000**	**80,000**
Coke	do.	3,000	3,000	3,000	3,000	3,000
Copper:						
Mine output, Cu content		15,000	15,000	15,000	15,000	15,000
Metal:						
Smelter, primary and secondary		18,000	18,000	18,000	18,000	18,000
Refined, primary and secondary		22,000	22,000	22,000	22,000	22,000
Fluorspar		40,000	40,000	40,000	40,000	40,000
Gold, mine output, Au content	troy ounces	160,000	160,000	160,000	160,000	160,000
Graphite		25,000	25,000	25,000	25,000	25,000
Iron and steel:						
Iron ore and concentrate, marketable:						
Gross weight	thousand tons	8,000	8,000	8,500	8,500	9,000
Fe content	do.	3,200	3,200	r4,000	r4,000	4,200
Metal:						
Pig iron	do.	5,750	r7,750	r8,500	r8,500	8,500
Ferroalloys, furnace type unspecified	do.	120	120	120	120	120
Steel, crude	do.	6,500	6,500	4,500	4,500	4,700
Lead:						
Mine output, Pb content		110,000	110,000	110,000	110,000	110,000
Metal, primary and secondary		95,000	95,000	95,000	95,000	95,000
Magnesite, crude	thousand tons	1,900	1,900	1,900	1,500	1,500
Nitrogen, N content of ammonia	do.	450	450	450	450	500
Phosphate rock		500,000	500,000	500,000	500,000	500,000
Salt, all types		570,000	570,000	570,000	570,000	570,000
Silver, mine output, Ag content	thousand troy ounces	1,600	1,600	1,600	1,600	1,600
Sulfur	thousand tons	230	230	230	230	230
Talc, soapstone, pyrophyllite		170,000	170,000	170,000	170,000	170,000
Tungsten, mine output, W content		1,000	1,000	1,000	r500	500
Zinc:						
Mine output, Zn content		140,000	180,000	r225,000	r220,000	225,000
Metal, primary		120,000	180,000	180,000	210,000	210,000

p Preliminary. r Revised.

[1] Table includes data available through Aug. 18, 1989.

[2] In addition to the commodities listed, crude construction materials such as sand and gravel and other varieties of stone presumably are produced, but available information is inadequate to make reliable estimates of output levels.

TABLE 2

NORTH KOREA: APPARENT EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987[p]	Principal destinations, 1987
METALS			
Aluminum: Metal including alloys, all forms	11,459	6,998	Japan 3,678; Hong Kong 2,247; Singapore 1,073.
Copper: Metal including alloys, all forms	962	949	Japan 453; Singapore 427.
Gold: Metal including alloys, unwrought and partly wrought troy ounces	27,301	NA	
Iron and steel: Metal:			
Scrap	25,160	17,771	Japan 17,751; Netherlands 20.
Pig iron, cast iron, related materials	73,206	67,254	Japan 66,295; Hong Kong 959.
Ferroalloys	4,298	1,569	All to Japan.
Steel, primary forms	107,873	132,366	Japan 81,681; Thailand 34,864; Philippines 14,959.
Semimanufactures:			
Bars, rods, angles, shapes, sections	598	27	Italy 19; Japan 8.
Universals, plates, sheets	48,319	57,779	Hong Kong 25,563; Japan 20,664; Philippines 10,768.
Hoop and strip	182	20	All to Singapore.
Wire	198	19	Cyprus 14; Singapore 5.
Tubes, pipes, fittings	166	705	Niger 671; Trinidad and Tobago 26.
Castings and forgings, rough	85	11	All to Japan.
Lead: Metal including alloys, all forms	15,483	11,232	Japan 10,205; Singapore 1,027.
Magnesium: Metal including alloys, all forms	20	107	All to Japan.
Platinum-group metals: Metals including alloys, unwrought and partly wrought value, thousands	$1,828	—	
Silver: Metal including alloys, unwrought and partly wrought do.	$8,664	$1,291	Do.
Zinc:			
Ore and concentrate	11,033	—	
Metal including alloys, all forms	41,658	52,707	Japan 36,487; Singapore 12,148; Hong Kong 3,436.
Other:			
Ores and concentrates	10	21	All to Japan.
Ashes and residues	3,331	4,117	Japan 3,761; Hong Kong 356.
Base metals including alloys, all forms	15	21	All to Singapore.
INDUSTRIAL MINERALS			
Abrasives, n.e.s.: Grinding and polishing wheels and stones	—	19	All to Philippines.
Cement	370	50	All to Japan.
Clays, crude	9,122	2,491	Do.
Feldspar, fluorspar, related materials	880	607	Do.
Fertilizer materials: Manufactured:			
Nitrogenous	—	4,000	Do.
Unspecified and mixed	—	75	All to Niger.
Graphite, natural	4,560	6,511	Japan 6,475; Austria 36.

See footnotes at end of table.

TABLE 2—Continued

NORTH KOREA: APPARENT EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987[p]	Principal destinations, 1987
INDUSTRIAL MINERALS—Continued				
Magnesium compounds, unspecified		194,163	[2]4,762	All to Spain.
Precious and semiprecious stones other than diamond: Natural and synthetic	value, thousands	$101	—	
Stone, sand and gravel:				
Dimension stone, all forms		8,457	8,258	All to Japan.
Gravel and crushed rock		494	827	Do.
Quartz and quartzite		—	928	Do.
Sulfur: Elemental including native and byproduct		131	—	
Talc, steatite, soapstone, pyrophyllite		23,800	9,864	Do.
Other:				
Crude		701	2	Do.
Slag and dross, not metal-bearing		—	2,167	Do.
MINERAL FUELS AND RELATED MATERIALS				
Carbon black		615	294	All to Thailand.
Coal, all grades including briquets		405,766	288,571	All to Japan.
Petroleum refinery products:				
Mineral jelly and wax	42-gallon barrels	79	—	
Kerosene and jet fuel	do.	442	—	
Residual fuel oil	do.	639	602,397	Japan 229,317; Singapore 217,529; Hong Kong 155,551.

[p] Preliminary. NA Not available.

[1] Table prepared by Audrey D. Wilkes. Owing to a lack of official trade data published by North Korea, this table should not be taken as a complete presentation of this country's mineral exports. These data have been compiled from United Nations information and data published by the partner trade countries. The United States did not report any imports of mineral commodities from North Korea during 1987.

[2] Excludes unreported quantity valued at $4,478,000 imported by Japan.

plex has a production capacity of 3 million tons per year. The Sariwon and Kaechon cement complexes were planned in the third 7-year plan (1987–93) to utilize raw materials from local sources. The country's production target of cement is 22 million tons per year by 1993 as compared with an output of 10 million tons in 1988. Daesong Jeryuk Trading Co. started the construction of a new 6,600-ton-per-year, coal-fired cement plant 20 kilometers from Pyongyang.

The Sariwon potassic fertilizer complex was still under construction. When completed, it will process 3 million tons of potassic feldspar and produce 510,000 tons of potassic fertilizer, 420,000 tons of alumina, and 10 million tons of cement per year. The complex is to be fed ore from mines at Chongdan and Chonggye, under development, and a mine at Chongpyong.

In coal mining, at the Sunchon vinalon complex, a 22-kilometer belt conveyor was under construction to link the coal mines with the carbide unit, the fuel processing unit, and the thermal powerplant of the complex. The powerplant has an installed capacity of 200,000 kilowatts with four turbo-generators. The Sunchon District coal mining complex increased coal production to an estimated 1.8 million tons in 1988. The coal mines in South Pyongan Province, the country's leading coal production base, and the Kaechon and Tokchon District coal mining complexes also increased coal output. North Korea produced 70 million tons of coal in 1987 and an estimated 80 million to 85 million tons in 1988. The Government projected the coal output to reach 120 million tons per year by 1993.

The country relied on oil from China and the U.S.S.R. during the past several years. According to a recent arrangement with Iran, North Korea will import 2 million tons per year of crude oil from Iran, which will be sufficient for domestic needs and displace oil imports from China and the U.S.S.R. In exchange North Korea will export raw material and metal to Iran.

TABLE 3

NORTH KOREA: APPARENT IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987[p]	Principal sources, 1987
METALS			
Alkali and alkaline-earth metals value, thousands	$6	$14	All from Japan.
Aluminum:			
Oxides and hydroxides	11,539	7,554	Do.
Metal including alloys:			
Scrap	—	16	All from Cyprus.
Unwrought	—	128	Hong Kong 119.
Semimanufactures	—	1,012	Japan 676; Italy 213; Belgium-Luxembourg 94.
Chromium:			
Ore and concentrate	25,000	—	
Oxides and hydroxides	64	83	Singapore 50; Hong Kong 28.
Cobalt: Oxides and hydroxides	3	1	All from Japan.
Columbium and tantalum: Metal including alloys, all forms, tantalum kilograms	386	([2])	Do.
Copper:			
Ore and concentrate	1,649	—	
Metal including alloys:			
Scrap	816	78	Cyprus 46; Singapore 32.
Unwrought	500	409	Hong Kong 400; Japan 9.
Semimanufactures	84	313	Japan 196; Singapore 91.
Gold: Metal including alloys, unwrought and partly wrought value, thousands	$7	—	
Iron and steel: Metal:			
Scrap	—	674	All from Japan.
Ferroalloys:			
Ferromanganese	843	6,653	Japan 5,000; Hong Kong 1,540.
Unspecified	1,922	7,211	Hong Kong 4,524; Japan 2,669.
Semimanufactures:			
Bars, rods, angles, shapes, sections	478	1,680	Hong Kong 1,608; Japan 70.
Universals, plates, sheets	3,486	3,955	Japan 2,376; Hong Kong 1,569.
Hoop and strip	434	398	Japan 346; Singapore 50.
Rails and accessories	1,687	1,396	All from Japan.
Wire	104	[3]1,244	Singapore 1,000; Italy 244.
Tubes, pipes, fittings	3,794	4,708	Japan 4,213; Hong Kong 440.
Castings and forgings, rough	1	([4])	All from Austria.
Lead:			
Ore and concentrate	2,375	2,200	All from Thailand.
Oxides	10	—	
Metal including alloys, all forms	6,940	7,504	Japan 6,556; Hong Kong 907.
Magnesium: Metal including alloys, all forms	68	56	All from Singapore.
Manganese:			
Ore and concentrate	30,578	200	Do.
Oxides	168	148	Japan 108; Singapore 40.

See footnotes at end of table.

TABLE 3—Continued

NORTH KOREA: APPARENT IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987[p]	Principal sources, 1987
METALS—Continued			
Mercury 76-pound flasks	145	—	
Molybdenum: Metal including alloys, all forms	—	7	All from Japan.
Nickel: Metal including alloys:			
Unwrought	638	1,894	Hong Kong 1,888; Belgium-Luxembourg 6.
Semimanufactures	2	NA	NA.
Platinum-group metals: Metals including alloys, unwrought and partly wrought value, thousands	$520	$107	All from Japan.
Silver: Metal including alloys, unwrought and partly wrought do.	$75	$25	Australia $23; Japan $2.
Tin:			
Ore and concentrate	20	—	
Oxides	2	—	
Metal including alloys:			
Unwrought	247	140	Singapore 83; Hong Kong 56.
Semimanufactures	([4])	17	All from Japan.
Titanium:			
Oxides	34	106	Japan 73; Hong Kong 33.
Metal including alloys, all forms	18	—	
Tungsten:			
Ore and concentrate	488	919	Hong Kong 855; Singapore 64.
Metal including alloys, all forms	1	([5])	All from Japan.
Zinc:			
Ore and concentrate	—	5,300	All from Australia.
Oxides	6	—	
Metal including alloys, all forms	147	2	All from Japan.
Other:			
Ores and concentrates	12,579	317	All from Australia.
Base metals including alloys, all forms	74	82	Hong Kong 34; Japan 27; Singapore 21.
INDUSTRIAL MINERALS			
Abrasives, n.e.s.:			
Natural: Corundum, emery, pumice, etc.	47	—	
Artificial: Corundum	58	—	
Dust and powder of precious and semiprecious stones excluding diamond value, thousands	$14	$62	Switzerland $35; Japan $27.
Grinding and polishing wheels and stones	28	92	Japan 59; Austria 33.
Asbestos, crude	—	36	All from Italy.
Boron materials: Oxides and acids	79	226	Italy 109; Hong Kong 95; Singapore 20.
Bromine including iodine and fluorine	24	—	
Cement	15	30	All from Japan.
Clays, crude	14	136	All from Singapore.
Diamond:			
Gem, not set or strung value, thousands	$150	—	
Industrial stones do.	$30	$36	All from Switzerland.

See footnotes at end of table.

TABLE 3—Continued

NORTH KOREA: APPARENT IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987[p]	Principal sources, 1987
INDUSTRIAL MINERALS—Continued			
Fertilizer materials:			
Crude, n.e.s.	298	—	
Manufactured:			
Nitrogenous	—	118	Japan 100; Italy 18.
Phosphatic	12	—	
Potassic	23,000	—	
Unspecified and mixed	513	23	All from Japan.
Fluorspar	2,304	—	
Gypsum and plaster	23,000	25	All from Thailand.
Iodine including bromine and fluorine kilograms	—	475	All from Hong Kong.
Magnesium compounds: Magnesite, crude	36	—	
Mica:			
Crude including splittings and waste	—	3	All from Singapore.
Worked including agglomerated splittings	—	[6]2	All from Austria.
Phosphates, crude	47,570	—	
Phosphorus, elemental	20	—	
Pigments, mineral: Iron oxides and hydroxides, processed value, thousands	—	$4	All from Japan.
Precious and semiprecious stones other than diamond:			
Natural do.	$23	$12	Japan $7; Thailand $3; Hong Kong $2.
Synthetic do.	$20	$46	Switzerland $28; Japan $18.
Salt and brine	296	319	All from Japan.
Sodium compounds, n.e.s.: Carbonate, natural and manufactured	—	1,770	Japan 1,620; Hong Kong 150.
Stone, sand and gravel:			
Dimension stone, all forms	1,207	304	Italy 299; Japan 5.
Quartz and quartzite	12	—	
Sulfur:			
Elemental, all forms	14,000	3	All from Japan.
Sulfuric acid	—	10	All from Singapore.
Other:			
Crude	142	—	
Metalloids, unspecified[7]	—	148	All from Hong Kong.
MINERAL FUELS AND RELATED MATERIALS			
Carbon black	988	1,189	Hong Kong 941; Singapore 246; Japan 2.
Coal, all grades including briquets	128,380	2	All from Singapore.
Coke and semicoke	104,490	14,280	All from Japan.
Petroleum refinery products:			
Gasoline 42-gallon barrels	274	—	
Mineral jelly and wax do.	1,866	1,739	Hong Kong 865; Japan 732.

See footnotes at end of table.

TABLE 3—Continued

NORTH KOREA: APPARENT IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987[p]	Principal sources, 1987
MINERAL FUELS AND RELATED MATERIALS—Continued				
Petroleum refinery products—Continued				
Kerosene and jet fuel	42-gallon barrels	352	186	All from Japan.
Distillate fuel oil	do.	165	—	
Lubricants	do.	26,463	4,590	Singapore 3,451; Spain 686.
Residual fuel oil	do.	372,020	2,944	All from Japan.
Bitumen and other residues	do.	18,659	—	
Petroleum coke	do.	—	22,000	Do.

[p] Preliminary. NA Not available.
[1] Table prepared by Audrey D. Wilkes. Owing to a lack of official trade data published by North Korea, this table should not be taken as a complete presentation of this country's mineral imports. These data have been compiled from the United Nations information and data published by the partner trade countries. The United States did not report any exports of mineral commodities to North Korea during 1987.
[2] Excludes unreported quantity valued at $247,000 exported by Japan.
[3] Excludes unreported quantity valued at $340,000 exported by Japan.
[4] Less than 1/2 unit.
[5] Unreported quantity valued at $21,000.
[6] Excludes unreported quantity valued at $20,000 exported by Japan.
[7] Reported under SITC item number as "selenium, tellurium, phosphorus, arsenic, etc."

REPUBLIC OF KOREA

The Republic of Korea produces limited quantities of mineral commodities that are not enough to provide the raw material requirements for its booming industries. Imports of coal, iron ore, nonferrous metal ore, and oil accounted for the major source of materials from abroad. Nevertheless, the country's economic growth had been steady at 12.2% and produced a gross national product (GNP) valued at $154 billion.[4] Per capita GNP increased to $3,624, a 28% jump from that of 1987.

The country produces no oil or gas and wants to obtain as much energy as possible from joint ventures in foreign countries in addition to other imports. The Government allocated $25.3 million in 1988 to help finance domestic companies investigating energy resources abroad and actively engaged in several overseas projects for oil, gas, and uranium development. Kodeco Energy Co. signed joint venture contracts with P.T. Gunanusa Utama Fabricators of Indonesia for natural gas exploration in West Madura, Indonesia. In the iron and steel sector, an additional $34.7 million by Pohang Iron and Steel Co. Ltd. (Posco) was invested in its U.S. subsidiary.

Production

Mineral production in the Republic of Korea contributed only 3.2% of the total industrial output in 1988. Coal mining was the most active sector with an output of 23 million tons of anthracite followed by industrial minerals and metal mining.

Trade

The Republic of Korea's foreign trade registered a moderate increase in value over that of 1987. Exports reported at $60.6 billion, a 28.3% increase, and imports reported at $51.8 billion, a 26.3% increase. The trade surplus, combined with nontrade earnings, pushed its current account to a record surplus at $14.3 billion. Among major exports, steel products worth $3.87 billion increased 32.5%, automobiles worth $3.6 billion increased 23.4%, and ships worth $1.7 billion increased 52.6%.

The Korean won surged 15.8% against the dollar in response to pressure from the U. S. Government, depressing the external cost for Korean merchandise. About 44% of the total value of exports went to the United States in 1988, while the value of exports to Japan and developing Pacific Rim countries was expected to increase in 1989. The country's trade with centrally planned economies increased 56% in 1988 to $2.7 billion and the largest chunk of that was with China. Trade with China through Hong Kong and Japan almost doubled 1987's level and was more than the amount reported between North Korea and China.

Commodity Review

***Metals.*—Copper.**—The rise in copper demand had been stalled by high copper prices. As a result, Korea Mining and Smelting Co. Ltd. had a small

TABLE 4

REPUBLIC OF KOREA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987	1988[p]
METALS						
Aluminum, primary		18,252	17,695	18,643	21,654	17,500
Bismuth metal		126	135	—	145	—
Cadmium, smelter		230	—	—	—	490
Copper:						
Mine output, Cu content		279	309	220	178	36
Metal:						
Smelter		100,200	106,900	165,024	157,923	169,000
Refined, primary		129,078	140,144	157,846	154,591	168,334
Gold metal	troy ounces	79,156	77,258	149,436	244,345	357,548
Iron and steel:						
Iron ore and concentrate:						
Gross weight	thousand tons	625	542	[r]582	470	390
Fe content	do.	350	304	[r]326	263	218
Metal:						
Pig iron	do.	8,763	8,833	9,017	11,057	12,577
Ferroalloys:						
Ferromanganese		58,600	61,396	53,721	58,044	75,924
Ferrosilicon		35,300	34,840	30,939	12,646	8,909
Other		50,215	54,879	66,499	90,382	89,966
Total		**144,115**	**151,115**	**151,159**	**161,072**	**174,799**
Steel, crude	thousand tons	13,034	13,539	14,554	16,782	19,117
Lead:						
Mine output, Pb content		10,837	9,699	11,864	13,998	13,688
Metal, smelter		20,304	22,394	22,890	62,593	60,799
Manganese ore and concentrate:						
Gross weight		74	—	177	91	—
Mn content		30	—	71	36	—
Molybdenum, mine output, Mo content		158	333	315	325	144
Silver metal	thousand troy ounces	3,759	3,990	5,034	6,721	7,288
Tin, mine output, Sn content		19	21	1	3	—
Tungsten, mine output, W content		2,702	2,579	2,455	2,375	2,029
Zinc:						
Mine output, Zn content		49,232	45,746	37,282	23,530	21,820
Metal, primary		108,460	111,653	127,439	186,078	223,000
INDUSTRIAL MINERALS						
Asbestos		8,062	4,703	2,983	2,518	2,428
Barite		2,729	2,785	3,768	2,942	[e]3,000
Cement, hydraulic	thousand tons	20,413	20,424	23,403	25,662	28,995
Clays: Kaolin		721,220	658,282	846,742	630,945	832,110
Diatomaceous earth		48,496	53,613	54,841	64,783	71,952
Feldspar		127,057	145,414	130,895	180,269	241,511

See footnotes at end of table.

TABLE 4—Continued

REPUBLIC OF KOREA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987	1988[p]
INDUSTRIAL MINERALS—Continued						
Fluorspar, metallurgical-grade		4,672	705	243	63	261
Graphite:						
Crystalline		2,305	1,602	641	838	3,383
Amorphous		56,258	69,877	96,577	106,507	104,384
Total		**58,563**	**71,479**	**97,218**	**107,345**	**107,767**
Kyanite and related materials: Andalusite		209	42	33	85	—
Mica: All grades		24,436	20,044	41,997	31,938	[e]30,000
Nitrogen: N content of ammonia		464,194	441,983	426,778	474,891	506,471
Salt		518,000	643,000	729,000	664,000	1,020,000
Sodium carbonate, manufactured		247,927	250,890	264,213	[e]288,500	[e]280,000
Stone, sand and gravel:						
Limestone	thousand tons	33,456	35,164	38,117	41,675	46,377
Quartzite	do.	868	872	885	1,235	1,379
Sand including glass sand	do.	858	1,096	1,233	1,350	1,488
Talc and related materials:						
Pyrophyllite		656,442	738,304	587,049	690,819	673,776
Talc		192,208	194,174	210,631	161,052	146,478
MINERAL FUELS AND RELATED MATERIALS						
Carbon black		82,369	91,019	120,534	146,758	183,346
Coal: Anthracite	thousand tons	21,370	24,543	24,253	24,273	24,295
Coke	do.	5,199	[e]5,200	[e]5,100	[e]5,100	[e]5,200
Fuel briquets: Anthracite briquets		21,316	19,453	20,595	23,587	22,926
Petroleum refinery products:						
Gasoline	thousand 42-gallon barrels	5,519	9,729	9,821	10,936	13,618
Jet fuel	do.	10,469	10,000	9,662	[e]9,500	[e]9,500
Kerosene	do.	9,109	10,452	9,559	7,966	10,619
Distillate fuel oil	do.	54,156	54,783	58,859	60,296	73,504
Residual fuel oil	do.	84,907	75,566	75,937	[e]73,400	[e]75,000
Lubricants	do.	1,962	3,807	7,317	[e]7,100	[e]7,300
Other	do.	43,288	19,031	13,576	[e]15,000	[e]15,000
Refinery fuel and losses[e]	do.	6,400	4,036	4,000	4,000	4,000
Total	**do.**	**215,810**	**187,404**	**188,731**	**[e]188,198**	**[e]208,541**

[e]Estimated. [p]Preliminary. [r]Revised.
[1]Includes data available through June 20, 1988.

surplus of 10,000 tons to export-through Singapore in 1988. On the other hand, Hyosung Corp., a South Korean trading company, for the first time via Hong Kong, imported 200 tons of North Korean copper to be used to make electric cables. Domestic demand rose to 310,000 tons, which was used by cable makers, fabricators, and others.

Korea Mining and Smelting's Changhang smelter had been operating at one-half of its 50,000-ton-per-year capacity for the past few years, but, in 1988, it produced 50,000 tons while the Onsan complex was expanded from a capacity of 100,000 to 140,000 tons per year. Imported copper scrap and blister amounted to 60,000 tons. The country was the largest importer of alloyed and unalloyed copper scrap from the United States.

TABLE 5

REPUBLIC OF KOREA: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
METALS				
Alkali and alkaline-earth metals value, thousands	—	$5	—	All to Japan.
Aluminum:				
Oxides and hydroxides	91	191	—	Bangladesh 93; Thailand 33.
Metal including alloys:				
Scrap	266	71	—	Japan 70.
Unwrought	786	2,875	4	Japan 2,194; Singapore 548.
Semimanufactures	18,108	24,925	812	Hong Kong 7,693; Philippines 4,311.
Antimony:				
Oxides	53	NA		
Metal including alloys, all forms	280	NA		
Arsenic: Oxides and acids	41	NA		
Bismuth: Metal including alloys, all forms	178	NA		
Cadmium:				
Oxides and hydroxides	465	NA		
Metal including alloys, all forms	104	NA		
Chromium: Oxides and hydroxides	—	3	—	Mainly to Indonesia.
Cobalt: Oxides and hydroxides	21	42	—	All to Japan.
Columbium and tantalum: Metal including alloys, all forms: Tantalum value, thousands	—	$31	—	Japan $30.
Copper:				
Matte and speiss including cement copper do.	—	$2	$1	NA.
Metal including alloys:				
Scrap	1,180	454	7	Japan 329; Hong Kong 31.
Unwrought	5,756	183,920	—	Malaysia 179,937; Japan 2,329.
Semimanufactures	40,334	42,844	1,699	Hong Kong 10,114; India 7,706.
Gold: Metal including alloys, unwrought and partly wrought troy ounces	48,270	NA		
Iron and steel:				
Iron ore and concentrate excluding roasted pyrite	3,092	8	—	All to Japan.
Metal:				
Scrap	71,525	42,164	249	Japan 27,538; Thailand 13,800.
Pig iron, cast iron, related materials	1,515	3,532	7	Spain 2,000; Japan 1,431.
Ferroalloys:				
Ferromanganese	5	5	—	All to Japan.
Ferrosilicon	20	NA		
Unspecified	3,031	114	—	Do.
Steel, primary forms thousand tons	1,354	1,686	161	Japan 976; Indonesia 87.
Semimanufactures:				
Bars, rods, angles, shapes, sections	1,939,537	1,611,308	145,936	Japan 335,511; Dominica 55,735.
Universals, plates, sheets	1,642,980	1,732,537	462,324	Japan 697,200; Saudi Arabia 62,048.

See footnotes at end of table.

TABLE 5—Continued

REPUBLIC OF KOREA: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987 United States	Destinations, 1987 Other (principal)
METALS—Continued				
Iron and steel—Continued				
Metal—Continued				
Semimanufactures—Continued				
Hoop and strip	41,348	55,732	7,289	Japan 11,855; Singapore 6,245.
Rails and accessories	50,424	62,345	3,729	India 16,346; Singapore 10,289.
Wire	144,834	161,254	11,498	Japan 42,175; Hong Kong 13,779.
Tubes, pipes, fittings	779,874	912,871	390,377	Japan 202,103; Canada 55,949.
Castings and forgings, rough	23,281	29,295	13,061	Japan 6,388; Canada 3,072.
Lead:				
Ore and concentrate	—	4,606	—	Australia 3,070; Japan 1,536.
Oxides	20	3,598	3	Japan 3,348; Indonesia 239.
Metal including alloys:				
Scrap	2	716	—	Japan 710.
Unwrought	9,187	8,715	28	Japan 3,632; Singapore 1,540.
Semimanufactures	81	188	([2])	Saudi Arabia 114; Pakistan 20.
Magnesium: Metal including alloys:				
Scrap	20	11	—	All to Japan.
Unwrought	28	18	—	Do.
Semimanufactures	27	93	—	Japan 87.
Manganese:				
Ore and concentrate, battery-grade	70	—		
Oxides	31	107	—	Japan 70; Sri Lanka 25.
Molybdenum:				
Ore and concentrate	308	—		
Metal including alloys, all forms	—	1	—	All to United Kingdom.
Nickel: Metal including alloys:				
Scrap	225	639	8	Japan 630.
Unwrought	—	42	—	All to Japan.
Semimanufactures	6	53	([2])	France 19; Hong Kong 15.
Platinum-group metals:				
Waste and sweepings value, thousands	$819	—		
Metals including alloys, unwrought and partly wrought do.	$298	$895	$306	Japan $423; Hong Kong $166.
Silver:				
Waste and sweepings kilograms	193	10,650	44	United Kingdom 8,491; Japan 1,681.
Metal including alloys, unwrought and partly wrought value, thousands	$3,907	$22,330	$1	Japan $18,936; Hong Kong $716.
Tin: Metal including alloys:				
Scrap	32	53	—	Japan 52.
Unwrought	116	206	([2])	Japan 205.

See footnotes at end of table.

TABLE 5—Continued

REPUBLIC OF KOREA: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Destinations, 1987	
				United States	Other (principal)
METALS—Continued					
Tin: Metal including alloys—Continued					
Semimanufactures		13	29	—	Hong Kong 4; Pakistan 4; Japan 3.
Titanium: Oxides		1,496	3,215	214	Japan 2,290; Indonesia 221.
Tungsten:					
Ore and concentrate		514	467	—	Japan 330; Netherlands 108.
Oxides and hydroxides		15	NA		
Metal including alloys, all forms		261	289	2	Japan 174; United Kingdom 55.
Zinc:					
Oxides		4,445	5,638	17	Japan 4,533; Sri Lanka 458.
Ash and residue containing zinc		9,452	NA		
Metal including alloys:					
Scrap		1	100	—	All to Indonesia.
Unwrought		1,720	38,035	6,047	Japan 24,800; Indonesia 1,165.
Semimanufactures		445	870	45	Japan 228; Jordan 152.
Other:					
Ores and concentrates		—	43,719	—	Japan 43,593; Belgium-Luxembourg 54.
Base metals including alloys, all forms		—	715	190	Japan 413; Netherlands 105.
INDUSTRIAL MINERALS					
Abrasives, n.e.s.:					
Natural: Corundum, emery, pumice, etc.		23	([3])	—	Mainly to Thailand.
Artificial: Corundum	value, thousands	—	$3	$3	
Dust and powder of precious and semiprecious stones including diamond	do.	$4	$63	$1	West Germany $35; Japan $26.
Grinding and polishing wheels and stones		1,278	2,147	382	Australia 527; Canada 187.
Asbestos, crude		—	41	—	Japan 40.
Cement	thousand tons	4,401	4,910	549	Japan 1,526; Hong Kong 1,303.
Chalk		11	—		
Clays, crude		63,158	60,671	—	Japan 52,059; Thailand 397.
Diamond:					
Gem, not set or strung	value, thousands	$1,662	$581	$123	Japan $340; Belgium-Luxembourg $118.
Industrial stones	do.	—	$2	—	All to Japan.
Diatomite and other infusorial earth		167	423	—	Indonesia 155; unspecified 250.
Feldspar, fluorspar, related materials		16,759	19,258	—	Japan 23; unspecified 19,235.
Fertilizer materials:					
Crude, n.e.s.		388	861	—	All to Japan.
Manufactured:					
Ammonia		32	27	—	Norway 20.
Nitrogenous		143,772	117,524	—	Philippines 57,363; Nigeria 15,000; Fiji 12,100.
Phosphatic		35,713	26,580	—	Japan 22,030; Fiji 4,300.

See footnotes at end of table.

TABLE 5—Continued

REPUBLIC OF KOREA: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
INDUSTRIAL MINERALS—Continued				
Fertilizer materials—Continued				
Manufactured—Continued				
Potassic	36,677	41,172	—	Malaysia 20,829; Japan 12,950.
Unspecified and mixed	927,415	902,341	—	Thailand 199,314; Japan 135,813; Hong Kong 35,056.
Graphite, natural	30,969	56,833	—	Japan 48,250; Kuwait 700.
Gypsum and plaster	69	86	—	Sudan 12; unspecified 70.
Lime	7,432	2,010	—	Ethiopia 1,500; Papua New Guinea 503.
Magnesium compounds: Magnesite, crude	16	33	—	Mainly to Philippines.
Mica: Worked including agglomerated splittings	([2])	3	—	All to Japan.
Pigments, mineral: Iron oxides and hydroxides, processed	27	46	—	France 10; unspecified 36.
Potassium salts, crude	—	10,176	—	All to Thailand.
Precious and semiprecious stones other than diamond:				
Natural value, thousands	$10,039	$11,522	$5,178	Japan $5,173; Hong Kong $868.
Synthetic do.	$15,920	$17,977	$13,235	Switzerland $1,096; Spain $1,067.
Salt and brine	11,689	50,269	22,345	Japan 27,726; Canada 94.
Sodium compounds, n.e.s.: Carbonate, manufactured	715	9	—	Malaysia 6; Libya 2.
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked	298,709	329,985	5	Japan 308,892.
Worked	69,527	118,222	—	Japan 116,031.
Dolomite, chiefly refractory-grade	116,563	163,195	—	Japan 163,152.
Gravel and crushed rock	412	347	—	Japan 327; Indonesia 20.
Quartz and quartzite	6,654	4,919	—	Japan 4,414; Indonesia 53.
Sand other than metal-bearing	2,012	1,985	—	Japan 168; unspecified 1,800.
Sulfur: Elemental, crude including native and byproduct	3,399	4,961	—	Indonesia 1,872; Bangladesh 1,209.
Sulfuric acid	108	178	—	Libya 12; unspecified 150.
Talc, steatite, soapstone, pyrophyllite	42,486	36,580	701	Thailand 9,778; Japan 6,600.
Vermiculite	78	NA		
Other:				
Crude	249,130	342,306	—	Japan 225,752; unspecified 111,339.
Slag and dross, not metal-bearing	124,517	77,545	—	Japan 77,524.
MINERAL FUELS AND RELATED MATERIALS				
Carbon black	15,836	12,572	—	Indonesia 3,651; Sudan 2,885; Japan 1,742.
Coal: Anthracite and bituminous	—	1,120	—	Japan 1,001.
Coke and semicoke	2,462	7,817	—	Japan 7,500; Thailand 200.

See footnotes at end of table.

TABLE 5—Continued

REPUBLIC OF KOREA: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Destinations, 1987	
				United States	Other (principal)
MINERAL FUELS AND RELATED MATERIALS—Continued					
Petroleum:					
Crude	value, thousands	$7,579	$144	$144	
Refinery products:					
Liquefied petroleum gas	thousand 42-gallon barrels	(2)	112	—	Japan 103; Madagascar 9.
Gasoline including naphtha	do.	10,445	7,528	243	Japan 6,696.
Mineral jelly and wax	do.	1	4	—	Bangladesh 2; Japan 1.
Kerosene and jet fuel	do.	2,900	60,767	24,182	Singapore 25,700; Saudi Arabia 6,870.
Distillate fuel oil	do.	5,069	5,635	13	Japan 4,477.
Lubricants	do.	775	563	10	Japan 37; unspecified 428.
Residual fuel oil	do.	104,882	90,969	56,401	Japan 16,410; Singapore 12,341.
Bitumen and other residues	do.	53	36	3	Hong Kong 19; Malaysia 5.
Bituminous mixtures	do.	(2)	16	—	Pakistan 10; Japan 4.

NA Not available.
[1] Table prepared by Audrey D. Wilkes.
[2] Less than 1/2 unit.
[3] Unreported quantity valued at $2,000.

Gold.—Gold is one of the country's most valuable mineral resources. Because of the rebound in gold price and strong domestic demand, the Ministry of Energy and Resources planned to increase gold production by 20% each year for the next 5 years, reaching 35,400 troy ounces in 1988 and 48,200 troy ounces in 1991. Kumwang Mining Co. Ltd. and Young Poong Corp. were actively engaged in gold mining in Kumwang, about 75 kilometers southeast of Seoul. Other mining companies either developed new pits in Dongwon or concentrated more on recovering the precious metal from their mines. Meanwhile, gold imports of 643,000 troy ounces were reported to have taken place in 1988.

Iron and Steel.—Sammi Steel Co. Ltd., the only stainless sheet producer, planned to boost stainless and special steel production capacity to 1 million tons per year at its Chang Won works near Pusan by 1990. The installed total combined capacity of this plant and the Ulsan plant, north of Pusan, was 385,000 tons per year in 1988. Domestic and imported stainless scrap and imported stainless hot coil from Japan were the major sources for these plants. Posco continued construction of its 240,000-ton-per-year stainless steel plant at Pohang, which was to cost $140 million. When completed in 1989, the plant is expected to produce 190,000 tons of hot-rolled coil and 50,000 tons of wire rod.

The commissioning in July of Posco's new 3,800-cubic-meter blast furnace at Kwangyang brought an end to second-phase construction, increasing raw steel capacity to 5.4 million tons per year. Together with Pohang's earlier capacity of 9.1 million tons per year, it made Posco the third largest steel company in the world. The third phase of expansion was started in November, including a second hot coil mill capable of producing 7.5 million tons per year when completed in 1990. The expansion will add 2.7 million tons of raw steel, raising Posco's total capacity to 17.2 million tons per year by 1991.

Posco also commissioned its 1.22-million-ton-per-year cold-rolling mill at Kwangyang. Another cold-rolled maker, Dongbu Steel Co. Ltd., was building a second color-coating line with a capacity of 100,000 tons per year at its Inchon works. The works' first color line produces 70,000 tons.

Posco contributed nearly 90% of all the steel produced in the country. The increased demand for iron ore and coal by Posco bolstered 3 domestic shipyards to build at least 10 bulk carriers to transport cargo required by Posco. The country's shipyards were recovering from the worldwide shipbuilding slump. In addition, the won apprecia-

TABLE 6

REPUBLIC OF KOREA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS				
Alkali and alkaline-earth metals	(2)	197	33	Japan 110; France 34.
Aluminum:				
Ore and concentrate	15,571	30,363	3	Hong Kong 17,115; Guyana 7,532.
Oxides and hydroxides	93,127	107,010	223	Australia 63,364; Japan 40,583.
Metal including alloys:				
Scrap	8,799	43,244	35,366	Saudi Arabia 1,413; Kuwait 1,176.
Unwrought	184,512	513,496	8,954	Hong Kong 314,524; Australia 79,915.
Semimanufactures	30,582	44,461	5,767	Japan 15,694; Australia 7,543.
Antimony:				
Ore and concentrate	4,655	NA		
Oxides	644	NA		
Metal including alloys, all forms	298	NA		
Beryllium: Metal including alloys, all forms value, thousands	—	$49	$47	Japan $2.
Chromium:				
Ore and concentrate	3,274	41,150	—	Japan 36,000; Philippines 5,053.
Oxides and hydroxides	2,422	2,668	1,124	Japan 910; United Kingdom 333.
Cobalt:				
Oxides and hydroxides	30	56	1	Finland 24; Japan 10.
Metal including alloys, all forms	444	NA		
Columbium and tantalum: Metal including alloys, all forms: Tantalum value, thousands	$89	$730	$26	Japan $693.
Copper:				
Ore and concentrate	389,143	555,628	25,912	Papua New Guinea 166,409; Canada 83,745.
Matte and speiss including cement copper	18,897	9,941	3,277	India 6,159; Norway 505.
Oxides and hydroxides	924	NA		
Sulfate	84	NA		
Metal including alloys:				
Scrap	74,949	215,937	120,059	Hong Kong 28,407; Saudi Arabia 23,657.
Unwrought	99,682	120,012	2,859	Chile 47,765; Japan 22,941.
Semimanufactures	17,355	26,324	458	Japan 13,537; Thailand 445.
Gold:				
Ore and concentrate	4,783	NA		
Metal including alloys, unwrought and partly wrought troy ounces	189,524	NA		
Indium: Metal including alloys, all forms kilograms	243	NA		
Iron and steel:				
Iron ore and concentrate:				
Excluding roasted pyrite thousand tons	11,941	18,011	(3)	Australia 6,527; Brazil 4,884; India 3,578.
Pyrite, roasted	—	9,832	—	Philippines 9,831.

See footnotes at end of table.

TABLE 6—Continued

REPUBLIC OF KOREA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS—Continued				
Iron and steel—Continued				
Metal:				
Scrap thousand tons	3,115	3,519	2,619	Australia 247; Netherlands 188.
Pig iron, cast iron, related materials	392,146	679,644	40,358	Brazil 310,498; Hong Kong 19,569.
Ferroalloys:				
Ferrochromium	10,431	NA		
Ferromanganese	1,124	4,409	—	Japan 969; Spain 740; Norway 650.
Ferromolybdenum	582	NA		
Ferronickel	725	NA		
Ferrosilicomanganese	5	NA		
Ferrosilicon	15,834	NA		
Ferrovanadium	262	—		
Silicon metal	2,627	NA		
Unspecified	3,852	63,069	310	Philippines 8,451; Norway 4,369.
Steel, primary forms thousand tons	1,688	1,908	12	Japan 671; Brazil 344.
Semimanufactures:				
Bars, rods, angles, shapes, sections	424,717	998,918	10,908	Japan 520,455; Belgium-Luxembourg 15,591.
Universals, plates, sheets	1,471,716	1,314,482	3,100	Japan 1,155,042; Brazil 31,783.
Hoop and strip	38,889	45,751	111	Japan 40,037; France 2,281.
Rails and accessories	1,531	3,060	31	Japan 2,433; West Germany 366.
Wire	37,543	85,827	228	Japan 84,173; France 599.
Tubes, pipes, fittings	119,396	245,599	40,259	Japan 161,904; Austria 14,639.
Castings and forgings, rough	2,237	2,845	187	Japan 2,485.
Lead:				
Ore and concentrate	—	4,861	—	All from Canada.
Oxides	16	11	—	West Germany 9; Japan 2.
Metal including alloys:				
Scrap	39,382	45,894	6,415	Australia 12,470; Saudi Arabia 9,054.
Unwrought	55,032	76,529	1,648	Australia 46,116; Peru 10,932.
Semimanufactures	376	78	10	Japan 59.
Lithium:				
Oxides and hydroxides	287	NA		
Metal including alloys, all forms kilograms	176	NA		
Magnesium: Metal including alloys:				
Scrap	5	8	8	
Unwrought	838	1,157	454	Norway 557; Canada 84.
Semimanufactures	85	279	74	Canada 180; Japan 13.

See footnotes at end of table.

TABLE 6—Continued

REPUBLIC OF KOREA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987	
				United States	Other (principal)
METALS—Continued					
Manganese:					
Ore and concentrate		222,529	368,375	—	Australia 164,885; India 118,228; Gabon 28,862.
Oxides		2,408	4,117	(3)	Japan 2,213; Belgium-Luxembourg 332.
Mercury	76-pound flasks	568	841	58	Japan 232; West Germany 116.
Molybdenum:					
Ore and concentrate		263	NA		
Metal including alloys, all forms		28	32	7	Japan 21.
Nickel:					
Matte and speiss	value, thousands	$5	$5	$5	
Oxides and hydroxides		36	NA		
Metal including alloys:					
Scrap		284	555	118	Japan 135.
Unwrought		5,839	4,962	56	Canada 2,239; Australia 587.
Semimanufactures		1,085	2,130	245	France 533; Japan 447.
Platinum-group metals: Metals including alloys, unwrought and partly wrought	value, thousands	$3,067	$3,162	$988	United Kingdom $1,122; Japan $671.
Selenium, elemental		11	NA		
Silver:					
Ore and concentrate		4,783	4,007	28	Japan 2,368; Peru 924.
Waste and sweepings	value, thousands	$1	$1,703	$1,703	
Metal including alloys, unwrought and partly wrought	do.	$1,294	$1,650	$147	Japan $1,195; France $171.
Tin:					
Ore and concentrate		1,532	3,698	—	Thailand 919; Burma 525; Nigeria 215.
Metal including alloys:					
Scrap		35	3	—	All from Japan.
Unwrought		3,754	4,295	7	Malaysia 2,767; Indonesia 1,106.
Semimanufactures		263	415	203	Japan 80; Malaysia 33.
Titanium:					
Ore and concentrate		50,095	NA		
Oxides		4,196	3,558	89	Japan 2,456; West Germany 879.
Metal including alloys, all forms		204	NA		
Tungsten: Metal including alloys, all forms		169	121	78	Japan 37.
Uranium and/or thorium:					
Ore and concentrate	value, thousands	—	$11	—	All from Malaysia.
Metal including alloys, all forms		64	NA		
Zinc:					
Ore and concentrate		179,136	408,138	—	Australia 194,794; Canada 100,534.
Oxides		151	309	79	Japan 207.

See footnotes at end of table.

TABLE 6—Continued

REPUBLIC OF KOREA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS—Continued				
Zinc—Continued				
Ash and residue containing zinc	1,387	NA		
Metal including alloys:				
Scrap	13,109	10,010	1,238	Japan 6,863; Saudi Arabia 915.
Unwrought	117,492	36,388	—	Hong Kong 3,119; Peru 1,229; unspecified 21,470.
Semimanufactures	750	1,308	9	Japan 896; Peru 400.
Zirconium: Ore and concentrate	10,844	NA		
Other:				
Ores and concentrates	—	58,709	187	Malaysia 43,510; Australia 21,785.
Ashes and residues	—	1,487	143	Japan 681; Saudi Arabia 635.
Base metals including alloys, all forms	—	1,895	81	Japan 461; Hong Kong 266.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	7,002	16,309	1,795	Japan 9,497; Indonesia 3,608.
Artificial:				
Corundum	21,923	29,139	207	Japan 13,853; Brazil 2,732.
Silicon carbide	7,097	NA		
Dust and powder of precious and semiprecious stones including diamond value, thousands	$23,385	$30,197	$2,954	Ireland $25,605; Japan $1,335.
Grinding and polishing wheels and stones	1,129	1,309	60	Japan 974; Austria 48.
Asbestos, crude	68,017	77,596	—	Canada 28,014; Zimbabwe 9,766.
Barite and witherite	1,436	3,241	—	Thailand 1,425; United Kingdom 893; Ireland 452.
Boron materials:				
Crude natural borates	1,862	2,523	1,564	Turkey 954.
Oxides and acids	2,329	2,932	2,214	Italy 526.
Bromine	228	NA		
Cement	16,634	7,691	34	France 4,390; Japan 2,216.
Chalk	2,571	4,950	—	France 4,908.
Clays, crude	112,484	244,230	171,509	Hong Kong 24,233; Japan 18,277.
Cryolite and chiolite	10	40	—	Japan 35; Denmark 5.
Diamond:				
Gem, not set or strung value, thousands	$2,173	$1,029	$330	Belgium-Luxembourg $692.
Industrial stones do.	$1,131	$1,775	$1,220	Japan $206; Belgium-Luxembourg $130.
Diatomite and other infusorial earth	77	98	18	Japan 57; Spain 19.
Feldspar, fluorspar, related materials	29,393	63,660	37	Thailand 35,440; Japan 2,409.
Fertilizer materials: Manufactured:				
Ammonia	375,636	422,975	275,878	Indonesia 41,975; Saudi Arabia 34,916.
Nitrogenous	987	22,931	22,057	Chile 300; West Germany 176.

See footnotes at end of table.

TABLE 6—Continued

REPUBLIC OF KOREA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
INDUSTRIAL MINERALS—Continued				
Fertilizer materials: Manufactured—Continued				
Phosphatic	—	3	—	All from West Germany.
Potassic	429,960	697,864	15,288	Canada 512,461; Jordan 61,338.
Unspecified and mixed	783	883	(3)	Japan 59; unspecified 774.
Graphite, natural	3,180	3,784	(3)	Japan 317; Hong Kong 234; unspecified 3,131.
Gypsum and plaster	227,813	198,685	70	Thailand 156,517; Mexico 28,439.
Iodine	14	NA		
Kyanite and related materials	3,141	NA		
Lime	28	41	2	Japan 32.
Magnesium compounds: Magnesite, crude including calcined	76,097	59,209	155	Japan 16,945; Hong Kong 6,215; unspecified 35,467.
Mica:				
Crude including splittings and waste	988	1,084	227	Malaysia 419; India 241.
Worked including agglomerated splittings	235	403	3	Switzerland 161; Japan 149.
Nitrates, crude	6,680	7,798	—	Chile 7,276; West Germany 62.
Phosphates, crude thousand tons	1,608	1,702	1,357	Jordan 141; Morocco 56.
Phosphorus, elemental	1,856	NA		
Pigments, mineral:				
Natural, crude	195	NA		
Iron oxides and hydroxides, processed	7,617	15,228	3,152	Japan 9,662; Belgium-Luxembourg 778.
Precious and semiprecious stones other than diamond:				
Natural value, thousands	$7,657	$7,611	$3,246	Hong Kong $1,427; Brazil $1,289.
Synthetic do.	$12,902	$20,688	$8,805	Japan $6,389; Switzerland $718.
Pyrite, unroasted	10	—		
Salt and brine	872,771	1,102,544	3	Australia 865,022; Yemen (Sanaa) 106,610.
Sodium compounds, n.e.s.:				
Carbonate, manufactured	36,127	44,310	44,307	Singapore 3.
Sulfate, manufactured	19,028	NA		
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked	3,166	4,936	187	India 2,116; Japan 1,124.
Worked	6,453	4,253	704	Italy 2,989; Japan 342.
Dolomite, chiefly refractory-grade	459	425	—	United Kingdom 174; Japan 140; Norway 111.
Gravel and crushed rock	2,215	2,642	54	France 1,401; Japan 1,123.
Limestone other than dimension	12,008	5,779	21	Japan 5,674; United Kingdom 83.
Quartz and quartzite	809	1,146	72	Sweden 522; Japan 153.
Sand other than metal-bearing	198,992	260,925	171	Australia 205,982; Malaysia 41,000.

See footnotes at end of table.

TABLE 6—Continued

REPUBLIC OF KOREA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
INDUSTRIAL MINERALS—Continued				
Sulfur:				
Elemental:				
Crude including native and byproduct	518,369	521,005	11,048	Canada 396,885; Japan 108,935.
Colloidal, precipitated, sublimed	1,330	1,903	1,148	Japan 711.
Sulfuric acid	147,353	108,749	810	Japan 107,938.
Talc, steatite, soapstone, pyrophyllite	41,926	63,958	4,317	Hong Kong 12,750; Australia 9,311.
Vermiculite	(4)	NA		
Other:				
Crude	98,987	100,124	731	Japan 45,968; Australia 24,996.
Slag and dross, not metal-bearing	62,733	9,530	14	Japan 9,020; United Kingdom 496.
MINERAL FUELS AND RELATED MATERIALS				
Asphalt and bitumen, natural	89	80	79	Japan 1.
Carbon black	5,800	6,992	1,303	Japan 1,974; Australia 947.
Coal:				
Anthracite and bituminous thousand tons	20,919	21,819	3,624	Australia 7,821; Canada 3,991.
Briquets of anthracite and bituminous coal	—	103	19	Australia 50.
Lignite including briquets	54,255	39,280	—	Australia 39,263.
Coke and semicoke	126,618	134,929	1,424	Japan 112,889; Australia 14,388.
Petroleum:				
Crude thousand 42-gallon barrels	212,286	216,731	685	Saudi Arabia 33,459; Oman 26,836.
Refinery products:				
Liquefied petroleum gas do.	9,120	29,388	1	Indonesia 19,575; Saudi Arabia 7,422.
Gasoline do.	967	5 9,797	28	Singapore 3,367; Saudi Arabia 1,826.
Naphtha do.	8,032	NA		
Mineral jelly and wax do.	95	109	13	Japan 78.
Kerosene and jet fuel do.	395	3,073	90	Singapore 1,111; Japan 521.
Distillate fuel oil do.	3,984	10,353	2,190	Saudi Arabia 3,614; Singapore 1,091.
Lubricants do.	231	349	47	Japan 210; West Germany 59.
Residual fuel oil do.	13,857	16,118	6,490	Japan 4,389; Saudi Arabia 1,672.
Bitumen and other residues do.	19	(3)	(3)	Japan (3).
Bituminous mixtures do.	5	4	1	United Kingdom 2.
Petroleum coke do.	575	1,058	1,017	Japan 41.

NA Not available.
[1] Table prepared by Audrey D. Wilkes.
[2] Unreported quantity valued at $853,000.
[3] Less than 1/2 unit.
[4] Unreported quantity valued at $2,821.
[5] Includes naphtha.

tion and wage increases eroded price competitiveness. Posco bought more than 100,000 tons of Chinese coking coal in 1988 for its blast furnace mix. The imports of Indian iron ore were increased to 4 million tons per year. The Republic of Korea was the leading importer of iron scrap from the United States in 1988 with 307,000 tons valued at $34 million.

The country's steel industry could not meet the demand of the booming economy, which grew 12.2%. Steel consuming industries were automobiles, electronics, machinery, and shipbuilding. The steel shortage was further aggravated by the strike at Union Steel Manufacturing Co. Ltd. As a result, the Government planned to reduce or maintain its level of exports in 1989 as compared with that of 1988. Meanwhile, steel imports reportedly rose 22% in 1988. Steel demand was forecasted to be 27.2 million tons by 1990, whereas domestic production was expected to reach 21.8 million tons.

Lead and Zinc.—The Republic of Korea's lead consumption has been increasing steadily. In the first 7 months of 1988, 81,000 tons was used compared with 60,000 tons in the same period of 1987. The nation's only primary lead smelter and refinery, with a capacity of 15,000 tons per year, was run by Korea Mining and Smelting at Changhang. To meet the growing domestic demand, lead smelting capacity will be expanded with the announcement that Korea Zinc Co. Ltd. and Lurgi Gmbh of the Federal Republic of Germany plan to build a lead smelter using the QSL process. The new plant, with a capacity of 60,000 tons per year, will be near a zinc plant at Onsan using existing infrastructure. The plant is scheduled to be completed at the end of 1990. Raw material feed will come from indigenous resources and from imported materials.

Tungsten.—Owing to continued low world prices and the weakening of the U.S. dollar, the country's production of tungsten metal decreased to 1,900 tons in 1988. Korea Tungsten Mining Co. Ltd.'s Sang Dong scheelite mine cut back production to 1,750 tons of metal content, and instead of scheelite concentrate, the output was processed into downstream products such as ammonium paratungstate, tungsten metal, carbide powders, and cemented tungsten carbide, mostly sold at home with less for export to longstanding customers.

Industrial Minerals.—**Barium and Strontium Carbonates.**—Samsung Corning Co. Ltd. and Kali-Chemie AG of the Federal Republic of Germany entered into a 50-50 joint venture for the production of barium carbonate and strontium carbonate on the northwest coast of the Republic of Korea with an investment of $35 to $40 million. The joint venture company, Daehan Speciality Chemicals Co. Ltd., plans to build the plant at a capacity of 30,000 to 40,000 tons per year of chemicals for use in the television, specialty glass, and electronics industries in the Republic of Korea initially and in the Far East market in the future. Plant completion is scheduled for 1989.

Cement.—The country's major cement producers, including Ssangyong Cement Industrial Co., planned to resume cement exports to the Middle East after the truce between Iran and Iraq took effect in August 1988. The Republic of Korea had exported 3 million tons of cement to the region in 1981. The region's market situation is expected to boom as reconstruction projects start.

Sulfur.—The Republic of Korea imported 521,000 tons of sulfur in 1987. To meet increasing domestic consumption, the Government (75%) and Daeboo Battery Co. Ltd. (25%) formed a 50-50 joint venture with Rich Coast Sulfur Co. of Vancouver, Canada, to develop the latter's Gongora sulfur deposit in Costa Rica. The Koreans will provide $9 million for development and working capital and have the right to buy the sulfur at a 5% discount to the world price. The deposit was reported to have a grade of 15% elemental sulfur, and the plan was to produce sulfur at the rate of 127,000 tons per year with a mine life of 5 to 6 years.

Mineral Fuels.—The Republic of Korea's coal reserves were mainly anthracite, which was its only major indigenous energy resource, with 640 million tons estimated to be economically minable. However, only 23 million tons of anthracite was being mined annually. Anthracite production and imports were cut back as domestic demand for anthracite for heating and cooking decreased because of growing environmental concerns and a shift to higher quality fuels such as liquefied natural gas (LNG). It was estimated that 2.8 million tons per year would be lost in anthracite production from small local mines. The country imported 1.5 million tons of anthracite in the first 10 months of 1988. However, the percentage share of domestic consumption of anthracite imports increased slightly. The major sources of anthracite imports in 1988 were China, the Soviet Union, the United States, and the Republic of South Africa, in descending order. Through Dai Han Coal Corp., the country imported 500,000 tons of Soviet anthracite in late 1988, compared with 170,000 tons in the first 8 months. Australia, India, Swaziland, and Vietnam also supplied anthracite to the Republic of Korea.

The country's iron and steel industry used one-half (as coking coal) of the bituminous coal imports, which totaled 14.3 million tons for the first 8 months. Australia was the largest supplier of bituminous coal with a market share of 40%, followed by Canada (24%), the United States (14%), and China. Posco reportedly sold its Tanoma Mine in Pennsylvania to American Metals & Coal Inc. of Greenwich, Connecticut, because of high operating costs. However, its coking coal imports were 2 million tons in 1988 of which 900,000 tons was from the Tanoma Mine or brokered by Tanoma. Posco's other two overseas mining projects, one in Canada and the other in Australia, provided over 1 million tons of coking coal per year. Steam coal imports of 7.1 million tons in the first 8 months were used in the power and cement industries as substitutes for oil. Korea Electric Power Corp. consumed a little over one-half that amount.

The Republic of Korea imported 230 million barrels of crude oil, mostly from the Middle East and Indonesia in 1988. Of particular significance were indirect imports from China, which totaled 3.5 million barrels, reflecting more relaxed trade relations between the two countries. To meet the rising demand for oil derivatives, three oil refineries (Yukong, Ssangyong, and Kyung In) planned to increase their refining capacities to a national total of 1.1 million barrels per day by 1991. The current oil refining capacity of the country is 840,000 barrels per day. The Government also planned to build a new $401 million underground petroleum storage center in the southern coastal area to increase its oil reserves. The present two oil storage facilities have a combined capacity of 36 million barrels.

The country's petrochemical industry plans to build two naphtha-cracking facilities: Korea Petrochemical Industry Co.'s 250,000-ton cracker near the Ulsan petrochemical complex in Onsan and either Hanyang Chemical Corp.'s or Honam Petrochemical Corp.'s 350,000-ton facility at the Yochon complex on the south coast. Three crackers already under construction were Yukong Ltd.'s 400,000-ton plant, Daelim Petrochemical Co. Ltd.'s 200,000-ton facility, both due for completion in 1989, and Lucky Ltd.'s 350,000-ton cracker to be completed in 1991. Altogether the ethylene capacity will become 2.1 million tons in 1992, whereas capacity was only 505,000 tons at yearend. Honam Oil Refinery Co. Ltd. dedicated a 120,000-ton polypropylene plant in January 1988. Three propylene plants were planned: Tongyang Nylon Co. Ltd.'s 150,000-ton facility in Ulsan, Isu Chemical Co. Ltd.'s 250,000-ton plant in Onsan, and STC Corp.'s 100,000-ton plant in Yochon.

The use of LNG rose 66% over that of 1987, still a relatively small fraction of overall energy consumption. Imported LNG from Indonesia was used for power generation, primarily, and city gas. The country's LNG demand was expected to rise to as much as 6 million tons annually by the year 2000 from about 2 million tons in 1988.

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[1] Physical scientist, Division of International Minerals.

[2] Where necessary, values have been converted from Korean won (W) to U.S. dollars at the rate of W730.6=US$1.00 for 1988.

[3] Where necessary, values have been converted from Korean won (W) to U.S. dollars at the rate of W0.94=US$1.00 for 1987 and 1988.

[4] Work cited in footnote 2.

THE MINERAL INDUSTRIES OF

SOUTH ASIA

By David B. Doan, Gordon L. Kinney, and David Yen

AFGHANISTAN[1]

In 1980, Soviet troops were introduced into Afghanistan to back the National Government. However, civil disorder was pervasive throughout the country and rebel insurgents controlled rather substantial areas of Afghanistan. Civil disorder generally hampered industrial development and activity, severely limiting economic growth. With the pullout of Soviet troops completed in 1988, the country had undergone close to a decade of lost opportunities for many forms of foreign aid for development.

Afghanistan is a landlocked country flanked by the U.S.S.R., China, Pakistan, and Iran. Its major trading partner has been the Soviet Union and, to a very much smaller extent, member countries of the Council for Mutual Economic Assistance (CMEA). The most valuable item Afghanistan exports to the Soviet Union is natural gas. The two largest gasfields—Hodja-Gugerdag and Djar Kuduk—were in northern Afghanistan. Most of the output of the two fields was moved by twin 32-inch, 62-mile pipelines to the U.S.S.R. Annual exports to the Soviet Union may have exceeded 78 billion cubic feet and may have been as much as 105 billion cubic feet. A 55-mile pipeline to the east to the industrial center at Maza-i-Sharif transported the natural gas for use at a 36,000-kilowatt electrical power station and a 105,000-ton-per-year urea fertilizer plant. However, transmission to the terminus was repeatedly disrupted by rebel action.

In addition to natural gas, Afghanistan exported all of its output of copper ore and concentrate from the Ainak Mine south of Kabul, most of the urea output at Maza-i-Sharif, and about 5% of the national output of cement to the U.S.S.R. Because Afghanistan's revenue is largely in rubles, the country was dependent on the Soviet Union for credits, materials, equipment, and technical assistance for industrial development. Furthermore, any new Kabul Government must continue to accept the Soviet Union as its major trading partner, or else must obtain a massive infusion of capital outlay from other sources to prevent economic collapse.

Coal deposits extend from Herat to Badakhshan in northern Afghanistan. The country's coal resources were estimated at 400 million tons, of which 100 million tons was considered proven reserves. Coal was mined at Karkar in Pul-e-Khumri, Ishpushta near Doshi, north of Kabul, and Dar-e-Suf, south of Mazar. CMEA countries were to deliver equipment for reconstruction of mines in the north, as well as to exploit new deposits to raise production in the area.

Soviet geologists working in Afghanistan mapped finds of many minerals. Large deposits of iron ore were found around the hills of Hajigak in Bamyam Province, about 100 kilometers (km) west of Kabul, and chromite was present in the Logar valley near Herat. Other minerals located and mapped by the Soviets included gold and silver in Panjshir; lapis lazuli in Badakhshan; asbestos, mica, and sulfur near Maimana; beryl in Junar; and barite in Bamyam. In addition, there were reportedly Soviet finds for bauxite, emerald, fluorspar, lead, lithium, tantalum, and zinc.[2]

TABLE 1

AFGHANISTAN: PRODUCTION OF MINERAL COMMODITIES[1] [2]

(Metric tons, unless otherwise specified)

Commodity		1984	1985	1986	1987[p]	1988[e]
Barite[e]		2,000	2,000	2,000	2,000	2,000
Cement, hydraulic[e]		112,000	77,000	85,000	100,000	100,000
Coal, bituminous[e]		148,000	151,000	160,000	150,000	150,000
Copper: Mine output, Cu content[e]		—	5,000	5,000	5,000	5,000
Gas, natural:						
Gross[e]	million cubic feet	106,000	111,000	111,000	112,000	110,000
Marketed	do.	95,859	100,655	100,840	[e]101,000	100,000
Gypsum[e]		3,000	3,000	3,000	3,000	3,000
Natural gas liquids[e]	thousand 42-gallon barrels	81	93	81	80	80
Nitrogen: N content of ammonia[e]		[3]41,000	45,000	40,000	40,000	40,000
Salt, rock[e]		10,000	10,000	10,000	10,000	10,000

[e]Estimated. [p]Preliminary.
[1]Table includes data available through Aug. 16, 1989.
[2]In addition to the commodities listed, asbestos, lapis lazuli, and a variety of crude construction materials (clays, stone, and sand and gravel) presumably were produced. However, output is not reported quantitatively, and available information is inadequate to make reliable estimates of output levels.
[3]Reported figure.

BANGLADESH[3]

Bangladesh, whose population passed 110 million by yearend, remained one of the poorest countries in the world, with an estimated per capita gross domestic product (GDP) of $168.[4] Its only economically significant mineral production was natural gas. A few other minerals or mineral-based commodities were also produced, generally for local consumption. These included cement, clays, limestone, nitrogenous fertilizer, salt, and steel. Heavy mineral sands and crude oil were produced in token amounts but both have the potential to add significantly to the mineral sector's output. The Government planned to open 21 oil leaseholds, covering the entire country, to bidding from the international oil companies. A major promotion was slated for early 1989.

In response to multilateral and bilateral donor organization requests, the Bangladesh Government began planning an energy sector reorganization during 1988. A main feature is that the Bangladesh Oil, Gas and Minerals Corp. (BOGMC) is to become a holding company for five Government-owned natural gas exploration and marketing companies. A new exploration firm called Bangladesh Oil and Gas Exploration and Development Co. is to be formed also. BOGMC will be responsible for monitoring performance, planning, investment, and formulating policy in the oil and gas sectors. For the time being, at least, BOGMC and its subsidiaries will remain wholly owned by the Government.

In a related policy decision, the Government planned to increase the price of gas 15% and also the price of electricity by an unannounced amount. The changes will substantially reduce energy subsidies and improve the energy firms' financial performances.

In order to further exploit the natural gas resources, an Indian industry publication reported the Bangladesh Government has made an "attractive" offer to India to put up export-oriented nitrogen fertilizer plants in Bangladesh using Indian capital and domestic gas.[5] India had been considering putting up plants in Persian Gulf countries until this offer was made.

Production of natural gas and nitrogenous fertilizer increased substantially during the fiscal year (FY) beginning in June 1987.[6] Cement production was unchanged and clays, oil refinery output, salt, steel, and stone all declined a modest amount. Some of the declines were probably an indirect result of disruptions in the flow of raw materials because of widespread flooding. No direct damage by the flooding to mineral production facilities was reported. Railroads and highways were damaged in numerous places which may cause some longer term problems with distribution of the mineral and mineral-related commodities. A coal deposit at Barapukuria was being studied for possible development of the country's first commercial coal mine.

Mineral trade was modest and consisted mostly of imports of petroleum and coal in the energy sector, and cement and nonnitrogen fertilizers in the industrial minerals sector. Metal imports were mainly primary and semimanufactured forms of iron and nonferrous metals and metal-based machinery and transportation equipment.

Commodity Review

Industrial Minerals.—**Fertilizer Materials.**—A contract for the modernization and expansion of the Bangladesh Chemical Industry Corp.'s (BCIC) ammonia/urea plant in Ghorasal was awarded to Toyo Engineering Corp. of Japan. The plant, originally built by Toyo in 1970, will be improved by incorporating newly developed technology, which reduces energy consumption and increases output. Ammonia capacity is to increase from 218,000 tons per year to 272,000 tons per year and urea capacity from 375,000 tons per year to 467,000 tons per year. The revamping will cost $88 million, some of which is to be provided by Japan's Overseas Economic Cooperation Fund and the Japanese Government.

A turnkey contract has been awarded to Mitsubishi Heavy Industries Co. of Japan for the BCIC ammonia/urea plant in Jamuna. The long planned project had been delayed over financing arrangements. Production capacities are to be 1,078 tons per day of ammonia and 1,700 tons per day of urea. It is scheduled to cost $300 million and come on-stream in 1991.[7]

The export-oriented Karnaphuli fertilizer plant was still awaiting final approval by the Bangladesh Government. Go-ahead on the construction was expected during 1989.

All of the country's fertilizer plants use domestic low-cost natural gas as feedstock and fuel.

The reported offer by the Government to invite Indian industry to build fertilizer plants in Bangladesh contains inherent advantages for both parties. The Government reportedly would offer complete flexibility in India's equity participation; gas, worker wages, and construction costs considerably below those of the Gulf countries; and a set of investment and tax incentives very favorable to foreign investment. There had been uncertainty as to whether India would be allowed a dominant position in shareholding and management of proposed projects in the Gulf countries. This was considered a key point in any Indian plans because pricing of the fertilizer produced had to be under India's control. An additional advantage of the Bangladesh offer would be a much lower freight cost to Paradip, which is the best Indian port for handling imports of ammonia and urea.

Mineral Sands.—Mineral sand deposits were discovered a number of years ago 100 km south of Chittagong in the Cox's Bazar region. Samples have been tested recently and a separation of the valuable components appeared to be feasible for commercial exploitation. The Government has reportedly decided on a 5-year program to develop the deposits at a cost of $7 million. The reserves, which occur both on the mainland beach and on the beaches of several nearby islands, are estimated at 5 million tons of ore.[8]

***Mineral Fuels.*—Coal.**—Development of the Barapukuria coal deposit edged a step forward during the year. The British Overseas Development Administration had awarded a $2.8 million grant to Wardell Armstrong Co. to conduct a high-resolution seismic survey and feasibility study for the development of a 0.5- to 1.0-million-ton-per-year mine. The coal was discovered in the Gondwana geologic formation extending over an area of 30 square km. The coal seam is reportedly 40 meters thick and the first discovered in Bangladesh in geologic conditions believed suitable for economic development.[9]

A 700-million-ton deposit of high-grade coal was discovered some years ago at Jamalganj during petroleum exploration drilling at a depth of 900 meters. Unfortunately, the depth and geologic conditions at the site make economic development virtually impossible with current mining technology.

Natural Gas and Petroleum.—The expansion of the gas transmission and distribution system continued with help from a $74 million Asian Development Bank concessional loan. Five new Districts north of Dhaka were to be serviced by 352 km of high-pressure pipeline. The 24-inch main line begins at Ashuganj and runs 117 km to Elenga on the east bank of the Jamuna River. Smaller feeder and distribution lines are to service a nitrogen fertilizer plant, a powerplant, and the towns and cities along the route.

At Haripur, a 100-megawatt (MW) gas turbine powerplant began operating in June, further increasing gas consumption and replacing expensive imported oil and coal. The plant was built with technical assistance from Mitsubishi Heavy Industries Ltd. and financial aid from the Overseas Economic Cooperation Fund of Japan.

The development of the natural gas resources in Bangladesh has enabled the country to reduce its dependence on imported petroleum. Domestically produced gas now accounts for 57% of all commercial energy consumed in Bangladesh. With the emergence of gas as an alternative to oil, Bangladesh has reduced the amount of oil refined at its Chittagong Refinery from 36,000 to 22,000 barrels per day (bbl/d). The resultant saving of at least $50 million in foreign exchange per year was an important favorable factor in an economy not characterized by many encouraging developments.

All told, 73 wells have been drilled within the country's present boundaries since 1910. The drilling resulted in discovery of 13 commercial gasfields, one of which, Kutubdia, was offshore. Estimated reserves vary considerably among sources but 13 trillion cubic feet is now being accepted as a realistic minimum in most circles. Additional drilling at the Haripur Gasfield resulted in the country's first crude oil production in 1987.

Notwithstanding its abundant gas re-

TABLE 2

BANGLADESH: PRODUCTION OF MINERAL COMMODITIES[1 2]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987	1988[p]
Cement, hydraulic[3]		272,619	240,176	[e]292,000	[e]310,000	359,812
Clays: Kaolin[3]		2,613	4,178	2,695	12,272	10,097
Gas, natural, marketed[3 4]	million cubic feet	80,257	90,958	101,138	118,955	151,646
Iron and steel: Metal:[3]						
Steel, crude (ingot only)		73,387	101,419	95,514	82,081	81,285
Steel products		100,741	126,582	111,593	129,986	121,865
Nitrogen: N content of ammonia and ammonium sulfate		352,888	358,480	390,515	435,900	673,400
Petroleum refinery products	thousand 42-gallon barrels	7,958	7,357	7,405	[e]7,610	7,411
Salt, marine[3]		671,832	489,000	[e]500,000	[e]416,000	409,000
Stone: Limestone, industrial[3]		24,564	40,392	22,082	44,660	30,040

[e]Estimated. [p]Preliminary.

[1]Table includes data available through Aug. 18, 1989.

[2]In addition to the commodities listed, crude construction materials such as sand and gravel and other varieties of stone presumably are produced, but available information is inadequate to make reliable estimates of output levels.

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

[4]Gross production is not reported; the quantity vented, flared, or reinjected is believed to be negligible.

serves, the Bangladesh Government was determined to increase its exploration for commercial discoveries of crude oil. The Government planned to begin a promotional campaign aimed at finding coproduction partners for 21 oil leaseholds covering the entire country. The effort will involve seminars in Houston, United States; London, United Kingdom; and Dhaka, Bangladesh. Reportedly, a number of international firms have expressed interest. The Bangladesh press reported that traces of oil have been found at gas well sites at Bogra in western Bangladesh and at Kailashtilla in Sylhet. Testing of these discoveries was underway at yearend. Favorable findings at these sites would certainly add interest to the promotional program.

Shell Oil Corp. has ceased drilling in Bangladesh after investing nearly $40 million since signing a production sharing contract with the Government in 1981. Its latest test in the Chittagong Hill Tracts failed to strike hydrocarbons to a depth of 1,450 meters.

INDIA[10]

After several years of drought with increasingly serious consequences to India's economy, rains in 1988 ended the dry period and agricultural production rebounded. The entire economy was stimulated as hydroelectric power generation improved from increased volume of streamflow. Such power-intensive mineral industries as aluminum, copper, and steel benefited from a decrease in national or regional power outages. Meanwhile, they were increasingly installing their own on-site power-generating facilities. There was reason to believe that the real gross national product (GNP) grew by as much as 11% in FY 1988[11] compared with about 4.4% in 1987. Industrial production was up 9% overall and the services sector increased about 7%. Production of mineral commodities was generally greater than in 1987, with one or two exceptions that were of secondary significance to the primary industrial needs of the economy.

Amidst this favorable performance, serious problems beset the country, including a large budget deficit, an increasing number of industrial insolvencies, a projected 300 million people living below the Government's stipulated poverty line, crippling power shortages, and a danger of increasing inflation.

The rupee depreciated by 14.8% against the dollar[12] in calendar year 1988 after a 2% gain the previous year. The rupee depreciated 11.6% against the British pound, 13.2% against the yen, and 4.5% against the deutsche mark. Although official opinion was that the rupee had adjusted downward to an optimum level against other currencies, it was not clear that the value of the rupee had stabilized. Moreover, the proportionate increase in GNP turned out to be a number fairly closely resembling the proportionate decrease in the value of the rupee in FY 1988. If in fact the economic expansion was being fueled by inflation, the consequences were not entirely unpredictable based on the experience of other countries.

The most difficult, and even dangerous, of the economic problems facing India over the longer term was the increasing inability to supply commercial power amidst rising industrial demand. India is economically sensitive to its rainfall, and for several years the yearly monsoon brought inadequate amounts. Consequences were severe to agriculture, stream and river discharge, and the generation of hydroelectric power. In 1988, the monsoon ended the drought by delivering heavy rains, stimulating the growing season, and providing the discharge to enable a significant increase of hydroelectric power generation. The replenishment of most of India's reservoirs assured an opportunity to close down some of the thermal generating plants for maintenance that had been deferred overly long. The fiscal year ended with a total electric power generation of 221 billion kilowatt hours versus a demand of 238 billion kilowatt hours,[13] a much greater shortfall having been forestalled only by the favorable rains. Of the total power produced, a little less than 3% was generated at nuclear powerplants.

India's continual power shortages had multiple causes, chief among them delays in commissioning new power projects, lack of coordination between generators and distributors, chronic underpricing and undercollection, low utilization of capacity, widespread and continuing theft of electricity through illegal connections, and a rapid increase in domestic consumption. Not only did industry need increasing amounts of electricity, but so did the rapidly expanding middle class as well as the new office towers and hotels changing the appearance of many old cities.[14] No clear indication was seen that this power shortage would end in the foreseeable future.

The per-capita consumption of commercial energy in India has been very low, approximating one-tenth of the global average. The physical quality-of-living index likewise put India in an extremely modest category, indicating great future demand for energy and growth of energy production. With a population of 817 million people increasing at least 2% annually, India was on the way to becoming the most populous country on earth in the next two or three decades. This eventuality has been accorded significance in projections involving the global environment.

Assuming India were to go through the same general cycle of energy production and development as did Europe and North America, with continued development of central power generation, the automobile, air conditioning, and a rapid increase in the use of electrical appliances, power production will need to undergo almost explosive development. Consequences to the world environment would depend upon the method of generation. With large reserves of mostly low-grade coal and lignite, India needed to consider moving rapidly toward such technologies as fluidized-bed combustion to avoid atmospheric pollution in thermal power generation.

As of 1988, the future of exploration for petroleum hydrocarbons in India was not readily predictable. New exploration programs were launched, resulting in some discoveries, but it was too early to know if India had other resources similar to the prolific Bombay High that would enable the country to become a major producer. If so, some atmospheric pollution would be created by petroleum-based energy, but extra time could be bought in which to phase into a greatly expanded nuclear power program. If not, the rapidly expanding burden of power generation would fall on coal, with its relatively greater pollution, as demand became exacerbated.

India's nuclear generation of power achieved a record high of 6.068 billion kilowatt hours in 1988, an increase of 14% over the previous year and, it was hoped, a portent of things to come.[15] In midyear, India's Atomic Energy Commission told the press it had approved sites for six new 500-MW, and two 235-MW nuclear powerplants. Additionally, two 1,000-MW nuclear plants were to be imported from the Soviet Union. All of the new plants were projected to become operational by the year 2000, by which time total nuclear-generating capacity was projected at 10,000 MW. The need for this new installed nuclear capacity was clearly critical; it would equal only slightly more than 4% of the total power demand of 1988.

Production

The most significant changes in production of mineral commodities in India for 1988 include alumina, up 83% over the previous year; gem-stone cutting and polishing, up 64%; metallic aluminum, up 42%; bauxite, up 36%; and copper blister, up 32%. Except for gem-stone processing, these were mainstream commodities having an impact on national development. Gem-stone cutting and polishing, however, was the single largest foreign-exchange earner. Because it provided employment to a rapidly growing number of workers, more than 1 million, it contributed to the economy of India in a somewhat different way than the other commodities. Other important changes were chromite, up 21%; the fertilizer mineral urea, up 16%; ammonium nitrate, up 10%; and cement, up 10%.

In the mineral fuel sectors, coal production was up 6% and lignite up only 1%, despite the desperate need for increased energy. Petroleum crude production was up a bare 4%, with new discoveries both onshore and offshore offset by declining output from earlier wells. Natural gas production climbed 18%, the best achievement of the fuels sector in 1988.

Other noteworthy events included India's first-ever commercial production of a small quantity of metallic tin at the end of the year, by an industry that was expected to grow significantly. Moreover, the production of iron ore pellets was increased substantially according to early reports; the proportionate gain over previous years was not clear, as yet.

Two of the more significant negative changes in mineral commodity production were in mica, which was down 16% in the midst of nearly chaotic conditions of production, sale, and Government control; and diamonds, down 11% as expanding imports for cutting and polishing took some of the momentum out of exploration and mining.

All things considered, it was a good year for mineral production in India in spite of disappointment that greater increases were not realized for some mineral commodities, particularly in energy and steel. For example, the Visakhapatnam (Vizag) steel plant (VSP) was delayed yet another year, coal production did not come close to matching demand, and petroleum exploration and drilling seemed to be moving forward only very slowly.

India's labyrinthine bureaucratic process has not helped matters of mineral production and development. An intricate system of proposals, counter proposals, approvals, disapprovals, policy changes, licensing, and regulation, all amidst private-sector venturing versus public sector sponsorship, generally exceed anything the industrialized countries have experienced in their individual histories. For India to be able to succeed in producing more of any mineral commodity than in a previous year could only engender admiration for their dedication and entrepreneurship.

Trade

Although data were not yet available for a systematic inventory of India's international mineral-commodity trade for 1988, certain preliminary reports and observations were possible. India's declining rupee had the dual effect of increasing the competitiveness of exports and impairing its purchasing power for imports, thus the difficult matter of conserving foreign-exchange credits continued. Early indications were that exports could be expected to increase about 20% over that of 1987. Cut and polished gem stones, primarily diamonds, were the largest single item of export, earning approximately $2.66 billion during the year and tightening India's hold on world leadership in this field.

The National Aluminium Co. (NALCO), commissioned in 1988, reportedly exported 384,000 tons of alumina, valued at more than $100 million, to the United States, Norway, Brazil, North Korea, and China.

Exports of iron ore were burgeoning, Japan having agreed to buy 10 million tons during the year, Romania at least 3.5 million, the Republic of Korea 3 million; together with the commitments of other customers, projected exports were at least 17 million tons and, according to one unsubstantiated report, as much as 25 million tons, for 1988. However, concern was expressed that Japan considered some of its purchases of iron ore to grade only 54% to 60% iron versus the 64% iron content

TABLE 3

INDIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1984	1985	1986	1987	1988[p]
METALS						
Aluminum:						
Bauxite, gross weight	thousand tons	2,093	2,281	2,338	2,814	3,829
Alumina, gross weight	do.	587	587	586	650	1,188
Metal, primary		268,520	260,010	257,096	265,000	375,000
Cadmium metal		148	194	160	214	237
Chromium: Chromite, gross weight		423,000	560,000	629,671	625,000	759,000
Copper:						
Mine output, Cu content		44,132	45,892	48,103	56,529	55,429
Metal, primary:						
Smelter		40,536	32,460	39,074	32,923	44,840
Refinery:						
Electrolytic (cathode)		32,580	28,020	37,853	[e]33,200	39,596
Fire refined[e]		1,000	1,000	1,000	780	1,000
Total[e]		**33,580**	**29,020**	**[e]38,853**	**30,587**	**40,596**
Gold metal, smelter	troy ounces	65,234	58,771	60,250	60,250	62,822
Iron and steel:						
Iron ore and concentrate:						
Gross weight	thousand tons	41,026	42,545	47,800	51,018	52,322
Iron content	do.	25,682	26,633	29,923	31,937	32,754
Metal:						
Pig iron	do.	9,382	9,835	10,509	10,893	[e]10,000
Ferroalloys:						
Ferrochromium (including charge chrome)		[3]55,578	66,497	84,000	126,227	123,422
Ferromanganese		[3]121,829	163,438	179,132	172,819	137,689
Ferrosilicochromium		[3]3,892	12,499	[e]10,000	12,321	2,769
Ferrosilicon		[3]50,802	39,478	50,096	52,409	42,007
Other		[r]284	[e]500	[e]500	529	[e]500
Steel, crude:						
Steel ingots	thousand tons	[3]10,261	10,962	11,332	12,605	[e]12,500
Steel castings	do.	[3]84	92	95	278	340
Total	**do.**	**[3]10,345**	**11,054**	**11,427**	**12,883**	**[e]12,840**
Semimanufactures[4]	do.	[3]6,967	[3]7,841	7,753	8,600	9,200
Lead:						
Mine output, Pb content		24,839	27,085	37,578	[e]36,725	30,522
Metal, refined:						
Primary		15,246	15,567	19,933	20,669	18,833
Secondary		[e]10,000	[e]10,000	11,300	12,126	14,000
Total		**[3]25,246**	**[3]25,567**	**31,233**	**32,795**	**32,833**
Manganese:						
Ore and concentrate, gross weight	thousand tons	1,130	1,240	1,213	1,302	1,324
Mn content		420,812	461,776	455,287	484,865	493,058

See footnotes at end of table.

TABLE 3—Continued

INDIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]	1984	1985	1986	1987	1988[p]
METALS—Continued					
Rare-earth metals: Monazite concentrate, gross weight[e]	4,000	4,000	4,000	4,000	4,000
Selenium kilograms	4,191	[e]4,850	[e]4,800	4,026	[e]4,100
Silver, mine and smelter output thousand troy ounces	862	816	1,134	1,220	1,429
Titanium concentrates, gross weight:					
Ilmenite	[e]140,000	[3]143,000	[e]140,000	[e]140,000	[e]38,000
Rutile	[e]6,000	[3]6,800	[e]7,000	[e]7,000	[e]5,000
Tungsten, mine output, W content	21	28	23	26	[e]30
Zinc:					
Mine output, concentrate:					
Gross weight	85,260	87,082	94,597	104,809	111,430
Zn content	44,335	45,283	49,198	54,500	57,944
Metal:					
Primary	55,753	70,947	72,000	68,899	68,940
Secondary[e]	200	200	200	200	200
Total	**55,953**	**71,147**	**[e]72,200**	**69,099**	**69,140**
Zirconium concentrate: Zircon, gross weight	[e]12,000	14,800	[e]16,000	[e]16,000	[e]16,000
INDUSTRIAL MINERALS					
Abrasives, natural, n.e.s.:					
Corundum, natural	442	498	968	469	475
Garnet	[e]3,000	5,917	5,366	[5]6,699	4,099
Jasper	[e]5,000	5,078	2,426	4,407	3,782
Asbestos	25,450	30,183	25,236	29,110	31,303
Barite	446,000	579,742	344,000	247,000	393,000
Bromine, elemental[e]	350	350	350	350	350
Cement, hydraulic thousand tons	29,030	33,050	[3]36,400	36,980	40,700
Chalk	[e]80,000	114,964	106,708	101,641	105,658
Clays:					
Ball clay	[e]135,000	236,625	277,460	279,912	308,144
Diaspore	[e]6,000	9,605	11,580	11,018	10,029
Fire clay	602,000	592,047	583,000	634,000	692,000
Kaolin:					
Direct salable, crude thousand tons	504	585	733	684	526
Processed do.	116	[e]110	[e]100	[e]150	[e]150
Total do.	**620**	**[e]695**	**[e]833**	**[e]834**	**[e]676**
Other[e] do.	80	100	100	100	100
Diamond:					
Gem[e] thousand carats	13	14	13	16	12
Industrial[e] do.	2	2	2	3	3
Total do.	**15**	**16**	**16**	**19**	**15**

See footnotes at end of table.

TABLE 3—Continued

INDIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1984	1985	1986	1987	1988[p]
INDUSTRIAL MINERALS—Continued						
Feldspar		39,943	46,101	46,288	49,663	51,086
Fluorspar:						
Concentrates:						
Acid-grade		[e]12,000	11,107	[e]7,624	[e]8,261	[e]8,200
Metallurgical-grade[e]		5,000	5,000	4,109	4,448	4,500
Total		**[e]17,000**	**[e]16,107**	**11,733**	**12,709**	**[e]12,700**
Other fluorspar materials, graded		4,232	[e]4,000	6,841	5,790	4,387
Gem stones excluding diamond:						
Agate including chalcedony pebble		[e]1,000	750	[e]776	752	796
Garnet	kilograms	[e]2,000	2,399	5,021	2,007	1,399
Graphite[6]		38,986	27,337	38,412	42,589	52,134
Gypsum		1,378,000	1,260,369	1,549,000	1,861,000	1,576,000
Kyanite and related materials:						
Andalusite		2,700	504	732	122	—
Kyanite		37,024	30,472	32,394	39,959	36,951
Sillimanite		13,377	17,095	14,905	12,756	13,925
Lime[e]		500,000	500,000	600,000	700,000	750,000
Magnesite		414,029	417,412	422,000	430,000	460,000
Mica:[e 7]						
Exports:						
Block		1,100	1,200	1,200	1,000	1,000
Film and book for M cuttings		200	250	250	200	200
Splittings		3,000	4,000	4,000	3,000	3,000
Scrap		7,000	11,000	11,000	10,000	10,000
Powder		4,000	4,700	4,700	3,800	3,800
Manufactured		500	1,000	1,000	2,000	2,000
Total		**15,800**	**22,150**	**22,150**	**20,000**	**20,000**
Domestic use, all forms		3,000	3,500	3,500	4,000	4,000
Total mica		**18,800**	**25,650**	**25,650**	**24,000**	**24,000**
Nitrogen: N content of ammonia[3]	thousand tons	[r]3,832	[r]4,270	[r]4,933	5,300	6,205
Phosphate rock including apatite		892,000	929,098	667,070	679,419	678,000
Pigments, mineral, natural: Ocher		107,852	108,549	98,668	145,245	[e]145,000
Pyrites, gross weight		44,238	17,744	20,773	36,000	30,000
Salt:						
Rock salt	thousand tons	5	4	2	1	4
Other	do.	7,723	9,875	10,116	9,900	[e]9,200
Total	**do.**	**7,728**	**9,879**	**10,118**	**9,901**	**[e]9,202**
Sodium carbonate		830,863	813,600	873,600	969,600	[e]980,000
Stone, sand and gravel:[8]						
Calcite		[e]20,000	26,049	26,318	37,194	30,996
Dolomite	thousand tons	2,277	2,217	2,139	2,233	2,213

See footnotes at end of table.

TABLE 3—Continued

INDIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1984	1985	1986	1987	1988[p]
INDUSTRIAL MINERALS—Continued						
Stone, sand and gravel—Continued						
Limestone	thousand tons	45,483	48,070	52,562	57,170	61,054
Quartz and quartzite	do.	[e]300	259	274	299	289
Sand:						
Calcareous	do.	570	706	571	147	26
Other	do.	[e]1,200	2,349	1,113	3,639	2,397
Slate		[e]5,000	5,529	6,483	6,637	6,216
Sulfur:						
Content of pyrites		17,695	7,098	8,309	14,400	12,000
Byproduct:						
From metallurgical plants[e]		115,000	120,000	120,000	120,000	125,000
From oil refineries		[e]5,000	305	[e]1,000	—	[e]1,000
Total[e]		**137,695**	**127,403**	**129,309**	**134,400**	**138,000**
Talc and related materials:						
Pyrophyllite		84,159	53,741	53,005	60,457	58,789
Steatite (soapstone)		333,576	329,192	343,000	371,000	382,000
Vermiculite		1,953	1,805	6,681	2,905	3,987
Wollastonite		[e]20,000	26,040	23,770	31,021	35,163
MINERAL FUELS AND RELATED MATERIALS						
Coal:						
Bituminous	thousand tons	145,800	149,259	162,800	177,220	188,000
Lignite	do.	7,500	7,774	7,900	8,311	8,400
Total	**do.**	**153,300**	**157,033**	**170,700**	**185,531**	**197,200**
Coke:[e]						
Coke oven and beehive	do.	12,000	13,000	13,000	13,000	13,000
Gashouse	do.	100	100	100	100	100
Other, soft	do.	50	100	200	200	200
Total	**do.**	**12,150**	**13,200**	**13,300**	**13,300**	**13,300**
Gas, natural:						
Gross	million cubic feet	255,700	287,200	[e]360,000	[e]350,000	[e]350,000
Marketable[9]	do.	114,420	133,561	232,090	223,685	263,158
Petroleum:						
Crude	thousand 42-gallon barrels	204,943	219,132	228,416	220,929	229,183
Refinery products:[e]						
Gasoline	do.	26,000	34,000	42,000	[r]49,000	50,500
Kerosene and jet fuel	do.	27,000	38,000	45,000	50,000	51,500
Distillate fuel oil	do.	84,000	95,000	110,000	116,000	119,500
Residual fuel oil	do.	51,000	63,000	58,000	59,000	60,800
Lubricants	do.	3,000	[10]3,000	3,000	4,000	4,100

See footnotes at end of table.

TABLE 3—Continued

INDIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1984	1985	1986	1987	1988[p]
MINERAL FUELS AND RELATED MATERIALS—Continued						
Petroleum—Continued						
Refinery products—Continued						
Other	thousand 42-gallon barrels	42,000	50,000	55,000	56,000	57,700
Refinery fuel and losses	do.	19,000	28,800	21,660	23,100	23,900
Total	**do.**	**252,000**	**305,800**	**[r]334,660**	**357,000**	**368,000**

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

[1] Table includes data available through Sept. 20, 1989.

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

[3] Data are for fiscal year beginning Apr. 1 of that stated.

[4] Excludes production from steel miniplants.

[5] Official Indian Bureau of Mines figure is believed to be production from Government-owned operations. Private Indian production brings 1987 total to more than 20,000 tons.

[6] India marketable production is 10% to 20% of mine production.

[7] Data supplied here (exports plus domestic use) are provided in lieu of officially reported production because the latter figures are evidently incomplete. Officially reported production figures are as follows, in metric tons: 1984—7,171; 1985—6,965; 1986—4,684; 1987—4,299; and 1988—3,609.

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

[9] Includes reinjected gas.

[10] Reported figure.

declared by India's Minerals and Metals Trading Corp. (MMTC); Three shiploads of ore were sent back to India after reaching Japan. It was thought more would be heard on this subject. Exports of steel were reported to amount to 144,000 tons, 97,000 tons of it to the United States.

Other important exports in 1988 were chrome ore, thought to be at least three times the quantity exported in 1987 (the volume reached twice that of the previous year during the first 6 months of 1988); bauxite, possibly slightly more than was exported in 1987; manganese ore, evidently about the same as the quantity exported in 1987. Coal and mica exports, while significant, were down from those in 1987.

Imports of nonferrous metals were up in 1988, and the cost for copper, nickel, zinc, and other metals was reportedly expected to be 20% more than the $665 million expended in 1987. Copper imports were projected to rise from 75,000 to 80,000 tons, zinc from 65,000 to 75,000 tons, and lead from 24,000 to 25,000 tons. Moreover, as much as 5,000 tons of nickel and an unspecified quantity of antimony were expected to be imported during the year. Although tin imports were up in the early part of 1988, India's new tin production, just started up, may have reduced the requirement for subsequent imports later in the year. Imports of aluminum, handled separately from the above metals as a result of decontrol, were difficult to project. Aluminum was previously imported at a cost of $3,059 per ton by MMTC and resold domestically at $2,015 per ton. Because the unsubsidized higher price was shifted directly to the consumers, some changes in buying patterns were anticipated.

Commodity Review

Metals.—**Aluminum and Bauxite.**—Both bauxite and aluminum metal were produced in significantly greater quantities in 1988 than in 1987, despite problems plaguing the industry.

At 3.011 million tons, bauxite production exceeded that of the previous year by 10% and penetrated the 3-million-ton mark for the first time. Metallic aluminum output was up a full 25% over that of the previous year to 334,500 tons.

Troubles abounded in the industry. Early in the year, NALCO, a new public-sector company in Orissa State at Angul, was forced to shut down 64 of 194 newly commissioned pots at its Orissa smelter after they went out of control, reportedly because of the inability of the potline workers to adapt to the rigorous operating schedules required by the new technology. This idle capacity was later restarted and the company began commissioning the remaining pots needed to bring the smelter up to the total of 240 pots. The changes were successful, and potrooms were able to produce 1.30 tons per pot per day versus a projected 1.26 tons per pot. Although output was thus reduced

TABLE 4

INDIA: EXPORTS OF MINERAL COMMODITIES[1 2]

(Metric tons unless otherwise specified)

Commodity	1984–85	1985–86	Destinations, 1985–86	
			United States	Other (principal)
METALS				
Aluminum:				
Ore and concentrate	61,547	36,436	—	United Arab Emirates 36,000; Bangladesh 436.
Oxides and hydroxides	49,474	40,967	—	U.S.S.R. 39,516; Japan 1,368.
Metal including alloys, all forms	5,598	13,509	115	U.S.S.R. 9,574; Iran 1,715; Bangladesh 1,147.
Cadmium: Metal including alloys, all forms	12	7	—	NA.
Chromium:				
Ore and concentrate	238,387	229,729	—	Japan 152,379; China 24,000; Bangladesh 18,500.
Metal including alloys, all forms	—	8,600	—	Japan 6,400; Italy 2,200.
Copper:				
Ore and concentrate	18,746	45,350	—	Republic of Korea 30,500; Taiwan 10,500.
Metal including alloys, all forms	1,325	1,729	129	U.S.S.R. 809; Taiwan 570.
Iron and steel:				
Iron ore and concentrate including roasted pyrite thousand tons	25,527	30,150	NA	Japan 20,249; Romania 3,334; Republic of Korea 2,972.
Metal:				
Scrap	52,449	64,182	NA	Philippines 46,534; Japan 17,625.
Pig iron, cast iron, related materials	1,466	221	139	Kenya 25; Canada 14.
Ferroalloys:				
Ferromanganese	1,950	5,330	NA	Japan 3,000; Qatar 2,320.
Ferrosilicon	—	10	—	All to Bangladesh.
Silicon metal	8	12	—	Bangladesh 6; North Korea 5.
Unspecified	42	180	NA	NA.
Steel, primary forms	197,103	95,122	39,372	China 14,920; Saudi Arabia 7,859; U.S.S.R. 6,091.
Lead: Metal including alloys, all forms	65	13	—	United Arab Emirates 8; Bangladesh 5.
Magnesium: Metal including alloys, all forms	—	2	NA	NA.
Manganese:				
Ore and concentrate, metallurgical-grade	621,432	486,380	—	Japan 259,978; Romania 142,614; Republic of Korea 67,288.
Oxides	204	33	—	Philippines 18; Bangladesh 14.
Metal including alloys, all forms	10	3	—	All to United Kingdom.
Nickel: Metal including alloys, all forms	76	14	—	Thailand 6; Czechoslovakia 4.
Selenium, elemental	r15	—		
Tin:				
Ore and concentrate	50	—		
Metal including alloys, all forms	607	73	—	Nepal 48; Sudan 9; Sri Lanka 7.
Titanium: Ore and concentrate	r7,852	17,956	—	United Kingdom 13,199; Japan 4,619.
Tungsten: Metal including alloys, all forms	4	1	—	Mainly to Bangladesh.

See footnotes at end of table.

TABLE 4—Continued

INDIA: EXPORTS OF MINERAL COMMODITIES[1 2]

(Metric tons unless otherwise specified)

Commodity	1984-85	1985-86	Destinations, 1985-86: United States	Destinations, 1985-86: Other (principal)
METALS—Continued				
Vanadium: Ore and concentrate[3]	202	—		
Zinc: Metal including alloys, all forms	36	70	42	Sri Lanka 15; Bangladesh 6.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.: Natural: Corundum, emery, pumice, etc.	1,127	752	NA	NA.
Asbestos, crude	158	126	—	Czechoslovakia 46; West Germany 40; Bangladesh 20.
Barite and witherite	347,317	374,927	317,595	United Arab Emirates 24,673; U.S.S.R. 19,975.
Boron materials:				
Sodium borate	279	443	—	Sri Lanka 368; Singapore 32; Saudi Arabia 15.
Oxides and acids	34	21	—	Sri Lanka 14; Nepal 4.
Cement	21,543	47,659	NA	Nepal 11,466; unspecified 36,193.
Chalk	73	133	—	Bangladesh 131; Nepal 2.
Clays, crude:				
Bentonite	69,170	21,348	—	Kuwait 11,095; Sudan 2,966; Indonesia 2,500.
Fire clay	1,100	966	—	Bangladesh 856; Kenya 100.
Kaolin	5,307	8,329	NA	Bangladesh 6,762; Syria 800; Japan 700.
Unspecified	596	1,084	1	Bangladesh 1,021; Sudan 35.
Diamond: Gem, not set or strung value, thousands	$955,236	$1,126,606	$556,487	Belgium-Luxembourg $147,501; Japan $144,920.
Feldspar	r19,707	16,781	NA	Malaysia 8,638; Taiwan 2,084; Bangladesh 2,058.
Graphite, natural	1,876	1,045	249	Japan 215; Australia 148.
Gypsum and plaster	18,565	3,449	NA	Sri Lanka 3,137; Bangladesh 165; Oman 100.
Kyanite and related materials: Sillimanite	—	21	—	All to Bangladesh.
Magnesium compounds:				
Magnesite, crude	—	14	—	All to Australia.
Oxides and hydroxides	3,030	1,357	—	United Kingdom 899; Japan 417.
Mica:				
Crude including splittings and waste	16,430	18,107	3,963	France 3,238; Belgium-Luxembourg 3,106.
Worked including agglomerated splittings	13,125	15,779	951	West Germany 3,739; Japan 2,281; U.S.S.R. 2,156.
Phosphorus, elemental	4	102	44	Iraq 51; Republic of Korea 5.
Pigments, mineral:				
Natural, crude	360	860	—	Philippines 663; Bangladesh 57; Singapore 52.
Iron oxides and hydroxides, processed	5,190	3,619	54	United Kingdom 1,305; Philippines 601.

See footnotes at end of table.

TABLE 4—Continued

INDIA: EXPORTS OF MINERAL COMMODITIES[1 2]

(Metric tons unless otherwise specified)

Commodity		1984–85	1985–86	Destinations, 1985–86: United States	Destinations, 1985–86: Other (principal)
INDUSTRIAL MINERALS—Continued					
Precious and semiprecious stones other than diamond: Natural:					
Emerald	value, thousands	$2,940	$1,608	$972	Hong Kong $132; Japan $121.
Other	do.	$12,454	$21,955	$10,010	Hong Kong $2,441; West Germany $1,824.
Salt and brine		29,684	15,915	NA	Bangladesh 6,100; Singapore 6,000; Nepal 3,730.
Sodium compounds, n.e.s.: Carbonate, manufactured		7	350	NA	NA.
Stone, sand and gravel:					
Dimension stone, all forms		489,155	371,607	2,357	Japan 184,021; Italy 82,019.
Dolomite, chiefly refractory-grade		2,142	7,786	NA	Bangladesh 7,203; Yemen, Aden 500.
Limestone other than dimension		187,255	230,488	NA	Bangladesh 225,798; Nepal 4,183.
Quartz and quartzite		53,784	70,775	NA	Japan 69,044; Bangladesh 1,621.
Sand other than metal-bearing		9,075	8,435	NA	Japan 5,207; United Arab Emirates 1,730.
Sulfur: Elemental: Crude including native and byproduct		22	1	—	All to Nepal.
Talc, steatite, soapstone, pyrophyllite		12,563	12,444	—	Netherlands 3,098; Kenya 2,324; Austria 2,000.
Vermiculite		465	1,044	—	Kuwait 567; United Arab Emirates 254; Taiwan 155.
MINERAL FUELS AND RELATED MATERIALS					
Coal, all grades including briquets	thousand tons	100	190	—	Bangladesh 92; Nepal 63; Republic of Korea 35.
Coke and semicoke		353	3,745	—	All to Nepal.
Petroleum:					
Crude	thousand 42-gallon barrels	48,203	3,929	NA	NA.
Refinery products:[4]					
Light distillates:					
Naphtha	do.	5,202	15,266	NA	NA.
Other	do.	119	136	NA	NA.
Middle distillates	do.	985	970	NA	NA.
Heavy ends	do.	1,166	140	NA	NA.

[r] Revised. NA Not available.
[1] Table prepared by Audrey D. Wilkes.
[2] Data are for Indian fiscal years Apr. 1 through Mar. 31 and have been compiled from the Indian Minerals Yearbook 1989.
[3] May include other unspecified ores.
[4] Defined as provided in data source.

TABLE 5

INDIA: IMPORTS OF MINERAL COMMODITIES[1 2]

(Metric tons unless otherwise specified)

Commodity	1984–85	1985–86	Sources, 1985–86	
			United States	Other (principal)
METALS				
Aluminum:				
Oxides and hydroxides	971	368	32	West Germany 87; United Kingdom 81.
Metal including alloys, all forms	61,794	69,976	430	Bahrain 12,314; Brazil 10,352; Venezuela 10,347.
Antimony:				
Ore and concentrate	103	—		
Metal including alloys, all forms	352	993	—	China 844; Taiwan 132.
Arsenic: Oxides and acids	5	—		
Cadmium: Metal including alloys, all forms	20	64	—	All from Australia.
Chromium: Metal including alloys, all forms	73	28	—	United Kingdom 14; Japan 11.
Cobalt: Metal including alloys, all forms	116	134	3	Zambia 49; Zaire 39.
Copper:				
Ore and concentrate	—	88	—	NA.
Metal including alloys, all forms	80,138	142,377	6,103	Zambia 54,684; Zaire 16,909; Singapore 9,201.
Iron and steel: Metal:				
Scrap	618,646	1,331,719	663,438	Netherlands 250,144; West Germany 179,570.
Pig iron, cast iron, related materials	3,546	21,360	NA	Pakistan 8,655; Japan 7,200; Brazil 4,900.
Ferroalloys:				
Ferrochromium	9,172	11,390	—	Sweden 4,847; West Germany 3,049; Japan 2,077.
Ferromanganese	811	962	—	West Germany 312; Netherlands 233; Japan 148.
Ferromolybdenum	10	2	—	All from Austria.
Ferronickel	19,036	23,324	705	France 6,803; Colombia 4,339; New Caledonia 3,236.
Ferrosilicochromium	5	—		
Ferrosilicon	129	300	—	United Kingdom 84; Japan 72; Netherlands 65.
Silicon metal	1,387	2,152	28	Norway 652; France 434; Canada 217.
Unspecified	r1,027	1,430	NA	NA.
Steel, primary forms	1,842,312	2,302,074	33,449	West Germany 604,172; Japan 592,468.
Lead:				
Ore and concentrate	10,097	384	—	United Kingdom 160; Iran 150; Morocco 54.
Metal including alloys, all forms	42,902	48,222	3,264	Australia 37,852; Zambia 1,160.
Magnesium: Metal including alloys, all forms	634	753	249	Norway 249; France 147.
Manganese:				
Ore and concentrate:				
Battery-grade	106	150	—	Singapore 200; Gabon 50.

See footnotes at end of table.

TABLE 5—Continued

INDIA: IMPORTS OF MINERAL COMMODITIES[1 2]

(Metric tons unless otherwise specified)

Commodity	1984–85	1985–86	Sources, 1985–86 United States	Sources, 1985–86 Other (principal)
METALS—Continued				
Manganese—Continued				
Ore and concentrate—Continued				
Metallurgical-grade	3,841	4,559	—	Singapore 2,560; Gabon 1,950.
Oxides	285	647	—	Japan 347; Belgium-Luxembourg 280.
Metal including alloys, all forms	217	235	38	China 122; Japan 48.
Molybdenum: Metal including alloys, all forms	5	6	3	Austria 2.
Nickel:				
Ore and concentrate	1,589	3,367	56	Cuba 2,270; U.S.S.R. 235.
Metal including alloys, all forms	11,881	7,507	362	Norway 1,416; U.S.S.R. 1,100; Finland 937.
Platinum-group metals: Metals including alloys, unwrought and partly wrought troy ounces	6,044	6,334	2,251	U.S.S.R. 3,858.
Selenium, elemental	2	28	18	Bulgaria 3; Japan 3.
Silver: Metal including alloys, unwrought and partly wrought troy ounces	8,584	23,148	836	West Germany 16,815; Switzerland 1,800.
Tin: Metal including alloys, all forms	17,187	14,228	2,519	United Kingdom 2,549; Spain 1,407.
Titanium:				
Ore and concentrate	229	155	—	NA.
Oxides	10,376	5,286	1,189	United Kingdom 1,596; West Germany 866.
Tungsten:				
Ore and concentrate	212	475	—	Burma 359; Thailand 54; Canada 36.
Metal including alloys, all forms	22	47	6	Canada 18; Netherlands 9.
Vanadium: Ore and concentrate[3]	604	895	229	West Germany 217; United Kingdom 122.
Zinc:				
Ore and concentrate	4,955	12,550	NA	Peru 12,063; Belgium-Luxembourg 236.
Metal including alloys, all forms	63,887	80,927	1,215	Canada 12,532; Australia 11,672; Zaire 10,452.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.: Natural: Corundum, emery, pumice, etc.	10	6	NA	NA.
Asbestos, crude	68,827	77,874	1,751	Canada 40,678; U.S.S.R. 12,891; Brazil 8,555.
Boron materials:				
Crude natural borates	11,813	9,089	4,033	Turkey 5,036.
Oxides and acids	—	4	—	All from Japan.
Cement	267,812	321,078	—	Republic of Korea 64,628; East Germany 65,775.
Clays, crude:				
Bentonite	12	43	18	Singapore 18; United Kingdom 7.
Kaolin	107	93	35	United Kingdom 29; Philippines 18.
Unspecified	1,141	1,673	86	United Kingdom 642; Japan 497.

See footnotes at end of table.

TABLE 5—Continued

INDIA: IMPORTS OF MINERAL COMMODITIES[1 2]

(Metric tons unless otherwise specified)

Commodity		1984–85	1985–86	Sources, 1985–86: United States	Sources, 1985–86: Other (principal)
INDUSTRIAL MINERALS—Continued					
Diamond:					
Gem, not set or strung	value, thousands	$855,313	$867,310	NA	Belgium-Luxembourg $315,882; United Kingdom $264,381.
Industrial stones	do.	$197	—		
Diatomite and other infusorial earth		8	23	NA	NA.
Fertilizer materials: Manufactured:					
Phosphatic[4]		745,200	804,800	NA	NA.
Potassic		1,030,853	1,089,577	—	Canada 319,096; West Germany 263,405; Jordan 223,124.
Fluorspar		12,824	8,807	—	China 5,497; Taiwan 2,977.
Graphite, natural		245	621	7	Japan 382; Sri Lanka 153.
Gypsum and plaster		9	23	19	Belgium-Luxembourg 2; United Kingdom 2.
Magnesium compounds:					
Magnesite, crude		2	169	—	Singapore 150; Japan 12.
Oxides and hydroxides		4,805	9,517	—	Japan 6,340; Austria 1,361; Turkey 1,000.
Mica:					
Crude including splittings and waste		3	3	—	All from United Kingdom.
Worked including agglomerated splittings		12	25	5	West Germany 8; Austria 7.
Phosphates, crude	thousand tons	1,593	1,849	407	Jordan 827; Morocco 306.
Phosphorus, elemental		96	222	—	United Kingdom 107; China 50; West Germany 44.
Pigments, mineral:					
Natural, crude		19	30	NA	NA.
Iron oxides and hydroxides, processed		370	197	—	West Germany 111; Iran 80.
Potassium salts, crude		13,000	55,006	—	All from West Germany.
Precious and semiprecious stones other than diamond: Natural:					
Emerald	value, thousands	$7,577	$11,764	$7,401	Zimbabwe $761; Switzerland $719.
Other	do.	$1,756	$11,997	$6,117	France $1,060; West Germany $987.
Salt and brine		r7,355	37,704	269	Pakistan 37,424.
Stone, sand and gravel:					
Dimension stone, all forms		r60,399	256	(5)	Italy 137; Nepal 118.
Quartz and quartzite		53,784	70,775	NA	Japan 69,044; Bangladesh 1,621.
Sand other than metal-bearing		2,016	872	778	Australia 36; United Kingdom 30.
Sulfur: Elemental:					
Crude including native and byproduct		1,153,089	989,860	63,153	Canada 358,003; Saudi Arabia 266,028.
Colloidal, precipitated, sublimed		221	28	—	West Germany 21; Japan 5.
Talc, steatite, soapstone, pyrophyllite		15	157	—	Nepal 135; United Kingdom 5.

See footnotes at end of table.

TABLE 5—Continued

INDIA: IMPORTS OF MINERAL COMMODITIES[1 2]

(Metric tons unless otherwise specified)

Commodity		1984–85	1985–86	Sources, 1985–86	
				United States	Other (principal)
MINERAL FUELS AND RELATED MATERIALS					
Coal, all grades including briquets	thousand tons	543	2,396	—	Australia 2,295; Canada 38.
Coke and semicoke		r17,163	53,028	—	Australia 40,882; Japan 12,134.
Petroleum, crude	thousand 42-gallon barrels	98,430	111,924	—	Iran 25,471; U.S.S.R. 18,890; Saudi Arabia 17,597.

r Revised. NA Not available.
[1] Table prepared by Audrey D. Wilkes.
[2] Data are for Indian fiscal years Apr. 1 through Mar. 31 and have been compiled from the Indian Minerals Yearbook 1989.
[3] May include other unspecified ores.
[4] P_2O_5 content. Data from the Fertiliser Association of India, New Delhi. Fertiliser Statistics, 1987–88, pp. I–172.
[5] Less than 1/2 unit.

to a little over 67,000 tons for the year against a targeted 130,000 tons and an expected 100,000 tons, the difficulties seemed to have been overcome.

Meanwhile NALCO's alumina operations went smoothly during the year, with expected 1988 production in the 550,000-ton range, compared with 167,000 tons the year before. This was far from its rated capacity of 800,000 tons per year. NALCO's Andhra Pradesh bauxite project, however, remained sidetracked by the Government of India since the previous year as negotiation proceeded on custom bonding for the project. NALCO posted a bond with the state forestry authorities for enumeration of trees in the proposed mining area, and an agency was appointed for a peg-marked survey of the area.

The Bharat Aluminium Co. (BALCO), in the public sector, was facing closure in 1 year, or at most 2 years. Its bauxite reserves at Amarkantak and Phutkapahar were running out and its new Gandhamardan bauxite project was embroiled in squabbles involving environmentalism, religion, politics, and apathy. Since 1983, BALCO has battled charges of environmental pollution, ecological imbalance, damage to temples, and uprooting of tribal people plus deprivation of their livelihood. Against these charges, BALCO has promulgated a program of reclamation of mined-out areas, reforestation with a nursery capacity of 40,000 saplings per year, and various other welfare and development activities intended to compensate for the effects of mining. Other producers declared their support of BALCO, asserting their willingness to commit shares of bauxite or alumina if BALCO exhausted its reserves before the Gandhamardan disputes were resolved.

Power shortages continued, restricting BALCO's aluminum output to about 66% of installed capacity. The Government of India, seeing little prospect of improving the ability of the state and national power grids to deliver electricity to the aluminum smelters, gave BALCO permission to install its own 270-MW power facility. NALCO already had set up its 500-MW plant at Angul. A private-sector company, Madras Aluminium Co. (MALCO), faced closure because the Tamil Nadu State government did not accept a recommendation for increasing power supply to the languishing company. A fully integrated company producing 27,000 tons per year of alumina and 13,800 tons per year of ingots, extrusions, and wire rod, MALCO was supported by various financial institutions in an effort to make the company profitable. However, the State government would only consider raising MALCO's energy quota if the company was prepared to pay stiff increases in energy tariffs and compete with the power needs of other industries. India was endowed with bauxite reserves estimated at 3 billion tons but, primarily because of power shortages, continued to import aluminum to meet domestic demand.[16]

Chromium.—Production by Indian Charge Chrome Ltd. (ICCL), a totally export-oriented operation promoted by Indian Metals and Ferro Alloys Ltd. (IMFA), was scheduled to begin at the end of the year at its plant at Chowdwar, in Orissa State. Built with assistance from Elkem of Norway, the plant had a production target of 62,500 tons per year. IMFA already produced charge chrome at its Therubali plant in Orissa's Koraput District. ICCL operated mines in the Sukinda-Nausahi ore belt of Orissa, one of the world's richest deposits of high-grade chrome ore.[17]

The Government of India's Secretary of Mines announced that new discoveries of chrome ore totaling 3 million tons had been found in the Sukinda area. This brought Orissa's total reserves to more than 137 million tons of chromite ore and India's reserves to at least 140 million tons and perhaps closer to 150 million tons if consideration were given to smaller deposits in Karnataka, Bihar, and Tamil Nadu.

Cobalt.—India was not a producer of cobalt but consumed about 270 tons per year, imported from Zambia. In 1988, India planned domestic recovery as a byproduct of lead and zinc at Hindustan Zinc Ltd.'s operation at Udaipur, Rajasthan, where the ore was said to contain 0.0024% cobalt. At last year's throughput, this would have been enough to yield 25 to 30 tons of cobalt and displace that much in current and lost foreign exchange. Significantly, the Bhaba Atomic Research Centre provided the technical expertise for this plant, scheduled to go onstream in 1989. Other byproduct recovery operations were projected elsewhere, including a pilot plant built by Sandvik Asia at Pune to recover about 10 tons per year of cobalt from copper, nickel, and zinc scrap.

In the early 1980's, the Geological Survey of India (GSI) completed its exploration for cobalt- and nickel-bearing laterites in the Kalimati-Bichaburu area of Singhbhum District, Bihar. The Survey estimated reserves there of 5.33 million tons containing 0.01% to 0.06% cobalt.[18]

Copper.—In accordance with the proverb that a rising tide lifts all boats, the world increase of copper prices lifted India's copper-mining industry out of its economic troubles.

After considerable study of recurrent problems centering on modest ore grades and lack of profitability, Hindustan Copper Ltd. (HCL), a public-sector company, was instructed by the Government of India to begin phasing out the uneconomic mines and to diversify the work force to new mines. Accordingly, HCL decided to open up Banwas in the Khetri copper complex in Rajasthan and Chapr Sideshwar in the Indian copper complex of Bihar, so that mine development began at both sites. Smaller operations at the Ghatsila complex, also in Bihar, were discontinued, and activity at some of the leaner ore blocks at Khetri was redirected to other sites where roughly 15 million tons of ore grading 1.7% copper were found. HCL initiated detailed studies of the Singhbhum copper belt in Bihar and proposed similar studies for determination of copper reserves in Madhya Pradesh. Other efforts were underway to modernize and upgrade the two sets of smelters and refineries at the Khetri complex and bring their yearly output up to full capacity at 31,000 and 16,500 tons per year of improved-quality copper with better byproduct recovery. Long-term measures by the Government of India included increased research and development in technology for better performance and higher recovery. These actions were all intended to enable HCL to raise its yearly production of copper from the current level of about 48,000 tons per year to 70,000 tons per year by 1990 and so cut back on imports.

Further to the above changes and improvements, HCL planned to expand its operations at Malanjkhand in Madhya Pradesh to underground extraction from surface mining alone of ore there which, at approximately 1.4% copper, ranks among the best in the country, with reserves projected at 287 million tons. HCL acknowledged, however, that it sees little possibility of meeting the Government's 1990 target.

Within the Government of India, which was not especially committed to a market-driven price dynamic, controversy continued over the setting of domestic copper prices. The Bureau of Industrial Costs and Prices (BICP) submitted its report, "The Normative Cost of Copper Production," to the Ministry of Steel and Mines, which in turn asked BICP to propose a pricing policy for copper in India based on the cost of production at HCL, import costs, and (whatever it could be taken to mean) the overall interests of consumers.[19]

Near the end of the year, it became clear that favorable world-market prices had overwhelmed artificial pricing efforts by the Government of India. All HCL production figures equaled or exceeded targets. For a record output of 5 million tons of ore, the company scored new highs in production and sales, the latter having climbed 48% from 1987 to a value just less than $26.1 million. Capacity utilization ran about 94%, a significant improvement over that of previous years, and productivity per worker-year improved to a level 30% higher than that of 4 years before.[20]

Final developments in 1988 included the discovery of copper in Chitradurga, Raichur, Hassan, and Gulbarga Districts of Karnataka State; the establishment of a 60,000-ton-per-year continuous-cast copper-wire-rod plant at Taloja in Maharashtra State; and the Government's granting of a letter-of-intent (but not yet an industrial license) to a private-sector firm, Apurv Bagri, to set up a 15,000-ton-per-year continuous-cast copper-rod plant at Raigarh in Madhya Pradesh.

Gold.—Gold smuggling was on the rise in 1988, amounting to about 40% of the value of all contraband confiscated at points of entry and estimated by Indian officials at roughly 100 tons per year. Much of the impetus for smuggling was attributable to the Indian national policy of prohibiting the import of gold other than for small amounts devoted to the jewelry trade. Domestic black-market gold prices as high as 70% above the world price thus provided incentive to the entrepreneurs of the business of illegal importing. As domestic production amounted only to about 62,822 ounces of gold in 1988, the estimated 100 tons or so smuggled into the country evidently helped fill a large gap between production and demand. As the country endured a declining rupee and currency restrictions, many of its citizens sought gold as a way of protecting their wealth.

Production of larger quantities of gold was one of the known palliatives for such a situation, but rising operating costs, depletion of higher grade ores, and declining overall reserves caused a steadily decreasing profitability in India's gold mines. In an effort to alleviate the situation, Bharat Gold Mines Ltd. (BGML) was newly authorized by the Government of India to sell 1 kilogram (kg) of gold per year, each, to private dealers at artificially high domestic prices. Until then, the Government of India had bought all BGML output at much lower prices, which amounted to about 47% of the actual production cost. The new policy had little or no effect. In order to survive, BGML was forced to diversify into mine construction, shaft sinking, and the manufacture of tools for the mining industry. After having produced 267 tons of gold as of 1988, BGML was forced to close some mines and phase out workers at the rate of about 500 per year. Only the Mysore, Champion Reef, and Nandidurg mines approached economic viability, but under the circumstances needed ore grading 7 to 8 grams per ton (g/t) to be profitable.

An accelerated exploration effort by the Government of India focused on several states, including Karnataka, Andhra Pradesh, Bihar, and Maharashtra. Proven foreign technology was sought to aid the GSI and the Mineral Exploration Corp. in their search for new deposits.

Late in the year, a discovery in BGML's Kolar Mine began to change the outlook for the company and to some extent for the nation. Relatively rich mineralization on the order of 6.5 g/t was found while blasting underground at a relatively shallow level. Although first reports were sketchy, the ore zone was thought to be 2.5 meters wide and to extend 3 km beneath the surface. Meanwhile the GSI and the Karnataka State Department of Mines and Geology jointly located new deposits of gold grading 4.8 to 6 g/t in Kolar, Raichur, Hassan, Tumkur, and Dharwar Districts. Although these events did not alleviate the national problem of artificial pricing for gold, nor the vigorous smuggling operations in response to those prices, they did bode well for continued economic life for the gold-mining companies.[21]

Iron Ore and Pellets.—Production of iron ore increased slightly over that of the previous year, rising about 2.5% to a total of 52.3 million tons. Early in the year, Romania signed a new protocol with MMTC agreeing to import 5 to 6 million tons per year of Indian iron ore through the year 2000. This protocol replaced a previous agreement for 4 million tons per year that Romania unilaterally cancelled because of various difficulties it had in assembling enough rupees or hard currency to meet payments. About 3 months later it was said that Romania might import something on the order of 3.5 million tons, versus the intentions expressed above. An erratic customer, Romania itself may not know what it can afford from year to year in iron ore imports from India. Japan, MMTC's best customer for the ore, signified its intention of importing 10 million tons in 1988 but balked momentarily at a price increase requested by the Government of India. Press reports speculated that MMTC's iron ore exports might total 17 million tons for 1988 after the Republic of Korea indicated it was willing to raise its long-term commitment to buy from 3 to 4 million tons of iron ore annually. Another 9 million tons was exported by private-sector sources.

The other major player in iron ore exporting, the state-owned Kudremukh Iron Ore Co. Ltd. (KIOCL), successfully broadened its export market and perhaps finally overcame the impact of revolutionary Iran's failure to honor the Shah's promise to purchase the entire KIOCL production. After exporting approximately 3.2 million tons of iron ore concentrates and 800,000 tons of pellets to some 15 different countries in 1987, KIOCL in 1988 agreed to export 1 million tons of concentrates annually to Bahrain. Rumors of Saudi Arabian interest in importing a small amount on a trial basis were followed by expressions of interest by Austria and Taiwan. Here Romania appeared again by agreeing to import 1.6 million tons of pellets in 1989. Hungary likewise contracted for 1.2 million tons of pellets. It may be recalled that Romania furnished KIOCL technical and financial assistance to set up the pelletization plant for utilizing the concentrates it produced.

KIOCL iron ore concentrates and pellets played a growing role in India's total iron ore exports. From 1984 to 1987, earnings rose by a factor of three while earnings from iron ore itself remained fairly steady. Near the end of the year, Japan conceded price increases to MMTC of 17.3% for iron ore lumps and 13% for fines, and further agreed to take 12.5 million tons of ore from MMTC in 1989. Another 8 to 9 million tons of iron ore was to be exported by private-sector sources in Goa.[22]

Iron and Steel.—A new feature of India's steel industry in 1988 was a high-tech startup of great interest and potential significance. Sunflag Iron and Steel, the first Government-approved integrated steel plant in the India private sector since independence four decades ago, began production in August and hot rolling at the end of the year near Nagpur in Maharashtra State, central India. The plant used ore from the Government's Bhilai iron mines, domestic coal for fuel, and established computer control of the entire operation from furnace to cold shear. With a feedstock of scrap and direct reduced iron, the 50-ton electric-arc furnace (EAF) was soon to be charged with sponge iron from the company's own plant at the same location, whose capacity was to be expanded from 150,000 to a projected 450,000 tons per year. The plant was thus the only Indian EAF plant making its own charge in the form of sponge iron. The EAF, of Mannesmann Demag design, incorporated eccentric bottom tapping; facilities for continuous feed of sponge iron; and injection of sponge-iron fines, coke, and oxygen. A Demag ladle furnace was installed for secondary metallurgy; a three-strand continuous casting machine, also of Demag design, had automatic mold-level control, gas shrouding, and computer-controlled secondary cooling. With a capacity of 200,000 tons per year, the entire plant was tightly staffed. More than 50 local operators were trained in the Federal Republic of Germany, where much of the equipment and process technology was engineered. Although India has found it politic to keep its industries as labor-intensive as possible within the context of industrial activities, thus affording employment to an optimum number of workers at any particular site, the Sunflag plant may have decided to try fewer and better trained workers as a way of increasing productivity. Moreover, national and international interest was focused on the testing of the several new process concepts in which interlinked viability was not yet proven.

Meanwhile VSP in Andhra Pradesh, whose cornerstone was laid in 1971 by Prime Minister Indira Gandhi, was said to be nearing completion, at which time it would be India's sixth integrated and first shore-based steel plant. Under construction with technical assistance from the U.S.S.R., VSP has had a long history of problems, many of them centering on the availability of water and power supply. Generally, not more than 19 million gallons per day was drawn from the Raiwada reservoir near Vizag, much less than the latter's minimal needs of 32 million gallons per day for the blast-furnace stage and 40 million gallons per day for the rolling mills. Commissioning of the blast furnace was delayed until the Andhra Pradesh State government could ensure completion of the Yeleru water project, which was intended to supply 73 million gallons per day to VSP. Engineers at the Vizag site were confident that the water problems would be solved in time for the VSP's anticipated commissioning date at the end of 1989.

For the planned first-stage capacity of 3 million tons per year, Vizag needed 280 MW of electric power with a peak load requirement of 292 MW and an essential load level of about 249 MW. From its own generating facilities, VSP could assure a supply of 140 MW from a combination of thermal and waste-gas power generation, and even a peak output of 220 MW but, as a practical matter, it had to depend upon another 140 MW from the Andhra Pradesh State Electricity Board (APSEB). In the midst of APSEB's recent 60% cut to the state's high-tension-transmission power consumers, VSP officials were concerned whether sufficient power could be guaranteed for the next several years.

Because VSP was some distance from sources of raw materials such as iron ore, limestone, dolomite, coking coal, and steam coal, it planned to spend as much as $62 million more on freight charges than similar plants elsewhere in India. Despite these problems, certain advantages were recognized. In addition to power generation from waste gases, the plant was to have 7-meter-high coke-oven batteries with dry-quenching facilities and 3,200-cubic-meter blast furnaces as compared with the 2,000-cubic-meter blast furnaces operating elsewhere in India. The plant also was to have a new system for charging the blast furnaces with raw materials, continuous casting, and computerized operations. Labor productivity per ton produced was expected to be three to four times higher than for other Indian steel plants, and management anticipated eventually increasing capacity to 5.7 million tons per year, thereby lowering unit capital costs even further.[23] The latest report was that VSP lighted up its first coke-oven battery on the last day of FY 1988.

Tata Iron and Steel Co., the oldest operating integrated iron and steel plant in India, completed a major 8-year, two-phase modernization. Phase 1 included the establishment of continuous casting as well as the commissioning of a bar and rod mill. Phase 2 included rebuilding, respectively, the coke-oven battery, sinter plant No. 2, and an enhanced blending and bedding system. This phase also included new attention to the improvement of raw materials as Tata, which was already importing low-ash coking coal, concentrated on improving the quality of metallurgical coal from its own mines.

Besides the VSP project, the Government-owned Steel Authority of India Ltd. (SAIL) continued planning and contracting for the modernization of four of its other plants. The first plant, Durgapur, never reached its intended capacity of 1.6 million tons per year after a previous expansion more than 20 years ago. Through general repair and the revamping of upstream facilities including coke ovens and raw-material processing, Durgapur was targeted for a new increased capacity of 1.66 million tons per year.

The Rourkela plant, also expanded in the 1960's from about 1 million tons per year to a targeted 1.8 million tons per year, thereafter achieved slightly more than 1.5 million tons in one unusual year; actual capacity was considered to be closer to 1.1 million tons per year. After modernization in two successive phases, the newest target for the Rourkela plant was 1.9 million tons per year. The proposed financing worked out to slightly over $2 billion to add 800,000 tons per year of crude steel capacity,[24] or about $2,500 per ton of installed capacity.

Burnpur plant, operated by the SAIL subsidiary Indian Iron and Steel Co., continued talks with Japan's Nippon Steel as the leader of a proposed consortium for upgrading Burnpur. Ingot steel capacity was to be raised from 800,000 tons per year to 1.55 million tons per year at first, and later to 2.15 million tons per year. Finally, the Bokaro Steel Ltd. plant, built in the 1960's with help from the U.S.S.R., continued work on expanding its capacity to 4 million tons per year of ingot steel including 3.16 million tons per year of salable steel. The U.S.S.R. proposed financing of a further expansion to 4.5 million tons per year of ingot steel, to include reconstruction of the converter shops, installation of continuous casting, and upgrading of the hot rolling mill. Although ingot, or liquid steel, capacity would increase by 500,000 tons per year, salable-steel capacity would thus increase to 800,000 tons per year. The U.S.S.R. would make low-interest loans available for the entire cost of the second phase of expansion.

India's Government-owned (SAIL) steel plants continued to experience problems, none of which was new. Coal from Government mines had a high ash content in the first place, but is known to arrive at the mills in short weight because of the inclusion of useless mine gob and waste, causing burning problems and lowering the relative calorific value on both a volumetric and a weight basis. Electric power was undependable and not very predictable. Some advantage accrued to on-site power generation, particularly cogeneration, but fuel-quality variations would not automatically go away. Lack of flexibility in changing product mix with changes in demand suggested an unresponsive managerial structure, along with outdated equipment. Low profitability was an inevitable consequence of these problems, but with an excess of employed workers whose large numbers were not necessary to the production of steel, profitability deteriorated further.

Lead and Zinc.—Output of lead concentrates was down almost 16% to 39,898 tons, with zinc concentrates up 6% to 111,430 tons produced in 1988. Primary metallic lead output was down 9% at 18,833 tons while primary metallic zinc was virtually unchanged at 68,940 tons. Output of secondary lead was up 15% at 14,000 tons even. Not much growth occurred in the lead-zinc industry during the year. As in previous years, changes for the better were more anticipated than realized, but in 1988 some critical steps were accomplished.

Hindustan Zinc Ltd. (HZL) finally received clearance from the Government of India to begin construction of its Rampura-Agucha zinc-lead integrated complex in Rajasthan. The project was to include an open pit mining operation delivering 3,500 tons of ore per day, grading 13.5% zinc and 1.9% lead, to a concentrator, a sinter plant, and an Imperial Smelting Furnace (ISF) smelter, the latter two at Chanderia in Chittorgarh District. The concentrates would grade plus 55% zinc and plus 50% lead, the latter somewhat low because the relatively higher proportion of lead reports as an oxide in the zinc concentrate. Yearly output was projected to be 70,000 tons of metallic zinc and 35,000 tons of metallic lead.

As byproducts, the complex was expected each year to produce 375 tons of cadmium, 176,000 tons of sulfuric acid, 74 tons of silver, 1,929 ounces of gold, 30 tons of mercury, and 10 tons of bismuth. Originally planned to cost $412 million, revised estimates moved the total cost up to $519 million, some $106 million of which has been extended as a credit from the United Kingdom in the form of a loan plus a grant-in-aid. Near the end of the year Prime Minister Rajiv Gandhi laid the foundation stone of the complex; after years of delay, construction officially got underway. Actual production of lead and zinc from this facility would go far toward fulfilling India's requirements and precluding the expenditure of valuable foreign-exchange credits.

HZL also assumed the role of promoting and developing lead- and zinc-based alloys such as lead-antimony, zinc-aluminum foundry alloys, and so-called Galfan coating alloys. As a recent member of the International Lead and Zinc Research Organization (ILZRO), HZL was empowered to petition ILZRO for authorization to produce Galfan alloy in India.

Elsewhere the Bombay-based private-sector Binani Group, operating Cominco-Binani Zinc Ltd. (CBZL) in Alwaye, Kerala State, had nearly completed its expansion from 17,000 to 20,000 tons annual capacity. This included installation of a 22,000-ton-per-year roaster and a large electrolytic-cell house, which together cost $36.6 million. Moreover, CBZL applied for a license to import a 5 MW, $3.3 million diesel generator for use during power cuts imposed by the State electricity authority. During 1987, the 600-worker plant at times sustained cuts so heavy as to have lost more than 50% of the power required to operate.

The Gujarat Mineral Development Corp. Ltd. (GMDC) went forward with development of its complex-sulfide ore body near Ambamata where it planned to mine 350,000 tons per year of ore grading 5.33% zinc, 3.0% lead, and 1.12% copper by open pit methods. The company had not decided whether to produce three separate concentrates, a combined bulk sulfide concentrate, or a zinc concentrate plus a copper-lead concentrate for the new ISF smelter being installed by HZL described above.[25]

Nickel.—After publicity in midyear to the effect that the Federal Republic of Germany offered approximately $1.5 million to India toward equipment costs and worker training in connection with the extraction of nickel from laterite ores in the Sukinda District of Orissa, the project was halted for reevaluation. Fifteen years of work toward the goal of recovery of lateritic nickel, including construction of a pilot plant, ended when the Government of India decided not to proceed. Citing "techno-economic" reasons, thought to mean that the experimental technology failed, the need was seen for further exploration and the construction of another pilot plant at a cost of $3.3 million. Mineralization in the Sukinda laterites grades about 1% nickel with a cutoff grade (below which mining is uneconomic) of somewhere between 0.5% and 0.7%. This suggested the necessity of including the simultaneous recovery of cobalt and perhaps iron chromite in an integrated operation. Although determination of grade and tonnage of ore could become more complex with multiple recovery, India was a net importer of nickel (and cobalt) and has had to conserve its foreign-exchange reserves every way possible. Developments in the technology of nickel recovery from laterite were awaited with interest.[26]

Tin.—Although India had produced and accumulated a modest quantity of tin concentrates over the past few years, there existed no domestic smelter for production of the metal. Export was prohibited because the concentrates were considered a strategic material by the Government of India and so consigned to stockpiles. No particular incentive existed to carry on organized mining even though tin deposits were known both in the Koraput District of Orissa and the proximal Bastar District of Madhya Pradesh. It was noted that tribesman in Koraput had smelted cassiterite in crucibles over charcoal and typically produced about 0.7 kg of tin from 3 kg of the oxide.

At the end of the year, however, India's first commercial production of metallic tin occurred at Saru Smelting Ltd. of Delhi's Sartin Ltd. plant, near Cuttack in Orissa State, from concentrates said to grade 65% tin. Sartin, a private company formed to take advantage of State-aided funding by Madhya Pradesh State Mining, expected to satisfy about 10% of India's tin needs by processing concentrates from the two adjoining States as well as imported concentrates from China and perhaps the United Kingdom. The Sartin smelter was built with the technical assistance of Base Metal Synergy Associates (BMSA) of Humberside in the United Kingdom. BMSA and Sartin were providing private consulting to Orissa Mining Corp. so that mine output from Koraput could be expanded.

The tin slags, reported to contain as much as 30% tantalum-columbium, were a potentially valuable mineral commodity but, like the tin concentrates, were also considered a strategic material and consequently could not be sold or exported. The slags themselves were stockpiled and added to the tin-tantalum-columbium slags remaining from the primitive smelting over charcoal fires. Because of low tantalum prices, a planned tantalum treatment plant was not carried forward; by the end of the year there were no further plans.[27]

Primary tin mineralization grading about 0.29% but occurring in micron-sized particles was discovered at Tosham, near Bhiwani in the State of Haryana, northern India. Hindustan Zinc Ltd. obtained mining rights and was studying the problems of mining and processing.

Tungsten.—The Uttar Pradesh Mineral Development Corp. reported a tungsten find in Almora District of Uttar Pradesh estimated to include 10 million tons of ore grading 0.4% tungsten, said to have been verified by the Indian Bureau of Mines. Plans were made for a pilot plant to begin commercial operation in 4 to 5 years. Near the end of the year, however, the find was downgraded to 200,000 tons of material containing 0.1% tungsten trioxide. Reserves of tungsten trioxide in other States were 2,608 tons in Rajasthan, 17,666 tons in Maharashtra, 298 tons in West Bengal, 5,926 tons in Karnataka, and 62 tons in Andhra Pradesh. Not all of these reserves were thought to be large enough for commercial extraction.

The Government of India's Mineral Exploration Corp. Ltd. (MEC) has entered into an agreement with an unnamed French company for tungsten exploration in Khuchi Khobna, Maharashtra, using French exploration technology. Earlier field efforts by the Geological Survey of India indicated tungsten occurrences in Bhaonri, Ranbori, and Mokabardi, all in Nagpur District.[28]

Uranium and Thorium.—The Chairman of the Atomic Energy Commission of India reported a uranium discovery in Maghalaya possibly significant in terms of the apparent size of the reserves.[29] Other research work in India concluded that certain species of pine and juniper plants absorb uranium and selenium from the soil and could be used in geobotanical exploration to identify uranium enrichment at or near the surface.

Following a decision of the Atomic Energy Commission of India to move all facilities away from the Bhaba Atomic Research Centre that are not directly connected with Bhaba's research and development programs, a new thorium nitrate plant was proposed in Orissa. The plant, of unspecified capacity, was to be next to the Orissa Sand Complex of Indian Rare Earths Ltd., also operated by the Department of Atomic Energy.

The public-sector firm Uranium Corp. of India Ltd. (UCIL) announced plans to exploit two monazite-sand mines in Bihar State at Narwapahar and Turanmdih, which were expected to yield a combined 1,500 tons per day. The thorium content of the monazite would be a useful substitute for uranium in nuclear powerplants. In light of India's ambitious plan to increase its nuclear power-generating capacity to 10,000 MW by the year 2000, the country would need 40,000 tons of uranium annually, or the equivalent in uranium plus thorium.

***Industrial Minerals.*—Cement.**—The Indian cement industry achieved a total output of 40.7 million tons in 1988, an increase of more than 10% over that of 1987 and a new high. This burgeoning industry did not quite equal the estimate of 43.5 million tons for the year, but did begin to realize surplus accumulation of product stocks in marked contrast to earlier days of critical shortages and consequent problems in construction. With an estimated total investment of about $3.989 billion, the cement industry was located primarily in the southern and western regions of India where limestone was available for short haul in many localities. Andhra Pradesh, Karnataka, Tamil Nadu, Gujarat, Madhya Pradesh, and Rajasthan included the majority of cement plants.

The impressive growth of the cement industry followed partial decontrol in 1982, which initiated a notable surge of investment from private-sector sources, some completely new to the industry. Driven by a demand that was continually ahead of supply, the industry utilized modern technology, expanded capacity, and increased both production and productivity per worker to the optimum for existing price levels. By 1988, after the establishment of many new miniplants (100 to 200 tons per day) and so-called tiny plants (20 to 100 tons per day), cement was available off the shelf. The vigorous black market in cement of 1982 had vanished, and the free flow of newly produced cement to the market resulted in lower prices, which created new problems in reducing production costs. Near the end of the fiscal year in early 1989, all controls on cement production and distribution were removed. New technologies were being studied and adapted and a more productive use of labor was mandated.

While the industry paused to allow demand to take up the slack (thought to amount to as much as 4 million tons), it was clear that further expansion would be required through the next decade or two. The per-capita consumption of cement in India was 46 kg per year, quite small compared to 240 kg in the United Kingdom, about 330 kg in the United States, 380 kg in France, and 560 kg in Japan. The world average per-capita consumption was thought to be about 200 kg per year; the probability was that India would need to expand its capacity to 100 million tons per year by the year 2000, thus affording the use of concrete for roads, canal linings, and prefabrication of construction units and modules.[30]

Fertilizer Materials.—Production of nitrogenous and phosphatic fertilizers forged ahead during the year, both achieving new highs. India ranked fourth in the world in the production and consumption of nitrogen fertilizers and sixth in phosphates. After more than 3 years of drought, widespread rains stimulated consumption of all fertilizers, which in turn promoted solid increases in production. The successful monsoon season relieved a burden of high stocks and low prices that characterized poor growing conditions. It also relieved the tendency of the fertilizer industry toward stagnation, as evidenced by the forced discounting of sales to buyers, shrinkage of investment from the private sector, and questions concerning the advisability of any further increases in capacity.

Still relying heavily on imports of phosphate, with undesirable consequences for foreign-exchange reserves, India witnessed renewed large-scale buying by China. This latter country's absence in the world market the previous year had seriously affected suppliers by leaving them with no buyer for their excess production. Phosphoric acid producers raised prices sharply at the end of 1988, causing the delivered price to India to climb from $425 to $480 per ton of phosphorus pentoxide. The Indian Ministry of Finance thereupon refused to allot monies for the purchase of phosphoric acid for the first one-half of 1989, causing confusion in the international market. As the two most populous countries in the world, China and India jointly accounted for 65% of phosphate fertilizer consumption in Asia in 1988. Given this volume, each is critical to the stability of the international market, so that the implications of these swings in purchasing policy were far from clear.[31] It was expected that much more would be heard from Government and industry on the problem of India's imports of phosphate, and especially the negotiation of price.

Gem Stones.—Although production of combined industrial- and gem-quality diamonds dropped 11% from a total of 16,484 carats in 1987 to 14,613 carats in 1988, overall activity in diamond production, cutting, and polishing increased significantly. Gem and jewelry exports, at nearly $2.66 billion, were about 65% higher than in the previous year and were, once again, the leading foreign-exchange earner. During the year, India imported roughly $2.181 billion worth of uncut diamonds and other precious stones for cutting and polishing, thereby adding more than one-third to their value (versus an added-value rate of 25% in Israel)[32] and affording employment to 1 million skilled and semiskilled workers. In 1988, India processed 70% of all diamonds used in jewelry and clearly intended to maintain this position; special diamond-cutting tools could be imported freely for the application of new technology at the cutting centers around Bombay and Surat. Indian cutting concentrated on the small diamonds not amenable to mechanized processing, in which Israel is the world leader.

Tax raids by the Government of India on the diamond-cutting centers toward the end of FY 1988 resulted in protest "close-downs" of the entire diamond trade for 5 days, followed by vows to close every Thursday until problems with the tax authorities could be resolved. Because these closures disrupted a booming yearend market, final export statistics for the year vary somewhat according to source. The dollar values expressed above represent an approximate median.

In Orissa, the State government promulgated a new bill to stop the illegal mining and sale of precious stones that was rampant in Bolasngir, Kalahandi, and Sambalpur Districts. Under the bill, a license would be required to possess, store, sell, or trade any mineral including precious, semiprecious, and uncut stones. The act was aimed at illegal traders of Rajasthan, Gujarat, and Andhra Pradesh who have exploited tribal people and caused a loss of revenue to the State. Orissa Mining Corp. was planning to set up new purchasing centers offering fair prices to local people for gem stones and to inaugurate a cutting and polishing industry in the region.[33] Gem stone production in Orissa grew rapidly amidst the discovery of new localities, but organized mining was generally not established. In an exposed pegmatite belt comprising 2,500 square km, discoveries included green, yellow, and pink (morganite) beryl, aquamarine, rhodolite, almandine, ruby, alexandrite, and white topaz. Emerald rough of good color was found in the Patnagarh area in masses of 5 or 6 grams.[34]

Granite.—The Bihar Government brought forward a proposal for a State-owned granite mining and processing plant in Palamau District at Daltonganj. Estimated to cost $6.7 million, the mine and facilities were designed to produce 13,560 tons (5,000 cubic meters) of export-quality black and pink granite per year. Bihar seemed evidently to have been impressed by the success of granite ventures in Andhra Pradesh, Tamil Nadu, and Karnataka. India's granite-export industry operated at the $66-million-per-year level in 1988 according to industry sources.[35]

Graphite.—India continued to develop its graphite-mining industry with the hope of exporting for purposes of earning foreign exchange. In 1987, the Industries Minister of Tamil Nadu sought a license for establishing an operation for mining, cutting, and polishing graphite entirely for export. In 1988, the Bihar State Mineral Development Corp. received State approval for setting up a facility for graphite beneficiation, and proposed to beneficiate 1,500 tons annually to a purity of 96%. At the same time, work began on the State-owned Tamil Nadu plant, designed to manufacture for export 9,240 tons of graphite per year having a purity of 96% to 99%. The plant was at Sivaganga in the District of Pasumpon Muthuramalingam, where a high-grade graphite deposit was discovered on a 364-hectare area comprising about 200,000 tons to a depth of 15 meters. Together with other local lower grade mines the discovery was expected to give a boost to this economically backward district. Based on a total investment of $18.3 million the entire project aimed at a 200-ton-per-day throughput that would add up to $5.6 million per year in foreign exchange earned.[36]

Limestone and Dolomite.—While exploring for coal, the Maharashtra State Directorate of Geology and Mining reported discovery of a limestone deposit of unknown size in Gadchiroli and Velabai Districts. In Rajasthan, a very large deposit of steel-grade limestone was discovered in Jaisalmer, bordering Pakistan south of Ramgahr and Sam. Occupying an area of 1,000 square km with only 1 meter of overburden, the deposit was estimated at 500 million tons excluding about 60% waste. Of this, the State-owned Rajasthan Mineral Development Corp. has leased an area of 10 square km for mining a deposit containing an estimated 80 million tons, but acknowledged problems of difficult terrain, lack of communication facilities, and an unwillingness of laborers to work in the interior of Jaisalmer.[37]

The Madhya Pradesh State Mining Department discovered a high-grade dolomite deposit, from which it was thought possible to extract manganese, of about 1.5 million tons in the Kakya development block in Mandka District. Another deposit at Balaghat in Seoni District was estimated to include 300 million tons of steel-grade dolomite.[38]

Mica.—At 3,610 tons in 1988, production of crude mica was down about 16% from that of the previous year. A new mica paper factory was proposed to be near Gudur in the Nellore District of Andhra Pradesh, where one plant was already working. The Gudur area, which has maintained a reputation for the quality and weight of its shipments, has three mines producing ruby mica and nine other mines yielding clear mica. Some spotted mica, although available, was not in demand.[39]

Mica Trading Corp. (MITCO) announced price increases and decided to quote in U.S. dollars. Effective April 1, 1988, MITCO arbitrarily raised scrap prices by nearly 40% in terms of rupees, but in dollar terms the increase was much less as the result of the rupee's decline in relation to the dollar. Prices per ton, f.o.b., for uncrushed mica scrap became:

Up to 1/2-inch screening	$398.50
1/2- to 3/4-inch screening	438.50
3/4- to 1-inch screening	478.50

MITCO said it raised prices (1) to promote production of better grades of scrap and a better return to producers and (2) to encourage the reopening of mines that had closed in past years. To boost foreign-exchange earnings, according to MITCO, India was encouraging the export of value-added products such as mica powder, micronized mica powder, and mica paper. MITCO established a 2,400-ton-per-year factory at Jhumritalaiya, with Japanese backing, for manufacture of these products including 600 tons per year of mica paper. U.S. mica importers expressed concern as to the availability of scrap mica, the new higher prices, and the allocation of 50% of the Jhumritalaiya output to the Japanese. Concern was expressed that MITCO has placed a limit of $62,500 per importer on the annual value of mica that each was permitted to buy from private Indian exporters. Orders exceeding this amount had to be shared with MITCO, which procured its supplies from many small producers whose quality commonly was not up to par. MITCO also announced that importers who had not bought from India in the past 2 years would not be served and that no new buyers would be registered.[40] It was predictable that buyers would be driven toward other markets.

Sulfur.—India's State-owned Minerals and Metals Trading Corp. (MMTC) reconsidered its intention to enter into equity participation in Costa Rican sulfur mines, based apparently on pricing that would have the effect of making Canadian sulfur as much, or more, economical. For Costa Rica to compete would have required economies of scale and, in turn, port facilities, that did not exist.[41] India's Oil and Natural Gas Commission (ONGC) planned to install a total of seven desulfurization units at its Bombay High offshore natural gas production operations of Gujarat. Three units were installed, each having the capacity to produce 12.5 tons per day, or about 4,560 tons per year.[42]

Plant-nutrient sulfur was thought to have become a critical factor in Indian agriculture, particularly for the nourishment of oilseeds such as groundnuts and rapeseeds, but also increasingly for soybeans, sunflower, safflower, and sesame seeds. The State-owned Pyrites, Phosphates, and Chemicals Ltd. mined pyrite at Bihar and Rajasthan, whose reserves were thought to include 275 million tons and 120 million tons, respectively.

Talc and Steatite.—At 382,000 tons, 1988 production of steatite exceeded 1987 production by 11,000 tons or 3%, but this did not even approach the planned increase in yearly production of between 115,000 and 200,000 tons announced by India's Golcha Group as its 1990 target. As India consumed the bulk of its own production of steatite, and because many widely scattered small mines were worked in various States, official production data were deemed incomplete. India had large reserves of steatite, talc, and soapstone, all basically the mineral steatite but called by different names depending upon minor constituents, color, ornamental aspect, and whiteness. Whatever the name, the final product was used as paper filler, dressing or filler for rubber and textiles, paint extender, and as a constituent in ceramics. Increasingly, steatite was used in fertilizers, insecticides, abrasives, asbestos products, insulators for electrodes, and cosmetics.[43] Place value was very high, in that average transportation costs were about twice the value of the product as it came from the mine, and thus short haulage to local users or consumers was typical. Large industrial users were greatly separated, and had to resort to long haulage distances.

***Mineral Fuels.*—Coal.**—Production of coal in 1988 increased to 188 million tons, or 6% more than was produced the previous year. Opencast, or surface, mining played a growing role in total output and of itself was responsible for the continued expansion of output over the past years. In 1973, surface mining of coal at the mines owned by Coal India Ltd. (CIL) produced only about 30% as much as underground mining. By 1978, surface mining yielded almost half as much as below-ground extraction; in 1985, it exceeded underground production by 16%. By 1987, the equivalent figure was 69% and it was expected to be at least 66% for 1988. In general, the output of coal from CIL's underground mines has ranged from 51 to 63 million tons per year while surface mining has climbed steadily from 18 to 106 million tons per year, thus accounting for the bulk of the growth of this industry. Although other private-sector companies and State joint ventures mine coal in India, CIL accounted for 85% of total production in the latest year for which a detailed breakdown is available, 1987.[44]

Output of coal per worker per shift (OWS) in this large and sprawling industry increased very slowly, having only recently exceeded 1 ton and, for 1988, was perhaps fractionally more than 1 ton based on all sources. Even more than the fact that most (if not all) Indian coal contains very high ash, this low OWS testifies to the difficulties of mining coal economically in the country. Compared to high-speed, unit-shift, completely mechanized mining in such places as western Kentucky in the United States, where 13 workers produce 800 to 1,000 tons of coal per 8-hour shift, affording an OWS of 60 to 75 tons, the Indian situation points up the absence of technology and mechanization. Opencast mining, by its notable growth in output, virtually assures that economies of scale are being realized through some degree of mechanization, probably bulldozing of overburden followed by dragline recovery. At an underground OWS of around 1 ton, it begs the question of whether the discounted future value of operations of the typical underground coal mine would not involve negative numbers. While the coal produced was critical to India's economy, even high-quality coal produced by these methods would not compete in world markets.

Efforts were made to improve technology and mechanization, particularly underground. With only 11 powered-support longwall faces in operation during 1988, plans were advanced to acquire 100 such longwall machines by 2000. Foreign technology for thick-seam mining by sublevel caving and multislicing was being adopted. Indigenous procurement of new machinery and equipment from both public and private sectors approximated 80% of the total. The other 20% were imports, obtained only where bilateral assistance was funded by the World Bank. Standardization of sizes and specifications of equipment was emphasized, together with the establishment of spare parts depots and manufacturers' centers for service and support of deployed equipment owned by the coal companies.[45]

Exploration for new coal reserves was pressed vigorously for much of the year, centering on metallurgical coal for the steel sector of the economy and power-grade ("steam") coal for the generation of electric power. From April to December, 245,000 meters of drilling were accomplished, based on geology and geophysical techniques including downhole wireline logging, magnetic surveys, temperature and resistivity measurements, and seismic and gravity studies. New coal reserves were established to the extent of 2.104 billion tons proven and 118 million tons indicated,[46] certainly a welcome achievement in the light of India's dependence upon this energy source. With a labor force headed toward 850,000, however, it was not easy to see how even radical improvements in technology and mechanization could help productivity sufficiently to offset the burgeoning wage bill.

Lignite.—Production of lignite rose to 8.4 million tons in 1988, an increase of 100,000 tons or a little more than 1% over the previous year's output. Five new mining blocks were found in the Neyveli Lignite Corp. (NLC) area. In addition to the 3.3 billion tons projected at Neyveli, reserves were placed at 1.5 billion tons in the Bahur area of the Union Territory of Pondicherry and Jayakondacholapuram area of Tiruchy District of Tamil Nadu. Together with reserves of 220 million tons in the Kutch and Broach Districts of Gujarat; 573 million tons in Bikaner, Barmer, and Nagaur Districts of Rajasthan; 90 million tons in Jammu and Kashmir; and a few smaller minable occurrences, the grand total of lignite reserves was about 5.8 billion tons; even this total was being augmented as exploration continued.

Petroleum.—Once again, new production offset decline rates in established production to enable a new high of 230 million barrrels of crude produced in 1988, but the increase over 1987 was only 10 million barrels or slightly more than 4%. This does not match the yearly increase in domestic demand of at least 7% by an energy-starved economy, so that ideas of self-sufficiency in oil for India seem to be contingent upon future drilling and discovery. Although an output of approximately 337 million barrels per year was predicted by Indian officials for the end of the eighth 5-year plan in 1994-95, the year 1988 demonstrated once again that new discoveries do not simply add to the initial production from previous discoveries. Decline curves for each well and each reservoir exerted their inexorable effect on production statistics.

India's Oil and Natural Gas Commission (ONGC) planned to increase production substantially in the western offshore area over the next 6 years, but this assumed availability of production that as yet has not been clearly defined. Much exploration and subsequent drilling, however, remained to be done in the area around the Bombay High and southward to the southern tip of India. New discoveries in the western offshore area would depend on progressively increasing sophistication of the exploration effort.

Of the 27 new lease blocks flanking the coastline from Panaji (on the west coast south of Bombay) around the south point of India and up the east coast essentially all the way to Calcutta, 9 had been taken up, as of the end of 1988, by major companies since the bidding had opened in 1986. Contract terms in this third round of bidding were changed to stimulate more interest in exploring these waters. For example, signature bonuses were abolished and, although permit holders had to assume the entire cost of exploration, they could terminate their holding if they deemed seismic-survey results to be negative. ONGC had the right to a 40% interest in any fields discovered, taken out of production. Also, foreign operators had to offer any crude remaining after cost recovery to the Indian Government for purchase at world prices until India achieved self-sufficiency in crude-oil production.[47] It was anticipated that a fourth round of bids would be invited from foreign oil companies, probably in late 1989, for both onshore and offshore sites, unlike the previous rounds that focused on the offshore areas only. It was thought that terms of the fourth round would be similar to those of the third. Good offshore performance thus far by foreign companies, compared to a very modest record of onshore exploration success by the domestic companies, suggested a potential solution to India's increasing energy shortfall in the midst of its financial strictures. Although this was seen to involve relinquishing some proportion of profit to the foreign companies on oil in reservoirs not yet found, it reinforces an old saying among U.S. oil operators that ". . . a fair share of something is better than 100% of nothing," learned the hard way again and again. It could be added parenthetically that for exploration and production in India it was not only a matter of hardware technology transfer; real success has tended to arise also from decisionmaking by oil-finders with years of experience.

Successes there were in 1988. Offshore discoveries occurred in several places starting with a good one in the Cauvery Basin off Tamil Nadu, where a well designated PY-3-2 gauged at 2,740 bbl/d of crude increasing to 4,500 bbl/d a month later. With the oil came 1.97 million cubic feet per day (cf/d) of gas. This oil tested as a light, high-quality crude at 40° API gravity. Off the west coast, southwest of Bombay City and about 15 km due south of the Ratna field the so-called R-10 structure delivered an initial 2,227 bbl/d of crude and 781,000 cf/d of gas for a new-field discovery. North of Bombay City, off Daman, the SD-1 structure yielded a find of 1,025 bbl/d of crude along with 7.8 million cf/d of gas. Nearby, the SD-4 structure tested at 1,000 bbl/d of crude with 3.1 million cf/d of gas. Lastly, offshore, the Ravva-3A structure, formerly the GS-16, flowed 1,020 bbl/d of crude and 5.3 million cf/d of gas.

Onshore discoveries included two in Assam. The first was in the Cachar Hills of Karimganj District, where 3.9 million cf/d of gas was encountered; the other was at Sonari in Sibsagar District where ONGC tested a discovery at 700 bbl/d of crude and 706,000 cf/d of gas. Far to the south in Tamil Nadu at Narimanam in Thanjavur District, ONGC announced a find that tested at 350 bbl/d in the onshore extension of the Cauvery Basin.

In western India, Oil India Ltd. announced a find in its first test in western Rajasthan, where the Tanot No. 1 well in Jaisalmer District (almost on the Pakistan border) gauged at 1.6 million cf/d of gas. Near the end of the year, in Gujarat State 100 km south of Baroda, the Nada structure in Broach District yielded a test of 2,010 bbl/d of crude and 4.5 million cf/d of gas from Nada No. 1 well, thus tentatively becoming the largest onshore producer in India's history. This structure was within the onshore extension of the Cambay Basin, notable for its offshore inclusion of the Bombay High. Finally, In Andhra Pradesh, about 25 km southeast of Rajahmundry, a gas strike testing at 5.4 million cf/d was brought in by ONGC on the Mandapeta structure in the first well drilled.[48]

In all, a total of 472 wells comprising 3.4 million feet of hole was drilled in India during 1988, an increase of 16% in wells and 7.5% in footage over those of the year before.[49] It became increasingly clear that India offered good petroleum prospects in various parts of the country, and that plenty of wildcat testing was justified along with development drilling if the country were to come to terms with its energy deficiencies.

India was in the final stages of negotiating a $325 million loan from the World Bank to finance various petroleum development projects.[50] It was hoped that this funding, along with capital invested by foreign oil companies, would accelerate India's curve of discovery.

NEPAL[51]

The mining sector contributed only minimally to the economy of this landlocked, overcrowded nation. Only 1% of the population derived their living from the industrial sector and just a small proportion of those were employed in mining or mineral processing.

Nepal is a land of contrast. Its terrain varied from the highest mountains in the world to almost sea level plains. In its agrarian economy, over 93% of the population was engaged in subsistence agriculture. The nonagricultural labor force was 600,000 out of a population of 17.5 million. Rural, isolated villages are common where life goes on much as it did 100 years ago and annual per capita income may be $20,[52] if the figure is even meaningful where cash transactions are seldom involved in the day-to-day living. In contrast, the modernized capital or cities along the Indian border may have per capita incomes up to $600.

In order to promote development and trade the industrial policy act has been rewritten, emphasizing both direct foreign investment and export promotion. Both the Government and private entrepreneurs actively seek joint ventures in all areas.

The volume of foreign trade in FY 1987 increased by 22.8% to $720 million.[53] Imports of $550 million and exports of $170 million gave a trade deficit of $380 million. Magnesite, talc, and marble were the main mineral exports in order of value and probably accounted for less than 3% of total export value. Mineral imports were much more significant and consisted mostly of mineral fuels, chemical fertilizer, and construction materials in estimated descending order of value.

Nepal's first petroleum exploration well could be spudded early in 1989. In light of the country's chronic economic problems, a commercial petroleum discovery would make an important contribution to its foreign exchange, even if it was very modest by world standards.

The Foundry Development Project, a 470-ton-per-year foundry, was expected to be converted into a limited company during 1989. The project was started in 1984 under an agreement between His Majesty's Government and the United Nations Industrial Development Organization. The plant has added hand water pumps and tubewell parts to its other products on a trial basis. It is equipped with sophisticated (for Nepal) machines for building accessories and replacement parts for local equipment. Grinding balls for the cement mills are a large potential output. Raw materials for the foundry consist of locally derived scrap from vehicles and textile industry equipment and imported coal, bentonite, foundry sand, and scrap. Budget problems and a shortage of skilled labor have prevented the plant from running at its modest capacity during the year.[54]

Nepal Metal Co. Ltd. continued its slow progress toward opening the country's first commercial-scale metal mine. Near the end of the third quarter of FY 1988, the company announced the offering of 2.4 million shares of common stock at Rs10/share to the general public. Other owners included His Majesty's Government, Hyderabad Industries Ltd. (India), K.K. Bamford & Co. Ltd. (Hong Kong), Mutual Trading Co. Pvt. Ltd. (Nepal), and other Nepalese investors. The cost of the project was put at $1.6 million which apparently includes only the mine and mill costs. A considerable outlay has already been made in the yet-to-be-completed motorable road to the mine and millsite. Construction of the road from Trishuli to the southern part of the Somdang valley has been completed, leaving 12 km to be constructed to the site. His Majesty's Government was constructing the remaining road on a priority basis. The erection of power transmission lines from Trishuli to the southern part of the valley and construction of the transformer building have been completed. The manually excavated mine adit has been under construction for a number of years. In May 1987, the 1,430-meter tunnel intersected the ore body and samples showed a higher grade ore than indicated by surface drilling—15.7% zinc, 1.62% lead, and 30 grams of silver per ton. Original estimates were, respectively, 11.86%, 1.66%, and 14 grams. Ore reserves were estimated to provide a mine life of 13 years versus 8 years originally.[55]

The Industry Minister attended the opening of the D.M. Brick and Tile Factory at Lubhu near Lalitpur in the Kathmandu Valley. The plant was designed and built with Chinese technical assistance at a cost of $850,000. The capacity of the plant was 10 million brick per year or about 8% of the needs of the Kathmandu Valley. In addition, Chinese firms were planning to set up two more brickworks and a window-glass factory in support of an increasingly active construction industry.

The Himal Cement Co. operated successfully after recently doubling its original 160-ton-per-day capacity. The plant produced more than 59,000 tons during FY 1987. At a ceremony marking the 15th anniversary of the company's opening, the Minister for Industry suggested that the capacity be further raised to 500 tons per day. He also said that the company, as well as other industries with major share holdings by His Majesty's Government, should be converted to private ownership.

Site preparation has begun on the Udayapur Cement Industry property. Work on the plant and limestone mine is to begin in 1989. The rotary kiln facility was being built under a 1987 agreement between His Majesty's Government and the Overseas Economic Cooperation Fund of Japan. It will be the third and largest cement plant in the country. Limestone reserves at the Jaljale Mine were sufficient for 160 years of production.[56]

The jointly owned Nepal Government-Orissa Industries Ltd. (India) magnesite company commissioned the dead-burnt magnesite plant at Lamosangu, 85 km east of Kathmandu, in July 1988. The plant is to produce 50,000 tons per year of 92% to 96% MgO dead-burnt magnesite and 10,000 tons per year of talc.[57] The mine has been operating on a relatively small scale for several years. The mine and processing plant have 500 workers and generate indirect employment for another 2,000 persons. The long-planned refractories plant has been delayed until economic conditions improve.

The Department of Mines and Geology planned to open a second round of bidding for petroleum exploration acre-

TABLE 6

NEPAL: PRODUCTION OF MINERAL COMMODITIES[1 2 3]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987	1988[p]
Cement, hydraulic		39,225	31,479	92,853	151,631	215,010
Clays for cement manufacture		[e]2,000	4,242	6,798	[e]10,000	8,033
Coal: Lignite		7,595	6,808	4,536	5,081	8,311
Copper ore:						
Gross weight		[e]9	6	[e]6	[e]6	9
Cu content		[e]3	2	[e]2	2	3
Gem stones:						
Garnet	kilograms	[e]20,000	27,300	[e]25,000	[e]25,000	[e]25,000
Tourmaline	do.	[e]12	60	[e]50	[e]50	22
Lime, agricultural		7,000	7,000	584	[e]500	21,200
Magnesite, crude		14,603	19,851	63,190	38,388	45,000
Salt		700	7,500	[e]7,000	[e]7	6
Stone:						
Limestone		[e]45,000	55,953	174,798	334,270	323,584
Marble:						
Chips		609	700	[e]700	11,644	1,164
Cut	square meters	[e]3,000	7,641	10,442	15,847	15,855
Craggy	do.	708	691	3,590	6,168	6,171
Talc		7,595	6,015	[r][e]8,780	3,539	4,430

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

[1]Table includes data available through Aug. 18, 1989.

[2]In addition to the commodities listed, crude construction materials such as sand and gravel and other varieties of stone presumably are produced, but available information is inadequate to make reliable estimates of output levels.

[3]Data are for the fiscal year ending mid-July of that stated.

age in April 1989. The opening is to be accompanied by offering 970 line km of high-resolution seismic data recently acquired in Blocks 6 through 9 by Petro-Canada International Assistance Corp. under a bilateral aid agreement. The first round offering in 1985 included 1,250 line km of reconnaissance survey.

The southern border area of the country has been divided into 10 exploration blocks, of which, Blocks 1 through 9 will be offered. Block 10 is currently held by a production-sharing joint venture between Shell Exploration (Nepal) B.V. and Triton Energy Corp. (United States) and the Department of Mines and Geology signed in 1986. Shell—Triton has essentially completed detailed seismic and surface geology studies of the block and was preparing to spud its first well in the spring of 1989. In September 1988, Texaco Inc. received exploration permits to conduct surface geologic field studies prior to determining whether to make a bid for one of the exploration blocks. The study and laboratory analysis was to be completed prior to the spring 1989 offering.

PAKISTAN[58]

In current prices, Pakistan's GDP reached $38.5 billion in 1988.[59] While the annual growth in the economy has averaged about 6.5% in real terms during this decade, Pakistan is not a wealthy country. The per capita GDP was only $370, reflecting a growth of about 3%. Because of a high annual population growth rate of 2.9% and a low ratio of natural resources to the country's population, overcoming poverty remains a formidable task.

Pakistan's mineral industry was dominated by fossil fuels, constituting more than 95% of the total value of its mineral production. The output of natural gas in 1988 was valued at $1.4 billion, followed by oil at about $0.4 billion and coal at $0.1 billion. By world standards, there is only modest output of a wide array of minerals that are, however, significant to the local economy. Agriculture is the principal sector of economy, employing over one-half of the work force and accounting for about 25% of the GDP. Manufacturing accounts for about 20% of the GDP, and output in this sector includes tonnage quantities of cement, chemical fertilizers, and steel, again important only in terms of the local economy.

The value of the Pakistani rupee (PRs) has eroded each year since fixed parity was abandoned on January 8, 1982. Since that time, the decline in 1988 was more precipitous than in any previous year. In January 1988, the parity to the U.S. dollar was PRs17.51. On November 2, the State Bank of Pakistan, which is responsible for managing the float, revised the parity to PRs18.65 and then, on November 8, adjusted the rate to PRs18.70. As a result of the revision, the rupee conceded ground to almost all foreign currencies. The steady erosion in rupee value may be partly due to a deliberate Government policy to boost exports and to strengthen the country's balance-of-payment position. Pakistan's export income is heavily dependent on cash crops, principally cotton and rice. Shipments of these commodities account for about 40% of the total value of exports. Hence, its economy is subject to the vagaries of nature and foreign import quotas or duties and tariffs. Imports of oil and petroleum products, machinery, transport equipment, and iron and steel manufactures contribute heavily to Pakistan's trade deficit.

Production

Pakistan's largest mining sector, in terms of value, was fossil fuels. However, by world standards, the output of crude oil and natural gas was small, while the annual mine output of coal averaged less than 2.5 million tons. Mine output of metalliferous ores was also small in quantity and limited to bauxite and chromite. Mine production of antimony and manganese was sporadic as well as negligible in quantity. The largest quarrying operation was stone, followed by sand and gravel. Production of various clays—bentonite, fire clay, fuller's earth, and kaolin—dominates the remaining mine output of industrial minerals. Annual production of salt was about 1 million tons, and that for gypsum approached 0.5 million tons. In addition, there was mine production of barite, celestite, chalk, emery, feldspar, fluorspar, magnesite, ocher, phosphate rock, soapstone, and sulfur, each of which was in inconsequential quantities. The manufacture of cement and chemical fertilizers was the dominant component in the industrial mineral sector. Metals production is limited to iron and steel and refining of secondary lead.

Trade

The value of Pakistan's total trade increased from $8.5 billion in 1986 to $9.0 billion in 1987, the most recent year for which complete trade data are available. In 1987, total exports were valued at $3.7 billion, and imports were valued at $5.3 billion, reflecting a trade deficit of $1.6 billion. Pakistan has an agrarian economy. By extension, its major industries, aside from cement and steel, are agriculturally oriented. Its major export commodities are agricultural-derivative products, which collectively account for more than 30% of the total value of exports. Because Pakistan lacks a broad industrial base, it must import high-value manufactured goods. Its major import classes in descending order of value are plant and machinery, transport equipment and vehicles, petroleum and refinery products, and iron and steel manufactures, which collectively account for over 50% of the total value of imports. Hence, Pakistan's foreign trade historically reflects a negative balance of trade. The country's annual foreign trade deficit during this decade is shown in the text table, in billions of dollars.

Year	Annual deficit	Cumulative deficit
1980	$2.3	$2.3
1981	2.4	4.7
1982	2.7	7.4
1983	2.5	9.9
1984	2.8	12.7
1985	3.2	15.9
1986	2.4	18.3
1987	1.6	19.9

In 1987, the major export commodities were cotton yarn and thread, $492 million; raw cotton, $431 million; cotton fabric, leather, and carpet, $754 million; and animal and vegetable commodities, $210 million. The major import commodities in 1987 were machinery and transport equipment, $1,547 million; chemicals, $886 million; minerals, fuels, lubricants, and related materials, $832 million; animal and vegetable commodities, $789 million; and various manufactured goods classified by materials, $645 million.

Based on value, the largest export market was Japan, followed by the United States, the United Kingdom, the Federal Republic of Germany, and Italy. The largest receipts were from Japan, followed by the United States, Kuwait, the Federal Republic of Germany, and the United Kingdom.

Commodity Review

Metals.—Pakistan has a very weak metalliferous minerals resource base. There were a number of small operations for mining metal-bearing ores for antimony and manganese. The annual output of each was very minor as well as sporadic. The only established metal-producing sector was iron and steel and shipbreaking. Pakistan must import iron ore, ferroalloying ingredients, and scrap metal to meet the requirements of its single iron and steel complex as well as import virtually all of its requirements for nonferrous metals.[60]

Aluminum.—About 2,500 tons of bauxite were produced at Manshera and Khusab, both southwest of Rawalpindi. The Manshera operation accounts for more than 75% of the annual output.

Chromium.—There were numerous small operations for the mining of chromite around Hindubagh, north of Quetta. In recent years, annual mine output has varied from 3,000 tons to 10,000 tons.

Copper.—In October 1988, Resource Development Corp. (RDC) and China Metallurgical Construction Corp. (CMCC) ratified a cooperation agreement for the construction of a smelter utilizing ore to be mined from the copper deposit at Saindak. Under the terms of the agreement, CMCC agreed to build a smelter that excludes infrastructure on a turnkey basis at a fixed cost of $181 million and to provide a credit of $84 million. RDC agreed to repay CMCC through the export of blister copper. After electrorefining the copper in China, CMCC agreed to return the recovered gold and silver to RDC. A formal contract will be negotiated and is expected to be ratified in 1989.

Iron and Steel.—The Bin Qasim steelworks of Pakistan Steel Mills Corp. Ltd. (PSM) was the country's only integrated iron and steel complex, which reached its rated output of 1.1 million tons per year in 1987.

Karachi Rolling Mills Ltd., Newshera Engineering Co. Ltd., and Special Steels of Pakistan Ltd. collectively provided steel output of 100,000 tons. A few small steel mills contributed about 40,000 tons of steel production capacity. The smaller, nonintegrated mills generally utilized scrap metal. About 75% of the ship plate generated by Pakistan's shipbreaking industry went directly for rerolling, and the remainder went for remelting.

Other.—In addition to the gold and silver in Saindak copper deposit, there was associated magnetite, molybdenite, and pyrite that could be recovered for local treatment or for export. Frontier and Tribal Areas Development Corp. (FTAD) drilled around Shinkai, Waziristan, to evaluate copper deposits. Pakistan Mineral Development Corp. (PMDC) evaluated gold occurrences in north Pakistan and in Chagai. PMDC's objective was to locate the source rock of the gold particles found in the tributaries of the Indus River. Another objective was to evaluate the iron ore deposits at Nokkundi around Chagai for gold content. FTAD was investigating manganese in north Waziristan and chromite in Bajaur.

Industrial Minerals.—There is mine production of a wide array of industrial minerals in Pakistan. However, the large activities are quarrying operations for low-unit-value material—sand and gravel and stone. About 1 million tons of various grades and types of clays was produced. The only other minerals produced in locally significant quantities were salt, both rock and marine, and gypsum. The remainder of the industrial minerals domestically produced were negligible in terms of world output. The largest manufacturing sectors were cement and fertilizers.

Cement.—There were eight private-sector cement producers, each with a single plant. They collectively constituted an annual kiln output capacity of 2.3 million tons. In addition, the State Cement Corp. of Pakistan (Pvt.) Ltd. had 13 companies operating 15 plants with a total annual kiln capacity of 5.24 million tons. Altogether, Pakistan's aggregate kiln capacity was 7.56 million tons. In 1988, the total production of cement was 7.3 million tons. This estimate was based on 8 private companies and 10 state companies operating 11 plants, collectively producing at 96.5% of rated capacity.

Fertilizer Materials.—Because Pakistan has an agrarian-based economy, the chemical fertilizer sector is one of

TABLE 7

PAKISTAN: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987	1988[p]
METALS						
Aluminum: Bauxite, gross weight		2,720	1,759	2,881	3,447	2,452
Antimony ore:						
Gross weight		6	24	—	45	[e]50
Sb content[e]		1	4	—	7	8
Chromium: Chromite:						
Gross weight		2,997	5,188	8,299	10,181	3,327
Cr content[e]		989	1,712	2,739	[r]3,330	1,090
Iron and steel:						
Pig iron	thousand tons	[e]566	803	892	[e]1,200	[e]1,200
Steel, crude[e]	do.	610	700	800	[r]1,100	1,100
Lead, refined, secondary[e]		1,000	1,000	1,000	2,000	2,000
Manganese ore:						
Gross weight		8	135	635	30	—
Mn content[e]		2	41	190	[r]9	—
INDUSTRIAL MINERALS						
Abrasives, natural: Emery		1,393	4,630	4,972	[e]3,500	[e]3,500
Barite		27,230	29,932	39,047	10,031	22,198
Cement, hydraulic	thousand tons	4,697	[e]5,229	[e]6,130	6,832	[e]7,300
Chalk		1,360	2,082	2,192	4,292	5,035
Clays:						
Bentonite		1,740	1,611	1,282	2,537	4,880
Fire clay		79,528	68,537	87,522	122,513	124,581
Fuller's earth		19,139	10,647	15,228	17,945	12,395
Kaolin (china clay)		11,711	6,644	37,056	32,208	41,968
Other		130,000	285,000	520,000	680,661	924,237
Feldspar		5,486	5,633	11,575	6,675	9,026
Fluorspar		2,724	3,175	4,353	3,528	284
Gypsum, crude		375,000	409,000	373,000	449,013	374,258
Magnesite, crude		4,153	2,113	1,757	3,824	3,081
Nitrogen: N content of ammonia		1,127,700	1,106,800	1,154,400	1,179,000	[e]1,200,000
Phosphate rock:[e]						
Gross weight		—	—	50,000	32,000	35,000
P_2O_5		—	—	16,000	10,000	11,000
Pigments, mineral, natural: Ocher		1,046	553	608	1,792	1,040
Salt:						
Rock	thousand tons	598	583	576	268	406
Marine	do.	[e]180	269	242	14	[e]250
Total	**do.**	**[e]778**	**852**	**818**	**282**	**656**
Sand and gravel:						
Gravel		74,000	16,000	—	10,750	—

See footnotes at end of table.

TABLE 7—Continued

PAKISTAN: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987	1988[p]
INDUSTRIAL MINERALS—Continued						
Sand and gravel—Continued						
Sand:						
Bajri and common		294,397	352,496	136,964	208,339	[e]210,000
Glass		100,000	202,000	115,000	148,783	133,991
Sodium compounds, n.e.s.:						
Caustic soda		[e]40,600	[e]52,300	[e]54,000	56,571	[e]62,000
Soda ash, manufactured		[e]121,000	118,087	130,894	133,133	[e]140,000
Stone:						
Aragonite and marble		80,000	62,000	168,000	228,619	211,896
Dolomite		121,750	121,578	136,271	141,846	69,131
Limestone	thousand tons	5,184	6,685	6,339	7,278	6,428
Other (reported as "ordinary stone")	do.	525	366	677	551	[e]580
Strontium minerals: Celestite		564	718	997	1,114	488
Sulfur:						
Native		926	877	890	[e]1,120	690
Byproduct, all sources[e]		26,000	26,000	26,000	26,000	26,000
Total[e]		**26,926**	**26,877**	**26,890**	**27,120**	**26,690**
Talc and related materials: Soapstone		15,568	20,183	23,021	23,278	37,429
MINERAL FUELS AND RELATED MATERIALS						
Coal, all grades	thousand tons	2,134	2,199	2,025	2,419	3,199
Coke	do.	[e]533	556	630	526	[e]600
Gas, natural:						
Gross production	million cubic feet	352,933	366,282	392,485	410,849	[e]445,000
Marketed production (sales)[e]	do.	331,108	345,000	370,000	388,000	420,000
Natural gas liquids[e]	thousand 42-gallon barrels	45	55	65	70	75
Petroleum:						
Crude	do.	6,534	12,522	15,065	15,230	[e]16,700
Refinery products:						
Gasoline	do.	5,457	5,738	5,865	7,012	[e]7,000
Jet fuel	do.	3,792	3,712	3,944	[e]3,712	[e]3,700
Kerosene	do.	2,000	2,379	3,209	[e]3,015	[e]3,000
Distillate fuel oil	do.	10,004	11,473	13,152	13,040	[e]13,000
Residual fuel oil	do.	10,216	10,250	11,382	11,635	[e]12,000
Lubricants	do.	742	875	980	[e]1,005	[e]1,000
Other	do.	2,592	3,217	3,526	[e]3,615	[e]4,000
Total	**do.**	**34,803**	**37,644**	**42,058**	**43,034**	**[e]43,700**

[e]Estimated. [p]Preliminary. [r]Revised.
[1]Table includes data available through July 31, 1989.

TABLE 8

PAKISTAN: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
METALS					
Aluminum: Metal including alloys:					
Scrap		15	—		
Unwrought		—	2	—	All to Yugoslavia.
Chromium: Ore and concentrate		31,223	6,772	—	All to Sweden.
Copper: Metal including alloys, scrap		810	605	—	Japan 356; Republic of Korea 93.
Iron and steel: Metal:					
Scrap	value, thousands	$691	$715	—	Japan $487; India $121; Republic of Korea $64.
Pig iron, cast iron, related materials		133,444	113,153	—	China 52,500; Bulgaria 28,622; Bangladesh 21,500.
Steel, primary forms		59,504	25,340	10,005	West Germany 9,796; Japan 5,539.
Semimanufactures:					
Bars, rods, angles, shapes, sections		818	8	—	Bangladesh 7.
Universals, plates, sheets		230	205	—	Sri Lanka 100; Austria 40.
Wire		134	213	—	West Germany 167; Bangladesh 28.
Tubes, pipes, fittings		714	300	—	Afghanistan 274.
Castings and forgings, rough		4	—		
Lead: Oxides		—	5	—	All to Bangladesh.
Mercury	76-pound flasks	—	29	—	All to Hong Kong.
Nickel: Metal including alloys, scrap		4	52	—	All to United Kingdom.
Silver: Ore and concentrate	value, thousands	$2,212	$1,180	—	Do.
Uranium and/or thorium: Ore and concentrate	do.	$562	—		
Zinc:					
Oxides		10	—		
Metal including alloys, semimanufactures		—	700	—	All to United Arab Emirates.
Other:					
Ores and concentrates	value, thousands	$9	$55	—	United Arab Emirates $27.
Ashes and residues		—	20	—	All to United Arab Emirates.
Base metals including alloys, all forms		17	—		
INDUSTRIAL MINERALS					
Abrasives, n.e.s.: Grinding and polishing wheels and stones		1	2	—	All to West Germany.
Asbestos, crude		2	—		
Barite and witherite		—	5	—	All to Bangladesh.
Cement		—	214	—	All to Maldives.
Clays, crude		100	144	—	Bangladesh 114; China 30.
Cryolite and chiolite		—	150	—	All to Bangladesh.
Fertilizer materials:					
Crude, n.e.s.		213,594	198,637	—	United Arab Emirates 191,968; Qatar 5,174.
Manufactured: Nitrogenous		173,003	—		

See footnotes at end of table.

TABLE 8—Continued

PAKISTAN: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
INDUSTRIAL MINERALS—Continued				
Gypsum and plaster	60	—		
Mica:				
Crude including splittings and waste	10	45	—	All to Kuwait.
Worked including agglomerated splittings	—	1	—	Do.
Precious and semiprecious stones other than diamond: Natural value, thousands	$4,839	$6,568	$1,157	Hong Kong $3,300; Switzerland $714.
Salt and brine	18,409	18,746	—	India 12,766; United Arab Emirates 791; Kenya 350.
Sodium compounds, n.e.s.: Carbonate, manufactured	—	1,056	—	Bangladesh 937; Malaysia 75.
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked	5,617	6,161	45	Italy 1,134; Japan 988; Singapore 668.
Worked	20	—		
Dolomite, chiefly refractory-grade	350	1,303	—	All to Bangladesh.
Gravel and crushed rock	395	1,042	—	Do.
Limestone other than dimension	—	1,002	—	Do.
Sand other than metal-bearing	3,194	—		
Sulfur:				
Elemental: Colloidal, precipitated, sublimed	1	20	—	All to Hong Kong.
Sulfuric acid	102	105	—	Afghanistan 93; India 12.
Other: Crude	20	15,000	—	All to Sweden.
MINERAL FUELS AND RELATED MATERIALS				
Carbon black	46	803	—	Sri Lanka 578; India 100; Tanzania 80.
Coke and semicoke	20,000	449	—	All to Bangladesh.
Petroleum refinery products:				
Lubricants thousand 42-gallon barrels	178	309	—	India 161; United Arab Emirates 69; Singapore 30.
Residual fuel oil do.	906	992	—	Yemen, Aden 664; United Arab Emirates 246.
Bitumen and other residues do.	120	69	—	United Arab Emirates 50; Oman 19.
Bituminous mixtures do.	36	12	—	All to United Arab Emirates.

[1] Table prepared by Audrey D. Wilkes.

TABLE 9

PAKISTAN: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS				
Alkali and alkaline-earth metals	1	69	—	West Germany 43; China 11.
Aluminum:				
Ore and concentrate	—	1	—	All from Japan.
Oxides and hydroxides	3,007	2,792	101	China 1,574; West Germany 296.
Metal including alloys:				
Scrap	21,799	27,955	225	Netherlands 5,773; United Arab Emirates 4,736.
Unwrought	7,747	13,753	502	Bahrain 6,599; United Arab Emirates 3,672.
Semimanufactures	7,522	9,058	747	Switzerland 948; West Germany 944.
Beryllium: Metal including alloys, all forms	—	265	—	United Kingdom 185; Saudi Arabia 35.
Chromium:				
Ore and concentrate	15	21	—	All from Netherlands.
Oxides and hydroxides	88	112	3	China 77; U.S.S.R. 19.
Cobalt: Oxides and hydroxides	13	15	11	Netherlands 2.
Columbium and tantalum: Metal including alloys, all forms: Tantalum value, thousands	—	$1	—	All from West Germany.
Copper:				
Matte and speiss including cement copper	9	20	—	All from China.
Metal including alloys:				
Scrap	209	232	—	Bahrain 100; United Arab Emirates 69.
Unwrought	162	194	—	West Germany 83; Japan 76.
Semimanufactures	9,984	12,628	46	Japan 5,886; Saudi Arabia 1,823.
Iron and steel:				
Iron ore and concentrate excluding roasted pyrite thousand tons	1,469	1,105	—	Australia 315; Brazil 244; Liberia 178.
Metal:				
Scrap	147,210	587,023	375,140	United Arab Emirates 60,878; United Kingdom 49,687.
Pig iron, cast iron, related materials	4,971	1,216	100	West Germany 612; Canada 397.
Ferroalloys:				
Ferromanganese	8,056	12,397	—	China 5,797; France 2,871; Switzerland 1,869.
Unspecified	54,575	13,713	—	China 3,949; Belgium-Luxembourg 3,557; Brazil 2,013.
Steel, primary forms	9,562	30,172	35	Australia 17,878; West Germany 9,543.
Semimanufactures:				
Bars, rods, angles, shapes, sections	35,106	31,741	253	Japan 20,202; West Germany 6,577.
Universals, plates, sheets	326,088	356,596	21,216	Japan 146,192; West Germany 47,322.
Hoop and strip	25,355	8,927	8	Japan 5,866; West Germany 1,638.
Rails and accessories	12	—		

See footnote at end of table.

TABLE 9—Continued

PAKISTAN: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS—Continued				
Iron and steel—Continued				
Metal—Continued				
Semimanufactures—Continued				
Wire	19,419	6,871	—	Japan 3,039; China 1,452; Republic of Korea 1,446.
Tubes, pipes, fittings	81,547	63,478	3,765	Japan 31,698; Republic of Korea 12,245.
Castings and forgings, rough	1,835	774	4	United Kingdom 297; Italy 119.
Lead:				
Ore and concentrate	205	204	—	Morocco 199; Liberia 5.
Oxides	857	658	—	China 508; West Germany 69.
Metal including alloys:				
Scrap	210	37	—	All from China.
Unwrought	2,743	4,196	239	China 799; U.S.S.R. 672.
Semimanufactures	19	229	(2)	United Kingdom 201.
Magnesium: Metal including alloys, all forms	14	11	5	Italy 6.
Manganese:				
Ore and concentrate	229	27,592	—	Australia 27,572.
Oxides	1,799	2,230	9	Singapore 868; China 591.
Mercury 76-pound flasks	1,828	2,814	—	China 2,379; Mongolia 406.
Molybdenum: Metal including alloys, all forms value, thousands	$82	$31	—	Austria $12; Afghanistan $10.
Nickel:				
Matte and speiss	638	341	—	Australia 127; West Germany 80.
Metal including alloys:				
Scrap	19	—		
Unwrought	246	452	3	United Kingdom 156; West Germany 131.
Semimanufactures	57	163	1	Bahrain 100; West Germany 20.
Platinum-group metals: Metals including alloys, unwrought and partly wrought value, thousands	$3	$7	$7	
Silver:				
Ore and concentrate[3] do.	$14	—		
Metal including alloys, unwrought and partly wrought do.	$75	$122	—	West Germany $118.
Tin: Metal including alloys:				
Scrap	30	—		
Unwrought	570	188	—	Malaysia 161; China 11.
Semimanufactures	17	75	—	Mainly from United Kingdom.
Titanium: Oxides	3,339	3,566	218	United Kingdom 1,837; West Germany 683.

See footnotes at end of table.

TABLE 9—Continued

PAKISTAN: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS—Continued				
Tungsten:				
Ore and concentrate	1	—		
Metal including alloys, all forms value, thousands	$591	$1,045	—	Netherlands $949; United Kingdom $45.
Uranium and/or thorium:				
Ore and concentrate do.	$50	$42	—	All from Australia.
Metal including alloys, all forms do.	$13	$21	—	Hong Kong $14; United Kingdom $7.
Zinc:				
Oxides	294	444	—	France 168; China 146; Belgium-Luxembourg 73.
Metal including alloys:				
Scrap	—	39	—	All from Malaysia.
Unwrought	14,634	16,443	100	China 7,982; Australia 2,620.
Semimanufactures	114	14	—	United Kingdom 12.
Other:				
Ores and concentrates	424	885	5	Australia 823.
Base metals including alloys, all forms	78	102	([4])	Hong Kong 46; China 38.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	936	1,804	154	China 460; Netherlands 384.
Artificial: Corundum	64	192	—	France 54; Italy 54; Brazil 48.
Dust and powder of precious and semiprecious stones including diamond value, thousands	$8	—		
Grinding and polishing wheels and stones	783	1,220	2	China 863; West Germany 81.
Asbestos, crude	4,383	6,300	—	Canada 4,484; Singapore 1,060.
Barite and witherite	6	73	—	China 50; West Germany 23.
Boron materials:				
Crude natural borates	77	38	—	All from Turkey.
Oxides and acids	406	537	—	China 244; Italy 228.
Cement	132,326	32,894	26	United Arab Emirates 12,456; U.S.S.R. 8,000; Japan 4,883.
Chalk	7,594	5,491	—	Belgium-Luxembourg 3,269; United Kingdom 2,037.
Clays, crude	65,845	21,886	76	United Kingdom 17,386; Belgium-Luxembourg 1,588.
Cryolite and chiolite	1	5,005	—	All from Denmark.
Diamond: Industrial stones value, thousands	—	$3	—	All from Hong Kong.
Diatomite and other infusorial earth	143	493	409	Spain 55; West Germany 19.
Feldspar, fluorspar, related materials	207	65	—	All from France.
Fertilizer materials:				
Crude, n.e.s.	—	1,028	—	France 1,000; West Germany 28.

See footnotes at end of table.

TABLE 9—Continued

PAKISTAN: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
INDUSTRIAL MINERALS—Continued				
Fertilizer materials—Continued				
Manufactured:				
Ammonia	24	17	3	United Kingdom 9; West Germany 3.
Nitrogenous	65,481	252,320	14,700	U.S.S.R. 90,269; Kuwait 62,678.
Phosphatic	654,981	808,535	407,559	Jordan 182,315; Netherlands 62,090.
Potassic	—	5	—	All from United Kingdom.
Unspecified and mixed	26,501	83,389	—	All from Netherlands.
Graphite, natural	1,959	2,271	—	China 1,666; France 217.
Gypsum and plaster	([2])	13	3	West Germany 10.
Lime	25,013	14	—	United Kingdom 9; Indonesia 5.
Magnesium compounds: Magnesite, crude	486	1,178	16	Austria 466; China 242.
Mica:				
Crude including splittings and waste	—	2	—	All from United Kingdom.
Worked including agglomerated splittings	2	4	—	China 2; Japan 1.
Nitrates, crude	46	9	—	All from West Germany.
Phosphates, crude	147,975	193,838	—	Jordan 193,827.
Pigments, mineral: Iron oxides and hydroxides, processed	2,571	3,172	20	China 2,541; West Germany 548.
Precious and semiprecious stones other than diamond:				
Natural value, thousands	$162	$670	—	Hong Kong $353; Switzerland $230.
Synthetic do.	$11	$10	—	Hong Kong $6; France $2.
Pyrite, unroasted	$275	—		
Salt and brine	([2])	203	—	Denmark 107; West Germany 95.
Sodium compounds, n.e.s.: Carbonate, manufactured	51	50	—	Spain 25; Thailand 20.
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked	462	357	13	Italy 278; Greece 45.
Worked	919	8,769	—	United Kingdom 8,696; Italy 73.
Dolomite, chiefly refractory-grade	1,160	5,071	55	Italy 4,646; Spain 250.
Gravel and crushed rock	—	32	9	Hong Kong 20.
Quartz and quartzite	19	—		
Sand other than metal-bearing	253	117	17	China 80; United Kingdom 13.
Sulfur:				
Elemental:				
Crude including native and byproduct	27,185	34,875	—	Iran 16,016; Qatar 8,059; Bahrain 3,791.
Colloidal, precipitated, sublimed	851	606	—	China 417; Republic of Korea 82.
Sulfuric acid	13	9	—	China 6; West Germany 3.
Talc, steatite, soapstone, pyrophyllite	13,638	1,429	—	China 1,105; Republic of Korea 100.

See footnotes at end of table.

TABLE 9—Continued

PAKISTAN: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987	
			United States	Other (principal)
INDUSTRIAL MINERALS—Continued				
Other:				
Crude	18,830	14,255	35	China 7,477; India 5,022.
Slag and dross, not metal-bearing	44	385	—	West Germany 323; Hungary 59.
MINERAL FUELS AND RELATED MATERIALS				
Asphalt and bitumen, natural	4,514	324	261	Netherlands 30; United Kingdom 27.
Carbon black	2,132	1,380	10	China 495; Singapore 343.
Coal:				
Anthracite and bituminous	810,234	809,190	77,832	Australia 542,424; Canada 188,535.
Briquets of anthracite and bituminous coal	—	15	—	All from United Kingdom.
Lignite including briquets value, thousands	$11	$20	$8	United Kingdom $12.
Coke and semicoke	29	3	—	All from United Kingdom.
Petroleum:				
Crude thousand 42-gallon barrels	26,933	27,569	—	Saudi Arabia 14,840; Iran 7,173; United Arab Emirates 5,556.
Refinery products:				
Liquefied petroleum gas value, thousands	$3	$11	$3	Japan $6.
Gasoline thousand 42-gallon barrels	875	1,114	—	Kuwait 1,098.
Mineral jelly and wax do.	76	75	(2)	China 43; Iraq 15.
Kerosene and jet fuel do.	4,051	5,037	—	Kuwait 5,021.
Distillate fuel oil do.	11,777	17,217	(2)	Kuwait 17,216.
Lubricants do.	61	69	12	West Germany 20; United Kingdom 7.
Residual fuel oil do.	66	(5)	—	Mainly from China.
Bitumen and other residues do.	(2)	—		
Bituminous mixtures do.	20	26	(2)	United Kingdom 20.
Petroleum coke do.	—	(2)	—	All from United Kingdom.

[1] Table prepared by Audrey D. Wilkes.
[2] Less than 1/2 unit.
[3] May include platinum-group metals.
[4] Unreported quantity valued at $11,000.
[5] Unreported quantity valued at $786,000.

the country's largest manufacturing industries. National Fertilizer Corp. Ltd. is the largest producer with three plants producing urea, one plant for ammonium sulfate, two for single superphosphate, one for ammonium nitrate, and one for nitrophosphate. Dawood Hercules Chemicals Ltd., Exxon Chemicals (Pvt.) Ltd., and Fanji Fertilizer Co. each have a single plant for urea production. Pakistan Steel Mills Corp. Ltd. produced ammonium sulfate as a byproduct of its steel operations. Pakistan's chemical fertilizer production is shown in the text table in metric tons.

	Urea	Ammonium nitrate	Nitro-phosphate	Ammonium sulfate	Super-phosphate
1980	640,511	199,000	137,230	98,868	101,198
1981	962,906	272,671	171,209	96,642	101,813
1982	1,223,478	321,391	210,510	94,005	102,691
1983	1,831,819	339,380	238,352	61,182	104,250
1984	1,797,553	383,011	316,450	72,985	105,690
1985	1,814,666	406,357	308,306	79,009	105,801
1986	1,820,214	394,255	321,392	92,285	105,760
1987	1,992,644	413,314	323,449	91,615	107,584
1988	2,048,000	343,656	332,502	99,305	106,150

Mineral Fuels.—Domestic production of coal, petroleum, and natural gas accounted for about two-thirds of Pakistan's primary commercial energy requirements. The remainder was supplied by imports of coal and petroleum.[61] However, production and imports of conventional fuels constituted about 60% of the country's total energy supplies, considering noncommercial fuels. The Ministry of Planning and Development estimated that up to 40% of the total energy supply was from the utilization of nonconventional energy forms such as bagasse, cotton sticks, dung cakes, fuelwood, rice husks, sawdust, and tobacco sticks. The majority of Pakistan's population, about 70%, lived in rural areas where these fuels were used in varying degrees. This estimate of vegetal fuels utilization indicated only an order of magnitude because of the difficulties in compiling, verifying, and standardizing data in nonstandard units such as bundles, baskets, bags, and headloads.

The three major Government-owned energy companies were the Oil and Gas Development Corp. (OGDC), Pakistan State Oil Co. (PSOC), and Pakistan Mineral Development Corp. (PMDC).

OGDC's activities included exploration, drilling, and production of crude oil, as well as the production and marketing of natural gas and condensate. OGDC also undertook exploration work for foreign private and public sector companies under a policy of sharing proportionate initial cost and profit in the event of commercial discovery. OGDC was the operator of the Toot, Fimkassar, and Tando Alam Fields and was developing the Dhodak Field.

PSOC was Pakistan's largest company with sales of about $1.2 billion. It was the country's main oil storage, distribution, and marketing company. PSOC has four storage terminals in Karachi, numerous blending plants for lubricating oil, sites for used-oil reclamation, and an 18% minority interest in Pakistan Refinery Ltd. PSOC markets liquefied petroleum gas and had a network of about 1,500 retail consumer outlets throughout the country for petroleum refinery products. PSOC had nearly two-thirds of the total market share for petroleum in Pakistan.

PMDC was originally created to undertake mineral exploration and development as an agent of the Ministry of Petroleum and Natural Resources. However, its influence in the energy sector was limited only to the coal produced by the public sector.

In 1988, 13 companies drilled 32 development wells and 24 exploration wells for oil and natural gas, totaling 125,665 meters. Twelve of these were abandoned as dry wells. At yearend, 10 wells were in the process of being drilled. In 1988, coal output increased 32% to 3.2 million tons, petroleum production increased 10% to 16.7 million barrels, and natural gas increased 8% to 445 billion cubic feet.

Coal.—Pakistan's coal resources were estimated at 800 million tons, of which 85 million has been reported by PMDC as measured reserves. Most of the measured reserves occur in the Lakhra coalfield in Sind Province. The other important coal-bearing regions include the Salt Range south of Islamabad, the area around Quetta in Baluchistan, and the Thatta District in southeast Pakistan.

The coal is generally of poor quality and is high in sulfur content. The caloric content ranges from high-volatile bituminous to subbituminous coal. Historically, mine production has been small because most of the mining has been from outcroppings of coal seams. About 53% of the mine output was in Baluchistan, 25% in Sind, 20% in Punjab, and only a little more than 1% in the Northwest Frontier Province. Private sector coal operations accounted for about 80% of the total coal production, while the public sector accounted for the remainder.

Coal accounted for about 8% of the country's total primary commercial energy requirements and for 10% of the total final commercial consumption. The brick industry, which utilizes coal-fired kilns, accounted for around 97% of the demand for domestically produced coal. The remainder is consumed by two coal-fired powerplant units at Quetta and by the residential sector for heating. Coal for heating use, however, declined because natural gas gained a larger share in the residential sector. Pakistan imported both anthracite and bituminous coal from Australia, Canada, and the United States, in order of value.

The Government continued to give priority for developing the country's coal resources as part of a national policy to reduce reliance on imported fuels. However, Pakistan Steel Mills Corp. Ltd. imports all of its requirements for metallurgical-grade coal for its operations. In 1988, the Geological Survey of Pakistan revised its estimate for the country's coal resources to be possibly as much as 7 billion tons. Punjab Mineral Development Corp. earmarked $1.5 million for coal exploration in Punjab Province. Seventy-eight boreholes totaling 12,120 meters were drilled in the Salt Range, yielding good quality coal deposits with a proven reserve of 15 million tons.

Mine output at Padhrar expanded from 25,000 tons per year to 60,000 tons per year. In addition, expansion of the output of the coal mines at Dandot to 15,000 tons per year was undertaken with financial assistance from the United Nations Development Program. FTA conducted exploration and evaluation of coal deposits in the Aurakzai Agency of the tribal area.

The Government embarked on a program to increase the coal share in the country's total primary commercial energy requirements. Under the expansion program, proposals for coal-fired powerplants were one 500-MW unit at Lakhra, one 100-MW unit at Lakhra (fluidized bed combustion), one 80-MW unit at Punjab (fluidized bed combustion), three 55-MW units at Chakwal (fluidized-bed combustion), and two 15-MW units at Quetta.

Natural Gas.—Natural gas accounted for about 35% of the country's total primary commercial energy requirements. Aside from hydropower electric generation, natural gas was Pakistan's major electricity generating fuel and provided about one-third of the country's total final energy consumption. Overall, natural gas was Pakistan's major fuel source because it accounted for 50% of the energy consumed by the industrial sector and 35% of the energy consumed by the residential sector. All gas consumed in Pakistan was domestically produced.

Proven reserves of natural gas were estimated to be 22.1 trillion cubic feet. The largest gasfields in the country were Sui and Mari in the center of Pakistan near the city of Jacobabad. They have proven reserves of 6.0 trillion cubic feet and 4.2 trillion cubic feet, respectively. Other gasfields in the area included Kandkhat and Pirkoh. The Dhodak and Rodho Gasfields each have less than 3 trillion cubic feet of reserves and are in the Indus fold belt in southwestern Punjab to the west of Multan. Natural gas produced in association with oil included the Dhurnal, Meyal, and Toot Oilfields in the Potwar Plateau in Punjab, south of Islamabad. Natural gas was also associated with the country's major oil-producing area of Badin in southwest Pakistan.

Natural gas production in 1988 averaged 1.2 trillion cf/d. About two-thirds of the total production came from the Sai Field (990 million cf/d) and about 20% from Mari (320 million cf/d). Natural gas production from the Badin Oilfield was expected to begin in early 1989 at the rate of 39 million cf/d. The gas will be transported by a new 100-km-long pipeline to Hyderabad where it will connect with the existing, extensive trans-Pakistan pipeline network. The Government planned to utilize the low-quality gas from Nandpur Field near Kabirwala, 60 km north of Multan, in a 90- to 110-MW gas-fired combined-cycle powerplant to be built and operated by the private sector.

Petroleum.—While the first oil well was drilled in 1866 at Jundal in Punjab, Pakistan remained largely underexplored for oil. The country's proven recoverable oil reserves were estimated at 96 billion barrels. Based on recent surveys in partially explored basins, there was a potential reserve of 35 to 50 billion barrels. The Potwar Basin in the north and the Sind Basin near the coast have been only partially explored, while drilling and mapping in the Baluchistan Basin and large areas in the North have been minimal. Moreover, the Government remained optimistic about the potential of the country's 250,000-square-km Continental Shelf, which includes the extension of the Indus Basin and is not far from India's Bombay High, a prolific oilfield. Drilling by PetroCanada International Ltd. to a depth of 3,500 meters, 160 km south of Karachi, confirmed the presence of hydrocarbons. In addition, a survey of the concession 65 km southwest of Islamabad held by Occidental Oil Co. (Occidental) indicated a large oil reservoir. Foreign companies intensified exploration activities in Pakistan. There were about 40 foreign firms in 1988 exploring and/or awaiting licenses for oil exploration.

More than 70% of Pakistan's production of crude oil came from fields operated by foreign companies. The major producing operations are the Dhurnal Field in the Potwar Basin in the North, 65 km southwest of Islamabad and operated by Occidental, and the fields in the Badin concession in the southeast operated by Union Texas Inc. Output at Dhurnal averaged 18,500 bbl/d and was expected to increase in 1989 when water injection will be introduced. Dhurnal crude was piped to Attock Refinery at Rawalpindi. In February 1988, commercial production from a fifth field at south Mazari increased output at Badin to 18,500 bbl/d. Badin crude was trucked to two refineries in Karachi, about 100 km away.

Because existing refinery capacity limits a higher level of crude oil production, Pakistan made its first export shipment of oil in December 1988. The consignment of the Badin crude went to Singapore. Exports through 1989 were expected to average 6,000 bbl/d; the expansion programs at the National and Karachi refineries were expected to be complete by yearend 1989 increasing throughput to 65,000 bbl/d.

SRI LANKA[62]

Sri Lanka is a 65,600-square-km island off the southeastern tip of India, with a population of 17 million, and a per capita GDP of $363 (1987).[63] It was a major world producer of colored gem stones and an important producer of heavy-mineral beach sands and graphite. Imported diamonds were cut and polished for the export trade. Cement, clays, feldspar, glass sand, gypsum, limestone, phosphate rock, and quartz were produced on a relatively small scale for domestic consumption. All mineral fuels, metals, and nitrogen fertilizer were imported. Crude oil was refined at Sapugaskanda near Colombo. Overall, the mineral industry was not an important factor in the highly agricultural economy. Minerals generally accounted for only a small proportion of exports, $54 million in 1987. Titanium minerals, gem stones, graphite, and surplus oil refinery products accounted for most of the value.

TABLE 10

SRI LANKA: PRODUCTION OF MINERAL COMMODITIES[1] [2]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987	1988[p]
Cement, hydraulic[e]	thousand tons	500	600	600	600	400
Clays:						
Ball clay		16,500	23,825	20,470	20,210	17,330
Kaolin		11,100	5,405	6,260	6,869	7,100
Brick and tile clay[e]		70,000	70,000	40,000	60,000	60,000
Clays for cement manufacture		[e]50,000	39,123	36,322	23,277	12,487
Feldspar, crude and ground		5,200	9,789	7,270	7,442	6,345
Gem stones, precious and semiprecious, other than diamond	value, thousands	$20,569	[e]$20,000	$23,304	$13,196	[e]$14,000
Graphite, all grades		5,623	7,413	7,453	[e]9,400	8,547
Iron and steel: Metal: Semimanufactures		15,990	9,310	10,872	33,508	[e]35,000
Mica, scrap[e]		200	200	200	200	200
Nitrogen: N content of ammonia		70,760	5,400	—	—	—
Petroleum refinery products:[e]						
Gasoline	thousand 42-gallon barrels	1,100	1,100	1,100	1,100	1,100
Jet fuel	do.	700	700	700	700	700
Kerosene	do.	1,400	1,400	1,400	1,400	1,400
Distillate fuel oil	do.	5,000	5,000	5,000	5,000	5,000
Residual fuel oil	do.	4,350	4,350	4,500	4,500	4,500
Other	do.	1,650	1,650	1,500	1,500	1,500
Refinery fuel and losses	do.	800	800	800	800	800
Total	**do.**	**15,000**	**15,000**	**15,000**	**15,000**	**15,000**
Phosphate rock		13,685	[e]14,000	14,977	20,600	22,995
Rare-earth metals: Monazite concentrate, gross weight[e]		[3]147	200	200	200	200
Salt		107,000	76,858	104,278	115,274	106,794
Stone:						
Limestone	thousand tons	[e]1,000	[e]1,000	649	2,044	733
Quartz, massive		1,100	1,566	1,090	1,190	953
Titanium concentrate, gross weight:						
Ilmenite		102,048	114,854	129,907	128,500	74,305
Rutile		6,467	8,558	8,443	7,200	5,255
Zirconium: Zircon concentrate, gross weight		3,708	4,061	[e]4,000	[e]4,000	[e]4,000

[e] Estimated. [p] Preliminary.
[1] Table includes data available through Aug. 18, 1989.
[2] In addition to the commodities listed, other crude construction materials such as sand and gravel and other varieties of stone presumably are produced, but available information is inadequate to make reliable estimates of output levels.
[3] Reported figure.

TABLE 11

SRI LANKA: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1985	1986	Destinations, 1986	
				United States	Other (principal)
METALS					
Aluminum: Metal including alloys, semimanufactures		38	[2]29	—	Bangladesh 22.
Copper: Metal including alloys, semimanufactures	value, thousands	$4	$1	—	All to Singapore.
Iron and steel:					
Iron ore and concentrate:					
Excluding roasted pyrite		1,365	—		
Pyrite, roasted	value, thousands	$354	—		
Metal:					
Scrap		3,535	([3])		
Steel, primary forms	value, thousands	$1	—		
Semimanufactures:					
Bars, rods, angles, shapes, sections	do.	$6	$12	—	Australia $10.
Universals, plates, sheets		1	[4]36	—	All to India.
Rails and accessories		3,250	—		
Wire		1	1	—	All to Maldives.
Tubes, pipes, fittings		[5]15	2	—	Do.
Castings and forgings, rough	value, thousands	—	$1	—	All to Singapore.
Lead: Metal including alloys:					
Unwrought		3	—		
Semimanufactures		40	—		
Silver:					
Ore and concentrate	value, thousands	—	$5	—	All to Japan.
Waste and sweepings	do.	$2	—		
Metal including alloys, unwrought and partly wrought	do.	$2	—		
Other:					
Ores and concentrates		145,350	151,434	17,700	Netherlands 79,860; Japan 53,700.
Ashes and residues		90	([6])	—	All to Japan.
Base metals including alloys, all forms	value, thousands	$1	—		
INDUSTRIAL MINERALS					
Abrasives, n.e.s.: Grinding and polishing wheels and stones	value, thousands	$1	—		
Asbestos, crude		—	10	—	All to Australia.
Cement		379	285	—	Maldives 280.
Clays, crude		1	—		
Diamond:					
Gem, not set or strung	value, thousands	$10,522	$35,622	$9	Belgium-Luxembourg $26,716; Switzerland $6,818.
Industrial stones	do.	$867	$1,069	—	All to Belgium-Luxembourg.

See footnotes at end of table.

TABLE 11—Continued

SRI LANKA: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1985	1986	Destinations, 1986: United States	Destinations, 1986: Other (principal)
INDUSTRIAL MINERALS—Continued					
Fertilizer materials:					
Crude, n.e.s.		23	124	—	Maldives 114.
Manufactured:					
Nitrogenous	value, thousands	$1	—		
Unspecified and mixed	do.	$51	$1	—	Mainly to Saudi Arabia.
Graphite, natural		9,170	9,824	1,933	United Kingdom 2,368; Japan 1,752.
Mica:					
Crude including splittings and waste		534	—		
Worked including agglomerated splittings		18	—		
Precious and semiprecious stones other than diamond:					
Natural	value, thousands	$20,404	$26,452	$3,773	Japan $14,038; Hong Kong $2,249.
Synthetic	do.	$35	—		
Salt and brine		1,000	2,000	—	All to Saudi Arabia.
Stone, sand and gravel:					
Dimension stone: Crude and partly worked		2,167	1,755	—	Maldives 1,102; Italy 607.
Gravel and crushed rock		—	23	—	West Germany 21.
Quartz and quartzite		1,243	1,625	—	All to Japan.
Sand other than metal-bearing		1,056	1,271	—	All to Maldives.
Other:					
Crude	value, thousands	—	$1	—	Do.
Slag and dross, not metal-bearing		107	—		
MINERAL FUELS AND RELATED MATERIALS					
Coke and semicoke	value, thousands	—	$1	—	Do.
Petroleum refinery products:					
Liquefied petroleum gas	do.	$16	$8	—	Do.
Gasoline, motor	do.	$2	$9	—	NA.
Kerosene and jet fuel	42-gallon barrels	509,043	505,943	—	NA.
Distillate fuel oil	do.	393,485	527,698	—	Maldives 46,356.
Lubricants	value, thousands	$502	$1,099	$2	NA.
Residual fuel oil	42-gallon barrels	2,416,288	2,972,531	—	Singapore 243,356; Malaysia 235,444; Bangladesh 120,459.

[1] Table prepared by Audrey D. Wilkes.
[2] Excludes unreported quantity valued at $30,000.
[3] Unreported quantity valued at $3,061,000, of which: the Republic of Korea $1,196,000; Thailand $1,050,000; and Japan $762,000.
[4] Excludes unreported quantity valued at $6,000.
[5] Excludes unreported quantity valued at $11,000.
[6] Less than 1/2 unit.

TABLE 12

SRI LANKA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1985	1986	Sources, 1986: United States	Sources, 1986: Other (principal)
METALS					
Alkali and alkaline-earth metals	value, thousands	$6	$7	$4	Hong Kong $2.
Aluminum:					
Ore and concentrate		18	36	—	All from China.
Oxides and hydroxides		636	1,516	2	United Kingdom 721; Japan 419.
Metal including alloys, all forms		3,597	5,386	81	India 759; Republic of South Africa 728; Malaysia 577.
Chromium: Oxides and hydroxides		4	(2)	—	All from West Germany.
Cobalt: Oxides and hydroxides	value, thousands	—	$120	—	All from Canada.
Columbium and tantalum: Ore and concentrate		1	—		
Copper: Metal including alloys, all forms		2,196	2,919	(3)	United Kingdom 1,009; Japan 1,005.
Iron and steel:					
Iron ore and concentrate excluding roasted pyrite		88	(4)	—	
Metal:					
Scrap		(5)	1,268	—	United Arab Emirates 20; unspecified 1,220.
Pig iron, cast iron, related materials		134	286	10	Australia 80; Singapore 56; Republic of South Africa 36.
Ferroalloys:					
Ferromanganese		108	6	—	India 4.
Unspecified		108	38	—	Sweden 20; Norway 6.
Steel, primary forms		8,092	20,336	3	Spain 9,916; Republic of South Africa 5,089.
Semimanufactures:					
Bars, rods, angles, shapes, sections		155,803	155,603	157	Zimbabwe 103,202; Republic of South Africa 16,728.
Universals, plates, sheets		36,053	43,296	149	Japan 17,096; Republic of South Africa 13,714.
Hoop and strip		1,264	2,094	—	India 648; Japan 389; West Germany 244.
Rails and accessories		84	5,498	—	Japan 5,483.
Wire		63,276	10,273	(6)	Republic of South Africa 5,145; Republic of Korea 3,611.
Tubes, pipes, fittings		[7]3,102	7,516	7	Republic of South Africa 2,355; Thailand 1,387.
Castings and forgings, rough		16	7	—	Mainly from United Kingdom.
Lead:					
Oxides		19	15	—	United Kingdom 10; China 5.
Metal including alloys, all forms		1,987	851	17	Australia 629.
Magnesium: Metal including alloys, all forms	value, thousands	$6	—		

See footnotes at end of table.

TABLE 12—Continued

SRI LANKA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1985	1986	Sources, 1986: United States	Sources, 1986: Other (principal)
METALS—Continued				
Manganese:				
Ore and concentrate	290	104	—	All from Singapore.
Oxides	1,044	1,685	—	Singapore 924; Belgium-Luxembourg 390.
Mercury 76-pound flasks	29	29	—	NA.
Molybdenum: Metal including alloys, all forms value, thousands	$4	$8	—	Japan $6.
Nickel:				
Matte and speiss	—	$2	$2	
Metal including alloys, all forms	9	6	([6])	Switzerland 4.
Platinum-group metals: Metals including alloys, unwrought and partly wrought value, thousands	$4	—		
Silver: Metal including alloys, unwrought and partly wrought do.	$16	$19	$1	West Germany $12; Switzerland $4.
Tin:				
Ore and concentrate	88	1	—	All from Japan.
Metal including alloys:				
Scrap	46	([8])		
Unwrought	4	18	—	United Kingdom 12.
Semimanufactures	26,229	7	—	India 6.
Titanium: Oxides	151	163	—	United Kingdom 48; Belgium-Luxembourg 35.
Tungsten:				
Ore and concentrate value, thousands	—	$2	—	All from United Kingdom.
Metal including alloys, all forms do.	$151	$104	$6	Belgium-Luxembourg $52; Sweden $34.
Uranium and/or thorium: Metal including alloys, all forms do.	$6	—		
Zinc:				
Ore and concentrate	2	1	—	India ([6]); United Kingdom ([6]).
Oxides	731	779	—	China 349; Republic of Korea 181.
Metal including alloys:				
Scrap	—	12	—	Belgium-Luxembourg 10.
Unwrought	1,031	1,524	126	Canada 827; Australia 551.
Semimanufactures	153	36	—	Canada 17; Singapore 6.
Other:				
Ores and concentrates	142	71	—	Japan 53; Italy 18.
Ashes and residues	9	—		
Base metals including alloys, all forms	15	16	—	China 15.

See footnotes at end of table.

TABLE 12—Continued

SRI LANKA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1985	1986	Sources, 1986: United States	Sources, 1986: Other (principal)
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	158	72	—	Hong Kong 40; India 25.
Artificial: Corundum	2	22	—	Japan 11; Italy 9.
Dust and powder of precious and semiprecious stones including diamond value, thousands	$317	$178	$23	Belgium-Luxembourg $95; United Kingdom $60.
Grinding and polishing wheels and stones	63	137	([6])	China 50; India 21; United Kingdom 16.
Asbestos, crude	8,590	5,586	—	China 4,350; Zimbabwe 1,225.
Barite and witherite	15	134	—	India 74; United Kingdom 40.
Boron materials: Oxides and acids	61	36	9	China 12; India 12.
Cement	319,775	400,784	4	Indonesia 193,246; Japan 82,165; Kenya 60,203.
Chalk	73	252	—	United Kingdom 158; Australia 41.
Clays, crude	6,403	9,720	7	Republic of Korea 8,000; United Kingdom 825.
Diamond:				
Gem, not set or strung value, thousands	$16,310	$28,639	$3	Ghana $13,548; China $8,930.
Industrial stones do.	$69	$460	—	Ghana $431.
Diatomite and other infusorial earth	15	83	47	China 20; West Germany 10.
Feldspar, fluorspar, related materials	—	3	—	All from Italy.
Fertilizer materials:				
Crude, n.e.s. value, thousands	$97	$3	—	Philippines $2.
Manufactured:				
Ammonia	113	99	—	United Kingdom 42; Netherlands 25.
Nitrogenous	236,399	([9])		
Phosphatic	33,087	31,242	—	Iraq 19,105; China 5,000; Jordan 3,300.
Potassic	91,714	60,308	—	Singapore 25,155; U.S.S.R. 13,210; Canada 10,250.
Unspecified and mixed	12,502	20,581	—	Japan 8,620; Republic of Korea 8,254; Republic of South Africa 3,606.
Gypsum and plaster	15,107	12,445	—	Thailand 5,165; India 3,219; Japan 3,092.
Lime	1,150	57	—	India 50.
Magnesium compounds: Magnesite, crude including calcined	214	19	—	Japan 10; China 5.
Mica: Crude including splittings and waste	133	7	—	United Kingdom 5.
Nitrates, crude	—	15	—	All from West Germany.
Phosphates, crude	24,025	13,434	—	Egypt 7,608; Israel 2,751; West Germany 2,000.
Pigments, mineral: Iron oxides and hydroxides, processed	952	618	—	West Germany 308; India 142.
Potassium salts, crude	1	—		

See footnotes at end of table.

TABLE 12—Continued

SRI LANKA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1985	1986	Sources, 1986: United States	Sources, 1986: Other (principal)
INDUSTRIAL MINERALS—Continued				
Precious and semiprecious stones other than diamond:				
Natural value, thousands	$226	$130	$47	Hong Kong $41; Canada $29.
Synthetic do.	$20	$25	$2	Hong Kong $14.
Salt and brine	260	216	—	United Kingdom 171.
Sodium compounds, n.e.s.: Carbonate, manufactured	3,243	5,488	—	Kenya 1,855; West Germany 1,115; Belgium-Luxembourg 1,058.
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked	174	42	—	Italy 19; Japan 7.
Worked value, thousands	$150	$503	—	Belgium-Luxembourg $386; Italy $60; Japan $41.
Dolomite, chiefly refractory-grade	18	11	—	Norway 8.
Gravel and crushed rock	1,148	1,376	([6])	India 1,211.
Limestone other than dimension	74	—		
Quartz and quartzite	([10])	7	—	All from Belgium-Luxembourg.
Sand other than metal-bearing	425	38	—	Japan 19; United Kingdom 11.
Sulfur:				
Elemental:				
Crude including native and byproduct	336	363	—	Republic of Korea 262; Belgium-Luxembourg 39.
Colloidal, precipitated, sublimed	309	280	—	Republic of Korea 157; Singapore 100.
Sulfuric acid	613	683	—	Singapore 610.
Talc, steatite, soapstone, pyrophyllite	1,789	1,381	2	China 703; India 605.
Other:				
Crude	1,813	1,144	—	West Germany 1,100.
Slag and dross, not metal-bearing	—	186	—	Singapore 165.
MINERAL FUELS AND RELATED MATERIALS				
Asphalt and bitumen, natural	1,557	165	4	Singapore 150.
Carbon black	3,179	18,261	120	Switzerland 14,107; Republic of Korea 1,731.
Coal, all grades including briquets value, thousands	$411	$1,420	$1	Australia $615; Republic of South Africa $606.
Coke and semicoke	1,670	1,334	—	Belgium-Luxembourg 426; Australia 314; Singapore 120.
Petroleum:				
Crude thousand 42-gallon barrels	12,392	12,283	—	United Arab Emirates 7,231; Iran 1,838; Malaysia 1,825.
Refinery products:				
Liquefied petroleum gas value, thousands	$549	$1	—	All from Japan.
Gasoline 42-gallon barrels	4,718	4,352	765	Australia 2,737; Singapore 527.

See footnotes at end of table.

TABLE 12—Continued

SRI LANKA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1985	1986	Sources, 1986: United States	Sources, 1986: Other (principal)
MINERAL FUELS AND RELATED MATERIALS—Continued					
Petroleum—Continued					
Refinery products—Continued					
Mineral jelly and wax	42-gallon barrels	12,576	14,158	—	China 917; Japan 625; West Germany 101.
Kerosene and jet fuel	value, thousands	$12,112	$15,589	$28	China $7,851; Singapore $3,890.
Distillate fuel oil	do.	$24,554	$21,463	—	Singapore $15,612; Saudi Arabia $3,434.
Lubricants	42-gallon barrels	12,383	12,306	378	Singapore 6,776; Republic of Korea 1,848; Netherlands 1,435.
Residual fuel oil	value, thousands	$1	$1	—	All from Japan.
Bitumen and other residues	42-gallon barrels	4,581	25,785	12	Pakistan 23,089.
Bituminous mixtures	do.	11,187	30,585	—	Singapore 30,391.

[1] Table prepared by Audrey D. Wilkes.
[2] Unreported quantity valued at $1,000.
[3] Unreported quantity valued at $5,000.
[4] Unreported quantity valued at $11,000.
[5] Unreported quantity valued at $6,000.
[6] Less than 1/2 unit.
[7] Excludes unreported quantity valued at $2,423,000.
[8] Unreported quantity valued at $28,000.
[9] Unreported quantity valued at $23,893,000 of which the U.S.S.R. was the principal source.
[10] Unreported quantity valued at $18,000.

The economy has suffered setbacks during the last few years because of serious civil strife. The GDP was projected at $6.2 billion for 1988 with a real growth rate of 3%. The budget deficit was estimated at $1.3 billion and the Government struggled to reduce an inflation rate of 15%. Defense, Government wages, and drought relief were some factors which led to increased spending. Overall foreign debt was $5 billion, 85% of which was in low interest long term concessionary loans. The debt service ratio was 27%.

After being suspended because of an environmental protest petition in August 1987, strip mining for gem stones was allowed to resume in the Kalu Gunga area near Elehara in Matale District by Ceylon Sapphires (Pvt.) Ltd. The situation was resolved after an in-depth review by a Government-appointed panel of experts by imposing a few adjustments to the strip mining operation to minimize environmental damage. Ceylon Sapphire and another company, P.N.P. Joint Ventures (Pvt.) Ltd. were expected to conduct mechanized strip mining on the 1,200-hectare lease site.[64]

Gem stones occur in several areas along lower Quaternary age alluvium and river gravel, mainly in Patnapura District. The main gem stones obtained were aquamarine, beryl, crysoberyl, garnet, moonstone, ruby, sapphire, spinel, topaz, tourmaline, and zircon. A rich deposit of topaz recently found at Polwatta in central Sri Lanka was reportedly now being worked by the State Gem Corp., which has proposed a topaz marketing center to supply lapidaries with rough topaz from the deposit. State Gem has already set up lapidaries at Ratnapura and Matale. Privately owned Blue Peacock Lapidary on the west coast specializes in diamonds and reportedly employs nearly 1,000 workers.

The Ceylon Mineral Sands Corp. reportedly was seeking tenders from mineral processing companies for synthetic rutile technology. The company would like to earn increased foreign exchange from the Pulmoddai operation by producing synthetic rutile. The much lower valued ilmenite concentrate was exported. Relatively high grade mineral sands occur intermittently along 70 km of the coastline, mostly north of Pulmoddai.

The zircon recovery plant at Pulmoddai was temporarily closed following a guerrilla attack that destroyed the water supply line to the plant.

[1] By David Yen, computer analyst, Division of International Minerals.

[2] Afghanistan in Mining Annual Review (London). July 1989, p. A98.

[3] By Gordon L. Kinney, physical scientist, Division of International Minerals.

[4] Where necessary, values have been converted from Bangladesh taka (T) to U.S. dollars at the rate of T31.92 = US$1.00.

[5] Chemical Industry News (New Delhi). V. 33, No. 11, Mar. 1989, p. 863.

[6] The Bangladesh fiscal year begins July 1 of the year stated.

[7] Nitrogen. No. 175, Sept.-Oct. 1988, p. 11.

[8] Australian Journal of Mining. V. 3, No. 24, Sept. 1988, p. 75.

[9] Indian Mining and Engineering Journal. V. 27, No. 10, Oct. 1988, p. 74.

[10] By David B. Doan, physical scientist, Division of International Minerals.

[11] India's fiscal year begins on Apr. 1 of the year stated.

[12] Where necessary, values have been converted from Indian rupees (Rs) to U.S. dollars at the rate of Rs15.04 = US$1.00, the rate reported as of Dec. 1, 1988.

[13] U.S. Embassy, New Delhi, India. State Dep. Telegram 15076, June 28, 1989, p. 1.

[14] Work cited in footnote 13.

[15] Government of India, Department of Atomic Energy. Annual Report 1988-89, pp. 1.1-2.6.

[16] U.S. Embassy, New Delhi, India. State Dep. Telegram 22272, Sept. 6, 1988, p. 6; and Metal Bulletin No. 7349, Jan. 9, 1989, p. 9.

[17] Engineering and Mining Journal. V. 189, No. 10, Nov. 1988, p. 75.

[18] Roskill Information Services Ltd. Economics of Cobalt, 6th ed., 1989. London, Feb. 1989, p. 46.

[19] Metal Bulletin. No. 7298, July 4, 1988, p. 15, and No. 7305, July 28, 1988, p. 6.

[20] Mining Journal (London). V. 312, No. 8024, June 16, 1989, p. 479.

[21] U.S. Embassy, New Delhi, India. Various State Dep. Telegrams from May 1988 and May 1989.

[22] ———. State Dep. Telegrams 16451, June 30, 1988, p. 4, and 03825, Feb. 16, 1989, p. 5.

[23] U.S. Consulate, Madras, India. State Dep. Telegram 2181, July 27, 1989. pp. 1-2.

[24] Steel Times International. V. 12, No. 4, Sept. 1988.

[25] Engineering and Mining Journal. V. 189, No. 9, Sept. 1988, p. 177; and U. S. Embassy, New Delhi, India. State Dep. Telegram 24051, Sept. 23, 1988, p. 1.

[26] U.S. Embassy, New Delhi, India. State Dep. Telegram 25667, Oct. 13, 1988, p. 5.

[27] Metal Bulletin. No. 7375, Apr. 13, 1989, p. 9.

[28] U.S. Embassy, New Delhi, India. State Dep. Telegrams 22272, Sept. 6, 1988, p. 4; and 03825, Feb. 16, 1989, p. 6.

[29] British Broadcasting Company, Summary of World Broadcasts, Far East, Oct. 19, 1988, p. 3.

[30] The Economic Times (New Delhi). Data-Bank 1989, pp. 45-49.

[31] Phosphorus & Potassium. No. 156, July-Aug. 1988, p. 19; No. 161, May-June 1989, p. 11; and Nitrogen No. 174, July-Aug. 1988, p. 19.

[32] Mining Journal (London). V. 312, No. 8011, 1989, p. 301.

[33] Indian Mining and Engineering Journal. V. 27, No. 5, May 1988, p. 33.

[34] Barot, N. A. The 1988 World Mining Report. International Colored Stone Association, 1989.

[35] U.S. Embassy, New Delhi, India. State Dep. Telegram 31160, Dec. 20, 1988, p. 7.

[36] Mining Magazine. V. 160, No. 3, Mar. 1989, p. 45.

[37] U.S. Embassy, New Delhi, India. State Dep. Telegram 31160, Dec. 20, 1988, p. 5.

[38] ———. State Dep. Telegram 22272, Sept. 6, 1988, p. 5.

[39] Indian Mining and Engineering Journal. V. 27, No. 8, Aug. 1988.

[40] U.S. Consulate, Calcutta, India. State Dep. Telegram 02574, Sept. 15, 1988, p. 1.

[41] Industrial Minerals (London). No. 259, Apr. 1989.

[42] Oil & Gas Journal. V. 86, No. 48, Nov. 28, 1988, p. 31.

[43] U.S. Embassy, New Delhi, India. State Dep. Telegram 01577, Jan. 20, 1989, pp. 1-2.

[44] Government of India, Ministry of Energy, Department of Coal. Report 1988-89, pp. 5-12.

[45] Page 33 of work cited in footnote 44.

[46] Page 69 of work cited in footnote 44.

[47] Gorst, Isabel. Expanding Oil Exploration. Petroleum Economist. V. 55, No. 12, Dec. 1988, p. 401.

[48] U.S. Embassy, New Delhi, India. State Dep. Telegrams 19690, 21418, and 22280, Aug. 8, 26, and Sept. 6, 1988, respectively; U. S. Consulate, Madras, India. State Dep. Telegrams 02531 and 02774, Sept. 8 and 26, 1988; U.S. Consulate, Bombay, India. State Dep. Telegrams 04312 and 00274, Sept. 13, 1988, and Jan. 20, 1989; and U.S. Consulate, Calcutta, India. State Dep. Telegram 02834, Oct. 12, 1988; all p. 1.

[49] World Oil. V. 209, No. 2, Aug. 1989, p. 118.

[50] Petroleum News. V. 19, No. 12, Mar. 1989, p. 38.

[51] By Gordon L. Kinney, physical scientist, Division of International Minerals.

[52] Where necessary, values have been converted from Nepal Rupees NR to U.S. dollars at the rate of NR23.5 = US$1.00.

[53] The Rising Nepal, (Kathmandu). V. 24, No. 64, Feb. 16, 1989, p. 6.

[54] The Nepalese fiscal year runs from mid-July to mid-July.

[55] The Rising Nepal, (Kathmandu). V. 24, No. 96, Mar. 20, 1989, p. 6.

[56] ———. V. 24, No. 133, Apr. 27, 1989, p. 5.

[57] Engineering and Mining Journal. V. 189, No. 9, Sept. 1989, p. 177.

[58] By David Yen, computer analyst, Division of International Minerals.

[59] Where necessary, values have been converted from Pakistan rupees (PRs) to U.S. dollars at the rate of PRs17.399 = US$1.00 in 1987 and PRs17.737 = US$1.00 in 1988.

[60] Bilgrami, S.A. Mining Annual Review. Pakistan. Min. J. (London), June 1989, p. A99.

[61] U.S. Embassy, Islamabad, Pakistan. State Dep. Telegram 07328, P031919Z, Feb. 24, 1989.

[62] By Gordon L. Kinney, physical scientist, Division of International Minerals.

[63] Where necessary, values have been converted from Sri Lankan rupees (Rs) to U.S. dollars at the rate of Rs31.9 = US$1.00.

[64] Mining Magazine, (London). V. 159, No. 2, Aug. 1988, p. 87.

THE MINERAL INDUSTRIES OF

SOUTHEAST ASIA

By John C. Wu, Gordon L. Kinney, David B. Doan, Travis Q. Lyday, Chin S. Kuo

BRUNEI[1]

Brunei Darussalam is the official name of the 5,765-square-kilometer country that covers two wedge-shaped pieces of land, surrounded by the Malaysian State of Sarawak and the sea. It is on the northern coast of Kalimantan Island (formerly known as Borneo) and lies south of the South China Sea. Most of the country was covered with tropical rain forest, and only a narrow coastal strip was being cultivated. The population is 277,000, including 70,000 non-Malaysian residents; and 60% of the population is under 20 years of age.

The country was almost totally dependent on oil and gas production but has emerged relatively unscathed from the drop in world oil prices during the 1980's. Revenue fell from $3.1 billion[2] in 1986 to $1.0 billion in 1987. The revenues for 1988 were not available, but the gradual increase in prices coupled with lower production plans of 150,000 barrels per day (bbl/d) indicated revenues remained little changed from that of 1987.

Brunei had no national debt, trade deficit, or balance of payment problem. Furthermore, the Government was able to draw on income derived from large annual budget surpluses, which have been invested throughout the world. The standard of living was not materially affected by the oil-price fluctuations. There was no personal income tax. All health services and primary and secondary education were free. Government subsidies were available for a wide range of services, and soft loans were available for many consumer goods. Price controls were strictly observed, and inflation was low.

In July 1983, the Government set up a Brunei Investment Agency (BIA) to manage its foreign reserves as part of the process of ensuring the long-term prosperity brought about by the petroleum resources. BIA's initial $5.5-billion reserve had increased 120% (excluding new revenues) by 1987. The BIA did not publish details of investment for commercial reasons, but it was known that there was specific interest in the hotel industry.

Commodity Review

Petroleum and natural gas were the only significant minerals produced. Coal production ceased many years ago. Some gravel and cobblestone was gathered in the Temberuong area but the amount was so small that the Government has stopped keeping records.

Crude oil production was limited to 150,000 bbl/d as a long-term conservation measure. Brunei Shell Petroleum Sendirian Berhad (BSP) remained the chief operator and was the only producer of crude oil during 1988. It was

TABLE 1

BRUNEI: PRODUCTION OF MINERAL COMMODITIES[1] [2]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987	1988[p]
Gas, natural:						
Gross[e]	million cubic feet	330,000	330,000	320,000	325,000	323,000
Marketed	do.	[e]300,000	307,645	284,565	[e]300,000	[e]298,000
Natural gas liquids:[e]						
Condensate	thousand 42-gallon barrels	5,460	5,500	5,400	5,500	5,460
Natural gasoline	do.	280	300	290	300	295
Liquefied petroleum gas	do.	115	110	100	100	95
Total	**do.**	**5,855**	**5,910**	**5,790**	**5,900**	**5,850**
Petroleum:						
Crude	do.	58,560	54,300	59,860	50,808	50,480
Refinery products:						
Gasoline	do.	605	600	[e]600	[e]650	[e]625
Distillate fuel oil	do.	395	400	[e]400	[e]450	[e]432
Residual fuel oil	do.	8	8	[e]10	[e]10	[e]9
Other including refinery fuel and losses	do.	272	300	[e]300	[e]350	[e]336
Total	**do.**	**1,280**	**1,308**	**[e]1,310**	**[e]1,460**	**[e]1,400**

[e]Estimated. [p]Preliminary.
[1]Table includes data available through Aug. 18, 1989.
[2]In addition to the commodities listed, other crude construction materials such as sand and gravel and other varieties of stone presumably are produced, but available information is inadequate to make reliable estimates of output levels.

owned by the Government of Brunei and Royal Dutch Petroleum Co. of the Netherlands. BSP operated 182 offshore structures and continued exploratory drilling in the offshore waters. It estimated that only two or three exploration wells per year would be needed to ensure that reserves of oil and gas in known fields would last 20 to 30 years at planned production rates.

One of the other companies holding exploration rights in Brunei was Elf Aquitaine Offshore BV Asia, a subsidiary of Elf Aquitaine S.A. of France. Elf spudded its first well in September and reported a flow of 2,000 barrels of oil per day and 21 million cubic feet of natural gas per day.[3]

The first phase of an ongoing development by BSP came on-line during the year. The Gannet-1 facility began producing 150 million cubic feet of gas per day and 10,000 barrels of condensate per day. The new production was delivered to the Fairley-4 offshore production complex.[4]

The production of liquefied natural gas (LNG) has become increasingly important for Brunei, the world's fourth largest producer of LNG. Natural gas produced by BSP on offshore platforms was piped to Lumut where one of the world's largest liquefaction plants was operated by Brunei LNG Sendirian Berhad, a joint venture between the Government of Brunei, Shell, and Mitsubishi Corp. of Japan. Under an exclusive 20-year contract, Brunei LNG has exported 5 million tons to Japan annually.

Transportation of the LNG required specially built tankers for the cryogenic liquid. The Government and Shell, therefore, formed a jointly owned company, Brunei Shell Tankers Co. Sendirian Berhad. It was registered in Brunei and shuttled seven tankers between Brunei and Japan on a continuous basis.

Much of the natural gas production was associated with the crude oil output. The Government was concerned that the natural gas contract would suffer when the oil production was limited to 150,000 bbl/d. They have, therefore, been concentrating on developing deposits that were either all natural gas or have the highest proportion of gas to oil. The new Gannet-1 production, which has condensate but no crude, may help keep the gas-to-crude-oil proportion at a satisfactory level. Also, the Elf discovery could eventually help increase the gas-to-oil proportion.

BURMA[5]

The Government's main objectives for the mining sector during the fifth 5-year plan were as follows: to expand mineral surveys and prospecting to increase production of crude oil, natural gas, and major raw materials for the development of heavy industry; to increase production and quality of concentrates that have the highest potential on the export market; to carry out research for the extraction of new minerals; and to emphasize those projects with the potential for the highest rate of return on investment. In addition, various incentives and amenities were to be provided workers with a view to enhancing mine productivity.[6] Toward the above goal, the Government of Burma's investment in the mining sector during fiscal year (FY) 1987[7] was \$82 million[8] or 6.7% of total public investment, substantially exceeding the originally planned allotment.

Approximately 30 minerals or mineral-related commodities were produced during 1988. The most important were barite, cement, copper concentrates, crude oil, gypsum, lead, natural gas, nitrogen fertilizer, silver, steel, and concentrates of tin, tungsten, and zinc. In value, crude oil was by far the most important followed by natural gas, copper concentrates, nitrogen fertilizer, and tin metal and concentrates. The longstanding policy of not importing crude oil was reversed during 1988. The shortage of foreign exchange was surpassed by the economic problems caused by the gradual but continued decline in domestic crude oil production. None of the minerals was produced in large enough quantity to be a major factor in the world market. The usually important tin and tungsten output dropped after midyear, probably losing several places in the world output standing.

The mining industry employed about 91,000 (revised) persons during FY 1987. About 14,000 were employed by the cooperative and private sectors, the remaining were employed in State-owned mining operations. The mining sector accounted for 4.4% of total Government employees, while less than 0.1% of privately employed persons were in the mining category. Mining accounted for 1.5% of the value of the net output of goods and services at current prices. Net output value of the mining sector at constant 1969 prices was \$67.7 million during FY 1987, excluding mineral fuels. This represented a nominal decline from FY 1986 levels.

Considering the political and social setting of FY 1988, the output value of the mining sector was believed to have declined substantially by yearend. The already hard-pressed economy was handed a severe setback by political turmoil and labor unrest. By September, the 25-year reign of the Chairman of the Burma Socialist Programme Party had come to an end and a military government, which had seized control, declared a "Union of Burma" dropping the words "Socialist Republic" from the country's name. In an attempt to break its international isolation and encourage badly needed foreign exchange, the new Government announced it was abandoning old rigid economic policies and welcomed foreign investment. In a statement on October 31, the Trade Minister abrogated the old trade laws by saying that a market-oriented economy will be practiced and limited liability companies and joint ventures between local and foreign private firms or with foreign governments will be permitted. Some constraints, however, were announced later. The present State monopolies

TABLE 2

BURMA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1984	1985	1986	1987	1988[p]
METALS						
Copper:						
Mine output, Cu content		12,000	16,700	11,368	17,312	13,808
Matte, gross weight		173	173	144	234	[e]200
Iron and steel: Pig iron		7,764	—	[r]2,669	—	—
Lead:						
Mine output, Pb content		21,937	21,935	18,156	27,132	16,728
Metal:						
Refined		6,996	9,585	5,359	3,985	4,402
Antimonial lead (18% to 20% Sb)		254	[e]300	299	305	153
Nickel:						
Mine output, Ni content[e]		20	20	20	20	26
Speiss, gross weight		80	80	86	[e]80	104
Silver, mine output	thousand troy ounces	455	568	527	839	311
Tin, mine output, Sn content:						
Of tin concentrate		745	622	600	256	102
Of tin-tungsten concentrate		1,283	1,129	895	683	427
Total		**2,028**	**1,751**	**1,495**	**839**	**529**
Metal: Refined		—	388	322	649	300
Tungsten, mine output, W content:						
Of tungsten concentrate		216	171	102	25	14
Of tin-tungsten concentrate		880	774	613	468	293
Total		**1,096**	**945**	**715**	**493**	**307**
Zinc, mine output, Zn content		5,320	4,353	4,643	2,561	2.743
INDUSTRIAL MINERALS						
Barite[3]		9,967	8,100	8,149	17,273	13,000
Cement, hydraulic		311,179	477,000	433,811	389,605	348,981
Clays:[3]						
Ball clay		960	110	496	203	203
Bentonite		725	710	851	406	508
Fire clay[4]		1,220	1,370	2,040	1,422	2,845
Industrial white clay		357	610	203	610	610
Feldspar[3]		6,220	2,446	2,861	1,916	2,626
Graphite[3]		234	234	722	—	—
Gypsum[3]		27,580	38,594	38,889	23,135	31,675
Nitrogen: N content of ammonia[5]		56,916	125,795	133,130	117,501	[e]125,000
Precious and semiprecious stones: Jadeite[3]	kilograms	90,990	43,145	12,804	13,529	[e]12,000
Salt[6]	thousand tons	280	320	321	341	249
Stone:[3]						
Dolomite		1,305	2,383	5,253	5,952	4,403
Limestone, crushed and broken	thousand tons	1,210	1,541	1,329	1,411	785
Talc and related materials: Soapstone[3]		91	128	56	22	25

See footnotes at end of table.

TABLE 2—Continued

BURMA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1984	1985	1986	1987	1988[p]
MINERAL FUELS AND RELATED MATERIALS						
Coal, lignite		44,232	43,000	43,848	45,700	32,514
Gas, natural:						
Gross[e]	million cubic feet	26,000	34,000	40,000	[7]42,000	44,000
Marketed[3]	do.	24,417	32,962	38,290	[7]41,284	42,350
Petroleum:						
Crude (gross wellhead)[3]	thousand 42-gallon barrels	11,200	10,253	10,103	6,351	4,612
Refinery products[e]	do.	8,000	8,000	7,500	5,800	6,000

[e] Estimated. [p] Preliminary. [r] Revised.
[1] Table includes data available through June 14, 1989.
[2] In addition to the commodities listed, pottery clay, common sand, glass sand, other varieties of crude construction stone, and other varieties of gem stones are produced, but available information is inadequate to make reliable estimates of output levels.
[3] Data are for fiscal years beginning Apr. 1 of that stated.
[4] Includes fire clay powder.
[5] Computed at 46% of reported fertilizer production.
[6] Brine salt production as reported by the Burmese Government was as follows: 1984—81,166; 1985—44,508; 1986—52,084; 1987—63,700 (revised); and 1988—66,460.
[7] Reported figure.

were to be retained on some of the commodities of most interest to foreign investors including gem stones, natural gas, petroleum, and teak.

During the political upheaval, a number of important industries were closed by strikes and some were reportedly looted of equipment and supplies. The operating petroleum refineries were closed for a time as were some of the oil and natural gas production facilities. By yearend, the status of the mineral sector was far from clear. Very little information was available on industrial operations and mining in particular. Both the press and the Government were heavily preoccupied with the political situation and the worsening economic conditions.

Production

Mineral production suffered several setbacks during the year. Petroleum output continued to decline early in the year, and then came almost to a complete halt for several weeks during the height of the political and labor problems. Monthly figures through October reflected a sharp decline in lead, tin, tungsten, and zinc production. No production was reported for tin, tungsten, or silver in July and August and only nominal production of mixed tin-tungsten and zinc concentrates during the remainder of the year.

Trade

In FY 1987, the major mineral exports were concentrates of copper, tin, tungsten, and zinc; a modest amount of refined copper, lead, silver, and tin; and various colored gem stones. According to a Government publication, the provisional value of mineral and gem stones exports totaled $35.7 million.[9] The 24th Gem and Pearl Emporium (1987) accounted for $6.4 million of that total, a decrease of more than $1 million from the 1986 level. Burma began the export of high-grade chromite during 1988.

Commodity Review

Metals.—**Chromite.**—Burma was to begin the export of metallurgical-grade chromite in September with a 5,000-ton shipment to a Japanese company. The shipment was delayed, however, until January 1989 because of the political turmoil. Ore specification was to be: 48% Cr_2O_3, Fe-Cr ratio of 1:3, and size range of 25 to 150 millimeters. The shipment was believed to represent the annual production from a recently opened mine.[10]

Gold.—In conjunction with the Burmese Ministry of Mines, the Yugoslavian Invest-Import Co. of Belgrade reportedly began construction of a gold mine near Kyauk Pahtoe (also spelled Chaukpato) in Kawlin Township 200 kilometers north of Mandalay. Under the contract, the Yugoslav company was to develop a 450,000-ton-per-year open pit, an ore flotation plant, and refining facilities. The $50 million cost was to be repaid by exports of nonferrous metal concentrates over a 6-year period. Most of the mining, concentration, and electrical equipment will be supplied by Yugoslav companies.[11]

The smelter and refinery, however, was to be designed and constructed by Davy McKee (Stockton) Ltd. under a separate contract with the Invest-Import Co. The plant was to treat 4,500 tons per year of high-grade gold-bearing pyrite concentrate to produce 3 to 4 tons of refined gold per year.[12]

Mineral Fuels.—The production of crude oil has been declining gradually during the last decade from more than 11 million barrels in 1979 to about 6.3 million barrels in 1987. The problem was serious enough to cause a definite hardship on the already strained Burmese economy. By midyear, however, the political disruptions in the Capital and major urban centers began to exacerbate the petroleum supply problem. It was reported over the Burmese radio that the operating oil refineries had closed down, and many of the oilfield workers had also left their jobs. The disturbance in the production routine was likely to extend well beyond the settlement of the political problems. A State-run newspaper, The Guardian, stated that machinery, parts, and lubricants reportedly had been looted and sold from the Syriam refinery near Rangoon. Maintenance of industrial equipment has been a serious problem for years in Burma. These reports, if true, could mean that serious delays will be encountered in reestablishing the normal refinery output at Syriam. The Mann refinery reportedly resumed production in late October.

The Government policy had not permitted imports of crude oil for many years. The ecomonic impact of the shortages finally became so severe during FY 1988 that the policy was rescinded and the Petroleum Industries Corp. was permitted to purchase 114,000 tons of crude oil from Australia using funds from an International Development Association loan.[13]

Following years of stability, official prices of petroleum products were raised four times from September through yearend. The Government ration of 26 gallons of gasoline per month, per car, was reduced in October to 16 gallons at more than triple the former price. During the June–December period, black market prices for gasoline went from \$5.30 to over \$12.46 per gallon in the Rangoon area and more than \$18.69 in Mandalay and outlying areas.

In an effort to increase crude oil production, the Asian Development Bank was to provide a technical assistance grant to finance a 7-month study to rehabilitate and further develop two of the major oilfields in Central Burma. It was hoped by the Government that updating present facilities and further development would increase production by 1.5 million barrels per year.[14]

CAMBODIA[15]

Events in Cambodia were dominated by the continuing political and military problems, which have plagued the country for the last two decades. The politically divergent Khmer People's National Liberation Front, National United Front for an Independent, Neutral, Peaceful and Cooperative Cambodia, and the Communist Party of Kampuchea (Khmer Rouge) were nominally united against Vietnamese troops who have occupied the capital of Phnom Penh and most of the populated agricultural areas since late 1978.[16] Until the political situation is resolved and a nationwide cease-fire is implemented, economic development on even a modest scale is going to be difficult or impossible. Mineral development was at a virtual standstill because of the security situation, a near-total lack of capital for investment, and lack of stable Government or administrative organization. The value of industrial and handicraft production reportedly increased 32% during 1988. Some 60 industrial establishments have been restored to operation. These consisted almost entirely of manual production of agricultural and textile products, the most advanced of which were a textile factory in Kompong Cham Province and a jute-bag factory in Battambang Province. A low-technology phosphate fertilizer plant at Touk Meas in Kampot Province has resumed producing phosphate fertilizer for local use. The product is phosphate rock, which is crushed, roasted, and ground to a coarse powder. No chemical treatment is performed. Nonmetallic construction materials were produced and used locally in most provinces. A small amount of salt was produced and distributed for cooking and food preservation.

A high-level Government committee was formed to survey, appraise, develop, and manage the gem stone mining sector. Its specific task was to survey the gem deposits along the western border for development and also for the ecological impact that development

TABLE 3

CAMBODIA: PRODUCTION OF MINERAL COMMODITIES[1 2]

(Metric tons unless otherwise specified)

Commodity	1984	1985	1986	1987	1988[p]
Salt	40,000	40,000	40,000	40,000	40,000

[p] Preliminary.
[1] Table includes data available through Aug. 18, 1989.
[2] In addition to the commodity listed, other crude construction materials such as sand and gravel and other varieties of stone presumably are produced, but available information is inadequate to make reliable estimates of output levels.

would have on the area. For many years, the gem stone pits have been worked haphazardly by Thais, Laotians, Burmans, and Cambodians in a strictly unofficial capacity. It has been reported that the Khmer Rouge, along the border, were selling passes to miners to permit them to cross the border from Thailand to dig for gem stones in the Phnom Pech area generally west of Battambang.[17] The old mining area near Pailin was too dangerous for work according to the refugees. Several thousand persons were reportedly involved in this mining and sold the gem stones across the border in Thailand. Forces opposed to the Phnom Penh Government claimed that Vietnamese nationals were the people mining gem stones in Samlot District of Battambang Province.[18]

Whatever the actual situation was, it was apparent that there was a considerable potential for the development of an economically significant gem stone industry in western Cambodia when political stability returns to the country.

CHRISTMAS ISLAND[19]

From 1897 until mining ceased in 1987, guano-based phosphate rock was the mainstay of the economy of the Territory of Christmas Island, an island territory of Australia in the Indian Ocean. The mining operation, owned by the Phosphate Mining Co. of Christmas Island, a wholly Australian Government-owned firm headquartered in Perth, was closed primarily due to the exhaustion of high-grade phosphate reserves. The operation was also plagued by intense labor unrest, low productivity, and diminishing profits.

TABLE 5

CHRISTMAS ISLAND: EXPORTS OF PHOSPHATE ROCK, BY DESTINATION

(Thousand metric tons)

Destination	1986	1987	1988
Australia	489.9	358.8	—
Indonesia	18.2	39.7	—
Japan	41.3	15.0	—
Korea, Republic of	22.3	9.3	—
Malaysia	196.2	253.8	—
New Zealand	107.1	164.9	—
Sri Lanka	1.1	—	—
Taiwan	3.7	5.4	—
Other	.3	—	—
Total	**880.1**	**846.9**	**—**

Source: Phosphate Rock Statistics 1987, International Fertilizer Industry Association Ltd.

INDONESIA[20]

Indonesia was the world's largest producer and exporter of LNG, the 2d largest producer of tin, the 5th largest producer of nickel, and the 14th largest producer of crude oil in 1988. Indonesia remained a significant producer of primary aluminum, bauxite, cement, coal, copper, iodine, and urea in the Far East. In line with the Government mineral policy, the mining capacity of coal, copper, gold, industrial minerals, and natural gas was expanded considerably. Because of improved world market conditions for Indonesia's exported minerals, export earnings and overall performance of the mineral industry improved.

The mineral industry continued to play a major role in the Indonesian economy in terms of contribution to gross domestic product (GDP), Gov-

TABLE 4

CHRISTMAS ISLAND: PRODUCTION OF MINERAL COMMODITIES[1] [2]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987[p]	1988
Phosphate rock, marketable:						
Gross weight	thousand tons	1,259	1,187	825	842	—
P_2O_5 content	do.	443	418	288	294	—

[p] Preliminary.
[1] Table includes data available through Aug. 15, 1989.
[2] In addition to the commodity listed, other crude construction materials such as sand and gravel and other varieties of stone presumably are produced, but available information is inadequate to make reliable estimates of output levels.

ernment revenues, and export earnings. In 1988, the output quota imposed by the Organization of Petroleum Exporting Countries (OPEC) and Association of Tin Producing Countries (ATPC) continued to limit the growth of the oil and tin industries. However, improvements in the world minerals market and the Government mineral policy resulted in higher growth in the output of coal, copper, gold, industrial minerals, and natural gas. Export of minerals other than oil and tin also resulted in record earnings especially for cement, coal, copper, gold, nickel, and urea.

Despite the lower level of crude oil production due to the continuing imposition of production quotas by OPEC and other economic reasons, the output of natural gas reached a new record high. This growth was due to a 12% increase in domestic consumption by the LNG plants and two newly completed liquefied petroleum gas (LPG) plants in Aceh, North Sumatra, and in Bontang, East Kalimantan. In February, a $316 million[21] contract for building the fifth LNG train in Bontang, East Kalimantan, was awarded to Chiyoda Chemical Engineering & Construction Co. of Japan. The LNG train was expected to come on-stream and begin exporting LNG to Taiwan in 1990.

Oil and gas exploration recovered from the 1987 slump as the world oil price stabilized. The number of exploratory wells drilled rose from 82 in 1987 to 119, and 43 oil and gas wells were discovered compared with 23 in 1987. In 1988, the Government signed eight new production-sharing contracts with major oil companies from Australia, Canada, France, Japan, the Netherlands, and the United States. To step up oil and gas exploration, in August, the Government introduced tax incentives that provide tax breaks and allow a more favorable production split for exploration of high-risk smaller oilfields. To offset the declining crude oil output of aging oilfields and the lower success in discovering large oilfields, the Government announced in early 1988 that higher priority would be given to secondary recovery programs using gas-lift and water- and steam-flooding processes.

Coal production reached a record high in 1988 as the Bukit Asam Mine in South Sumatra expanded output capacity and three foreign contractors began coal mining in Kalimantan and Sumatra. Coal production was expected to increase further when two or three more foreign contractors commence mining operations in Kalimantan in 1989. Indonesia's first modern coal terminal at Tarahan on the southern tip of Sumatra was finally completed after 3 years of delay. A self-loading 10,000-ton vessel to transport coal from the terminal to the Suralaya powerplant in West Java was also inaugurated in 1988. As part of the Bukit Asam expansion program, rehabilitation of the 415-kilometer railroad system to increase coal delivery from the Bukit Asam Mine to the Tarahan Terminal was not yet completed by yearend. A feasibility study sponsored by the International Bank of Reconstruction and Development (the World Bank) for Stage II of the Ombilin coal mine expansion was completed by Norwest Resources Consultants Ltd. of the United States. Under the Government plan, negotiation of funding for the Ombilin project was expected in 1989.

In the metallic minerals sector, Indonesia achieved its targeted tin production goals and displaced Malaysia as the world's second largest tin producer. Freeport Indonesia Inc. (FI) of the United States, operating under Contract of Work with the Government at the Ertsberg area of Irian Jaya, commissioned a second underground mine and produced a record-high tonnage of copper concentrate in 1988. To raise its mining and milling capacity to 32,000 tons of ore per day by 1990, FI launched a $120 million expansion program and announced the discovery at its Grasberg prospect of a new copper deposit with 92 million tons of reserves averaging 1.43% copper plus significant values of gold and silver.

Production of nickel ore from Gebe Island and the Pomalaa area of Sulawesi by P.T. Aneka Tambang (P.T. Antam) and from the Soroako area of South Sulawesi by P.T. International Nickel (P.T. Inco) increased because of higher demand from Japan. Gold, recovered as a byproduct of copper processing by FI at the Ertsberg Mine in Irian Jaya, continued to increase because of increased mining and milling capacity. Primary gold production from alluvial deposits operated by foreign companies under Contract of Work with the Government also increased when two more contractors started mining operations in Central and West Kalimantan in late 1988. Two or three foreign contractors who had completed their feasibility studies in 1988 were expected to start gold mining in 1989.

In the industrial minerals sector, Indonesia's first chromite sand mine at the Wosu area along the East Central Coast of Sulawesi was brought on-stream by a local company, P.T. Palmabim. The chromite mining and processing facilities had an annual capacity of 40,000 tons of concentrate per year. Most finished products were exported to Australia and used as a molding media by the iron and steel casting industry. Limestone and kaolin production continued the upward trend because of increased exports to the Far East market. A feasibility study by Acorn Diamond Indonesia Pty. Ltd. was completed in 1988, and a $17.5 million diamond development project in South Kalimantan was planned for 1989–90.

In the mineral processing sector, production of primary aluminum by P.T. Indonesia Asahan Aluminum (INALUM) in North Sumatra suffered a setback from a dispute between Indonesia and its Japanese partners on output allocation. Production of nickel matte by P.T. Inco at its Soroako smelter in South Sulawesi was adversely affected by an earthquake and transformer breakdown. However, P.T. Inco improved further its financial condition owing to higher nickel prices. In mid-1988, Inco Ltd. of Canada sold 20% of its equity in P.T. Inco to Sumitomo Metal Mining Co. Ltd. of Japan for $100 million. Inco planned to expand annual capacity of its Soroako smelter by 31% to 47,600 tons by 1990.

Because of the improved world tin market and a higher export quota provided by ATPC, production of refined tin by P.T. Tambang Timah (P.T. Timah) at Mentok on Bangka Island reached its highest level since 1981. To diversify its operations, P.T. Timah set up joint ventures in Singapore to market its tin in the world market and on Batam Island to produce tin solder. Indonesia's nitrogen fertilizer industry, supported by the Government, expanded its annual capacity of urea to 5 million tons when the third 570,000-ton-per-year urea unit was brought on-stream by P.T. Pupuk Kalimantan Timur in Bontang, East Kalimantan.

Higher growth in production and exports of nonoil commodities and increased capital investment resulted in an estimated growth of 4.2% in the Indonesian economy, as measured by the growth of GDP in 1983 constant rupiah, compared with 3.6% (revised) in 1987. Indonesia's GDP in 1983 constant dollars was estimated at $53.6 billion compared with $52.5 billion (revised) in 1987. The inflation rate, as measured by an increase in the Consumer Price Index, dropped to 7% from 8% in 1987. In 1988, Indonesia's total labor force was estimated at 72.6 million of which about 10% were unemployed.[22]

In 1988, merchandise exports rose 12% to $19.2 billion, of which 40% was exports of oil and gas. Exports of nonoil commodities increased by 34% to $11.5 billion owing to higher prices of export commodities and a 39% increase in exports of industrial products in 1988. Because of further liberalization of imports by the Government, imports also rose 9% to $13.5 billion, of which 38% was imports of machinery and transport equipment.

According to a report by the World Bank, total outstanding private and public foreign debt in 1988 was expected to reach $50 billion compared with $47.6 billion in 1987 and only $32.1 billion in 1986. Debt service payments were expected to increase 34% from that of 1987 to $9 billion. The substantial increase in Indonesia's external debt over the past 3 years was largely due to the rapid appreciation of the Japanese yen because a large portion of the country's debt was yen denominated. The report pointed out that a 6% real growth in exports of nonoil commodities is essential for Indonesia to reduce its current account deficit and meet its annual debt-service payment.[23]

Production

Despite a slight decline in output of crude oil, the oil and gas industry continued to account for more than 90% of the Indonesian mineral output value. The output of crude oil declined to a new low since 1982 because of lower OPEC quotas and other factors such as marketing difficulties. Production of natural gas rose to more than 1.8 trillion cubic feet owing to increased consumption for production and exports of LNG, LPG, and urea. Coal production rose sharply to more than 4 million tons resulting from increased capacity, stronger domestic demand by the utility and cement industries, and exports.

Production of tin recovered to a new high since 1982 because of higher prices and increased export quotas. Production of most metallic minerals was at a higher level than that of 1987 except for bauxite and primary aluminum. The continued decline in bauxite production was primarily due to reduced exports to Japan. The lower aluminum output was caused by a 2-month suspension of shipments to Japan resulting from a dispute related to redistribution of primary aluminum among partners.

The increased production of copper, gold, manganese, and nickel resulting from expanded capacity was largely attributable to higher world metal prices and stronger demand for these minerals, especially by Japan. To reduce cost of production with anticipation of continuing strong demand, production capacity of copper and nickel would be raised further in the next 2 years. As more contractors bring their gold mines on-stream, gold production capacity will also be raised in 1989. In 1988, Indonesia began production of chromite sand in Sulawesi for the first time.

To meet the growing demand for natural gas by Japan, the Republic of Korea, and Taiwan, production capacity of LPG was increased by 1.9 million tons per year in 1988, and LNG capacity will be raised by 1.5 million tons per year to 16.5 million tons per year by 1990. To meet the domestic agricultural requirement for nitrogen fertilizer material, production capacity of urea rose by 570,000 tons per year to 5 million tons per year in 1988. The Government planned to build another 570,000-ton-per-year urea plant by 1990. Indonesia's cement production rose slightly with record-high exports in 1988.

Trade

Indonesia's merchandise trade surplus improved substantially owing to a sharp increase in exports of nonoil commodities in 1988. According to the Central Bureau of Statistics, merchandise exports and imports were $19.2 billion and $13.5 billion, respectively, compared with $17.2 billion and $12.4 billion, respectively, in 1987.

Higher exports in 1988 resulted primarily from a 34% increase in exports of nonoil commodities to $11.5 billion. Industrial products accounted for $9.3 billion of these exports. Among the exports of industrial products, processed minerals such as primary aluminum, refined tin, nickel matte, cement, and fertilizer materials amounted to $1.1 billion. Exports of minerals other than crude petroleum and natural gas

TABLE 6

INDONESIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987	1988[p]
METALS						
Aluminum:						
Bauxite, gross weight	thousand tons	1,003	830	650	635	513
Metal, primary		198,960	216,820	218,772	201,402	185,112
Chromite sand, dry basis		—	—	—	—	7,636
Copper, mine output, Cu content		82,503	88,742	95,781	102,058	121,472
Gold, mine output, Au content[2]	troy ounces	78,677	[r]84,687	[r]102,820	114,433	152,104
Iron and steel:						
Iron sand, dry basis		82,997	130,930	153,271	193,986	202,748
Metal:						
Ferroalloys, ferronickel		22,774	23,789	22,554	8,354	24,324
Steel, crude		1,000,000	1,200,000	1,500,000	1,453,000	2,050,000
Manganese ore		12,267	[r]33,496	[r]6,612	1,855	10,278
Nickel:						
Mine output, Ni content[3]		47,604	40,336	[r]53,679	57,564	57,694
Metallurgical products:						
Matte: Ni content		22,815	24,946	27,975	26,508	25,179
Ferronickel: Ni content		4,826	4,802	4,548	1,683	4,905
Silver, mine output, Ag content	thousand troy ounces	[r]1,247	[r]1,232	1,498	1,623	1,979
Tin:						
Mine output, Sn content		23,223	21,759	[r]24,910	26,217	30,589
Metal		22,467	20,909	[r]22,083	24,200	28,366
INDUSTRIAL MINERALS						
Asbestos[e]		([4])	([4])	([4])	([4])	([4])
Cement, hydraulic	thousand tons	8,907	10,081	10,941	11,844	12,242
Clays:						
Bentonite		12,505	[r]6,111	5,730	7,171	3,791
Kaolin powder		83,414	[r]106,877	[r]132,240	112,046	139,799
Diamond:[e]						
Industrial stones	thousand carats	22	22	22	22	22
Gem	do.	5	5	6	7	7
Total	**do.**	**27**	**27**	**28**	**29**	**29**
Gypsum		712	622	532	1,367	894
Iodine	kilograms	24,970	13,416	5,790	8,227	9,753
Nitrogen: N content of ammonia		1,658,200	2,057,300	2,298,500	2,363,900	2,366,700
Phosphate rock		1,917	525	[r]608	2,592	411
Salt, all types	thousand tons	370	[e]600	[e]600	[e]600	[e]600
Stone:						
Dolomite		3,558	1,500	—	38,492	70,043
Granite	thousand tons	1,583	1,421	[r]1,422	1,181	1,122
Limestone[5]	do.	11,314	11,770	12,784	15,571	12,630
Marble	square meters	16,108	9,699	3,530	8,134	2,139
Quartz sand and silicon stone		541,827	682,125	782,620	821,563	421,126

See footnotes at end of table.

TABLE 6—Continued

INDONESIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987	1988[p]
INDUSTRIAL MINERALS—Continued						
Sulfur, elemental[6]		4,999	4,023	4,525	3,941	3,411
Zeolite		—	—	—	—	626
MINERAL FUELS AND RELATED MATERIALS						
Asphalt rock, natural		471,239	450,633	242,055	84,889	—
Coal	thousand tons	1,468	1,942	2,601	2,834	4,453
Gas, natural:						
Gross	million cubic feet	1,521,450	1,580,012	[r]1,628,860	1,731,083	1,846,861
Marketed	do.	1,386,051	1,148,628	1,113,286	1,188,358	1,312,090
Petroleum:						
Crude including field condensate	thousand 42-gallon barrels	516,990	483,768	[r]507,228	479,057	491,286
Refinery products:						
Gasoline	do.	21,879	23,619	28,119	30,007	[e]32,000
Jet fuel	do.	4,923	3,845	1,631	3,763	[e]4,000
Kerosene	do.	39,141	38,383	43,043	42,207	[e]43,000
Distillate fuel oil	do.	43,935	50,060	73,490	77,355	[e]76,000
Residual fuel oil	do.	67,160	19,006	30,221	42,245	[e]45,000
Lubricants	do.	93	1,263	1,574	1,574	[e]1,600
Liquefied petroleum gas	do.	674	2,101	2,787	3,905	[e]4,000
Paraffin wax	do.	32	79	116	152	[e]150
Naphtha	do.	14,736	17,148	17,306	17,309	[e]17,300
Unfinished oil requiring further processing	do.	1,032	25,710	22,621	1,663	[e]2,000
Unspecified	do.	3,678	24,150	2,533	1,806	[e]3,000
Refinery fuel and losses	do.	2,251	8,527	10,004	12,790	[e]12,000
Total	**do.**	**199,534**	**213,891**	**233,445**	**234,776**	**[e]240,050**

[e]Estimated. [p]Preliminary. [r]Revised.
[1]Table includes data available through July 25, 1989.
[2]Includes Au content of copper ore and output by Government-controlled foreign contractors' operations. Gold output by operators of so-called People's mines and illegal small-scale mines is not available but may be as much as 15 tons per year.
[3]Includes a small amount of cobalt that is not recovered separately.
[4]Revised to zero.
[5]Data represent 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.
[6]Sulfur produced by other than the Frasch process.

were $349 million, and exports of oil and gas totaled $7.7 billion. Export earnings from oil and gas were lower in 1988 because of reduced export volumes and increased consumption of crude oil by domestic oil refineries.

As a result of further liberalization of imports by the Government in 1988, total imports rose slightly to $13.5 billion of which 38% was machinery and transport equipment, 19% chemicals, 16% manufactured goods, 9% raw materials, 7% mineral fuels, and 11% other products.

To meet domestic requirements, Indonesia also imported a large amount of gypsum, phosphate rock, pyrite, and sulfur for its fertilizer and cement industries and a considerable amount of alumina, refined copper, and zinc for its metal manufacturing and fabricating industries. Other imports of minerals included asbestos, barite, bentonite, dolomite, feldspar, iron ore, kaolin, magnesite, molybdenum, and talc.

In 1988, Japan remained the largest trade partner of Indonesia and accounted for 42% of Indonesia's exports and 26% of its imports, followed by the United States accounting for 16% of

TABLE 7

INDONESIA: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1985	1986	Destinations, 1986: United States	Destinations, 1986: Other (principal)
METALS				
Aluminum:				
Ore and concentrate	631,763	525,811	—	All to Japan.
Oxides and hydroxides	2,803	1,669	—	Do.
Metal including alloys:				
Scrap	19	45	—	Do.
Unwrought	238,708	174,048	—	Japan 158,552; Netherlands 8,500.
Semimanufactures	534	54,138	132	Singapore 53,230.
Copper:				
Ore and concentrate	204,421	298,584	—	Japan 275,218; Republic of Korea 13,945.
Metal including alloys, all forms	405	437	—	Japan 140; Singapore 103.
Iron and steel:				
Iron ore and concentrate excluding roasted pyrite	12,000	—		
Metal:				
Scrap	484	6,625	—	Japan 5,595.
Pig iron, cast iron, related materials	86,542	96,392	—	India 43,567; Japan 28,600; Malaysia 15,225.
Ferroalloys, unspecified	—	168	([2])	Mainly to Japan.
Steel, primary forms	19,921	136,101	7,640	Japan 95,616; Malaysia 22,349.
Semimanufactures:				
Bars, rods, angles, shapes, sections	94,889	88,901	38,051	China 40,582; Hong Kong 9,671.
Universals, plates, sheets	50	16,699	8,079	Japan 8,607.
Tubes, pipes, fittings	r1,000	1	—	NA.
Castings and forgings, rough	898	820	—	Singapore 554; Vietnam 266.
Unspecified	—	2	—	All to Republic of Korea.
Lead:				
Ore and concentrate	485	—		
Metal including alloys, all forms	442	122	—	Japan 53.
Manganese: Ore and concentrate[3]	30,665	4,959	—	NA.
Nickel:				
Ore and concentrate	626,745	963,198	34,950	Japan 928,248.
Matte and speiss	54,004	54,315	—	Japan 44,188; Netherlands 8,380.
Tin:				
Ore and concentrate	3,240	4,694	—	All to Malaysia.
Metal including alloys:				
Unwrought	21,104	23,804	—	Singapore 15,199; Netherlands 6,025.
Semimanufactures	50	—		
Zinc:				
Ore and concentrate	1,565	—		

See footnotes at end of table.

TABLE 7—Continued

INDONESIA: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1985	1986	Destinations, 1986	
				United States	Other (principal)
METALS—Continued					
Zinc—Continued					
Metal including alloys:					
Scrap		599	2,478	—	Japan 2,290.
Unwrought		—	150	—	All to Philippines.
Semimanufactures		10	—		
Other:					
Ores and concentrates		86,102	752	—	All to Singapore.
Ashes and residues		263	563	—	Singapore 443; Japan 120.
INDUSTRIAL MINERALS					
Abrasives, n.e.s.:					
Natural: Corundum, emery, pumice, etc.		2,802	15,650	—	Hong Kong 13,664.
Grinding and polishing wheels and stones		79	278	—	Hong Kong 247.
Barite and witherite		3,591	—		
Cement		870,931	1,699,810	—	Bangladesh 857,210; Singapore 267,180; Sri Lanka 251,342.
Clays, crude		38,116	49,029	—	Japan 11,004; Thailand 8,330; Singapore 3,090.
Fertilizer materials: Manufactured:					
Ammonia		220,250	273,370	—	Republic of Korea 79,600; Philippines 76,265; India 48,339.
Nitrogenous		684,504	1,536,826	30,000	China 400,324; Philippines 223,384; Thailand 178,113.
Phosphatic		—	120	—	NA.
Unspecified and mixed		—	4	—	All to Singapore.
Gypsum and plaster		1,839	83,935	—	Philippines 73,435; Japan 10,500.
Iodine		2	—		
Mica: Crude including splittings and waste		—	6	—	All to Singapore.
Phosphates, crude		2,200	—		
Salt and brine		—	36	—	Do.
Sodium compounds, n.e.s.: Sulfate, manufactured		4,800	—		
Stone, sand and gravel:					
Dimension stone:					
Crude and partly worked	thousand tons	1,115	1,306	—	Mainly to Singapore.
Worked		548	255	23	Hong Kong 122; Singapore 68.
Gravel and crushed rock		314	—		
Quartz and quartzite		20,350	36,875	—	All to Japan.
Sand other than metal-bearing	thousand tons	59,284	61,693	—	All to Singapore.
MINERAL FUELS AND RELATED MATERIALS					
Coal: Anthracite and bituminous	thousand tons	1,081	999	—	Japan 332; Malaysia 228; Philippines 104.
Coke and semicoke		52,401	19,804	—	Japan 11,564; Netherlands 8,229.

See footnotes at end of table.

TABLE 7—Continued

INDONESIA: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1985	1986	Destinations, 1986	
				United States	Other (principal)
MINERAL FUELS AND RELATED MATERIALS—Continued					
Gas, natural: Liquefied	thousand tons	15,264	[4]16,250	156	Japan 15,721.
Petroleum:					
Crude	thousand 42-gallon barrels	293,886	326,648	101,586	Japan 144,469; Singapore 26,761.
Refinery products:					
Liquefied petroleum gas	do.	6,089	NA		
Mineral jelly and wax	do.	—	(2)	—	All to Japan.
Kerosene and jet fuel	do.	444	—		
Distillate fuel oil	do.	490	1,334	—	Singapore 652; Japan 529.
Lubricants	do.	[r]4	15	—	Singapore 1; unspecified 14.
Residual fuel oil	do.	15,856	34,312	8,164	Japan 25,466.
Bitumen and other residues	do.	—	243	—	Netherlands 134; Japan 69.
Petroleum coke	do.	—	53	—	Netherlands 44; Malaysia 9.

[r] Revised. NA Not available.
[1] Table prepared by Audrey D. Wilkes.
[2] Less than 1/2 unit.
[3] Includes manganiferous iron ore and concentrate.
[4] May include liquefied petroleum gas.

Indonesia's exports and 13% of imports. The total value of two-way trade between Indonesia and the United States increased slightly to $4.8 billion. The European Community (EC) countries, Malaysia, and Singapore were other important trade partners of Indonesia in 1988.

Commodity Review

***Metals.*—Aluminum and Bauxite.**—Bauxite production by P.T. Antam from the Kijang Mine on Bintan Island and other mines on nearby small islands decreased slightly from that of 1987. Exports of bauxite to Japan continued to decline as the Japanese alumina refining industry reduced its requirements, and overall exports of bauxite declined to 466,500 tons. In 1987, exports of bauxite were 583,900 tons, of which 484,000 tons went to Japan, 67,860 tons to the United States, and 32,040 tons to Venezuela. Export earnings from bauxite in 1987 and 1988 were valued at $7.3 million and $5.5 million, respectively. In 1987, Indonesia imported 265,700 tons of alumina, principally from Australia, to meet the annual requirements for its aluminum smelter at Kuala Tanjung in North Sumatra. The alumina imports in 1987 were valued at $48 million.

Production of primary aluminum by IN-ALUM's smelter at Kuala Tanjung reportedly dropped to 185,000 tons owing to power shortages caused by a lower level of water at Lake Toba where the smelter's hydroelectric powerplant is based. IN-ALUM made its first operational profit of $50 million in 1987 owing to higher prices of primary aluminum in the world market. Despite a further improvement in the world's aluminum market in 1988, exports of primary aluminum declined to 104,800 tons from 144,100 tons in 1987 mainly because of a 2-month suspension of shipments to Japan. The suspended shipments of July and August were caused by a dispute between the Government shareholders of IN-ALUM and their Japanese partners about the allocation of the smelter's output.

In July, the chairman of the Asahan Aluminum Authority ordered IN-ALUM to suspend shipments to Japan and demanded negotiations with their Japanese partners. This would reallocate the smelter's output based on a new formula that would raise Indonesia's share to 60% from one-third of the total output as originally set by the master agreement of the 1970's. The new formula proposed by Indonesia was to allocate one-third of the smelter's output for Indonesia's domestic market first, then distribute the remaining two-thirds between the two parties according to their 1987 equity shares.

In 1987, IN-ALUM underwent a

TABLE 8

INDONESIA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1985	1986	Sources, 1986	
			United States	Other (principal)
METALS				
Alkali and alkaline-earth metals	427	2	—	Singapore 1.
Aluminum:				
Ore and concentrate	112	8	—	Netherlands 6; United Kingdom 2.
Oxides and hydroxides	225,864	303,496	210	Australia 275,678; Japan 19,308.
Metal including alloys:				
Scrap	20	8	—	Singapore 7.
Unwrought	11,987	9,551	([2])	Canada 4,115; Australia 3,937.
Semimanufactures	110,947	23,772	114	Japan 3,852; Singapore 3,782; Canada 3,355.
Arsenic: Oxides and acids	75	NA		
Beryllium: Metal including alloys, all forms	—	167	—	West Germany 94; Japan 74.
Chromium:				
Ore and concentrate	237	43	—	Mainly from Japan.
Oxides and hydroxides	180	515	147	United Kingdom 161; Japan 86.
Cobalt: Oxides and hydroxides	33	27	9	Singapore 7; Belgium-Luxembourg 5.
Copper:				
Ore and concentrate	100	—		
Matte and speiss including cement copper	16	27	8	Norway 10; Hong Kong 9.
Sulfate	314	NA		
Metal including alloys:				
Scrap	250	2,127	—	Singapore 2,027.
Unwrought	16,297	18,294	2	Zambia 7,129; Chile 4,270; Japan 4,208.
Semimanufactures	7,748	7,298	52	Japan 3,262; West Germany 1,185.
Gold: Metal including alloys, unwrought and partly wrought thousand troy ounces	11	NA		
Iron and steel:				
Iron ore and concentrate:				
Excluding roasted pyrite	132,850	754	—	Malaysia 709.
Pyrite, roasted thousand tons	1,188	1,669	—	Brazil 896; Sweden 773.
Metal:				
Scrap	190,903	475,558	91,998	Singapore 147,283; Australia 114,176.
Pig iron, cast iron, related materials	80,604	100,826	936	Malaysia 69,942; U.S.S.R. 13,500; Mozambique 11,445.
Ferroalloys:				
Ferromanganese	13,465	15,696	—	Australia 7,210; Mozambique 2,977.
Ferrosilicon	9,650	NA		
Unspecified	1,651	9,468	([3])	Mozambique 3,685; Australia 2,208; Philippines 1,020.
Steel, primary forms	43,474	93,400	[4]9	Brazil 39,267; Australia 30,120; Belgium-Luxembourg 19,814.

See footnotes at end of table.

TABLE 8—Continued

INDONESIA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1985	1986	Sources, 1986: United States	Sources, 1986: Other (principal)
METALS—Continued				
Iron and steel—Continued				
Metal—Continued				
Semimanufactures:				
Bars, rods, angles, shapes, sections	114,872	95,035	635	Japan 69,721; Republic of Korea 7,647.
Universals, plates, sheets	753,639	790,544	5,392	Japan 678,583; Republic of Korea 40,696.
Hoop and strip	9,428	7,717	5	Republic of Korea 3,611; Australia 910; Japan 841.
Rails and accessories	5,754	5,399	—	Japan 3,099; Australia 694; United Kingdom 618.
Wire	14,360	14,954	6	Japan 3,756; Republic of Korea 3,465.
Tubes, pipes, fittings	164,867	167,493	5,323	Japan 131,070; Republic of Korea 11,264.
Castings and forgings, rough	6,458	4,422	574	Japan 929; Singapore 865; Australia 318.
Lead:				
Oxides	814	1,243	—	Mexico 482; Australia 292; China 200.
Metal including alloys				
Scrap	84	161	—	Australia 60.
Unwrought	13,170	15,144	16	Australia 12,358.
Semimanufactures	—	519	20	West Germany 469.
Magnesium: Metal including alloys, all forms	116	145	18	Norway 89; Malaysia 16.
Manganese:				
Ore and concentrate	1,152	1,170	—	Singapore 1,050; United Kingdom 90.
Oxides	13,863	17,672	232	Singapore 12,302; Japan 4,468.
Mercury 76-pound flasks	1,173	5,192	—	Japan 3,133; China 1,131.
Molybdenum: Metal including alloys, all forms	1	1	—	Mainly from Netherlands.
Nickel:				
Ore and concentrate	—	1	—	All from West Germany.
Matte and speiss	—	26	—	Japan 15; Finland 10.
Metal including alloys:				
Unwrought	8	—		
Semimanufactures	1,544	59,770	74	Australia 57,759.
Platinum-group metals: Metals including alloys, unwrought and partly wrought value, thousands	$20	$13	—	Austria $8; Australia $5.
Rare-earth metals including alloys, all forms	4	NA		
Silver:				
Ore and concentrate value, thousands	—	$4	$2	France $2.
Metal including alloys, unwrought and partly wrought do.	$23	$34	—	All from Japan.
Tin:				
Oxides	3	—		
Metal including alloys, all forms	103	24	3	West Germany 7; Japan 5.

See footnotes at end of table.

TABLE 8—Continued

INDONESIA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1985	1986	Sources, 1986: United States	Sources, 1986: Other (principal)
METALS—Continued				
Titanium: Oxides	13,787	12,749	2,427	Japan 5,044; Australia 2,362.
Tungsten:				
Ore and concentrate	—	148	—	Australia 147.
Metal including alloys, all forms	4	12	1	Netherlands 7.
Uranium and/or thorium:				
Oxides and other compounds	109	NA		
Metal including alloys, all forms	17	NA		
Vanadium: Oxides and hydroxides	24	NA		
Zinc:				
Ore and concentrate	—	4	—	All from Australia.
Oxides	747	765	16	China 237; Republic of Korea 225.
Metal including alloys:				
Scrap	495	392	—	Canada 250; Singapore 121.
Unwrought	50,612	48,558	55	Australia 40,726; Canada 3,409.
Semimanufactures	1,333	1,110	20	Republic of Korea 400; Australia 154; Singapore 120.
Other:				
Ores and concentrates	1,819	1,845	—	Malaysia 1,727.
Ashes and residues	16	32	—	Mainly from Singapore.
Base metals including alloys, all forms	117	103	—	Hong Kong 35; Japan 28; China 23.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	212	706	34	China 241; Japan 213.
Artificial:				
Corundum	19,613	167	—	Japan 165.
Silicon carbide[5]	104	NA		
Grinding and polishing wheels and stones	2,032	3,943	55	China 2,149; Japan 592.
Asbestos, crude	8,149	11,186	1,077	Canada 5,205; Mozambique 1,510.
Barite and witherite	67,536	57,959	52	Thailand 54,959.
Boron materials:				
Crude natural borates	448	17	—	All from West Germany.
Oxides and acids	1,375	300	144	France 36; United Kingdom 36.
Bromine	540	NA		
Cement	14,905	6,308	187	Thailand 1,410; Singapore 1,387.
Chalk	534	1,383	—	NA.
Clays, crude	59,079	50,617	31,114	Japan 5,140; Australia 2,990; India 2,506.
Cryolite and chiolite	2	69	—	United Kingdom 68.
Diatomite and other infusorial earth	637	769	561	Japan 177.
Feldspar, fluorspar, related materials	6,872	12,504	160	China 8,089; Japan 2,511.

See footnotes at end of table.

TABLE 8—Continued

INDONESIA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1985	1986	Sources, 1986: United States	Sources, 1986: Other (principal)
INDUSTRIAL MINERALS—Continued				
Fertilizer materials:				
Crude, n.e.s.	2,695	2,934	109	West Germany 2,745.
Manufactured:				
Ammonia	21	76	2	Japan 69.
Nitrogenous	97,200	3,349	26	Spain 2,000; West Germany 1,040.
Phosphatic	7,189	7,809	6	West Germany 5,769; Belgium-Luxembourg 1,300.
Potassic	311,674	92,123	12	Canada 71,865; Jordan 15,700.
Unspecified and mixed	13,264	30,300	304	Republic of Korea 9,854; Belgium-Luxembourg 8,800.
Graphite, natural	150	968	—	Republic of Korea 856.
Gypsum and plaster	304,939	197,530	7	Australia 105,488; Thailand 67,129.
Iodine	36	NA		
Kyanite and related materials	4	NA		
Lime	416	180	1	Singapore 139.
Magnesium compounds:				
Magnesite, crude including calcined	4,614	8,641	40	Hong Kong 3,809; China 2,190; Japan 1,209.
Oxides and hydroxides	3,153	NA		
Mica:				
Crude including splittings and waste	909	599	36	China 287; Japan 55; Singapore 46.
Worked including agglomerated splittings	107	49	9	Japan 35.
Nitrates, crude	9,265	836	—	All from Chile.
Phosphates, crude	817,431	717,572	32,525	Jordan 374,530; Morocco 201,763.
Pigments, mineral:				
Natural, crude	222	—		
Iron oxides and hydroxides, processed	4,536	4,766	2	West Germany 1,551; China 1,472.
Potassium salts, crude	—	29	—	All from Belgium-Luxembourg.
Precious and semiprecious stones other than diamond: Synthetic value, thousands	—	$6	—	All from United Kingdom.
Pyrite, unroasted	([3])	108	—	All from Republic of Korea.
Salt and brine	26,830	60,887	64	Australia 59,834.
Sodium compounds, n.e.s.:				
Carbonate, manufactured	145,119	151,326	77,124	France 16,747; Kenya 16,350; Japan 13,791.
Sulfate, manufactured	11,229	NA		
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked	12,283	2,260	—	Italy 1,437; China 221; Hong Kong 186.
Worked	5,870	5,493	17	Italy 1,272; Malaysia 397.

See footnotes at end of table.

TABLE 8—Continued

INDONESIA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1985	1986	Sources, 1986 United States	Sources, 1986 Other (principal)
INDUSTRIAL MINERALS—Continued				
Stone, sand and gravel—Continued				
Dolomite, chiefly refractory-grade	8,155	7,075	—	United Kingdom 3,175; West Germany 1,471.
Gravel and crushed rock	769	1,378	20	France 988; United Kingdom 166.
Limestone other than dimension	2,941	22	—	Malaysia 18; Singapore 4.
Quartz and quartzite	249	191	([3])	France 83; Sweden 56; China 20.
Sand other than metal-bearing	7,372	1,496	382	Japan 321; Singapore 161.
Sulfur:				
Elemental:				
Crude including native and byproduct	2,624	10,844	([3])	China 8,700; Republic of Korea 1,035.
Colloidal, precipitated, sublimed	182,619	221,404	50	Canada 184,432; Singapore 27,207.
Dioxide	7	NA		
Sulfuric acid	70	103	2	Singapore 83.
Talc, steatite, soapstone, pyrophyllite	13,386	27,722	141	China 19,851; Hong Kong 2,464.
Other:				
Crude	27,069	28,666	—	West Germany 21,780; East Germany 4,243.
Slag and dross, not metal-bearing	3,169	28,907	([3])	Japan 28,281.
MINERAL FUELS AND RELATED MATERIALS				
Asphalt and bitumen, natural	4,489	936	167	Singapore 350; Japan 325.
Carbon black	27,943	34,227	141	Australia 12,084; Thailand 3,826; Republic of Korea 3,140.
Coal:				
Anthracite and bituminous	15,388	335,038	54	Australia 334,737.
Briquets of anthracite and bituminous coal	29,970	—		
Lignite including briquets	475	562	264	Japan 178.
Coke and semicoke[6]	29,774	30,897	31	Japan 17,117; Australia 5,353.
Peat including briquets and litter	39	38	—	All from Singapore.
Petroleum:				
Crude thousand 42-gallon barrels	26,739	27,837	—	All from Saudi Arabia.
Partly refined do.	147	NA		
Refinery products:				
Liquefied petroleum gas do.	3	([3])	([3])	Mainly from Singapore.
Gasoline do.	126	330	—	All from Singapore.
Mineral jelly and wax do.	86	96	([3])	China 53; West Germany 12.
Kerosene and jet fuel do.	[7]3,000	3,378	1	Singapore 3,373.
Distillate fuel oil do.	1,111	4,993	([3])	Singapore 4,964.
Lubricants do.	70	389	186	Italy 70; Singapore 43.
Nonlubricating oils do.	57	NA		
Residual fuel oil do.	4,342	3,559	26	Singapore 3,510.

See footnotes at end of table.

TABLE 8—Continued

INDONESIA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1985	1986	Sources, 1986 United States	Sources, 1986 Other (principal)
MINERAL FUELS AND RELATED MATERIALS—Continued					
Petroleum—Continued					
Refinery products—Continued					
Bitumen and other residues	thousand 42-gallon barrels	1,422	1,190	(3)	Singapore 850.
Bituminous mixtures	do.	27	14	1	Singapore 8.
Petroleum coke	do.	296	303	302	NA.

NA Not available.
1 Table prepared by Audrey D. Wilkes.
2 Unreported quantity valued at $27,000.
3 Less than 1/2 unit.
4 Excludes unreported quantity valued at $62,000.
5 Includes boron carbide.
6 May include gas carbon.
7 Includes 3,000 barrels of white spirit.

complicated capital restructuring program to reduce its heavy debt burden caused by the appreciation of the Japanese yen and the low price of primary aluminum in the past several years. In the process, the Government of Indonesia converted its loan into equity, the Japanese loan was refinanced with a lower interest rate and longer repayment period, and new capital was injected by the Government of Indonesia and the Japanese partners. As a result, Indonesia raised its stake to 41% from 25%, and Nippon Asahan Aluminum Co. of Japan reduced its share to 59% from 75%.

The first negotiations between Indonesian Government shareholders and their Japanese partners for reallocating the smelter's output failed in August. In September, after the two Governments agreed to conduct further talks, Indonesia's Government permitted IN-ALUM to resume shipments to Japan. In December, officials from the Indonesian and Japanese Governments met in Jakarta to find solutions for ending the dispute. However, the issue remained unresolved at yearend.[24]

According to an Indonesian industry source, domestic demand for primary aluminum was estimated at 50,000 tons in 1988 and was expected to double in 1990 or 1991 when the $28 million aluminum casting facility is completed. The plant, to be built near IN-ALUM's smelter at Kuala Tanjung, would have an initial capacity of 35,000 tons of extrusion billets per year and 20,000 tons of foundry alloys per year. The plant will be operated by P.T. Asahan Aluminum Alloys (P.T. AAA). P.T. AAA, established in June 1987, was owned jointly by two Indonesian firms, P.T. Gesit Maju (40%) and P.T. Aluminum Development Corp. (20%), and Inter Asia Commodities Ltd. of the United Kingdom (40%).[25]

Chromite.—Indonesia completed construction of its first chromite sand mine and processing facilities in the Wosu area along the east coast of Central Sulawesi in March. The facilities were owned and operated by two Indonesian companies, P.T. Palmabim Mining and P.T. Bituminusa. The companies received technical assistance from Girond Ltd. of the United Kingdom and financial backing from Elders Resources Finance Group of Australia. The total cost of the mining and processing facilities was $3 million.

The chromite treatment plant at Wosu included a concentrator, a wood-fired rotary dryer, a high-tension electrostatic separator, and a magnetic separator. The treatment plant was capable of processing up to 500,000 cubic meters of chromite-bearing sand per year and producing 40,000 tons of chromite sand concentrate with a grading of 43% chromium oxide and less than 1% silica. Because the plant is modular, the capacity could be doubled if market conditions warrant. In 1988, production of chromite concentrate was about 7,600 tons. Most finished products, using the brand name Insulchrome, were exported to Australia for consumption by the iron casting and steel foundry industry.[26]

According to the company, chromite reserves covering a 30-kilometer coastline area around Wosu were estimated at 1 million tons, enough for a 20-year operation at an annual rate of 40,000 tons. P.T. Inco reportedly was also exploring for chromite in Sulawesi but has not yet discovered a commercially viable chromite deposit.

Copper.—Copper mining and milling operations by FI in the Ertsberg area of Irian Jaya achieved a record output of copper concentrate. The company's mining and milling capacity was expanded by 20% with opening of a new ore body in the Deep Ore Zone deposits under the Ertsberg East ore bodies in September and installation of a third primary ball mill and related flotation facilities at the mill in August.

According to the company's 1988 annual report, the ongoing expansion program for lowering the operating costs raised the mining and milling capacity to 22,000 tons of ore per day by the end of 1988 and will increase it further to 26,000 tons of ore per day by June 1989 and 32,000 tons per day by mid-1990. In 1989-90, FI planned to develop additional ore bodies at the DOM deposit using block cave mining and at the newly discovered Grasberg deposit using open pit mining. The total cost of the 3-year expansion program including development of new ore bodies, new milling facilities, and related infrastructure was estimated at $120 million.[27]

Ore processing averaged 17,054 tons per day in the first 6 months and reached 22,000 tons per day by yearend. Production of copper, gold, and silver contained in 292,000 tons of copper concentrate was 121,473 tons, 113,000 troy ounces, and 1,612,000 troy ounces, respectively. Despite the lower prices of gold and silver, FI's revenues rose to $335 million from $190 million in 1987 owing to increased exports and the higher market price of copper. The average market price of copper, gold, and silver was $1.27 per pound, $423.56 per troy ounce, and $6.32 per troy ounce, respectively, compared with $0.85 per pound, $441.73 per troy ounce, and $6.74 per troy ounce, respectively, in 1987.

As a result of ongoing exploration in its contract area, FI discovered a significant copper and gold ore body, named the Grasberg deposit, about 2.5 kilometers north of the existing Ertsberg East Mine in Irian Jaya. Following delineation drilling of 35 test holes on a 50-acre area of the 1,000-acre Grasberg prospect in 1988, FI announced that proven and probable ore reserves at Grasberg were estimated at 92 million tons of ore containing 2.9 billion pounds of copper, 4.5 million troy ounces of gold, and 7.2 million troy ounces of silver. As of December 31, 1988, FI's proven and probable ore reserves in its contract area were estimated at 185 million tons of ore containing about 6.4 billion pounds of copper, 5.8 million pounds of gold, and 27.4 million pounds of silver.[28]

After discovery of the Grasberg deposit, FI reportedly was conducting a feasibility study to expand its mill capacity to at least 50,000 tons of ore per day to handle additional ore production from the Grasberg deposit in 1990 or 1991. The result of the feasibility study was expected to be announced in the first half of 1989. FI, however, has no plans to expand its mining and milling operation downstream to copper smelting and refining.

FI was 85.39% owned by Freeport-McMoRan Copper Co. Inc., a 77%-owned subsidiary of Freeport-McMoRan Inc. of the United States; 8.95% by the Government of Indonesia; and 5.66% by Norddentsche Affineric of the Federal Republic of Germany and Fairchild Holdings Ltd. of the United States. In 1987, employees at FI's Ertsberg copper operation numbered 2,900, of which 85% were Indonesian. Exports of copper concentrate, valued at $159.2 million, totaled 250,769 tons, of which 88% went to Japan, 8% to Canada, and 4% to China in 1987.

Gold.—The overall gold production in 1988 was estimated to have reached 146,000 troy ounces, breaking the record-high level of 114,433 troy ounces (revised) in 1987. Gold that FI recovered as a byproduct from the Ertsberg copper mine at Tembagapura in Irian Jaya rose to 113,000 troy ounces from 92,000 troy ounces in 1987. Gold produced by P.T. Lusan Mining from the Lebong Tandai gold-silver mine in North Bengkulu, South Sumatra, rose to 28,000 troy ounces from 17,300 troy ounces (revised) in 1987. However, gold produced by P.T. Antam from the Cikotok gold-sliver mine in South Banten, West Java, declined to less than 5,000 troy ounces in 1988 because of the depleting ore reserves. Additionally, up to 15 tons of gold per year reportedly had been produced by small-scale people's mines and by about 150,000 illegal miners mainly in Kalimantan, Sulawesi, and Sumatra in 1987-88.[29]

Following the lifting of the gold export ban by the Government in 1986, gold exports were expected to reached a record-high level in 1988. According to the Department of Mines and Energy, exports for the first 9 months of 1988 were more than 16 tons compared with 12 tons for all of 1987. However, according to the Central Bureau of Statistics, gold exports in 1987 were 19.8 tons and were valued at $275 million. Almost all of the refined gold exports in 1987 went to Singapore, and most of the gold contained in copper concentrate went to Japan.

Among the 103 contractors exploring for gold in Indonesia, 2 went into gold production by 1988, and 1 is expected to begin production in 1989. Additionally, two other gold projects based on management contracts between Indonesian private mining companies and a foreign company were also expected to start gold production in 1989.

In late 1988, P.T. Ampalit Mas Perdana began gold production at Kasongan in the East Waringin area of Central Kalimantan. According to Pelsart Resources NL, one of the majority owners of the project, gold reserves at the mining area were estimated to have 16.4 million cubic meters of ore averaging 233 milligrams of gold per cubic meter and was expected to produce about 18,000 troy ounces of gold annually for the next 6 years beginning in 1989.

In late 1988, P.T. Ampalit Mas Perdana began gold production at Kasongan in the East Waringin area of Central Kalimantan. According to Pelsart Resources NL, one of the majority owners of the project, gold reserves at the mining area are estimated to have 16.4 million cubic meters of ore averaging 233 milligrams of gold per cubic meter and was expected to produce about 18,000 troy ounces of gold annually for the next 6 years beginning in 1989. This project was an Indonesia-Australia joint venture. The contractor, who signed a Contract of Work with the Government in December 1986 and completed a feasibility study in 1987, was the first contractor to produce gold in Kalimantan.

P.T. Monterado Mas Mining reportedly was expected to begin gold production at Monterado in the Sambas area of West Kalimantan in 1989. After signing a contract of work with the Government in December 1986, the company started construction of two 400-ton-per-hour flotation plants and a concentrate upgrading plant near the mine site in 1988. The concentrate upgrading plant was expected to produce 17,000 troy ounces of doré bullion annually for 12 years starting in May 1989. According to the Department of Mines and Energy, gold reserves in the two Monterado mining areas were estimated at 66.1 million cubic meters of ore averaging 143 milligrams of gold per cubic meter and 35.9 million cubic meters of ore averaging 193 milligrams of gold per cubic meter, respectively. The gold project was a joint venture of BP Minerals International Ltd. of the United Kingdom (70%), the International Finance Corp. of Washington, DC (20%), and P.T. Prima Searco of Indonesia (10%). In June 1987, the company reportedly relinquished part of its 128,000-acre contract area in West Kalimantan.

P.T. Ara Tutu, was expected to produce gold jointly with Indo Pacific Resources NL of Australia in 1989. The company formerly had a joint-venture agreement with Abaleen Minerals NL of Australia for gold exploration in the Woyla River area of Aceh in North Sumatra in 1985. Indo Pacific Resources, had signed a Contract of Work with the Government in December 1986 under P.T. Krueng Mesen Minerals, a joint venture of Indo Pacific Resources (60%), Advocate Holding Pty. Ltd. of Australia (25%), and P.T. Aneka Aceh Subur of Indonesia (15%). The company had proven reserves of 11.5 million cubic meters of ore averaging 0.29 grams of gold per ton and 20 million cubic meters of probable reserves in the Woyla River area of Aceh in North Sumatra. Indo Pacific Resouces, which completed construction of a floating treatment plant at the Marisa alluvial deposit in North Sulawesi in 1988, is expected to start gold production in 1989.

P.T. Indo Muro Kencana, which signed a contract with the Government for gold exploration in the Barito area of Central Kalimantan in February 1985, conducted a feasibility study in 1988. Pattern drilling at the Luit and Gunung Baruh prospects in the contract area indicated 3 million tons of ore reserves averaging 7.7 grams of gold and 148 grams of silver per ton. The exploration work in the area reportedly had been impeded by about 8,500 illegal miners in 1987. P.T. Indo Muro Kencana was a joint venture involving several parties: Duval Corp.(Indonesia), a subsidiary of Pennzoil Co. of the United States (60%); Pelsart Pty. Ltd. (20%) and Jason Mining Ltd. (10%) of Australia; and P.T. Gunung Muro Perkasa (10%) of Indonesia.

P.T. Sungai Kencana, which signed a contract with the Government in February 1985 for gold exploration in the Pontianak area of West Kalimantan, let a feasibility study for the Sungai Raya alluvial prospect in March 1988. The Sungai Raya placer deposit identified in the contract area in 1987 reportedly has sufficient gold reserves with ore grade ranging from 146 milligrams of gold per cubic meter to 224 milligrams per cubic meter. P.T. Sungai Kencana was a joint venture of Duval Alluvial Mining Inc. (50%) of the United States, Pelsart Mandor Pty. Ltd. (25%) of Australia, P.T. Amsya Lyna (15%) of Indonesia, and Jimberlaya Minerals Ltd. (10%) of Hong Kong.

P.T. Prima Lirang Mining, which signed a contract with the Government in December 1986, planned to conduct a feasibility study for developing a gold and silver mine on Wetar Island in Southeast Maluku in early 1989. Exploratory drilling in 1987–88 on Wetar Island, north of East Timor, indicated ore reserves were sufficient to support a mine with an annual production of up to 600,000 tons of ore containing about 60,000 troy ounces of gold and 1.1 million troy ounces of silver. P.T. Prima Lirang Mining was originally owned by Wetar Minerals Pty. Ltd. (90%), a subsidiary of Australia's CSR Group Companies, and P.T. Prima Maluku Indah (10%) of Indonesia. In 1988, CSR sold its interest to Billiton Metals Inc. of the United States, which was a subsidiary of the Royal Dutch/Shell Group Companies of the Netherlands.

P.T. Kelian Equatorial Mining, which signed a contract with the Government for gold exploration in the Kabupaten Kutai area of East Kalimantan reportedly planned to conduct a feasibility study for developing a gold mine at the Kelian prospect in the Kabupaten Kutai area. According to an estimate by CRA Kelian Pty. Ltd., a majority owner of the project, gold reserves in the Kelian deposit have 3.7 million tons of oxide ore averaging 2.3 grams of gold per ton and 27 million tons of sulfate ore averaging 2.2 grams of gold per ton. P.T. Kelian Equatorial Mining was originally owned by CRA Kelian (90%) of Australia and P.T. Buana Jaya Raya (10%) of Indonesia. In 1986, CRA Kelian sold 9.5% of its interest to New Zealand Goldfields Investment Ltd. of the United Kingdom and 22% to Clarement Petroleum of

Australia. Clarement Petroleum then transferred its interest to Kalimantan Gold Pty. Ltd. of Australia. In 1988, CRA reportedly sold its remaining interest in the project to Billiton Metals.

As some foreign contractors moved closer to starting gold production in Indonesia, about 44 of the 103 contractors did not meet the Government's required standard of conducting a general survey within 12 months followed by a 2-year period. According to the local press, 10 Australian contractors had either defaulted on their payment of performance bonds or had poor relations with the regional authorities and with local partners. These contractors will be required by the Government to relinquish their contract area.

In July, the Ministry of Home Affairs instructed seven Provincial Governments to eliminate illegal gold mining by confiscating equipment and encouraging prospectors to work with legal miners or contractors. To ensure successful control of the illegal mining activities by the Ministry of Home Affairs, the Department of Mines and Energy temporarily stopped accepting new applications for gold exploration in the Provinces of Bengkulu, Jambi, West Kalimantan, South Kalimantan, Central Kalimantan, East Kalimantan, and North Sulawesi, effective July 9, 1988.

The Government's efforts to control illegal mining and to protect the interests of small-scale people's mines and foreign contractors reportedly resulted in some progress in 1988. For example, a joint police and army operation in Central Kalimantan reportedly has successfully driven out illegal miners from a concession area held by an Australia-United States joint-venture company. However, according to a report by the Provincial Government of Central Kalimantan in late 1988, about 4,000 of the 20,000 illegal miners deported earlier had returned to some of the more remote Contract of Work areas.

Iron and Steel.—Iron sand produced by P.T. Antam from the mining area along the eastern shore of Cilacap in Central Java reached the highest level since that of 1977. Most iron sand production was consumed by the domestic cement industry. In 1987, only 5,500 tons of iron sand was exported to Japan. The feasibility study for building an iron sand processing plant at Kulonprogo, between the village of Bugel and Yogyakarta along the south-central coast of Java, was completed by Davy McKee Corp. of the United States in 1987. The study concluded that the project was uneconomical because of high capital investment and energy costs.

Crude steel, produced mainly by state-owned P.T. Krakatau Steel, reached a new record high as both domestic demand and exports continued to expand in 1988. The 5-year modernization and expansion program to upgrade and increase steel production of Krakatau Steel's integrated facilities moved forward in 1988. According to Krakatau Steel, bids for the $550 million project by Dravo Corp. of the United States, Siemens Aktiengesellschaft of the Federal Republic of Germany, and Kawasaki Steel Corp. and Kobe Steel Ltd. of Japan were submitted. The contract was to be awarded in 1989, and construction would start in 1990. To upgrade and increase production of sponge iron and steel products and to curb imports of steel products, Krakatau's direct-reduction plant capacity would be doubled to 4 million tons per year by converting its HYL I fixed-bed process to an HYL III continuous process. The annual capacity of the slab steel plant would be expanded to 2.5 million tons, and the annual capacity of the hot strip mill and wire rod mill would be increased to 1.8 million tons and 275,000 tons, respectively.

Nickel.—Despite a short supply and higher price of nickel on the world market in 1988, overall nickel production in Indonesia remained practically at the same level as that of 1987. Nickel ore produced by P.T. Antam from the Pomalaa area in southeastern Sulawesi and on Gebe Island in the North Moluccas decreased to 1.7 million tons from 1.9 million tons in 1987. Nickel ore produced by P.T. Inco from the Soroako area in South Sulawesi rose slightly in 1988. The two producers, benefiting from exceptionally high prices of nickel and tight market conditions, reportedly made record profits in 1988 and planned to expand their production capacity beginning in 1989.[30]

Most nickel ore produced by P.T. Antam was exported to Japan, and the remainder was used to feed its own ferronickel plant in the Pomalaa area. Exports of nickel ore reportedly rose 33% to 1.6 million tons owing to increased exports to Japan. Because of higher export prices and volume, export earnings from nickel ore in 1988 were expected to exceed $39 million. According to the Department of Mines and Energy, exports of nickel ore were 1.2 million tons (revised) in 1987, of which 90% went to Japan. To create new markets, P.T. Antam exported about 80,000 tons of ore to Australia and 20,400 tons to North Korea for trial smelting in those two countries. Export earnings in 1987 were valued at $19 million.

Ferronickel produced by P.T. Antam reached a record high in 1988 owing to a sharp increase in exports to Japan and European countries. Because of heavy damage to an old furnace, the Pomalaa ferronickel plant produced only 1,683 tons of nickel contained in 8,354 tons of ferronickel ingot in 1987. Under a special 1-year agreement, about 131,300 tons of nickel ore was shipped by P.T. Antam to Japan for toll smelting by Pacific Metals Co. Ltd., which produced 1,377 tons of nickel contained in ferronickel ingot for Indonesia in 1987. Exports of ferronickel were 2,506 tons of nickel contained in 10,604 tons of ferronickel ingot and were valued at $16.8 million in 1987. Most ferronickel toll smelted by Pacific Metals reportedly had been sold to the Japanese stainless steel producers at $6 to $7 per pound in mid-1988. Exports of ferronickel ingot reportedly rose to 4,461 tons of nickel content in 1988.

P.T. Antam, benefiting from higher export earnings of nickel in 1987–88, reported record gross profits of $28.8 million in 1988 compared with $1.8 million in 1987. In anticipation of continuing strong world demand for nickel, P.T. Antam conducted a feasibility study to double the annual capacity of its Pomalaa ferronickel plant to 10,000 tons of nickel in two stages. The cost of the expansion project was estimated at between $120 million and $150 million. The final decision for expansion would be made in 1989.

P.T. Inco, a 98% owned subsidiary of Inco Ltd. of Canada, also achieved a record-high production of nickel in matte, but the actual production was about 6,400 tons short of the planned output for 1988. The shortfall was a direct result of two factors: a 26-day production interruption in March caused by earthquake-related damage to a canal supplying water to the smelter's nearby hydroelectric powerplant and reduced capacity caused by a transformer blowout at the No. 2 furnace in December. Exports of nickel in matte totaled 28,712 tons and were valued at $299.2 million in 1988 compared with 29,603 tons and $109.2 million in 1987. Most exports were shipped to Japan for refining by Sumitomo Metal and Inco's affiliated nickel refineries in Japan, including Shimura Kako Co. Ltd. and Tokyo Nickel Co. Ltd. Because of higher nickel prices and reduced production cost, P.T. Inco made record-high operating earnings of $205 million compared with $15 million in 1987.

In July, Inco sold 20% of its equity interest in P.T. Inco to Sumitomo Metal Mining Co. Ltd. of Japan for $100 million and realized a net gain of $44.2 million. Under an agreement reached in May between the two companies, Inco was to expand the annual capacity of P.T. Inco's Soroako smelter by 31% to 47,600 tons of nickel in matte by 1990, and Sumitomo would have the right to purchase approximately 20% of the annual output from the expanded smelter. P.T. Inco reportedly started the engineering work on the expansion project in August and was expected to complete the project in mid-1990 at a cost of $80 million.[31] As of December, P.T. Inco was owned by Inco 78%, Sumitomo Metal (20.09%), and a Japanese consortium led by Mitsui & Co. and Nissho Iwai Corp. (1.91%). Proven and probable ore reserves in the Soroako area are estimated at 77.1 million tons containing 1.6 million tons of nickel.

Tin.—Indonesia displaced Malaysia as the top tin producer in Southeast Asia and became the world's second largest tin producer, accounting for 20% of the Western World production. The output of tin in concentrate was slightly more than the Government targeted level of 30,000 tons, and production of refined metal was at full capacity in 1988. Under an agreement reached by members of the ATPC in Kuala Lumpur in February, the 1988 export quota allocated to Indonesia was raised, effective March 1, 1988, until February 28, 1989, to 29,000 tons from 24,516 in 1987. Exports of refined tin reached 29,000 tons, a 30% increase from that of 1987. Indonesia reportedly was the only member, among the seven-member ATPC, meeting its export quota in 1987–88. Indonesia exported 24,241 tons of refined tin and earned $155.4 million of foreign exchange in 1987.[32]

The text table shows the tin production in Indonesia, according to the Department of Mines and Energy 1986–87, by company and area in metric tons:

Company and area	1986	1987
P.T. Tambang Timah:		
Bangka Island	12,900	12,785
Belitung Island	3,850	5,544
Singkep Island	2,900	3,306
P.T. Koba Tin:		
Bangka Island	4,682	4,042
P.T. Preussag Kelapa Kampit:		
Belitung Island	578	540
Total	**24,910**	**26,217**

P.T. Timah, the state-owned tin mining company, produced 23,919 tons of tin in concentrate, which accounted for 78% of the total tin production in 1988. However, according to the company, production costs rose by 11% to $2.87 per pound in 1988 because of higher maintenance costs and inflation. Between 1984 and 1987, P.T. Timah reduced its production costs 39% by closing some low-grade tin mines on Belitung Island and expanding production from high-grade tin deposits offshore Bangka Island. The company's work force reportedly had been reduced to 26,500 by 1987. In 1988, the company operated 13 offshore and 6 onshore suction dredges, 146 gravel pumping units, of which 16 were large scale, and 2 open pits.

P.T. Koba Tin, operated large-scale alluvial gravel pump mining and line dredging in the Koba area of Bangka Island. The company produced about 6,046 tons of tin in concentrate, which accounted for 20% of the total tin production in 1988. The company's work force was 1,550 in 1988. In April, C.S.R. Ltd. and Boral Ltd. of Australia sold their combined 75% majority interest in P.T. Koba to Renison Goldfields Consolidated Ltd. of Australia for $40 million. The remaining 25% was owned by P.T. Timah. According to P.T. Koba, ore reserves in its contract area comprised of 30,00 proven tons and an estimated total of 90,000 tons of tin.

P.T. Preussag Kelapa Kampit produced the remaining 2% or 625 tons of tin in concentrate from a partially open pit and partially underground tin mine on Belitung Island. P.T. Preussag, which took over the Contract of Work agreement with the Government from P.T. Broken Hill Pty. of Australia in 1986, was owned by Preussag AG of the Federal Republic of Germany.

In 1988, P.T. Timah took three major actions to diversify and integrate its operation. To diversify its mining operation, the company obtained a gold mining permit from the Department of Mines and Energy in February. To reduce the cost of marketing its refined tin, P.T. Timah established a joint-venture firm called Indonetal International Marketing Ltd. (IIM) with a private Indonesian company in December. To expand its downstream operation in tin solder production, the company set up a joint-venture firm called P.T. Asaflux Utama with a Singapore company in August. According to P.T. Timah, the company also planned to diversify into manufacturing pewter and tin oxides.

IIM reportedly was to market 50% of P.T. Timah's tin production and replace some former foreign marketing agencies and metal traders, which pulled out of the tin market after the October 1985 tin crisis. IIM, owned by P.T. Timah (20%) and P.T. Rajawali Perkasa Sejati (80%), was registered in Hong Kong and headquartered in Singapore.

P.T. Asaflux Utama completed construction of a tin solder plant on Batam Island near Singapore and started solder production in August. The plant initially produced 72 tons per month using imported lead and domestically produced tin. Most output of solder wire and bars was exported to the Far East market. P.T. Asaflux Utama was a joint venture of P.T. Timah and P.T. Asahi Solder Chemicals of Singapore.

***Industrial Minerals.*—Cement.**—Cement production rose to more than 12 million tons because of increased exports to the Far East market. The cement production in 1988 was equivalent to 70% of the industry's installed capacity in Indonesia. According to the Central Bureau of Statistics, cement exports rose to 3.1 million tons from 2.4 million tons in 1987, and export earnings from cement surged 35% to $75.6 million in 1988. In 1987, P.T. Indocement, Indonesia's largest cement producer, exported more than 1 million tons, which accounted for 60% of cement exports. Most cement exports in 1987 went to Bangladesh (46%), Sri Lanka (13%), Singapore (12%), and Mauritania (8%).

The table indicates, by company and location, Indonesia's cement production in thousand metric tons in 1986–87, according to the Department of Mines and Energy.

Company and location	1986	1987
P.T. Indocement, Cibinong, West Java	4,226	[1] 4,523
P.T. Semen Padang, Indarung, West Sumatra	1,294	1,311
P.T. Semen Gresik, Gresik, East Java	1,339	1,250
P.T. Semen Cibinong, Cibinong, West Java	994	1,087
P.T. Tridaya Manungal Perkasa Cement, Cirebon, West Java	749	911
P.T. Semen Tonasa, Bantimurung, South Sulawesi	813	800
P.T. Semen Nusantara, Cilacap, Central Java	766	789
P.T. Semen Andalas Indonesia, Aceh, North Sumatra	667	688
P.T. Semen Baturaja, Baturaja, South Sumatra	424	432
P.T. Semen Kupang, Kupang, East Nusatenggara	50	53
Total	**11,322**	**11,844**

[1] Includes 7,144 tons of white cement.

Diamond.—Following completion of a feasibility study, Acorn Security Ltd. of Australia reached an agreement with the Government in August to develop Indonesia's first diamond mine in the Danau Seran area of southeastern Kalimantan. Acorn reportedly had spent $6 million through its subsidiary, Acorn Diamond Indonesia Pty. Ltd., for drilling and bulk sampling in the area for the past 2 to 3 years. The estimated cost of developing a 15-kilometer alluvial diamond mine using a rehabilitated 0.5-cubic-meter dredge and draglines was about $18 million. Acorn reportedly negotiated with several potential investors for financing the diamond development project and plans to start diamond mining in 1990 or 1991.

Under an Acorn proposal, diamond mining with an initial recovery of 423,090 carats at a rate of 0.1037 carat per cubic meter during the first 5 years of operation would generate total revenues of $86.3 million. The mining operation could be expanded later to three dredges with a total operating investment of $100 million. Estimates of ore reserves in the Danau Seran area of southeastern Kalimantan show 2.6 million cubic meters of proven diamond-bearing gravel plus 16.6 million cubic meters of probable reserves and 29.8 million cubic meters of possible reserves.[33]

Another Australian company, P.T. Pelaihari Mas Utama, signed a Contract of Work with the Government in October 1987 to explore for precious metals and diamonds in South Kalimantan. The company reportedly was near the stage of conducting a feasibility study. P.T. Pelaihari Mas Utama, a joint venture of Pelsart Pelaihari Pty. Ltd. of Australia (85%) and P.T. Indoka & Co. of Indonesia, explored for diamonds in the Banjar and Tanah Laut areas of South Kalimantan.

Fertilizer Materials.—To meet the growing domestic and overseas demand for urea and ammonium sulfate, the nitrogen fertilizer sector continued to expand its production capacity. By yearend, P.T. Pupuk Kalimantan Timor (P.T. Pupuk Kaltim) completed construction in Bontang, East Kalimantan of its third unit, Kaltim III, with a designed annual capacity of 570,000 tons of urea. Kaltim III is expected to come on-stream in February 1989. In late 1988, P.T. Pupuk Sriwijaya (P.T. PUSRI), the largest state-owned fertilizer company, began renovation of its aging PUSRI I unit built in Palembang, South Sumatra in 1963. After renovation is completed in 1990, the annual capacity of PUSRI I, which was renamed PUSRI IB, will increase to 570,000 tons from 100,000 tons. According to an industry source, the Government plans to build another urea plant with a designed annual capacity of 570,000 tons either by P.T. Pupuk Kujang or P.T. Pupuk Iskandar

Muda by 1992.

The table shows Indonesia's 1987 production and annual capacity of urea, by company and location, in thousand metric tons.

Company and location	Capacity	Production
P.T. Pupuk Sriwijaya, Palembang, South Sumatra	[1]1,620	1,480
P.T. Pupuk Kujang, Tjikampek, West Java	570	552
P.T. Pupuk Asean-Aceh Fertilizer, Lhokseumawe, North Sumatra	570	572
P.T. Pupuk Iskandar Muda, Lhokseumawe, North Sumatra	570	589
P.T. Pupuk Kaltim, Bontang, East Kalimantan	[2]1,140	853
Total	**4,470**	**4,046**

[1] The annual capacity will be expanded to 2,090,000 tons in 1990.
[2] The annual capacity was expanded to 1,710,000 tons in 1988.

In addition to nitrogen fertilizer, Indonesia was capable of producing about 1 million tons of triple superphosphate per year and 650,000 tons of ammonium sulfate per year. P.T. Petrokimia Gresik, which operated a large compound fertilizer complex in Gresik, East Java, was the principal producer. However, Indonesia lacks resources of potash and phosphate rock. To meet the nutritional requirements of agricultural land, Indonesia imports annually about 350,000 tons of potassium chloride and 200,000 tons of manufactured triple superphosphate from overseas.

Most raw materials required for domestic production of triple superphosphate and other compound fertilizers were also imported. Indonesia imported 1.2 million tons of phosphate rock valued at $67 million and 379,000 tons of sulfur valued at $51 million in 1987. With abundant resources of natural gas, Indonesia was able not only to meet its requirements for nitrogen fertilizer but also to export about 640,000 tons of nitrogen fertilizer to neighboring countries in the Far East in 1987.

According to an industry source, domestic demand for urea, triple superphosphate, ammonium sulfate, and potassium chloride was estimated at 3.6 million tons, 1.5 million tons, 584,000 tons, and 360,000 tons, respectively, in 1988.

Mineral Fuels.—**Coal.**—Coal production rose sharply and reached a record-high level in 1988 because of increased output by two state-owned coal mining companies operated in West and South Sumatra by three foreign contractors, which began operation in West Sumatra and South and East Kalimantan in 1988. Exports of coal surged by 46% to 1.3 million tons, and export earnings rose 48% to $38 million in 1988.

Coal production by state-owned Perum Tambang Batubara at the Ombilin Mine in West Sumatra rose to 559,000 tons from 506,000 tons in 1987, but was still below its capacity because of mechanical problems. Coal production at Ombilin came from the Tanah Hitman open pit and the Sawan Rasau V underground operations developed under the stage 1 expansion project in 1985. A feasibility study for developing underground mines at Waringin and Northwest Sugar under the stage 2 expansion project reportedly was completed by Norwest Resources Consultants Ltd. of the United States in 1988. Stage 2 coal production with longwall mining at an annual rate of 750,000 tons was expected to begin in 1994. Financing and contracting for stage II has not yet been negotiated.[34]

Coal produced by P.T. Tambang Batubara Bukit Asam from its Air Laya open pit at Bukit Asam, South Sumatra, rose to 1.9 million tons from 1.4 million tons in 1987. An integrated part of the Bukit Asam expansion program for supplying coal to the Suralaya powerplant in West Java was construction, which reportedly was inaugurated in November, of the 2.5-million-ton-per-year Tarahan coal loading terminal near Bandar Lampung on the southern tip of Sumatra and a self-unloading 10,000-ton vessel.

Construction of the Tarahan terminal, which commenced in 1983 and was originally scheduled for completion in 1986, was delayed for 3 years because of ground instability and excessive foundation settling problems. The terminal construction, taken over from a British-Canadian consortium by Ballast Nedam BV of the Netherlands in 1987, was finally completed in November 1988.

The rehabilitation of the 450-kilometer railway linking Tanjungenim, near Bukit Asam, to the Tarahan terminal has not yet been completed. The rehabilitation project, including special reinforcement of 72 bridge abutments on the railroad, was a vital part of the expansion program to raise Bukit Asam's coal production and deliver more coal to West Java's Suralaya powerplant.

P.T. Allied Indo Coal, which signed a production-sharing contract with Perum Tambang Batubara in 1985 and commenced production in November 1987, reportedly produced 444,000 tons of good quality steam coal from its open pit at the Parambahan Mine located about 6 kilometers northeast of the Ombilin Mine in West Sumatra. About 20% of the output was delivered to Perum Tambang Batubara, and about 220,000 tons was exported to Japan, the Republic of Korea, and Taiwan. The coal mine was capable of producing 500,000 tons per year. The recoverable reserves at the mine were estimated at 12.5 million tons (0.5% sulfur, 7.1% ash, 4% inherent moisture, 37.3% volatile matter, and 51.6% fixed carbon) with an average heating value of 7,217 kilocalories.

P.T. Multi Harapan Utama, a joint venture of New Hope Indonesia Pty. Ltd. (50%) of Australia, Mr. Ibrahim Risyad (40%), and P.T. Asminco Bara Utama (20%) of Indonesia, started its open pit in the Busang area of Kutai Regency in East Kalimantan and produced 240,000 tons in 1988. The joint-venture firm, which has had a contract with the Government since December 1986, reportedly completed construction of processing and handling facilities in April at Beloro adjacent to the Mahakam River, about 25 kilometers from the mine site. The output was expected to reach 1 million tons in 1990. About 75% of the annual production would be delivered to the Suralaya powerplant. In 1988, about 103,000 tons was exported to Japan, Malaysia, and Taiwan. The measured reserves in the area were estimated at 13 million tons (0.8% sulfur, 5% ash, 11% inherent moisture, 40% volatile matter, and 44% fixed carbon) with an average heating value of 6,350 kilocalories.

P.T. Arutmin Indonesia, owned by Utah International Inc., which, in turn, was a wholly owned subsidiary of Broken Hill Pty. Ltd. of Australia, produced 105,000 tons from the Senakin Peninsula in South Kalimantan and exported most of its output to the Philippines in 1988. In 1985, about 60,000 tons was produced from the area and shipped to the Suralaya powerplant for trial burn, but the powerplant rejected it because it failed to meet specifications. The Senakin Peninsula Mine was capable of producing 1 million tons per year and had a potential to produce up to 4 million tons per year within the next 4 to 5 years.

P.T. Arutim, which signed a contract with the Government in November 1981 for coal exploration in South Kalimantan, was originally a joint venture of Utah Exploration Inc. (50%) and Atlantic Richfield Co. (50%) of the United States. In July 1986, Utah Exploration acquired the interest belonging to Atlantic Richfield. The reserves in the Senakin area were estimated at 300 million tons of subbituminous coal (0.7% sulfur, 17.3% ash, 4% inherent moisture, 40% volatile matter, and 38.7% fixed carbon) with an average heating value of 6,200 kilocalories.

Of the total production in 1988, about 1.2 million tons was produced by six major private companies with mining licenses operated mainly in East Kalimantan and South Sumatra. About 60% of the output by these private companies was exported and the remainder consumed domestically by the manufacturing sector. In the Mahakam River area of East Kalimantan, P.T. Kitadin Corp. produced 358,000 tons, P.T. Bukit Baiduri (formerly CV Baiduri Enterprise) produced 94,000 tons, P.T. Fajar Bumi Sakit produced 141,000 tons, and P.T. Tanito Harum produced 132,000 tons. In the Bengkulu area of South Sumatra, P.T. Danau Mas Hitam produced 338,000 tons, and P.T. Bukit Sunur produced 164,000 tons.

According to the Department of Mines and Energy, domestic demand for coal in 1987 was about 1.8 million tons. Major consumers included the Suralaya powerplant and the cement plants in Java and Sumatra. According to the Central Bureau of Statistics, exports of coal in 1987 were 892,600 tons: 60,500 tons was anthracite and the remainder was bituminous. The principal buyers included Japan, the Republic of Korea, Malaysia, and Taiwan. Export earnings from coal were $25.6 million.

Petroleum and Natural Gas.—Despite a stabilized world oil market, production of crude petroleum continued to decline in 1988. According to the Indonesian oil industry, the decline was the result of price and profit distortion caused by the Government pricing formula and new tax incentives, marketing difficulties, reduced output from aging oilfields, a recent slump in exploration, and fewer large exploration successes. Crude oil output, excluding condensate, averaged 1.18 million bbl/d compared with the 1988 OPEC quota of 1.19 million bbl/d. However, the output of condensate rose to an average of 165,000 bbl/d from 153,000 bbl/d in 1987.[35]

In 1988, crude petroleum was produced by state-owned PERTAMINA, 2 foreign contractors operating with Contracts of Work, and 18 foreign contractors operating with production-sharing contracts. The five leading producers were P.T. Caltex Pacific Indonesia (CPI) (39.7%), Atlantic Richfield Indonesia Inc. (10.0%), Mobil Oil Indonesia Inc. (Mobil) (8.6%), Indonesia Petroleum Ltd. (5.4%), and PERTAMINA (5.1%). The remainder was produced by 16 contractors.

Exports of crude oil and condensate dropped to 276.6 million barrels from 291.9 million barrels in 1987 because of increased consumption by domestic refineries. Export earnings from crude oil and condensate decreased to $4.1 billion from $5.0 billion (revised) in 1987. Japan and the United States remained the major buyers, together accounting for 70% of total exports. To meet requirements for domestic oil refineries, Indonesia also imported about 19.9 million barrels of crude petroleum compared with 29.2 million barrels in 1987.

Production of natural gas rose 6.6% to a new record high of an average 5 billion cubic feet per day in 1988. Increased consumption of natural gas by LNG plants remained the major contributing factor to higher natural gas production in 1988. According to Government statistics on natural gas, most of the increase in output of natural gas was attributable to increased production by the two largest producers, Mobil and Roy M. Huffington Co. (Huffco). In 1988, natural gas produced by Mobil from the Arun Gasfields in Aceh, North Sumatra, rose 8% to 858.6 billion cubic feet and accounted for 47% of the output. Production by Huffco from the Badak Gasfields in East Kalimantan rose 15% to 436.9 billion cubic feet and accounted for 24% of the output. The remainder was produced by 14 contractors and 2 state-owned oil and gas companies.[36]

The text table shows 1987-88 natural gas consumption, by end user, in billion cubic feet:

End user	1987	1988
Producers own use[1]	396.4	403.1
Flared	147.3	131.6
Utility industry	5.2	6.5
City gas industry	1.7	1.4
Nitrogen fertilizer industry	138.3	142.3
Oil refinery industry	20.9	26.3
Liquefied petroleum gas	24.5	29.2
Liquefied natural gas	917.0	1,025.0
Manufacturing industries[2]	80.8	81.5
Total	**1,732.1**	**1,846.9**

[1] For gas injection, gas lift, and fuel.
[2] Including manufacturers of cement, fertilizer materials, and steel.

In February, a $316 million contract to build the fifth 1.5-million-ton-per-year LNG train at the Badak LNG plant in East Kalimantan was signed between PERTAMINA and two Japanese companies, Chiyoda Chemical Engineering & Construction and Mitsubishi Corp. Project funding was to be provided on a nonresources basis by a Japanese consortium and a group of Japanese banks. In July, a consortium formed by Tokyo-based Indonesia Petroleum Ltd. and five Japanese trading companies reportedly was to finance 60% of the project's cost. The LNG train was scheduled to start production and begin exporting to Taiwan in early 1990. The natural gas will be supplied by the Tambora Tunu Gasfield in East Kalimantan.

Exports of natural gas in the form of LNG rose slightly to 868.6 trillion British thermal units or 149 million barrels of oil and were valued at $2.6 billion in 1988. In 1988, two LNG sales contracts were signed between PERTAMINA and Japanese buyers. The first contract, which was signed in September, was for Indonesia to supply an additional 1.45 million tons of LNG per year to Osaka Gas Co. Ltd. over the next 5.5 years. The second, which was signed in October, was to supply an additional 800,000 tons of LNG per year over the next 9.5 years to Toho Gas Co. Ltd.

In November, the President of Indonesia officially inaugurated Arun's 1.6-million-ton-per-year LPG plant and Bontang's 350,000-ton-per-year LPG plant built by JGC Corp. and Chiyoda Chemical Engineering & Construction Co. of Japan. However, the first shipment of LPG to Japan began in August following completion of phase I construction at Arun's complex in July. The total cost of the two LPG plants was $879 million, which was financed by Exports-Imports Bank of Japan (80%), a Japanese Government financial institution, and a syndicate of 23 Japanese banks and 7 Japanese insurance companies. Production and exports of LPG to Japan were planned to reach 1.95 million tons in 1989.[37]

Exports of natural gas in the form of LPG rose to 11.5 million barrels, almost double that of 1987. This increase resulted from increased exports to Japan from the two newly completed LPG plants at Arun in Aceh, North Sumatra, and in Bontang, East Kalimantan. Export earnings from LPG were valued at $89.2 million in 1988 compared with $47.9 million in 1987. Exports of LPG to Japan were made under a 10-year contract signed in July 1986 between Indonesia and seven Japanese companies led by Mitsubishi Corp. and Mitsui Liquefied Gas Corp.

Oil and gas exploration in Indonesia showed a noticeable improvement in 1988: the number of exploratory wells drilled increased to 135 from the historical low of 82 in 1987, and the number of oil and gas discoveries also increased to 43 from 23 in 1987. For exploration in the next 5 years, PERTAMINA signed eight new contracts with foreign companies compared with seven in 1987. Four of the eight contracts were based on joint operation agreements.

The four companies with JOA's in five contract areas were (1) North West Energy Ltd. of Canada in the 4,630-square-kilometer Ogan Komering block in South Sumatra, (2) Trend East Java Ltd. of the United States in the 7,391-square-kilometer Tuban block in East Java, (3) Esso Inc. of the United States in the 13,101-square-kilometer Musi-Klingi block in South Sumatra and the 81,901-square-kilometer Tuban in East Java, and (4) Shell B.V. of the Netherlands in the 57,201-square-kilometer block on Madura Island of East Java. The four other companies have production-sharing contracts. The joint venture of Total Indonesie Ltd. of France and Indonesia Petroleum Ltd. of Japan has a contract for the 1,534-square-kilometer Tengah block offshore East Kalimantan. The joint venture of Mobil Oil Corp. of the United States (60%) and Broken Hill Pty. Petroleum Inc. of Australia (40%) is in the 11,620-square-kilometer East Lengguru block in Irian Jaya and the 12,293-square-kilometer West Lengguru onshore and offshore Irian Jaya.

In February, the Government announced that Indonesia would give priority to secondary recovery programs. To tap oil reserves that are trapped in sandstone rock and cannot be extracted economically by conventional drilling, CPI began the secondary recovery program in its Duri Oilfield in late 1985. By yearend, the CPI had spent about $520 million, and the company was expected to invest $1 billion more in the next 6 to 7 years toward using the steam-flooding process to recover about 55% of Duri oil reserves. Crude oil production by steam-flooding in the Duri Oilfield was about 90,000 bbl/d in 1988.

PERTAMINA also planned to form a 50-50 joint venture with a foreign company to produce crude oil from its oilfields in the Limau area of South Sumatra using water-flooding or a gas lift process. Cost recovery in production-sharing contracts under the secondary recovery program would be limited to 65% of the contractor's share of revenue instead of 100% under the primary recovery method, and a tariff of $3 per barrel would be imposed for transporting crude oil from producing oilfields to the Plaju refinery near Palembang. Proposals submitted by six foreign companies and one Indonesian company were under consideration by PERTAMINA for contracts to be awarded in the next 5 years.[38]

LAOS[39]

Laos, with an estimated per capita income of $183[40] in 1988, was one of the poorest countries in the world, despite considerable resources of land, timber, minerals, and a large potential for hydroelectric power. The structure of production and employment was dominated by agriculture, which accounted for 65% of the GDP and provided 80% of total employment. The industrial sector was small, contributing 11.5% of the GDP, and consisted mostly of tin and gypsum mining; electricity production; small enterprises processing local raw materials, particularly food and wood; and consumer goods industries serving Vientiane, the capital city.

Against a declining economy and 53% inflation rate in 1983-85, the Government initiated a program of reforms in 1985 known as the New System of Economic Management. The program, expanded and modified in 1987 and 1988, extended autonomy to state enterprises and eased Government restrictions on trade and prices. Government subsidies were lowered or eliminated. The reforms were broadened further by allowing all forms of enterprises, including private companies and joint ventures, and stimulating competition among the various economic sectors.

Indications in late 1988 were that the reforms were showing positive results. Inflation dropped to 10%; exports, other than electricity, rose 36% from that of 1986; and several joint-venture enterprises were formed, mostly with Thai investors.

The impact of the reforms on growth and the balance of payments was partly masked by a persistent drought. Food production was lower and electricity output was halved in 1988. Despite the decline in these important economic weathervanes, 1988 real GDP was estimated to have increased 2%, reflecting the stronger nonagricultural activity.

Deposits of coal, gypsum, iron ore, potash, salt, and tin have been identified, but only gypsum and tin have been exploited in economically significant amounts. The Government has been encouraging the expansion of the modest tin industry in order to increase the foreign exchange earnings that the tin industry has generated. A 108-kilometer-long 22-kilovolt powerline was under construction from Thakhek to the Phon Tiou Mine. By the end of 1988, the plan called for 46 kilometers to be completed. Reliable power should be available for the first time at the mine during 1990. Construction was somewhat behind schedule because of a lack of funding and an inadequate supply of construction materials and transmission equipment. Several countries were looking into the possibility of investing in the industrial sector of Laos as a result of recent economic policy changes. Tin was one of those specifically mentioned as having good investment potential.

In order to further increase tin output without the expenditure of scarce capital, the Government has begun to encourage cottage-industry tin production. Placer tin was being panned or manually sluiced by families in the Hinboun District of Khammouan Province. All three of the Government-owned tin operations, Phon Tiou, Bo Neng, and Nong Seun, purchased panned concentrate from the villagers. About 10 tons of +51% Sn concentrate was purchased per month by these Government operations in the latter part of 1988.

Development of the potash resources of the Vientiane Basin could become a reality if the Foreign Trade Department of Laos has its way. Representatives of the department reportedly have asked Australia and India to look into the possibility of commercial exploitation. According to a World Bank report, the potash resources on the Laos side of the Mekong River contained a higher proportion of the mineral sylvite (KCl), and the Thailand-side deposits were believed to contain more of the less valuable carnalite. A Vietnamese geological group was exploring the deposits that have not been explored in detail. Published estimates of reserves appear to be widely exaggerated or based on erroneous assumptions. A

TABLE 9

LAOS: PRODUCTION OF MINERAL COMMODITIES[1 2]

(Metric tons unless otherwise specified)

Commodity	1984	1985	1986	1987	1988[p]
Cement (from imported clinker)	—	[3]2,500	4,000	4,500	4,500
Gypsum	[3]82,000	110,000	130,000	70,000	[3]80,000
Salt, rock	[3]8,000	10,000	30,000	13,000	30,000
Tin, mine output, Sn content	430	[3]540	550	450	[3]300

[p] Preliminary.
[1] Table includes data available through Aug. 18, 1989.
[2] In addition to the commodities listed, other crude construction materials such as sand and gravel and other varieties of stone presumably are produced, but available information is inadequate to make reliable estimates of output levels.
[3] Reported figure.

TABLE 10

LAOS: APPARENT EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987[p]	Principal destinations, 1987
Aluminum: Metal including alloys, scrap	69	926	All to Thailand.
Copper: Metal including alloys, scrap	10	398	Do.
Diamond: Gem, not set or strung value, thousands	—	$1	All to Cyprus.
Gypsum and plaster	—	682	All to Jordan.
Iron and steel: Metal: Scrap	—	408	All to Thailand.
Salt and brine	—	7,818	All to United States.
Stone, sand and gravel:			
Dimension stone: Crude	—	32	All to Jordan.
Limestone	—	13,805	All to United States.
Other: Base metals including alloys, all forms value, thousands	—	$33	Do.

[p] Preliminary.
[1] Table prepared by Audrey D. Wilkes. Owing to a lack of official trade data published by Laos, this table should not be taken as a complete presentation of this country's mineral exports. These data have been compiled from United Nations information and data published by the partner trade countries.

figure of 50 billion tons referred to in several sources was apparently derived by extrapolating data from a few widely spaced drill holes on the Thai side of the Mekong River. Until detailed information is available from either Vietnamese geologists or other qualified experts, it would not be possible to plan any specific exploitation of the potash. Laos should be able to supply low-cost electricity for mineral processing because it exported a large amount of power to Thailand in order to earn foreign exchange.

Thailand signed an initial agreement to supply refined petroleum products to Laos. The $13 million agreement was a direct result of the Thai Prime Minister's attempt to normalize trade relations with Laos. Thailand previously classified petroleum as a strategic product and banned exports to Laos.

In an additional agreement, a French trading company signed a contract with

TABLE 11

LAOS: APPARENT IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987[p]	Principal sources, 1987
METALS			
Aluminum: Metal including alloys, all forms	3	[2]18	Switzerland 12; Thailand 6.
Copper: Metal including alloys, all forms	1	1	All from Thailand.
Iron and steel: Metal:			
Ferroalloys	1	—	
Steel, primary forms	2	—	
Semimanufactures:			
Bars, rods, angles, shapes, sections	896	924	Thailand 834; Japan 90.
Universals, plates, sheets	5,138	120	Japan 62; Thailand 58.
Wire	493	50	Thailand 49; Italy 1.
Tubes, pipes, fittings	586	227	Thailand 220; Japan 7.
Lead: Metal including alloys, all forms	([3])	2	All from Thailand.
Nickel: Metal including alloys, all forms value, thousands	—	$1	Do.
Silver: Metal including alloys, unwrought and partly wrought do.	$1	$1	Do.
Tin: Oxides	3	—	

See footnotes at end of table.

TABLE 11—Continued

LAOS: APPARENT IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987[p]	Principal sources, 1987
METALS—Continued			
Zinc:			
Ore and concentrate	—	630	All from Thailand.
Oxides	—	1	Do.
Metal including alloys, semimanufactures	750	957	Do.
INDUSTRIAL MINERALS			
Abrasives, n.e.s.: Grinding and polishing wheels and stones	2	8	Do.
Cement	10,350	18,060	Do.
Fertilizer materials: Manufactured:			
Ammonia	5	1	Do.
Nitrogenous	1,910	447	Japan 377; Thailand 70.
Unspecified and mixed	250	[4]558	Japan 550.
Potassium salts, crude	—	34,507	All from Jordan.
Salt and brine	97	146	All from Thailand.
Sodium compounds, n.e.s.: Carbonate, natural and manufactured	27	—	
Stone, sand and gravel:			
Dimension stone: Worked	13	[5]51	Do.
Limestone other than dimension	—	24	Do.
Sand other than metal-bearing	8	3	Do.
Sulfur:			
Elemental: Colloidal, precipitated, sublimed	3	3	Do.
Sulfuric acid	18	8	Do.
Talc, steatite, soapstone, pyrophyllite	63	—	
MINERAL FUELS AND RELATED MATERIALS			
Carbon black	2	—	
Coke and semicoke	3	3	Do.
Petroleum refinery products:			
Liquefied petroleum gas 42-gallon barrels	12	—	
Lubricants do.	56	[6]14	Do.

[p] Preliminary.
[1] Table prepared by Audrey D. Wilkes. Owing to a lack of official trade data published by Laos, this table should not be taken as a complete presentation of this country's mineral imports. These data have been compiled from United Nations information and data published by the partner trade countries. The United States did not report any exports of mineral commodities to Laos during 1987.
[2] Excludes unreported quantity valued at $4,000 exported by Japan.
[3] Unreported quantity valued at $1,000 exported by Thailand.
[4] Excludes unreported quantity valued at $18,000 exported by Thailand.
[5] Excludes unreported quantity valued at $2,000 exported by United States.
[6] Excludes unreported quantity valued at $17,000 exported by Japan.

the Lao Government in September to supply 7,000 to 8,000 barrels per month of petroleum products. Shipments were to begin in March 1989.

The Vietnamese have also been helping with the development of the Lao infrastructure system. They have nearly completed a fuel depot in Pak District in the remote northwest Province of Oudomsai. The depot was believed to contain 10 tanks with a capacity of 1,572 barrels each.

Along with the petroleum agreement, Laos and Thailand were also consulting on setting up a joint-venture company to explore for and mine anthracite and other minerals in Laos. The proposal was initiated by the Lao Ministry of Commerce and Foreign Economic Relations. Lao workers reported a possible reserve of 4 million tons of high-grade anthracite 115 kilometers northwest of Vientiane.

The Asian Development Bank approved an $11 million concessional loan to the Lao Government for a 208-kilometer, 115-kilovolt, single-circuit power transmission line. The line would run from the Nam Ngum hydroelectric power station through Vang Vieng to the ancient, former capital city of Luang Prabang. The line is to bring continuous reliable power for the first time to its service area and, in particular, supply a planned cement plant in Vang Vieng.[41]

MALAYSIA[42]

The mineral industry remained an important sector of the Malaysian economy mainly because of its significant contribution to Government revenues, export earnings, and economic growth. After the decline of the tin industry in 1985, the oil and gas industry became the only driving force for the growth of the Malaysian mineral industry. The 8% growth in the mineral industry in 1988 was simply a reflection of increased output of the oil and gas industry. The tin industry, which was still adhering to the production restrictions of the ATPC, was unable to maintain its position as the world's largest tin supplier. Nevertheless, the financial condition of the oil and tin industries in Malaysia improved considerably when the world prices of oil and tin moved higher in 1988.

In line with the Government policy to develop the vast resources of oil and gas to increase Malaysia's export earnings, to generate revenues for the major industrial projects, and to support the expansion of the manufacturing sector under the Fifth Malaysia Plan (1986–90), the oil and gas industry began expansion of its production capacity in the oilfields and gasfields off Terengganu in the South China Sea. In 1988, Malaysia became a coal-producing country again when a new surface coal mine was opened.

The first-stage development of the Seligi Oilfield, Malaysia's largest, was completed in December by Esso Production Malaysia Inc. (EPMI). EPMI and Petronas Carigali Pty. Ltd. were also jointly developing the Dulang Oilfield in the South China Sea. Malaysia's crude petroleum production capacity would be raised by 180,000 bbl/d to 760,000 bbl/d when the seven-platform Seligi Oilfield and the Dulang Oilfield come on-stream in late 1990.

Substantial progress was made in the second phase of the project to bring natural gas from offshore Terengganu to southern Johore and Singapore, and to the industrial and population centers in western Peninsular Malaysia. In mid-1988, Malaysia agreed to supply at least 150 million cubic feet per day of natural gas to Singapore for 15 years starting in 1990. Under a separate agreement, the Japanese Government was to extend a $330 million[43] low-interest loan to Malaysia for construction of the 730-kilometer pipeline system. By yearend, the Government had chosen MMC Gas Sdn. Bhd. to lay the pipelines.

Malaysia signed 10 new production-sharing contracts compared with 7 (revised) in 1987 for oil and gas exploration offshore Peninsular Malaysia, Sabah, and Sarawak. Increased oil discoveries on the Indonesian side of the Strait of Malacca have resulted in renewed interest in oil exploration on the Malaysian side of the strait. Malaysia has 2.8 billion barrels of oil reserves, 42 trillion to 43 trillion cubic feet of nonassociated gas, and 9 trillion to 10 trillion cubic feet of associated natural gas.[44]

Performance of the metallic mining sector was disappointing, particularly in the production of bauxite, copper, and tin, which all moved lower despite improvement in the world's metal market. However, production of ilmenite and zircon continued to rise. To revive the metallic mining activity, especially in tin mining, the Government announced in March that it was working with the United Nations Development Program to draft a national mineral policy that would provide financial incentives to the mineral industry. The national mineral policy, which was expected to cover investment, production cost, mineral ownership and corporate taxes on tin and other hard-rock mining, was to be finalized in 1989.

Production of sponge iron, LNG, and nitrogen fertilizer materials were at full capacity. A plan to build a 115,000-ton-per-year aluminum smelter was still in a preliminary stage. Malaysia signed separate joint-venture agreements to build two steel mills in Malaysia. In partnership with Tioxide Group PLC of the United Kingdom, Malaysia considered plans to build a $192 million titanium dioxide plant in Terengganu. A decision on construction will be made after the studies on technical, environmental, and financial aspects of the project are completed.

According to Malaysia's Ministry of Finance, Malaysia's real GDP, in 1978 constant dollars, was estimated at $23.5 billion, of which about $2.6 billion was contributed by the mining industry. Malaysia's economic growth rate, as measured by the change in real GDP, was estimated to be 7.5%, compared with 4.8% (revised) in 1987. The manufacturing sector, which contributed 24% to Malaysia's GDP in 1988, continued to be the major driving force of economic growth in Malaysia. The merchandise trade surplus was slightly lower than that of 1987 because of higher imports of capital goods for the expanding manufacturing industry. Merchandise exports were estimated to increase 18% to $20 billion while imports grew 30% to $15 billion. The inflation rate rose to 2.7% from 1.1% in 1987. Malaysia's labor force increased 3% to 6.6 million, while the unemployment rate declined to 8.1% from 8.2% in 1987.

Production

The total output of the mining industry was estimated to have grown 8% from that of 1987 resulting from increased output of crude petroleum and natural gas. The output of crude petroleum rose to an average of 540,000 bbl/d, compared with 498,000 bbl/d in 1987. The output of natural gas reached a record 1.7 billion cubic feet per day in 1988. For the first time since 1960, Malaysia produced coal at an initial rate of 600,000 tons per year.

Despite improvement in the world's tin market, the tin industry could not hold the 1987 upward momentum in tin production because of high production cost and declining ore grade. As a result, Brazil passed Malaysia as the world's largest tin producer. Many small-scale tin mines, mainly gravel pumping operations, remained shut. Operators were cautious about reopening while the Government continued to enforce export controls that gave existing tin mines preference over the newly opened and reopened mines.

Production of bauxite and iron ore was lower than that of 1987 because of reduced exports. Production of copper concentrate also declined because a lower grade of ore was mined. Overall gold production remained unchanged. Production of ilmenite, monazite, and zircon concentrate, recovered from tailings of tin mining, continued to increase because of the growing demand in the Far East market. Production of kaolin and barite increased because of increased domestic and overseas demand.

Production of rare earths and yttrium oxide decreased because of strong environmental concerns by local residents about low-level radioactive waste. Production of sponge iron for exports on Labuan Island off Sahah remained at capacity while crude steel production at the Telok Kalong steel mill in Teregganu was lower than that of 1987 because of raw material shortage. Production of refined tin by two tin smelters was higher resulting from toll smelting of overseas tin concentrate. The two tin smelters had been toll smelting for Australia, Bolivia, and China in the past years. Production of LNG and nitrogen fertilizer in Bintulu, Sarawak, was at full capacity.

Trade

Malaysia's merchandise exports rose to an estimated $20.8 billion from $17.7 billion (revised) in 1987 while imports also rose to $15.4 billion from $11.8 billion (revised) in 1987. As a result, Malaysia's trade surplus was estimated to decline by 8.9% to $5.5 billion. The increase in export earnings was largely attributable to more exports of oil and gas as well as of manufactured products such as electronic components, telecommunication equipment, and textiles. Increased imports of capital goods for manufacturing facilities and production of primary commodities pushed up total imports.

In mineral trade, Malaysia exported more than 55% of its crude petroleum output, in decreasing order of value, to Singapore, Japan, the Republic of Korea, Thailand, and the Philippines. All exports of natural gas were to Japan. Exports of tin, in decreasing order of value, were to Japan, the Netherlands, the United States, and Singapore. Malaysia continued to ship all copper concentrate, and most bauxite, ilmenite, rare earths, and zircon concentrate to Japan.

In order of significance, Japan, the United States, and Singapore were the major trading partners of Malaysia. The United States became the second leading trade partner because of increased exports of manufactured goods to the United States in 1988. The United States accounted for 16.8% of Malaysia's exports and 17.4% of Malaysia's imports.

Commodity Review

***Metals.*—Aluminum and Bauxite.**—Production of bauxite from an open pit, operated by Promet Berhad Group, in the Pengerang (Telok Ramunia) area of Johore declined to an average rate of 34,400 tons per month from 40,200 tons per month in 1987. The lower production was caused by reduced exports to Japan. In 1988, Malaysia's Department of Mines reportedly was undertaking preliminary investigations of potential bauxite resources in central Peninsular Malaysia. Reconnaissance drilling by the Geological Survey of Malaysia in recent years delineated indicated reserves of 50 million tons of washed bauxite grading more than 48% Al_2O_3 in the Bukit Goh area of Pahang and 17 million tons of the same grade bauxite in the Jabor Valley area of Terengganu.

In November, the Government of Malaysia approved in principle the construction of a $400 million aluminum smelter in the Bintulu area of Sarawak. The project was initially proposed by the Japanese Government as part of a joint investment program with the Association of Southeast Asian Nations (ASEAN) countries. The production license for the 115,000-ton-per-year smelter was still awaiting an environmental impact assessment based on the Environmental Quality Act of 1987 and final approval of the Ministry of Science, Technology, and Environment. In the preliminary stage, an unnamed French company reportedly would hold a majority equity interest in the project, provide technology, and manage the smelter project. However, the supply sources of alumina and energy remained uncertain.[45]

Copper.—Production of copper concentrate from the Mamut Mine in Sabah dropped by 17% because of declining ore grade. For the first 6 months, the monthly output averaged 8,240 tons compared with 9,930 tons for the same period in 1987. The 1988 output was estimated at 100,000 tons of concentrate containing 24,000 tons of copper, 64,000 troy ounces of gold, and 369,733 troy ounces of silver. All copper concentrate was exported to Japan.

TABLE 12

MALAYSIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1984	1985	1986	1987	1988[p]
METALS						
Aluminum: Bauxite, gross weight	thousand tons	680	492	[r]566	482	361
Antimony, mine output, Sb content (Sarawak)		17	12	—	129	—
Columbium and tantalum concentrate, gross weight		45	80	215	228	—
Cb content of columbium[e]		7	12	32	34	—
Ta content of tantalum[e]		3	6	15	16	—
Copper, mine output, Cu content (Sabah)		28,852	30,507	28,301	29,861	22,014
Gold, mine output, Au content:						
Malaya	troy ounces	7,041	7,115	8,839	14,204	[e]20,400
Sabah	do.	82,012	78,818	71,396	87,333	[e]64,200
Sarawak	do.	474	4,371	6,791	10,136	[e]13,400
Total	**do.**	**89,527**	**90,304**	**87,026**	**111,673**	**[e]98,000**
Iron and steel:						
Iron ore and concentrate	thousand tons	194	182	208	161	272
Steel, crude	do.	350	550	750	750	[e]550
Rare-earth metals: Monazite, gross weight		[r]4,451	5,808	5,959	2,908	2,920
Silver, mine output, Ag content						
Sabah	thousand troy ounces	470	522	452	497	[e]325
Sarawak[3]	do.	—	—	—	10	[e]10
Tin:						
Mine output, Sn content		41,307	36,884	29,135	30,388	28,866
Metal, smelter		46,911	45,500	43,788	44,363	49,945
Titanium: Ilmenite concentrate, gross weight		[r]176,916	[r]315,736	414,941	509,202	486,305
Tungsten, mine output, W content		[r]371	[r]13	[r]4	—	[e]20
Zirconium: Zircon concentrate, gross weight		[r]6,732	11,652	12,633	17,828	25,671
INDUSTRIAL MINERALS						
Barite		23,421	23,394	[r]17,677	38,935	38,766
Cement, hydraulic	thousand tons	3,469	3,128	3,176	2,922	3,464
Clays: Kaolin		72,472	82,576	85,052	96,882	116,869
Nitrogen: N content of ammonia		38,900	53,400	[r]250,600	321,300	300,600
MINERAL FUELS AND RELATED MATERIALS						
Gas, natural (Sarawak):						
Gross	million cubic feet	398,700	483,224	525,965	580,350	693,500
Petroleum:[4]						
Crude	thousand 42-gallon barrels	163,082	156,950	183,814	181,724	197,799
Refinery products:						
Gasoline	do.	8,288	8,745	8,808	9,130	9,804
Jet fuel	do.	2,642	[e]2,650	[e]2,700	[e]2,900	[e]3,000
Kerosene	do.	4,623	3,461	3,876	3,943	4,041
Distillate fuel oil	do.	14,351	11,719	10,293	10,183	10,753
Residual fuel oil	do.	11,585	7,543	8,298	8,350	9,107
Other[5]	do.	3,929	[e]11,492	[e]11,500	[e]12,000	[e]12,500
Total	**do.**	**45,418**	**[e]45,610**	**[e]45,475**	**[r][e]46,506**	**[e]49,205**

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

[1] All production is from Peninsular Malaysia (Malaya) unless otherwise specified. Table includes data available through June 13, 1989.

[2] In addition to the commodities listed, a variety of crude construction materials (clays, sand and gravel, and stone), fertilizers, and salt are produced, but output is not reported, and available information is inadequate to make reliable estimates of output levels.

[3] Byproduct from gold mines in Sarawak.

[4] Includes production from Malaya, Sabah, and Sarawak.

[5] Includes liquefied petroleum gas, naphthas, and lubricants.

TABLE 13

MALAYSIA: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1985	1986	Destinations, 1986: United States	Destinations, 1986: Other (principal)
METALS				
Aluminum:				
Ore and concentrate	362,100	412,600	103,700	Japan 209,100; Ireland 50,500.
Metal including alloys:				
Scrap	7,115	8,993	—	Japan 8,010; Singapore 613.
Unwrought	62	237	—	Singapore 170; Hong Kong 40.
Semimanufactures	7,320	8,805	10	Singapore 4,445; Hong Kong 1,206; China 1,100.
Antimony: Ore and concentrate	20	NA		
Columbium and tantalum: Ore and concentrate	45	NA		
Copper:				
Ore and concentrate	125,767	118,758	—	All to Japan.
Matte and speiss including cement copper	95	18	—	All to Republic of Korea.
Metal including alloys:				
Scrap	12,354	14,637	123	India 4,325; Republic of Korea 4,057; Singapore 3,188.
Unwrought	134	—		
Semimanufactures	20,947	4,021	64	Singapore 3,200; Hong Kong 248.
Gold:				
Waste and sweepings kilograms	231	NA		
Metal including alloys, unwrought and partly wrought troy ounces	26,172	NA		
Iron and steel:				
Iron ore and concentrate excluding roasted pyrite	13,134	34,856	—	China 25,800; Singapore 9,026.
Metal:				
Scrap	21,530	45,990	12	Singapore 37,983; Indonesia 6,970.
Pig iron, cast iron, related materials	286,396	354,884	—	India 222,004; Indonesia 66,071.
Ferroalloys, unspecified	35	44	—	All to Singapore.
Steel, primary forms	11	8,967	—	Singapore 5,933; Japan 3,000.
Semimanufactures:				
Bars, rods, angles, shapes, sections	39,801	146,960	31,491	Singapore 79,851; China 19,071; Japan 11,322.
Universals, plates, sheets	2,153	7,945	—	Singapore 7,248.
Hoop and strip	98	481	—	Singapore 454.
Rails and accessories	560	1,914	—	Singapore 1,913.
Wire	598	1,178	3	Singapore 728; Hong Kong 389.
Tubes, pipes, fittings	30,142	53,861	5,528	Singapore 22,934; Netherlands 13,540.
Castings and forgings, rough	1,177	550	4	Singapore 518.
Unspecified	33	—		
Lead: Metal including alloys:				
Scrap	NA	90	—	All to Singapore.

See footnotes at end of table.

TABLE 13—Continued

MALAYSIA: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1985	1986	Destinations, 1986	
			United States	Other (principal)
METALS—Continued				
Lead: Metal including alloys—Continued				
Unwrought	624	1,101	—	Indonesia 768; Singapore 162.
Semimanufactures	70	24	8	Singapore 9; Republic of Korea 3.
Magnesium: Metal including alloys, all forms	—	34	—	Japan 21; West Germany 7.
Mercury 76-pound flasks	406	NA		
Nickel:				
Metal including alloys:				
Scrap	107	69	14	Japan 17; India 8.
Unwrought	106	10	—	Philippines 6; Japan 2.
Semimanufactures	40	146	1	Japan 120.
Platinum-group metals: Metals including alloys, unwrought and partly wrought[2] value thousands	$52	$125	$13	Papua New Guinea $57; Bahrain $38.
Silver:				
Waste and sweepings[2] do.	$2,899	$3,175	$2,901	Singapore $177.
Metal including alloys, unwrought and partly wrought do.	$69	$86	$3	Japan $60; Singapore $20.
Tin: Metal including alloys:				
Scrap	495	204	—	Singapore 129; Hong Kong 57.
Unwrought	57,481	40,658	2,991	Japan 12,955; Singapore 4,485; Netherlands 3,336.
Semimanufactures	892	584	—	United Kingdom 339; Hong Kong 65; Republic of Korea 44.
Titanium:				
Ore and concentrate	249,625	NA		
Oxides	32	NA		
Metal including alloys, all forms	30	—		
Tungsten:				
Ore and concentrate	30	10	—	All to West Germany.
Metal including alloys, all forms	4	3	—	Japan 2.
Uranium and/or thorium: Ore and concentrate value, thousands	$1,048	$355	$46	France $298.
Zinc:				
Oxides	64	57	—	India 32; Singapore 25.
Metal including alloys:				
Scrap	690	1,076	—	India 430; Singapore 253.
Unwrought	20	1	—	All to Singapore.
Semimanufactures	248	277	—	Singapore 225; Indonesia 31.
Zirconium:				
Ore and concentrate	2,499	NA		

See footnotes at end of table.

TABLE 13—Continued

MALAYSIA: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1985	1986	Destinations, 1986: United States	Destinations, 1986: Other (principal)
METALS—Continued					
Other:					
Ores and concentrates		—	401,758	—	Japan 249,790; Republic of Korea 43,523.
Ashes and residues		11,484	9,743	—	Singapore 8,856.
INDUSTRIAL MINERALS					
Asbestos, crude		49	—		
Barite and witherite		8,155	9,664	—	All to Singapore.
Cement		298,781	551,089	—	Singapore 455,181; Bangladesh 94,566.
Chalk		—	415	—	All to Singapore.
Clays, crude		37,494	54,371	—	Japan 23,135; Singapore 13,844.
Diamond:					
Gem, not set or strung	value, thousands	$9,606	$12,006	$740	Belgium-Luxembourg $10,672.
Industrial stones	do.	$30	$191	—	Belgium-Luxembourg $135; United Arab Emirates $56.
Diatomite and other infusorial earth		29	16	—	Singapore 12.
Fertilizer materials: Manufactured:					
Ammonia	value, thousands	$1,126	$3,953	—	Philippines $2,408; Thailand $454.
Nitrogenous		16,330	264,655	20,473	Thailand 75,489; Australia 58,739.
Phosphatic		30	76	—	All to Singapore.
Potassic		95	860	—	Thailand 401; Singapore 199.
Unspecified and mixed		3,272	3,430	—	Singapore 3,420.
Graphite, natural		—	216	—	Japan 215.
Gypsum and plaster		21	61	—	Singapore 46; Brunei 15.
Lime		9,070	10,754	—	All to Singapore.
Mica:					
Crude including splittings and waste		862	1,765	—	Japan 913; Republic of Korea 540.
Worked including agglomerated splittings		95	—		
Phosphates, crude		1,978	2,104	—	Singapore 1,177; Hong Kong 900.
Precious and semiprecious stones other than diamond:					
Natural	value, thousands	$754	$394	—	United Arab Emirates $161; Saudi Arabia $119.
Synthetic	do.	$609	$1,397	$2	Japan $1,394.
Pyrite, unroasted		—	16	—	Singapore 14.
Salt and brine		604	6,482	—	Singapore 5,780; Indonesia 374.
Sodium compounds, n.e.s.:					
Carbonate, manufactured		32	29	—	Papua New Guinea 18; Singapore 8.
Sulfate, manufactured		52	NA		
Stone, sand and gravel:					
Dimension stone:					
Crude and partly worked		417,352	[3]4,167	—	Mainly to Singapore.

See footnotes at end of table.

TABLE 13—Continued

MALAYSIA: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1985	1986	Destinations, 1986: United States	Destinations, 1986: Other (principal)
INDUSTRIAL MINERALS—Continued					
Stone, sand and gravel—Continued					
Dimension stone—Continued					
Worked		209	751	—	Singapore 443; Hong Kong 237.
Dolomite, chiefly refractory-grade		272	281	—	Singapore 245.
Gravel and crushed rock		99,847	109,487	—	Brunei 93,976; Singapore 15,510.
Limestone other than dimension		31,718	33,175	—	Singapore 32,709.
Quartz and quartzite		1,844	6,358	—	Brunei 5,750; Singapore 608.
Sand other than metal-bearing		1,276,611	2,644,451	—	Singapore 2,495,579; Japan 105,388.
Sulfur:					
Elemental:					
Crude including native and byproduct		4	17	—	Singapore 15.
Colloidal, precipitated, sublimed		3	19	—	Thailand 12.
Dioxide		16	NA		
Sulfuric acid		175	134	—	All to Singapore.
Talc, steatite, soapstone, pyrophyllite		20	142	—	Japan 126.
Other:					
Crude		256	337	10	Japan 179; Thailand 71.
Slag and dross, not metal-bearing		4,519	6,311	—	Japan 6,048.
MINERAL FUELS AND RELATED MATERIALS					
Carbon black		14,231	4,445	—	Indonesia 3,033; India 486.
Coal, all grades including briquets		NA	70,367	651	Panama 16,471; Liberia 10,880; Japan 6,617.
Gas, natural: Liquefied	value, thousands	$926,167	$749,020	—	Japan $746,340.
Petroleum:					
Crude	thousand 42-gallon barrels	120,917	145,836	4,043	Japan 51,668; Singapore 32,598; Republic of Korea 23,171.
Refinery products:					
Liquefied petroleum gas	value, thousands	$22,837	NA		
Gasoline	thousand 42-gallon barrels	3,061	3,303	—	Japan 2,005; Singapore 1,107.
Kerosene and jet fuel	do.	3,498	3,958	—	Singapore 1,912; Japan 909; India 776.
Distillate fuel oil	do.	2,085	1,979	—	Thailand 1,454; Singapore 523.
Lubricants	do.	9	3	([4])	Singapore 1.
Residual fuel oil	do.	4,910	6,615	282	Singapore 3,868; Japan 1,875.

NA Not available.
[1] Table prepared by Audrey D. Wilkes.
[2] May include other precious metals.
[3] Excludes unreported quantity valued at $2,730,000.
[4] Less than 1/2 unit.

TABLE 14

MALAYSIA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1985	1986	Sources, 1986	
			United States	Other (principal)
METALS				
Alkali and alkaline-earth metals	4	19	(2)	Australia 7; United Kingdom 3.
Aluminum:				
Ore and concentrate	1,001	1,319	—	Mainly from China.
Oxides and hydroxides	5,438	12,300	73	Japan 5,964; Australia 5,813.
Metal including alloys:				
Scrap	1,272	1,339	—	Thailand 616; Japan 418; Singapore 305.
Unwrought	21,753	26,449	101	Australia 10,663; Canada 8,303.
Semimanufactures	13,559	9,282	391	Japan 3,681; Singapore 1,762.
Chromium:				
Ore and concentrate	23	8	—	All from Japan.
Oxides and hydroxides	109	161	17	Netherlands 51; Singapore 41.
Cobalt:				
Oxides and hydroxides	22	12	(2)	Singapore 6; Belgium-Luxembourg 3.
Copper:				
Ore and concentrate	31	3	—	Singapore 2.
Matte and speiss including cement copper	2	81	1	Japan 68; Singapore 12.
Metal including alloys:				
Scrap	906	987	—	Thailand 634; Singapore 290.
Unwrought	20,745	8,827	1	Zambia 5,941; Chile 2,560.
Semimanufactures	16,126	17,428	—	Japan 7,236; Singapore 2,224; Chile 2,198.
Iron and steel:				
Iron ore and concentrate, excluding roasted pyrite	830,524	1.026,495	—	Brazil 586,398; Sweden 265,319; Australia 119,280.
Metal:				
Scrap	33,508	4,219	165	Singapore 3,311; Japan 564.
Pig iron, cast iron, related materials	3,563	1,657	7	Japan 1,008; Brazil 424.
Ferroalloys:				
Ferromanganese	6,578	5,927	3	Australia 2,443; France 1,650; Japan 1,496.
Unspecified	3,720	8,370	320	Norway 2,783; Australia 1,593.
Steel, primary forms	351,167	46,929	41	Netherlands 27,158; Brazil 18,741.
Semimanufactures:				
Bars, rods, angles, shapes, sections	260,261	169,450	223	Japan 70,939; United Kingdom 27,681; Republic of Korea 9,834.
Universals, plates, sheets	693,569	708,825	4,250	Japan 425,991; Republic of Korea 94,755; West Germany 38,259.
Hoop and strip	15,399	12,593	53	Japan 7,121; United Kingdom 1,945; Republic of Korea 1,552.
Rails and accessories	12,126	19,409	10	Poland 18,403.
Wire	13,660	20,316	42	United Kingdom 6,055; China 5,903; Japan 2,729.

See footnotes at end of table.

TABLE 14—Continued

MALAYSIA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1985	1986	Sources, 1986	
				United States	Other (principal)
METALS—Continued					
Iron and steel—Continued					
Metal—Continued					
Semimanufactures—Continued					
Tubes, pipes, fittings		153,805	110,772	8,018	Japan 89,337.
Castings and forgings, rough		1,514	1,557	9	China 455; Singapore 267; Japan 200.
Lead:					
Ore and concentrate		17	28	—	Thailand 26.
Oxides		820	304	2	Singapore 135; Australia 119.
Metal including alloys:					
Scrap		4,666	1,053	—	Japan 775; Singapore 265.
Unwrought		12,291	11,658	197	Australia 5,443; Burma 1,820.
Semimanufactures		5,916	1,717	7	Singapore 642; Australia 395; Japan 312.
Magnesium: Metal including alloys, all forms		28	41	3	Japan 15; Norway 9; West Germany 8.
Manganese:					
Ore and concentrate		1,128	985	—	Singapore 554; Brazil 296; Mexico 90.
Oxides		1,607	1,106	—	Japan 563; Singapore 365; China 102.
Mercury	76-pound flasks	232	174	—	Algeria 58; China 58.
Molybdenum: Metal including alloys, all forms		12	12	2	Belgium-Luxembourg 5.
Nickel:					
Ore and concentrate		2	15	([2])	Finland 7; United Kingdom 5.
Matte and speiss		81	41	—	Japan 22; Norway 17.
Metal including alloys:					
Scrap		3	22	—	Singapore 16.
Unwrought		104	133	21	Japan 35; Canada 28.
Semimanufactures		444	819	3	Singapore 606; Italy 88.
Platinum-group metals: Metal including alloys, unwrought and partly wrought	value, thousands	$370	$329	$4	Singapore $307.
Silver:					
Ore and concentrate	do.	$11	$41	$2	United Kingdom $27; Japan $8.
Waste and sweepings	do.	—	$139	$90	Singapore $25; Hong Kong $18.
Metal including alloys, unwrought and partly wrought	do.	$1,264	$752	$90	Japan $271; Hong Kong $131; West Germany $128.
Tin:					
Ore and concentrate		13,634	23,806	—	Australia 14,929; China 4,100; Indonesia 1,499.
Metal including alloys:					
Scrap		3	—		
Unwrought		795	600	263	Singapore 218.
Semimanufactures		305	161	50	Singapore 65; Hong Kong 13.

See footnotes at end of table.

TABLE 14—Continued

MALAYSIA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1985	1986	Sources, 1986: United States	Sources, 1986: Other (principal)
METALS—Continued				
Titanium: Oxides	7,623	7,616	1,246	Japan 1,686; United Kingdom 1,675; Australia 1,449.
Tungsten:				
Ore and concentrate	22	56	1	India 54.
Metal including alloys, all forms	41	146	4	Japan 86; Sweden 25.
Uranium and/or thorium: Ore and concentrate value, thousands	$857	$157	—	Australia $132; Thailand $25.
Zinc:				
Ore and concentrate	23	30	—	Mainly from Australia.
Oxides	251	205	10	West Germany 66; United Kingdom 52; China 27.
Metal including alloys:				
Scrap	64	138	—	Singapore 103.
Unwrought	18,230	14,894	7	Australia 9,677; Thailand 2,402.
Semimanufactures	976	1,152	23	Australia 586; Singapore 150; Japan 137.
Other:				
Ores and concentrates	([3])	2,597	—	Thailand 1,508; Australia 588; Japan 373.
Ashes and residues value, thousands	$265	$963	$1	Japan $698; Brazil $162.
Base metals including alloys, all forms do.	$868	$844	$61	Canada $417; Thailand $131.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	149	228	29	Japan 74; Indonesia 31.
Artificial: Corundum	3	28	—	Australia 23.
Dust and powder of precious and semiprecious stones including diamond value, thousands	$45	$41	—	All from Japan.
Grinding and polishing wheels and stones do.	$3,191	$2,849	$180	Japan $1,230; China $298.
Asbestos, crude	19,064	16,947	2,187	Canada 5,499; Singapore 3,905; Zimbabwe 3,780.
Barite and witherite	12,725	10,437	1	NA.
Boron materials:				
Crude natural borates	51	73	41	China 25.
Oxides and acids	203	402	180	China 150.
Cement	770,673	64,545	108	Singapore 34,731; Japan 16,551.
Chalk	806	869	—	United Kingdom 551; Australia 223.
Clays, crude	59,358	90,916	82,770	United Kingdom 2,618; China 1,034.
Cryolite and chiolite	10	—		
Diamond:				
Gem, not set or strung value, thousands	$25,309	$24,042	$236	Belgium-Luxembourg $12,390; United Kingdom $5,600.
Industrial stones do.	$48	$24	$18	Singapore $6.
Diatomite and other infusorial earth	489	788	584	Philippines 164.

See footnotes at end of table.

TABLE 14—Continued

MALAYSIA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1985	1986	Sources, 1986	
			United States	Other (principal)
INDUSTRIAL MINERALS—Continued				
Feldspar, fluorspar, related materials	24,246	20,866	508	India 11,884; Thailand 5,557; China 1,552.
Fertilizer materials:				
Crude, n.e.s.	39,339	40,109	—	Singapore 39,886.
Manufactured:				
Ammonia	4,797	339	9	West Germany 107; Indonesia 76; Japan 73.
Nitrogenous	513,232	388,272	157	Indonesia 182,604; Japan 109,435.
Phosphatic	11,755	15,216	3,708	China 7,091; Republic of Korea 2,087.
Potassic	510,310	466,456	10,988	Canada 199,987; U.S.S.R. 111,208; West Germany 77,491.
Unspecified and mixed	188,721	136,509	3,528	West Germany 50,147; Belgium-Luxembourg 40,958.
Graphite, natural	908	510	4	West Germany 242; Japan 114.
Gypsum and plaster	185,991	152,528	89	Thailand 146,436.
Lime	7,211	5,942	—	Thailand 5,684.
Magnesium compounds: Magnesite, crude including calcined	9,645	5,595	5	China 3,231; Japan 1,374.
Mica:				
Crude including splittings and waste	118	87	4	India 31; United Kingdom 22; Singapore 12.
Worked including agglomerated splittings	15	13	—	France 12.
Nitrates, crude	64	27	5	China 20.
Phosphates, crude	374,645	283,857	440	Christmas Island 172,384; Jordan 80,677.
Pigments, mineral: Iron oxides and hydroxides, processed	1,969	1,361	65	West Germany 493; United Kingdom 206; Japan 151.
Potassium salts, crude	287	10	—	All from West Germany.
Precious and semiprecious stones other than diamond:				
Natural value, thousands	$1,646	$2,436	$2	Switzerland $892; Singapore $493; West Germany $356.
Synthetic do.	$421	$410	—	Japan $314; Thailand $91.
Pyrite, unroasted	4	—		
Salt and brine	146,470	152,962	78	Australia 67,471; Thailand 44,411.
Sodium compounds, n.e.s.: Carbonate, manufactured	32,172	50,680	22,102	Kenya 22,639; West Germany 3,145.
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked	11,937	1,572	16	Italy 811; India 133.
Worked	11,986	8,383	5	Italy 6,189; China 561.
Dolomite, chiefly refractory-grade	5,211	2,605	—	Japan 60; unspecified 2,500.
Gravel and crushed rock	2,467	1,607	37	Japan 316; New Zealand 198; France 195.
Limestone other than dimension	5,655	7,443	—	Philippines 4,450.
Quartz and quartzite	191	51	—	West Germany 24; Japan 23.
Sand other than metal-bearing	3,046	1,480	128	Japan 675; New Zealand 282.

See footnotes at end of table.

TABLE 14—Continued

MALAYSIA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1985	1986	Sources, 1986	
				United States	Other (principal)
INDUSTRIAL MINERALS—Continued					
Sulfur:					
Elemental:					
Crude including native and byproduct		12,290	886	39	West Germany 238; Australia 140; Republic of Korea 128.
Colloidal, precipitated, sublimed		10,798	22,796	17	Singapore 19,012; China 3,040.
Sulfuric acid		2,119	1,591	47	Singapore 1,179; West Germany 341.
Talc, steatite, soapstone, pyrophyllite		5,473	7,010	43	China 4,577; Republic of Korea 1,550.
Other:					
Crude	value, thousands	$542	$337	$10	Japan $179; Thailand $71.
Slag and dross, not metal-bearing		9,346	10,233	2	Japan 8,187; Singapore 2,022.
MINERAL FUELS AND RELATED MATERIALS					
Asphalt and bitumen, natural		60,125	36,887	20	Singapore 33,672; China 500.
Carbon black		1,116	1,423	265	Singapore 233; Japan 112; West Germany 90.
Coal:					
Anthracite and bituminous including briquets		491,831	380,417	([2])	Indonesia 257,783; Australia 104,344.
Lignite including briquets		57	16	—	All from Australia.
Coke and semicoke		16,116	20,883	—	Japan 15,053; Australia 4,540.
Peat including briquets and litter		93	4	4	
Petroleum:					
Crude	thousand 42-gallon barrels	16,452	14,131	—	Kuwait 7,458; Oman 2,535; Saudi Arabia 2,508.
Refinery products:					
Liquefied petroleum gas	value, thousands	$21,504	$19,017	$27	Singapore $16,846.
Gasoline	thousand 42-gallon barrels	4,604	7,496	4	Singapore 7,363.
Mineral jelly and wax	do.	61	53	8	China 12; Indonesia 9.
Kerosene and jet fuel	do.	1,723	1,759	([2])	Singapore 1,745.
Distillate fuel oil	do.	8,284	7,176	—	Singapore 6,906.
Lubricants	do.	601	644	13	Singapore 476; Australia 44.
Residual fuel oil	do.	10,485	([4])	—	Mainly from Singapore.
Bitumen and other residues	do.	310	533	([2])	Singapore 525.
Bituminous mixtures	do.	16	20	([2])	Singapore 13; Australia 5.
Petroleum coke	do.	39	45	17	Indonesia 28.

NA Not available.
[1] Table prepared by Audrey D. Wilkes.
[2] Less than 1/2 unit.
[3] Unreported quantity valued at $455,000.
[4] Unreported quantity valued at $162,000.

Japanese trade statistics, show that imports of copper concentrate from Malaysia dropped to 104,040 tons from 134,653 tons in 1987.

After reorganization in 1987, the Mamut Mine reportedly was owned by Mamut Copper Mining Sdn. Bhd. of Malaysia, a majority equity holder; Bonanza Mining Co. Ltd. of Malaysia, and Sabah Mining Development Co. Ltd. (SMD) of Japan. SMD is a consortium of the seven major Japanese copper smelters, led by Mitsubishi Metal Corp.

Gold.—Overall production of gold remained at 1987 levels. Production from placer deposits in the Raub area of Pahang and the Bau area of Sarawak increased considerably, but gold produced as a byproduct of copper mining in Sabah declined because of the lower output of copper concentrate.

In January, the Government of Malaysia announced that it would promote joint-venture exploration and development of gold and other minerals with foreign companies. According to the Kelantan State Government, a 173-hectare area around Pulai and Gua Musang had been identified for gold mining. Dome Resources N.L. of Australia, which signed a joint-venture agreement with the State of Kelantan in 1987, announced in September that it had identified 31 potential hard-rock gold deposits in its leasing area in Kelantan.

According to a local press report, gold deposits have been discovered at Bukit Lubok Mandi, near Kuala Terengganu. Hundreds of prospectors reportedly obtained permits from the local district council to recover gold, mainly by panning, in the area.

In September, a small-scale gold open pit near Pulai in the southern Kelantan began operation. This gold project was a joint venture of Malaysia Mining Corp. (MMC) and a local company called Permodalan Kelantan Bhd. The mine was expected to produce 9,645 troy ounces of gold per year with 200 workers.[46]

Steel.—In an effort to reduce Malaysia's import reliance on flat steel and stainless steel wire products, separate joint-venture agreements were signed in 1988 to build two steel production facilities in Malaysia. Maruichi Malaysia Steel Tube Bhd., a subsidiary of Maruichi Steel Tube of Japan, announced that under a joint-venture agreement signed in July, Malaysia and Japan would build a $38 million cold-rolled strip mill at Kelang near Kuala Lumpur. Preparation of the site began in October, and construction of the cold reversing mill was expected to start in early 1989. The mill, scheduled for completion in the spring of 1990, would have an initial capacity of 70,000 tons per year or 23% of Malaysia's cold-rolled steel demand. Because Malaysia lacks hot coil production facilities, the input for the cold rolling mill would have to be imported.[47]

In November, a joint-venture agreement was signed between Perdama Corp. of Malaysia and the Chinese Metallurgical Construction Corp. (CMCC) to construct a $12 million plant for production of stainless steel wire and other alloyed steel products. The plant would have an initial capacity of 3,500 tons per year. Perdama was to invest about $8.5 million in the project.

Tin.—Despite further improvement in the price of tin on the Kuala Lumpur Tin Market (KLTM), Malaysia lost its position as the world's largest tin producer to Brazil in 1988. The high production cost and declining ore grade made it difficult for Malaysia to compete with lower cost tin producers such as Brazil and Indonesia.

Following implementation of the so-called Supply Rationalization Scheme (SRS) (export controls) by ATPC in March 1987, the prices of tin on the KLTM had moved up to $6.92 per kilogram from $6.67 in 1987 and $5.97 in 1986. According to a Malaysian industry source, the average production cost for the majority of tin mines in Malaysia remained between $6.00 and $7.00 per kilogram. The dredging sector, however, had reduced its production cost to about $5.56 per kilogram, almost equal to cost in Indonesia. Many previously closed tin mines reportedly would not resume operations unless the price of tin stabilized at about $9.00 per kilogram and unless lower cost producers did not raise their output.

For the first 11 months, tin production dropped 5.5% to 26,370 tons, from 27,914 tons in the same period of 1987. Fewer mines were operating; according to Malaysia's Department of Mines, the average number of operating mines dropped to 220 from 230 in 1987. Of the tin produced in the first 11 months, 46% was by dredging, 35% by gravel pumping, 8% by open pits, and 11% by other methods. Employment in the tin industry remained at 11,000 in 1987-88. Export earnings from tin reportedly rose to $361 million from $333 million in 1987 owing to higher prices of tin in 1988.

Following a 4-day meeting in Kuala Lumpur in January, ATPC revised export quotas for the second year's SRS from 96,027 tons to 101,900 tons effective from March 1, 1988, to February 28, 1989. Malaysia's export limit was raised to 31,650 tons from 28,526 tons. Brazil and China reportedly agreed to cooperate with ATPC by limiting their tin exports to 26,500 tons and 10,000 tons, respectively. The world tin surplus was around 47,700 tons in early 1988 and was reduced to 34,000 tons by yearend. According to some industry analysts, the price of tin could be stabilized between $8.50 and $9.20 per kilogram when the tin surplus is reduced to 20,000 tons and supply and demand are in balance.

Tin control regulations in Malaysia were enforced by the Tin Control Committee (TCC). The committee was chaired by the Director-General of the Department of Mines. Its members included officials from the Ministry of Primary Industry and various tin mining associations, tin smelters, and tin byproducts producers. The committee administered applications for new and reopened mines and monitored closely the tin output of each mine against their quotas. Under the second year's SRS, the TCC gave priority in allocating the output quota to existing mines (active on or before March 1, 1988) over new mines. The proportion of production cutback for new mines was twice that for existing mines. In the second year's SRS, the TCC tightened production controls by making quarterly comparisons of the output of each tin mine with their quotas.[48]

In August, the State government of Perak proposed to resume collection of royalties at the rate of 1% on tin sales when the price on the KLTM was less than $6.90 per kilogram; 1.5% when the price was between $6.90 and $8.05, and at 2% when the price was over $8.05 per kilogram. Four national and State mining associations opposed the proposal and asked the Federal Government to intervene. In response, the Federal Government reportedly expressed a willingness to discuss with the Perak State government the postponement of levying royalties until the world tin surplus is reduced to 22,000 tons. In the meantime, the Federal Government will provide some form of compensation to the State of Perak. The issue remained unresolved by yearend.

In March, the Sungei Lembing Mine, the country's largest and deepest underground tin mine near Kuantan in the State of Pahang, was closed permanently by the State government. Pahang Investments Public Ltd. Co. stopped tin production in 1986. Following the failure of a takeover attempt by MMC in 1987, a proposal to revive mining operations of the Sungei Lembing Mine by an unnamed British mining company did not materialize. According to a State official, more than $1.2 million had been spent to keep the tunnels from flooding. The Pahang government would not continue to spend money to keep the mine open in the absence of any commitment from the mining company to take over the mine.

About 93% of Malaysia's tin production was exported to Japan, the Netherlands, the United States, and Singapore. Domestic tin consumption was estimated at 2,000 tons, of which 58% was consumed by manufacturers of solder, 27% by manufacturers of tinplate, and 15% by the pewter industry.

Because of growing domestic demand for tinplate, Perstima, Malaysia's sole producer of tinplate, announced in early 1988 that it planned to invest $40 million to double its capacity to 180,000 tons per year by building a second electrolytic tinning line. Perstima's plant, in Pasir Gudang, Johore, increased its tinplate production to 95,400 tons from 85,500 tons in 1987. Malaysia's domestic demand for tinplate in 1988 was estimated at 120,000 tons. According to Perstima, its 1988 ex-warehouse price of tinplate was about 2% lower than imports from Japan.[49]

Titanium.—Tioxide Group PLC of the United Kingdom planned to invest $192 million in Malaysia for a titanium dioxide pigment plant in the State of Terengganu. Construction of the plant reportedly has been approved by the Malaysia Industrial Development Authority (MIDA). However, a final decision has not been made pending completion of feasibility studies on technical, environmental, and financial aspects of the project. According to an official of MIDA, if the plant is technically feasible, environmentally acceptable, and financially viable, construction would be started in July 1989 in Teluk Kalong.[50]

Other Metals.—Malaysia produced a variety of heavy metals and rare-earth concentrates as byproducts from tailings of alluvial tin mining operations, mainly in the States of Perak and Selangor. Since 1984, production of tin byproducts, especially ilmenite and zircon, had grown considerably because of increased demand from Japan, the Republic of Korea, and Taiwan.

In mid-1988, 68 tin tailings treatment plants were operating in Malaysia. The tailings from alluvial tin mines in the States of Perak and Selangor in general included small amounts of cassiterite and ilmenite and still smaller percentages of columbite, monazite, rutile, struverite, xenotime, and zircon. Content of these minerals varied by location. In 1988, Malaysia's two largest processors of tin tailings in Malaysia were Syarikat Pendorong Sdn. Bhd. and Beh Minerals Sdn. Bhd.[51]

Syarikat Pendorong, established in 1977, was the largest processor of ilmenite in Malaysia. It operated a plant near the city of Kampar, about 32 kilometers south of Ipoh in Perak. Syarikat Pendorong obtained its raw materials—tin tailings generated by MMC's dredges—under a special arrangement with Pernas Charter Management, a wholly owned mine management subsidiary of MMC. The tailings were trucked to a 10-acre yard and stockpiled by source. Each pile was analyzed for its chemical composition before processing.

The average throughput of Syarikat Pendorong's plant was 15,000 tons per month, working two shifts per day and 6 days per week. The daily production capacity of ilmenite and zircon was 300 tons and 13 tons, respectively, in 1988. The plant was also capable of producing 9 to 10 tons per day of monazite, xenotime, and struverite combined when the accumulated volume of tailings was adequate to justify running a batch operation.

Syarikat Pendorong produced two grades of ilmenite concentrate (FeO-grade containing 50% to 56% TiO_2 and 26% to 30% FeO, and TiO_2-grade containing 59% to 60% TiO_2 and 7% to 12% FeO); zircon concentrate containing 63% to 64% ZrO_2; and monazite containing 55% to 60% rare-earth oxides (REO). These products were shipped to MMC Marketing Bhd., another wholly owned subsidiary of MMC, for distribution to the world market.

Beh Minerals, established in 1969, was the largest processor of rare earths in Malaysia. Its processing plant, at Lahat, is about 6 kilometers west of Ipoh, Perak. Beh Minerals obtained its raw materials through open tenders from tin tailings treatment plants in Australia and Thailand as well as from Malaysia.

Beh Minerals said its processing capacity was flexible and that its output of rare earths and heavy metals depended upon the volume and chemical composition of the raw materials it stockpiled. Certain types of rare earths or heavy metals were produced only when there was a market for them. However, the plant's normal throughput was 1,000 tons per month. It was operating 10 hours per day in mid-1988, but operations could be expanded to 16 hours per day. The main products by Beh Minerals were monazite, xenotime, ilmenite, struverite, and zircon. Monazite concentrate was shipped to affiliated companies for further processing.

Asian Rare Earth Ltd. (ARE), a joint venture of Beh Minerals and Mitsubishi Chemical Industries Ltd. of Japan, processed monazite concentrate into rare-earth chlorides (46% REO). ARE's monazite cracking plant in Ipoh, with an annual capacity of 3,000 tons, reportedly produced about 2,000 tons of rare-earth chlorides in 1988. A civil suit by local residents for improper safety measures for storing low-level radioactive waste was still unresolved.

Malaysian Rare Earth Corp. Sdn. Bhd. (MREC), joint venture of Beh Minerals (35%), Mitsubishi Chemical (35%), and local investors (30%), processed xenotime into yttrium oxide concentrate (60% Y_2O_3). Its xenotime cracking plant, also in Ipoh and with a rated capacity of 80 tons per year, reportedly was shut down in 1988 for environmental considerations.

Heavy metals produced by Beh Minerals included ilmenite containing 57% to 60% TiO_2; refractory-grade zircon containing 60% to 65% ZrO_2 plus some hafnium and rutile; and struverite containing 9% to 16% Ta_2O_5 and 9% to 16% Cb_2O_5 plus 4% to 5% ilmenite and 3% to 4% tin. Beh Minerals distributed its products through traders on the spot market. It also marketed its products directly to end users.

Malaysia exported ilmenite mainly to Japan, the Republic of Korea, and Taiwan; rare-earth minerals and concentrate to France, Japan, and the Netherlands; and zircon to Japan, the Republic of Korea, and Taiwan. The total export earnings from these heavy metals and rare-earth minerals were estimated at $18 million in 1987.

Industrial Minerals.—Production of kaolin has been increasing over the past decade because of growing domestic requirements and increased exports to the Far East market. Kaolin was mined mainly in the States of Perak, Johore, and Selangor by open pit methods. According to the Department of Mines, 18 mines were operating in 1988, mostly small-scale operations. About 60% of the kaolin was produced by two major mines operated in the Bidor area of Perak and in the Jemaluang area of Johore.

Domestic consumption of kaolin was estimated at 51,000 tons. Kaolin in Malaysia was used for filler in manufacturing rubber, paint, adhesives, and plastics. Kaolin was also used as raw material for production of floor and wall tiles, sanitary ware, and white cement. Malaysia exported about 46,000 tons of kaolin, valued at $4 million, principally to Japan, Singapore, and Taiwan.

The Government estimated kaolin ore reserves in Peninsular Malaysia, mainly in the States of Perak, Johore, and Selangor, at 190 million tons.[52]

Mineral Fuels.—**Coal.**—Coal had not been produced in Malaysia since the last coal mine was shut down in 1960. In 1988, a new open pit coal mine was started by Global Minerals Sarawak Sdn. Bhd. (GMS) in the Merit-Pila deposits in the Belawei-Mujan area north of Kapit in Central Sarawak. GMS is a joint venture of Global Minerals Corp. (GMC) of the United States and a South Korean-Malaysian consortium called Lucky Hill Sdn. Bhd. According to GMS, the initial output from the two deposits was expected to be 600,000 tons and to be increased to 2 million to 3 million tons by 1992. The company was also constructing a coal crusher at the port about 50 kilometers away from the mine.

According to the Geological Survey of Malaysia, during 1974–78, GMC prospected for coal with intensive pattern drilling at the Merit and Pila deposits in the Belawei-Mujan area. The Government granted GMC a mining certificate in 1982 and a mining lease on 2,485 hectares in the Belawei-Mujan and the Long Hill areas in 1985. The ore reserves recoverable by surface mining at that time were estimated at between 4.4 million and 5.2 million tons. However, according to the Ministry of Primary Industry, the coal reserves at the Merit-Pila deposits covering 1 hectare were estimated at 63 million tons of subbituminous coal with a low ash and sulfur content and a heating value of 6,200 kilocalories per kilogram.[53]

Malaysia imported annually about 400,000 tons of coal to meet its domestic demand. Malaysia's coal requirements were expected to jump to 2 million tons per year when Malaysia's first 300-megawatt coal-fired powerplant comes on-stream in 1989 at Port Klang along the west coast of Peninsular Malaysia.

Natural Gas.—Natural gas production from offshore Sabah, Sarawak, and Terengganu increased to a record 1.7 billion cubic feet per day. About 80% of natural gas production was by Sarawak Shell Bhd. (SSB) from the Central Luconia Gasfield off Sarawak and was turned into LNG and nitrogen fertilizer in Bintulu, Sarawak. The remaining 20% was produced by EPMI and Sabah Shell Petroleum Co. (SSP). EPMI's output from the Duyong Gasfield and the Bekok Oilfield off Terengganu, went mostly into electrical power generation and production of LPG and sponge iron. SSP's production from the Samarang and Erb West Oilfields off Sabah was used mostly for electrical power generation and the production of methanol and sponge iron on Labuan Island off Sabah.

In 1988, two important agreements were reached in connection with the project to deliver offshore natural gas to Singapore and Peninsular Malaysia. The Government also awarded the pipeline construction contract to MMC Gas, a 55%-owned subsidiary of MMC.

A memorandum of understanding was signed in June between Malaysia and Singapore for the supply of natural gas and water to Singapore. Under the agreement, Singapore would purchase at least 150 million cubic feet per day of natural gas and a minimum of 250 million gallons per day of fresh water from Malaysia. The gas purchases would run for 15 years and Singapore would pay a minimum of $9.75 million for the first year. The agreed price reportedly was comparable to the price that Malaysia charged to its own Sultan Ismail power station in Paka, Terengganu.[54]

An agreement was signed in June between Malaysia and Japan for the Japanese Government to extend a $330 million (42 billion yen) soft loan to the Malaysian Government to finance the construction of the second phase natural gas project on Peninsular Malaysia. The loan was channeled through the Japanese Official Development Aid program to Malaysia and was provided from the Japanese Overseas Economic Cooperation Fund. The loan offered to Malaysia reportedly carried an annual interest rate of 4% for 25 years and had a 7-year grace period.[55]

In October, the Government awarded a contract through Petronas to MMC Gas for engineering, procuring, and constructing a $489 million three-segment gas pipeline system. It would link Chukai on the northeast coast of Terengganu and Segamat in Johore. At Segamat, one line would go south to Pasir Gudang near Johore Bahru and another west to Port Klang in Selangor. The second phase project was expected to be completed in 1992.

Petroleum.—To increase Government revenues and export earnings, Malaysia increased its crude petroleum output to an average of 540,000 bbl/d from 498,000 bbl/d in 1987. Much of the increase reportedly was attributable to the increased output by SSB from offshore oilfields. Of the total output, about 57% was produced by EPMI from oilfields off Terengganu in the South China Sea and the remainder from oilfields off Sabah and Sarawak, operated by SSB and SSP.

The producing oilfields operated by EPMI included Bekok, Guntong, Iron Barat, Kepong, Pulai, Tapis, Tinggi, Tiong, Seligi, and Semangkok. The oilfields operated by SSB included Barton, Erw West, Ketam, South Furious, St. Joseph, Semarang, and Tembungo. The oilfields operated by SSP included Bakau, Baram, Baronia, Bayan, Betty, Bokor, Fairley Baram, Siwa, Temana, Tukau, and West Lutong.

EPMI began production from its newly developed offshore platform in the Seligi Oilfield in the South China Sea at an initial rate of 20,000 bbl/d. According to a Malaysian oil industry source, six additional production platforms with a combined peak capacity of more than 100,000 bbl/d would be installed by 1994 at a total cost of $766 million. A total of 177 oil wells and 20 gas injection wells would be drilled from the seven platforms. The Seligi Oilfield, 275 kilometers off Terengganu and having oil reserves of 1.2 billion barrels, is the largest known oilfield in Malaysia.[56] As a result of increased output capacity from the Seligi Oilfield, the Government planned to raise Malaysia's crude petroleum output to 562,000 bbl/d in 1989.

In February, EPMI signed an agreement to jointly develop with Petronas Carigali Pty. Ltd., a subsidiary of Petronas, the Dulang Oilfield 126 kilometers off Terengganu at a cost of $389 million. The development project is scheduled for completion in late 1990 with a peak capacity of 67,000 bbl/d.

Following the signing of five production-sharing contracts by July 1987 for oil and gas exploration and development in Malaysia, 12 more contracts had been signed between August 1987 and December 1988. According to industry sources, the increased foreign interest in signing the contracts with the Malaysian Government was caused not only by the attractive conditions for exploration but also by the desire of foreign oil companies to add reserves to their portfolios in anticipation of a tighter oil market in the 1990's. The attractive conditions in Malaysia, reportedly, included a higher success rate, good geology, shallow waters, large and virtually untouched tracts that could be developed at low cost, and political stability.[57]

PHILIPPINES[58]

The country's real GDP increased by an estimated 6.7% over that of 1987, the second successive year of real growth, recovering to the precrisis level. The minerals industry represented an estimated 2% of the GDP.

The mining industry underwent a critical change during the year because many of the nation's leading producers attempted to cash in on strong base-metal prices, especially copper. However, for many, recovery was threatened by a Government decision to abandon the scheme introduced in 1984 that allowed financially distressed copper companies to defer all taxes and other levies when metal prices slumped. The copper mining firms of Atlas Consolidated Mining and Development Corp., Marcopper Mining Corp., Maricalum Mining Corp., and North Davao Mining Corp. were the major companies whose taxes had been deferred. The Government's decision required not only that current taxes and levies be paid because of healthy financial turnarounds by these companies, as under the original concept, but also required the repayment of taxes in arrears. This would affect the essential expansion programs and capital projects of the companies, which had suffered because of profitability losses and working capital deficits, by drawing off funds to service the large tax bills.

The Philippines is rich in mineral resources. There are large deposits of copper, chromium, gold, and nickel. Others included cadmium, iron ore, lead, manganese, mercury, molybdenum, and silver; the industrial minerals asbestos, gypsum, limestone, marble, phosphate rock, salt, and sulfur; and the mineral fuels asphalt, coal, and petroleum. The Philippines was among the top 10 world producers of chromium, ranking 6th in 1988; copper, 10th; and gold, 9th. It was an important regional producer of other commodities. Copper and gold remained the country's most important mineral products.

Government Policies and Programs

The bright outlook for the Philippine mining industry was expected to be enhanced by the approval of a new mining code by the Congress. Mining legislation, led primarily by the Chamber of Mines of the Philippines, was being drafted during the year. This legislation would include the model agreements covering exploration, development, and use of minerals mandated in the 1987 Constitution. The objectives of the new code were to provide (1) legal stability and predictability of mining tenure, (2) a fair return on mining investments, and (3) a reasonable mineral tax regime.

The first objective, stability and predictability, would be assured by the use of agreements governing exploration, development, and actual mining. The agreements would be guaranteed against alteration whether by rules and regulations or by legislation. The second objective, equitable profits, would be negotiated between the Government and the large U.S. minerals producer Freeport-McMoRan Inc. to establish guidelines for domestic and foreign mining companies. Reasonable taxation, the third objective of the code, would convince the Government to align mining taxes with those of its Southeast Asian neighbors so as to be competitive with them, to encourage new investments, and to promote the growth of the mining industry.

The drafting of the new mining code was constrained by the provisions in the Constitution, which ordain that minerals are owned by the state.

Production

The value of production of the Philippines mining industry was estimated to be $1.11 billion[59] during 1988, an increase of about 20% over that of the previous year. The increase was primarily due to strong prices for copper, gold, and nickel in the world market. Gold contributed the largest share with about $500 million, followed by copper with about $365 million.

Trade

Mineral exports, which were estimated at $760 million, were 64% more than in 1987 and contributed 11% to the total export earnings of the country. Copper and gold shipments, primarily to China, Japan, and the Republic of Korea, accounted for 82% of total mineral exports. However, about 20% of total export earnings, $148 million, was spent on mineral imports.

Most of the minerals produced in the country were for export, usually in an upgraded form rather than as ore, in order to increase their value and reduce shipping costs. Japan and the United States were the major trading partners of the Philippines.

The country continued to depend on imports for its supplies of iron ore and concentrate, crude fertilizer, and high-thermal coal.

Commodity Review

***Metals.*—Chromium.**—The Benguet Corp. planned a small-scale chromite project in Palawan for startup in 1989 at a target rate of 1,000 tons of metallurgical chromite per month.

Copper.—The Bond Corp. of Australia offered a proposal at yearend 1987 to Atlas Consolidated, not only the largest copper producer in the Philippines but also thought to have the largest reserves of copper ore in the country. Atlas rejected the proposal in August. The proposal would have given the Bond Corp. a stake in the Masbate gold mine on Masbate Island in return for a debt reduction scheme.

At its Toledo Mine on Cebu Island, Atlas Consolidated installed a belt conveyor that was estimated to have reduced ore hauling costs from the high-grade underground section to the Carmen concentrator by 45%. The company also expanded underground operations to the south, beneath the Ilag River, where reserves of 78 million tons had been defined. A second open pit was planned, at an estimated cost of $41.3 million, to offset nearly depleted ore reserves at the existing Toledo Mine.

On April 15, the Government ordered the closing of Marcopper's Tapian Mine and mill at Santa Cruz on Marinduque Island until a new tailings disposal system could be installed to handle the discharge of 28,000 tons of tailings per day. The Department of Environment, Energy and Natural Resources Pollution Adjudication Board ordered the closure because toxic mine tailings had been discharged into Calancan Bay off Marinduque Island. The mill produced about 300 tons of copper concentrate per day. Marcopper, the country's third largest copper producer, lost an estimated $175,000 per day while the mill was shut down from April 19 to May 14. The new discharge system was planned to dispose of the tailings deeper and further

TABLE 15

PHILIPPINES: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodities[2]		1984	1985	1986	1987[p]	1988[e]
METALS						
Arsenic: White (equivalent of arsenic acid)[e]		—	5,000	5,000	5,000	5,000
Chromium: Chromite, gross weight:						
Metallurgical-grade		123,015	122,359	85,271	69,429	70,000
Chemical-grade		5,369	15,038	16,109	19,899	20,000
Refractory-grade		132,505	134,634	72,850	98,572	100,000
Total		**260,889**	**272,031**	**174,230**	**187,900**	**190,000**
Cobalt, mine output, Co content		64	911	92	—	—
Copper:						
Mine output, Cu content		233,359	222,189	222,644	216,145	[3]218,090
Metal:						
Smelter		109,200	133,800	124,300	124,700	125,000
Refined		99,230	130,227	134,547	132,118	[3]132,183
Gold, mine output, Au content	troy ounces	827,149	1,062,997	1,154,917	1,048,081	[3]1,044,448
Iron and steel:						
Ferroalloys:						
Electric-furnace ferrosilicon[e]		18,500	20,000	20,000	—	—
Electric-furnace ferrochromium		48,049	50,815	[e]55,000	—	—
Steel, crude	thousand tons	250	250	[e]250	[e]250	250
Manganese ore and concentrate, gross weight		615	387	232	421	[3]670
Nickel:						
Mine output, Ni content		13,601	28,158	12,790	7,818	10,800
Metal, smelter		3,528	16,993	2,076	—	—
Silver, mine output, Ag content	thousand troy ounces	1,574	1,685	1,688	1,684	[3]1,662
Zinc, mine output, Zn content		2,189	1,880	1,573	1,129	[3]1,435
INDUSTRIAL MINERALS						
Barite		581	—	—	—	—
Cement, hydraulic	thousand tons	3,651	3,080	3,547	3,320	[3]4,300
Clays:						
Bentonite		38,249	24,971	1,800	759	[3]2,030
Red		200	—	350	[e]300	300
White		8,618	6,093	16,784	[e]7,000	10,000
Other		372,111	344,921	366,753	406,033	400,000
Feldspar		11,486	5,412	6,661	[e]6,000	6,000
Gypsum and anhydrite:						
Natural		600	300	13,080	13,233	13,000
Synthetic[e]		112,000	112,000	112,000	[e]112,000	115,000
Lime		50,711	47,427	38,110	[e]45,000	40,000
Magnesite		625	676	[e]650	[e]650	650
Nitrogen: N content of ammonia		16,200	[e]17,000	[e]17,000	—	—
Perlite		5,641	3,883	[e]3,500	[e]4,000	4,000

See footnotes at end of table.

TABLE 15—Continued

PHILIPPINES: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodities[2]		1984	1985	1986	1987[p]	1988[e]
INDUSTRIAL MINERALS—Continued						
Phosphate:						
Guano		552	1,229	3,466	[e]1,000	1,000
Phosphate rock		7,488	6,392	1,656	[e]8,000	8,000
Pyrite and pyrrhotite (including cuprous), gross weight		82,806	232,478	244,028	341,417	300,000
Salt, marine		401,008	421,058	785,354	446,532	500,000
Sand and gravel:						
Silica sand	thousand tons	432	317	259	213	[3]177
Other[4]	thousand cubic meters	14,695	11,235	11,525	13,943	15,000
Stone:						
Dolomite		368,052	362,101	281,346	[e]360,000	350,000
Limestone[5]	thousand tons	4,074	3,521	4,328	4,022	4,000
Marble (dimension), unfinished	cubic meters	4,919	4,010	7,586	5,000	5,000
Volcanic cinder	do.	—	6,630	[e]1,000	1,000	1,500
Sandstone		5,340	—	—	—	—
Tuff		29,269	19,505	[e]20,000	—	—
Quartz		79,536	93,735	46,972	80,000	75,000
Crushed, broken, other[6]	thousand cubic meters	600	701	599	1,000	1,000
Sulfur: S content of pyrite		38,505	108,102	113,473	158,179	160,000
Talc		927	345	[e]1,000	—	—
MINERAL FUELS AND RELATED MATERIALS						
Coal, all grades		1,216,388	1,257,881	1,128,449	1,152,342	[3]1,330,000
Petroleum:						
Crude	thousand 42-gallon barrels	3,890	3,285	2,190	1,800	[3]2,170
Refinery products:						
Gasoline	do.	8,124	[e]9,000	[e]9,200	[e]9,000	9,000
Jet fuel	do.	3,322	[e]3,000	[e]3,000	[e]3,000	3,000
Kerosene	do.	2,382	[e]2,500	[e]2,700	[e]2,500	2,500
Distillate fuel oil	do.	17,027	[e]17,000	[e]17,300	[e]17,000	17,000
Residual fuel oil	do.	18,544	[e]19,000	[e]20,000	[e]19,000	19,000
Other	do.	5,027	[e]4,500	[e]4,800	[e]4,500	4,500
Refinery fuel and losses	do.	[e]15,000	[e]15,000	[e]15,000	[e]15,000	15,000
Total	**do.**	**[e]68,426**	**[e]70,000**	**[e]72,000**	**[e]70,000**	**70,000**

[e]Estimated. [p]Preliminary.

[1]Table includes data available through July 11, 1989.

[2]In addition to the commodities listed, the Philippines produces platinum-group metals as byproducts of other metals, but output is not reported quantitatively, and no basis is available to make reliable estimates of output levels.

[3]Reported figure.

[4]Includes "pebbles" and "soil" not further described.

[5]Excludes limestone for road construction.

[6]Includes materials described as rock, crushed or broken; stones, cobbles, and boulders; rock aggregates; and broken adobe.

TABLE 16

PHILIPPINES: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Destinations, 1987	
				United States	Other (principal)
METALS					
Aluminum: Metal including alloys:					
Scrap		44	59	12	Japan 47.
Semimanufactures		12	47	—	Hong Kong 40; Thailand 3.
Chromium: Ore and concentrate		130,165	105,676	13,656	Sweden 25,990; West Germany 16,007.
Copper:					
Ore and concentrate		359,781	361,952	—	Japan 361,952; China 27,608.
Metal including alloys:					
Scrap		8,151	8,150	—	Singapore 6,000; Japan 1,648.
Unwrought		130,228	106,530	—	Japan 46,861; Taiwan 36,742; Republic of Korea 17,500.
Semimanufactures		5,235	3,607	163	Taiwan 1,255; Japan 751.
Gold:					
Contained in copper concentrates	troy ounces	394,572	212,068	—	Japan 192,331; Republic of Korea 10,810.
Waste and sweepings	do.	—	19	—	All to Hong Kong.
Iron and steel:					
Iron ore and concentrate:					
Excluding roasted pyrite:					
Agglomerated	thousand tons	3,587	4,017	—	All to Japan.
Not agglomerated		16,552	—		
Pyrite, roasted		7,917	10,408	—	Republic of Korea 9,841; Japan 567.
Metal:					
Scrap		849	1,313	—	Japan 1,002; Taiwan 238.
Ferroalloys:					
Ferrosilicon		10,079	10,225	18	Japan 3,926; Republic of Korea 3,072.
Unspecified		55,970	50,820	—	Japan 46,310; Republic of Korea 3,152.
Semimanufactures:					
Bars, rods, angles, shapes, sections		110	109	1	Australia 95.
Universals, plates, sheets		16	82	—	Thailand 59; Guam 13.
Wire		7	3	—	All to Pacific Islands Trust Territory.
Tubes, pipes, fittings		525	1,608	1,252	Hong Kong 194; Indonesia 78.
Castings and forgings, rough		408	528	213	Australia 296.
Lead: Metal including alloys:					
Scrap		—	3	3	
Semimanufactures	kilograms	95	—		
Magnesium: Metal including alloys, scrap		10	6	—	All to Japan.
Manganese: Ore and concentrate:					
Metallurgical-grade		216	20	—	Do.
Nickel:					
Ore and concentrate		420,809	483,417	—	Do.

See footnotes at end of table.

TABLE 16—Continued

PHILIPPINES: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Destinations, 1987	
				United States	Other (principal)
METALS—Continued					
Nickel—Continued					
Metal including alloys:					
Scrap		—	36	—	All to Netherlands.
Unwrought		2,566	—		
Semimanufactures		1,604	—		
Silver:					
Waste and sweepings[2]	kilograms	428	5,397	—	All to Hong Kong.
Metal including alloys, unwrought and partly wrought	troy ounces	708,034	157,627	12,286	France 58,958; Hong Kong 31,159.
Tin:					
Ore and concentrate		—	1	—	All to Singapore.
Metal including alloys:					
Scrap		15	34	3	Singapore 20; Japan 10.
Semimanufactures		—	16	—	All to Singapore.
Titanium: Oxides	kilograms	—	553	—	Republic of Korea 326; Taiwan 227.
Tungsten: Metal including alloys, scrap		4	—		
Zinc:					
Ore and concentrate		3,404	2,128	—	All to Japan.
Metal including alloys:					
Scrap		304	495	—	Japan 306; Taiwan 189.
Semimanufactures		—	1	—	All to Australia.
Other:					
Oxides and hydroxides		r110	134	21	Netherlands 54; United Kingdom 28.
Ashes and residues		8,467	22,881	—	Singapore 20,209; Japan 1,479.
Base metals including alloys, all forms		688	1,364	339	Japan 249; Australia 234.
INDUSTRIAL MINERALS					
Abrasives, n.e.s.:					
Natural: Corundum, emery, pumice, etc.		634	1,563	—	Hong Kong 704; Taiwan 629; Republic of Korea 135.
Grinding and polishing wheels and stones	kilograms	—	15	15	
Asbestos, crude		360	—		
Cement		105,366	38,552	—	Bangladesh 26,642; Vietnam 11,900.
Clays, crude		10	—		
Diamond: Industrial stones	carats	—	4,270	—	All to Singapore.
Feldspar, fluorspar, related materials		—	16,419	—	All to Taiwan.
Fertilizer materials:					
Crude, n.e.s.		1,173	3,124	—	Taiwan 1,772; Japan 1,301.
Manufactured:					
Nitrogenous		13,790	36,279	—	Australia 17,488; Thailand 15,740.
Phosphatic		544,503	321,068	—	China 162,666; Thailand 105,352.
Unspecified and mixed		30,614	181,850	—	China 158,299; Iran 15,750.

See footnotes at end of table.

TABLE 16—Continued

PHILIPPINES: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
INDUSTRIAL MINERALS—Continued				
Gypsum and plaster	5,250	61,227	—	All to Japan.
Lime	12	—		
Magnesium compounds: Magnesite, crude	—	80	—	All to Taiwan.
Mica: Crude including splittings and waste kilograms	500	—		
Phosphates, crude	600	700	—	Do.
Pigments, mineral: Natural crude	1	1	—	All to Guam.
Pyrite, unroasted	—	54	—	All to Japan.
Salt and brine	1	6	1	Pacific Islands Trust Territory 5.
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked	4,094	7,323	17	Taiwan 3,737; Japan 3,464.
Worked	2,136	5,345	1,850	Japan 2,227; Australia 471.
Dolomite, chiefly refractory-grade	271,247	215,721	—	Japan 212,721; Malaysia 3,000.
Gravel and crushed rock	15,114	24,399	7	Japan 16,336; Hong Kong 3,263.
Limestone other than dimension	39,954	175,882	—	Taiwan 141,904; Japan 32,774.
Quartz and quartzite	—	2	—	All to Australia.
Sand other than metal-bearing	2,668	3,455	920	Japan 1,260; United Kingdom 359.
Sulfur:				
Elemental: Colloidal, precipitated, sublimed kilograms	20	—		
Sulfuric acid do.	—	90	—	All to Malaysia.
Other				
Crude	2,198	6,222	—	Republic of Korea 4,037; Taiwan 1,940.
Slag and dross, not metal-bearing	480	—		
MINERAL FUELS AND RELATED MATERIALS				
Asphalt and bitumen, natural	18	14	—	All to Hong Kong.
Carbon black	1,477	575	—	Thailand 352; Taiwan 183.
Petroleum refinery products:				
Liquefied petroleum gas thousand 42-gallon barrels	868	1,362	—	Hong Kong 861; India 152; Thailand 123.
Gasoline:				
Aviation do.	—	10	10	
Motor do.	—	332	187	Japan 90; Thailand 47.
Naphtha do.	1,864	2,229	—	Japan 687; Taiwan 549; Malaysia 444.
Mineral jelly and wax do.	—	([3])	—	All to Australia.
Kerosene and jet fuel do.	336	291	—	Malaysia 223; Thailand 65.
Distillate fuel oil do.	—	606	—	Malaysia 402; Thailand 132.
Lubricants do.	10	17	—	Taiwan 11.
Residual fuel oil do.	442	34	—	Thailand 18; Nauru 16.
Bitumen and other residues do.	([3])	([3])	—	All to Hong Kong.

[r] Revised.
[1] Table prepared by Audrey D. Wilkes.
[2] May include other precious metals.
[3] Less than 1/2 unit.

TABLE 17

PHILIPPINES: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS				
Alkali and alkaline-earth metals	2	79	(2)	China 75.
Aluminum:				
Ore and concentrate	5,379	933	—	China 650; United Kingdom 206.
Oxides and hydroxides	5,380	8,257	85	Japan 5,742; Singapore 996.
Metal including alloys:				
Scrap	345	793	5	Hong Kong 578; Abu Dhabi 200.
Unwrought	6,271	10,808	—	Australia 6,953; Norway 1,134; France 981.
Semimanufactures	6,445	11,038	299	Republic of Korea 3,910; Japan 2,750.
Arsenic: Oxides and acids	16	52	—	Malaysia 46; United Kingdom 4.
Chromium:				
Ore and concentrate	17	12,000	—	All from India.
Oxides and hydroxides	27	93	18	West Germany 40; Japan 20.
Cobalt: Oxides and hydroxides kilograms	1,231	2,104	—	Hong Kong 2,000; Taiwan 54.
Copper:				
Ore and concentrate	—	22,005	—	All from Papua New Guinea.
Sulfate	245	135	(2)	Taiwan 49; Bulgaria 40; West Germany 26.
Metal including alloys:				
Scrap	16	2	—	All from Hong Kong.
Unwrought	8	543	5	Singapore 370; Indonesia 147.
Semimanufactures	3,241	4,540	365	Japan 2,380; Republic of Korea 449.
Gold: Metal including alloys, unwrought and partly wrought troy ounces	9,571	3,315	866	Singapore 1,339; Republic of Korea 922.
Iron and steel:				
Iron ore and concentrate excluding roasted pyrite, not agglomerated thousand tons	2,575	3,483	—	Brazil 1,558; Australia 1,471; Canada 454.
Metal:				
Scrap	85,243	108,994	80,664	Netherlands 22,357; Australia 5,358.
Pig iron, cast iron, related materials	22,366	70,612	1	Malaysia 61,023; China 8,802.
Ferroalloys:				
Ferromanganese	1,431	2,297	—	France 532; Mozambique 316; China 240.
Ferrosilicon	108	554	—	China 465; United Kingdom 43.
Unspecified	r184	563	2	Brazil 411; Japan 58.
Steel, primary forms	391,367	639,280	31,210	Brazil 205,036; Australia 78,455.
Semimanufactures:				
Bars, rods, angles, shapes, sections	37,685	79,718	1,078	Japan 20,601; Malaysia 12,200.
Universals, plates, sheets	199,923	358,779	5,013	Japan 172,232; Mozambique 41,793.
Hoop and strip	4,495	4,483	208	Japan 2,749; Singapore 352.
Rails and accessories	384	557	1	Republic of Korea 308; Japan 190.
Wire	7,128	10,785	73	Republic of Korea 4,176; Japan 3,140.
Tubes, pipes, fittings	12,445	20,614	389	Japan 7,553; West Germany 5,266.
Castings and forgings, rough kilograms	—	189	—	All from Taiwan.

See footnotes at end of table.

TABLE 17—Continued

PHILIPPINES: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS—Continued				
Lead:				
Oxides	12	27	(2)	Australia 22; Japan 4.
Metal including alloys:				
Scrap	4,307	9,069	—	Australia 6,759; Singapore 2,249.
Unwrought	4,532	8,739	164	Australia 3,696; Taiwan 2,874.
Semimanufactures	197	447	5	Australia 295; Japan 128.
Magnesium: Metal including alloys, all forms	36	3	—	Japan 2; United Kingdom 1.
Manganese:				
Ore and concentrate: Metallurgical-grade	3,040	3,594	(2)	Singapore 2,564; Japan 938.
Oxides	874	1,142	(2)	Japan 932; Australia 70.
Mercury 76-pound flasks	1,596	1,914	(2)	China 1,379; Hong Kong 271.
Molybdenum: Metal including alloys, all forms	2	4	2	Belgium-Luxembourg 1.
Nickel:				
Metal including alloys:				
Unwrought	50	91	12	Singapore 19; Canada 15.
Semimanufactures	68	91	3	Japan 49; West Germany 15.
Platinum-group metals: Metals including alloys, unwrought and partly wrought troy ounces	387	—		
Silver: Metal including alloys, unwrought and partly wrought do.	885	210	37	West Germany 161.
Tin: Metal including alloys:				
Scrap	—	5	5	
Unwrought	465	797	2	Indonesia 668; Malaysia 89.
Semimanufactures	62	3	—	China 2.
Titanium:				
Ore and concentrate	966	1,305	—	Australia 1,169; Republic of Korea 60.
Oxides	1,505	1,679	119	Japan 521; Australia 385.
Tungsten: Metal including alloys, all forms	8	82	(2)	Australia 77.
Uranium and/or thorium: Oxides and other compounds kilograms	—	60	—	All from Japan.
Zinc:				
Oxides	r377	700	11	Republic of Korea 366; China 92; Taiwan 65.
Blue powder	168	—		
Metal including alloys:				
Scrap	—	60	—	All from Taiwan.
Unwrought	18,897	21,376	150	Australia 7,937; China 4,152.
Semimanufactures	27	446	235	Taiwan 112; Italy 35.
Zirconium: Ore and concentrate	41	48	—	Australia 41.

See footnotes at end of table.

TABLE 17—Continued

PHILIPPINES: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS—Continued					
Other:					
Ores and concentrates		7	3	—	All from Japan.
Oxides and hydroxides		5,386	5,253	—	Belgium-Luxembourg 3,216; China 1,079.
Ashes and residues		38,535	66,740	267	Japan 66,353.
Base metals including alloys, all forms		30	151	42	Hong Kong 48; China 30.
INDUSTRIAL MINERALS					
Abrasives, n.e.s.:					
Natural: Corundum, emery, pumice, etc.		244	611	20	Hong Kong 190; China 180; Netherlands 148.
Artificial:					
Corundum		63	21	—	Austria 18; Japan 2.
Silicon carbide		51	37	5	Hong Kong 23; Brazil 7.
Dust and powder of precious and semiprecious stones including diamond	grams	150	—		
Grinding and polishing wheels and stones		788	1,336	270	Republic of Korea 327; Hong Kong 181.
Asbestos, crude		1,151	1,911	202	Canada 1,165; U.S.S.R. 425.
Barite and witherite		43	2,257	21	Thailand 1,265; Singapore 436.
Boron materials: Oxides and acids		174	300	97	France 130; Italy 72.
Bromine including fluorine and iodine		4	6	2	West Germany 3.
Cement		14,033	289,182	2,603	Republic of Korea 131,248; Indonesia 87,000.
Chalk		24	86	—	West Germany 64; Taiwan 22.
Clays, crude		19,291	26,816	9,131	Indonesia 3,694; Malaysia 2,016.
Cryolite and chiolite	kilograms	500	—		
Diamond: Industrial stones:					
Natural	carats	1,067,311	226,862	—	Belgium-Luxembourg 89,187; Ireland 54,150; Italy 50,000.
Synthetic	do.	—	4,700	—	All from Australia.
Diatomite and other infusorial earth		407	796	236	Taiwan 264; Japan 224.
Feldspar, fluorspar, related materials		1,535	6,516	49	Thailand 4,147; India 674.
Fertilizer materials:					
Crude, n.e.s.		12	—		
Manufactured:					
Ammonia		139,254	166,370	3,469	Indonesia 103,623; Qatar 18,052; Kuwait 15,018.
Nitrogenous		720,402	792,751	52,198	Indonesia 136,288; Kuwait 112,574.
Phosphatic		760	6,056	1,140	Japan 4,432.
Potassic		86,590	170,137	10,902	Canada 66,875; Israel 33,000.
Unspecified and mixed		52,860	951	18	Norway 390; Japan 238.
Graphite, natural		122	365	1	Republic of Korea 177; China 125.

See footnotes at end of table.

TABLE 17—Continued

PHILIPPINES: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
INDUSTRIAL MINERALS—Continued				
Gypsum and plaster	150,984	127,902	406	Japan 68,764; Indonesia 35,378.
Lime	431	90	—	United Kingdom 55; Taiwan 35.
Magnesium compounds: Magnesite, crude and calcined	8,375	29,268	11	Republic of Korea 19,732; China 4,920.
Mica:				
Crude including splittings and waste	109	134	48	China 22; Malaysia 18.
Worked including agglomerated splittings	3	21	9	Belgium-Luxembourg 6; Japan 3.
Nitrates, crude	74	98	—	Belgium-Luxembourg 60; Netherlands 20; West Germany 18.
Phosphates, crude thousand tons	1,287	1,035	—	Morocco 529; Senegal 352; Nauru 68.
Pigments, mineral:				
Natural, crude	3,106	3,491	73	India 2,808; United Kingdom 481.
Iron oxides and hydroxides, processed	871	1,269	110	West Germany 722; Spain 251.
Salt and brine	88,917	93,053	28	Australia 50,878; China 31,629.
Sodium compounds, n.e.s.:				
Carbonate, manufactured	71,229	115,432	50,792	Kenya 36,257; Japan 27,069.
Sulfate, manufactured	14,730	14,271	73	China 11,557; Hong Kong 2,096.
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked	154	810	—	Italy 415; China 228.
Worked	16	109	—	Spain 55; Hong Kong 42.
Dolomite, chiefly refractory-grade	1,271	1,488	—	United Kingdom 1,176; Thailand 163.
Gravel and crushed rock	214	173	—	France 134; Belgium-Luxembourg 20.
Limestone other than dimension	1,695	6,453	—	Taiwan 6,149; Japan 214.
Quartz and quartzite	2	113	6	China 81; Italy 6.
Sand other than metal-bearing	11,689	740	103	Taiwan 592.
Sulfur:				
Elemental:				
Crude including native and byproduct	2,015	17,233	163	Singapore 8,916; Canada 5,518.
Colloidal, precipitated, sublimed	17,318	1,704	15	Singapore 1,027; Taiwan 234.
Dioxide	1	2	([2])	Mainly from Netherlands.
Sulfuric acid	123,407	138,679	16	Japan 138,633.
Talc, steatite, soapstone, pyrophyllite	7,147	8,464	462	Republic of Korea 4,558; China 2,284.
Other:				
Crude	359	638	1	Australia 346; Japan 259.
Slag and dross, not metal-bearing	80,017	155,074	1	Chile 64,292; Taiwan 44,411.
MINERAL FUELS AND RELATED MATERIALS				
Asphalt and bitumen, natural	50	29	—	Singapore 28.
Carbon black	764	2,366	1,580	Taiwan 419; Australia 99.

See footnotes at end of table.

TABLE 17—Continued

PHILIPPINES: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
MINERAL FUELS AND RELATED MATERIALS—Continued					
Coal, all grades including briquets		960,308	480,048	42	Australia 338,612; China 110,788.
Coke and semicoke		85,134	80,379	1	Japan 77,277; Australia 3,096.
Petroleum:					
Crude	thousand 42-gallon barrels	49,391	62,471	—	Kuwait 15,324; Saudi Arabia 10,877; Malaysia 8,884.
Refinery products:					
Liquefied petroleum gas	do.	655	1,759	—	Saudi Arabia 634; Kuwait 473; Bahrain 371.
Gasoline	do.	25	122	1	Singapore 94; Australia 26.
Mineral jelly and wax	do.	54	76	7	China 55; Hong Kong 5.
Kerosene and jet fuel	do.	(2)	(2)	—	All from Japan.
Distillate fuel oil	do.	6,285	8,593	—	Kuwait 3,364; Singapore 3,132; Taiwan 1,030.
Lubricants	do.	46	117	24	Japan 35; Taiwan 15.
Residual fuel oil	do.	13	145	—	Singapore 118; Australia 27.
Bitumen and other residues	do.	(2)	(2)	—	All from Japan.
Bituminous mixtures	do.	(2)	(2)	(2)	Mainly from West Germany.

r Revised.
1 Table prepared by Audrey D. Wilkes.
2 Less than 1/2 unit.

out to sea, thus eliminating or at least reducing environmental damage to reefs and sea life.

After reopening the Tapian Mine, Marcopper announced plans to restart development at its San Antonio ore body 3 kilometers from the Tapian facility. Its earlier development stopped in 1983 when copper prices plunged to unprofitable levels. The San Antonio deposit reportedly contains an estimated 200 million tons of reserves grading 0.47% copper, which will be mined by open pit methods similar to those used at Tapian. The production rate was also expected to be similar.[60] Reserves at Tapian were expected to be exhausted in 1989.

Marcopper returned to making a profit in the first quarter after sustaining severe losses since 1984. The better performance was attributed to higher metal prices, lower production costs, and a favorable exchange rate. However, this performance was not expected to continue because the San Antonio project needed Government tax concessions, an agreement with lenders to restructure their defaulted loans, $50 million in new financing, and a Government permit to use the Tapian mill's disposal system. Marcopper stated that even if the Government agreed to all this, it would still take 6 years to complete the San Antonio project. Although production could begin in 3 years, there would be a break in mining of at least 18 months.[61] The Government owned a 49% share of the company.

The Philex Mining Corp. completed its $14.8 million expansion program at the Santo Tomas Mine at Tuba, Benguet Province, during the second quarter, thereby increasing its mining and milling capacity by 14% to 32,000 tons of ore per day. The expansion enabled Philex to mine richer ore and transport it to the concentrator via a cable belt at a rate of 1,800 tons per hour through a 2,500-meter inclined tunnel.

A joint-venture company, Far South East Gold Resources Inc., was formed in July by Lepanto Consolidated Mining Co. Inc, 60%; Canada's Galactic Resources Ltd., 30%; and the World Bank's International Finance Corp. (IFC), 10%. Far South East planned to develop an underground copper-gold mine at Mankayan in Benguet Province. Reserves in the Far South East porphyry deposit were estimated at 163 million tons of ore grading 0.81% copper. The mine life was projected to be 11 years, producing an average of about 32,000 tons of copper per year. (See the Gold section for additional information.)

The Philippine Associated Smelting and Refining Corp. (PASAR) was owned by the state-owned National Development Corp., 40%; a Japanese consortium led by Marubeni Corp., 32%; local copper producers led by Atlas Consolidated, 23%; and IFC, 5%. PASAR planned to increase production by 25% at its 138,000-ton-per-year smelter at Isabel in the central Province of Leyte. The expansion was expected to cost $51 million and to be financed partly by the Japanese Government.[62] A feasibility study conducted by PASAR indicated that project costs could be recovered within 2 years. Expansion of the smelter would mean importing copper concentrates to compensate for the limited supplies from local producers.

The Philippines ranked 10th among world copper producers. According to the Chamber of Mines of the Philippines, production of copper, by company, is shown in the text table in metric tons.[63]

Company	1987	1988
Atlas Consolidated Mining and Development Corp.	81,049	85,356
Maricalum Mining Corp.	40,606	38,711
Marcopper Mining Corp.	23,933	26,571
Philex Mining Corp.	23,618	21,912
Benguet Corp.	19,153	20,976
Lepanto Consolidated Mining Co. Inc.	r14,116	13,157
North Davao Mining Corp.	13,671	11,406
Total	**r215,015**	**218,089**

r Revised.

Gold.—The country's largest gold producer, Benguet, planned to extend the remaining life of the Dizon Mine, 50% owned by Dizon Copper-Silver Mines Inc. at San Marcelino, Zambales Province, by mining deep-seated ores. Benguet expected the mining of these ores would increase the reserves from 21 million tons of ore to 61 million tons of ore and would extend the mine life from 6 to 9 years. The projected cost of the project was $24 million.

Benguet began a feasibility study for switching from underground to surface mining at its Antamok Mine, 20 kilometers from Baguio, Benguet Province. If feasible, the mine would have a mine life of 13 years and would be in production by 1991 at the rate of 100,000 ounces of gold per year.

Benguet Exploration Inc. awarded a contract to Australia's BHP Engineering Ltd. to conduct a feasibility study for a gold-tailings-treatment plant to be located in Boringot, Davao del Norte Province. The plant was to be designed to treat the tailings of small-scale mines operating in the area and would use the carbon-in-pulp and carbon-in-leach processes.

Itogon-Suyoc Mines Inc., 54% owned by Benguet, planned to expand operations at its Itogon underground mine at Itogon, Benguet Province, in 1989.

At its gold-silver project at Aroroy on Masbate Island, Atlas Consolidated conducted accelerated exploration at five main pre-World War II workings, resulting in the expectation that the old Dabu-Panique Mine would come onstream early in 1989. Two other underground operations in the area were also expected to begin production to help replace depleted near-surface reserves at the Masbate open pit operation.

Far South East Gold Resources Inc. was formed to develop a mine in Benguet Province. Ore reserves were estimated at 163 million tons of ore grading 1.76 grams of gold per ton. An average of 250,000 ounces of gold per year was expected to be produced over the life of the mine, the largest single gold project in the history of the Philippines.[64] (See the Copper section for additional information.)

Cultus Gold NL of Australia and its Philippine affiliate, Alpha Resources Development Corp., identified a low-grade, bulk-tonnage, epithermal gold deposit in Camarines Norte in midyear and further explored the prospect.

Cultus Gold was awarded a contract at yearend by the Government to reprocess an estimated 10 million tons of tailings, with a potential grade of 0.5 to 1.5 grams of gold per ton at the former Philippine Iron Mines at Larap, 185 kilometers southeast of Manila. The mines were closed in 1974. Cultus Gold planned an evaluation program for the first half of 1989 to determine the volume and grade of the tailings, which were derived from processing magnetite from the mines. Under the terms of the contract, Cultus Gold was awarded right of possession for reprocessing in return for a 6% gross revenue royalty.[65]

Banahaw Mining and Development Corp., owned by Muswellbrook Energy and Minerals Pty. Ltd. of Australia and their Philippine partners, awarded a contract at yearend for the design and management of the plant at a project in Agusan del Sur on Mindanao Island. The plant was expected to treat 180,000 tons of ore per year to recover 30,000 ounces of gold. A batch carbon-in-pulp plant had been operating at the site.

Dublin-based Kenmare Resources PLC signed an agreement with Government-owned Planters Products Ltd. to heap leach a gold tailings deposit near Manila. The deposit was estimated to contain 240,000 tons of material. Test work began in August, and, should results be positive, leaching was scheduled to begin early in 1989.

Gold production in the Philippines was ranked ninth in the world in 1988. According to the Chamber of Mines of the Philippines, gold production by companies and small-scale gold panners is shown in the text table, in troy ounces.[66]

Company	1987	1988
Benguet Corp. (primary and byproduct)	249,137	275,302
Atlas Consolidated Mining and Development Corp. (primary and byproduct)	139,846	143,640
Philex Mining Corp. (byproduct)	158,068	137,890

Company	1987	1988
Lepanto Consolidated Mining Co. Inc. (byproduct)	73,373	82,670
Surigao Consolidated Mining Co. (primary)	39,596	33,428
Apex Mining Co. Inc. (primary)	44,952	27,580
Marcopper Mining Corp. (byproduct)	19,091	18,632
Itogon-Suyoc Mines Inc. (primary)	11,115	13,479
Manila Mining Corp. (primary)	8,086	9,770
Benguet Exploration Inc. (primary and byproduct)	11,368	9,685
Maricalum Mining Corp. (byproduct)	9,267	9,252
North Davao Mining Corp. (byproduct)	9,212	7,338
Small-scale gold panners[e]	500,000	500,000
Total[e]	**1,273,111**	**1,268,666**

[e] Estimated.

Nickel.—The Asset Privatization Trust (APT), a Government-formed body, oversees assets foreclosed by the Development Bank of the Philippines and the Philippines National Bank. APT evaluated three offers to operate the Nonoc Mining and Industrial Corp.'s (NMIC) nickel production facilities on Nonoc Island (mine) and Marinduque Island (refinery) in Surigao del Norte Province. The facilities were mothballed in March 1986 after financial and labor difficulties. The mine had proven reserves of about 100 million tons of lateritic ore, sufficient for a mine life of about 31 years. The refinery had a rated nickel capacity of 30,000 tons per year, and it also produced 1,500 tons of cobalt per year. Bringing the refinery back onstream will cost an estimated $70 million to $80 million for rehabilitation and extensive modernization, but this was considered cheaper than constructing a new plant. However, none of the offers was accepted, and APT decided near yearend to auction off the facilities instead. APT set the minimum acceptable bid at $300 million.[67] Several groups reportedly expressed an interest in NMIC at yearend. They included Dallhold Nickel Management Pty. Ltd., a wholly owned Bond Corp. subsidiary, and the U.S.S.R., which was known to be interested in processing technology for lateritic nickel ores and in obtaining more cobalt.

Steel.—National Steel Corp. purchased a 1 million-ton-per-year hot strip mill formerly installed at Wheeling-Pittsburgh Steel Co.'s Allenport, PA, steelworks for its Iligan steelworks, Misamis Oriental Province. The new mill was part of National's $230 million second-phase expansion and modernization program, which also included increasing capacity of its downstream cold mill and tinning lines. Flat product output was aimed to reach 1.2 million tons in 1992 and the expanded cold mill was expected to start operations in 1991.

***Industrial Minerals.*—Sulfur.**—Freeport-McMoRan Inc. of the United States negotiated with the Government a production-sharing agreement concerning a sulfur deposit owned by Pampelone Sulphur Mining Corp. The 20-million-ton, low-grade deposit was formerly examined by Benguet, which conducted drilling programs and constructed some buildings, but did not develop the deposit further. Freeport's interest stemmed from examination of these earlier drilling results, and the company saw a potential source of sulfur for serving the Pacific Rim fertilizer markets. Further progress was dependent upon the outcome of Government negotiations, because an agreement had been made with Pampelone Sulphur.

***Mineral Fuels.*—Petroleum.**—The Committee for Coordination of Joint Prospecting of Mineral Resources in Asian Offshore Areas (CCOP) assisted in the exploration of the first offshore oilfield in Palawan. CCDP agreed late in the year to help expand exploration for oil in Philippine offshore areas in order to reduce the dependence of the country on imported oil. CCOP was organized in 1966 to promote and coordinate joint prospecting and research in offshore areas in the Asian region.

SINGAPORE[68]

Singapore's GDP rose by 10.9% in 1988 with broad-based growth except for financial and business services. Strong external demand contributed 88% to the growth in demand. The country's exports of goods and services grew by 28% compared with 11% in 1987. Nonoil domestic exports and reexports increased by 41% and 39%, respectively. In the manufacturing sector, such as the electronics industry, the growth rate slowed down in the last quarter of 1988. The petroleum industry was also declining because of a reduction in sales to Japan and a fall in crude oil processing volumes from China. Investment in the country reached $1.03 billion[69] in 1988, the highest level in the decade.

The labor productivity level in the manufacturing sector varied among the top 10 industries. The chemical and gas industry was the highest in value added output (defined as the total value of output minus the cost of raw material inputs) per worker. The chemical and gas industry, with an output of $4.6 billion, achieved rapid growth at 28% and was more profitable. A modern $390 million titanium dioxide plant, funded by investments from Japan's Ishihara Sangyo Kaisha (ISK), was to be operational at Tuas in 1989 in order to cater to regional (60%) and worldwide (40%) markets. The first-phase facility, costing about $200 million, had a production capacity of 36,000 tons per year. When the second-phase facility is completed, the plant capacity

TABLE 18

SINGAPORE: PRODUCTION OF MINERAL COMMODITIES[1 2]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987	1988[p]
Cement, hydraulic	thousand tons	2,821	1,992	1,805	1,527	1,595
Iron and steel: Metal: Steel, crude[e]	do.	350	350	350	350	300
Petroleum refinery products:						
Gasoline	thousand 42-gallon barrels	17,731	[e]18,000	[e]18,000	[e]19,000	[e]19,000
Jet fuel	do.	43,578	[e]44,000	[e]44,000	[e]44,000	[e]45,000
Kerosene	do.	14,338	[e]14,000	[e]13,000	[e]13,000	[e]12,000
Distillate fuel oil	do.	76,677	[e]77,000	[e]75,000	[e]72,000	[e]72,000
Residual fuel oil	do.	87,418	[e]87,000	[e]85,000	[e]82,000	[e]82,000
Lubricants	do.	3,959	[e]4,000	[e]4,000	[e]4,000	[e]5,000
Other	do.	45,560	[e]46,000	[e]45,000	[e]45,000	[e]46,000
Refinery fuel and losses	do.	4,024	[e]4,000	[e]3,000	[e]3,000	[e]4,000
Total	**do.**	**293,285**	**[e]294,000**	**[e]287,000**	**[e]282,000**	**[e]285,000**
Stone: Granite, broken	thousand cubic meters	7,422	6,743	5,565	7,319	6,914
Sulfur, byproduct of petroleum		5,557	[e]6,000	[e]5,000	[e]5,000	[e]5,000

[e]Estimated. [p]Preliminary.

[1]Table includes data available through Aug. 18, 1989.

[2]In addition to the commodities listed, other crude construction materials such as sand and gravel and other varieties of stone presumably are produced, but available information is inadequate to make reliable estimates of output levels.

would double to 72,000 tons per year.

Overall, Singapore's trade in 1988 grew 30% to $74.6 billion from $57.2 billion in 1987. Exports rose 31% to $35.3 billion from $26.8 billion, and imports rose 29% to $39.3 billion from $30.4 billion. The country had a global deficit of $4 billion, up from $3.6 billion for 1987. Petroleum products worth $9 billion shipped from the refineries accounted for 18% of the total domestic exports, followed by computer equipment, telecommunications gear, and electronic components. Exports to the United States in 1988 grew 28% over 1987 to $8.4 billion. Trade surplus against the United States was $2.2 billion, 10% higher than in 1987. Sales to regional trade partners and to the EC showed considerably higher growth rates.

Singapore's trade with China was $5.7 billion in 1988, of which 7% covering 170 projects in China, were contracts sealed between Singapore and Chinese traders. There were only 20 Chinese enterprises, joint ventures, business representative offices, and cooperation projects in Singapore, worth $5 million. Compared with that of 1987, exports to China were up 65%, including electrical machines, spare ship parts, specialized equipment, natural rubber, palm oil, and household appliances. On the other hand, imports from China were up 11%, including crude oil, refined oil, textile products, foodstuffs, native and livestock products, light industrial products, arts and crafts, and equipment. Singapore is China's fourth-ranking trade partner in Southeast Asia.

The country's Kimetal tin smelter planned a joint venture with China to build a 200-ton-per-month tin smelter in southwest China. Kimetal, operating on one arc furnace, had been intermittently treating the tin concentrates from various sources at an average rate of 200 tons per month of refined tin output. A spare furnace at Kimetal and most of the other equipment were to be supplied by Singapore to the Chinese smelter. Eventually, another furnace would be added to the smelter in order to double the capacity to 500 tons per month. Singapore has become a major delivery point of zinc and the largest single center of zinc stocks for the London Metal Exchange. The country is also the second largest delivery center for aluminum. Other metals significantly distributed through Singapore include copper, lead, and nickel.

Cement manufacturing and granite quarrying were the major activities in the mineral industry in 1988. Singapore's six major local cement producers were Asia Cement, Indocement, Jurong Cement, Pan Malaysian Cement Works, Singapore Cement, and Ssangyong Cement. Arabian Bulk

TABLE 19

SINGAPORE: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987 United States	Destinations, 1987 Other (principal)
METALS				
Alkali and alkaline-earth metals	—	7	4	NA.
Aluminum:				
Ore and concentrate	7	5	—	All to Malaysia.
Oxides and hydroxides	119,180	31,101	—	China 11,010; Malaysia 5,341; Japan 4,234.
Metal including alloys:				
Scrap	12,434	15,770	120	Japan 13,608; Pakistan 575; Malaysia 477.
Unwrought	6,467	13,107	1	Malaysia 7,140; Japan 2,244; Thailand 1,941.
Semimanufactures	9,193	8,609	89	Australia 3,140; Malaysia 1,692.
Chromium:				
Ore and concentrate	27	20	—	All to Malaysia.
Oxides and hydroxides	29	186	—	Hong Kong 84; North Korea 50; Malaysia 28.
Cobalt: Oxides and hydroxides	8	6	—	Malaysia 3.
Columbium and tantalum:				
Ore and concentrate, tantalum	393	12	NA	Netherlands 11.
Metal including alloys, all forms, tantalum	([2])	([2])	—	All to Malaysia.
Copper:				
Ore and concentrate	1	56	—	Hong Kong 50.
Matte and speiss including cement copper	—	4	—	All to Malaysia.
Metal including alloys:				
Scrap	23,757	29,639	182	India 11,761; Japan 9,441; Republic of Korea 3,330.
Unwrought	7,086	12,499	—	Malaysia 10,840; Hong Kong 1,151.
Semimanufactures	5,199	6,487	10	Malaysia 3,281; Taiwan 632.
Gold:				
Waste and sweepings kilograms	1,280	1,749	170	Japan 1,329; West Germany 248.
Metal including alloys, unwrought and partly wrought troy ounces	132,750	151,591	4,212	Malaysia 75,490; Thailand 13,343.
Iron and steel:				
Iron ore and concentrate excluding roasted pyrite	19	23	—	Malaysia 20; Thailand 3.
Metal:				
Scrap	90,776	155,625	—	Malaysia 69,105; Thailand 56,295; Japan 24,848.
Pig iron, cast iron, related materials	1,413	996	—	Malaysia 872; Thailand 72.
Ferroalloys:				
Ferromanganese	232	613	—	Malaysia 279; Bangladesh 120; North Korea 113.
Ferrosilicon	206	426	—	Malaysia 355; India 40.
Unspecified	111	80	—	Malaysia 78.

See footnotes at end of table.

TABLE 19—Continued

SINGAPORE: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
METALS—Continued					
Iron and steel—Continued					
Metal—Continued					
Steel, primary forms		5,124	24,261	—	Taiwan 18,814; Republic of Korea 4,772; Malaysia 529.
Semimanufactures:					
Bars, rods, angles, shapes, sections		141,815	200,987	84,541	Japan 39,096; Malaysia 28,191.
Universals, plates, sheets		85,635	119,206	25	Malaysia 76,580; Hong Kong 6,202.
Hoop and strip		14,275	6,021	3	Malaysia 2,516; Saudi Arabia 1,188.
Rails and accessories		577	2,089	—	Malaysia 2,054.
Wire		3,620	5,032	57	Malaysia 2,453; North Korea 1,000.
Tubes, pipes, fittings		123,089	106,917	35,264	Malaysia 29,302; Brunei 7,306.
Castings and forgings, rough		749	620	113	India 150; Malaysia 68; Papua New Guinea 52.
Lead:					
Ore and concentrate		10	10	—	India 6; Israel 3; Malaysia 1.
Oxides		233	286	—	Malaysia 199; Sri Lanka 81.
Metal including alloys:					
Scrap		5,103	9,690	—	Taiwan 3,209; Republic of Korea 2,420; Philippines 2,148.
Unwrought		5,584	8,608	80	Thailand 3,372; Malaysia 3,044.
Semimanufactures		176	595	NA	Thailand 266; Malaysia 145; Republic of Korea 81.
Magnesium: Metal including alloys, all forms		33	79	—	North Korea 56; Bahrain 10; Malaysia 5.
Manganese:					
Ore and concentrate, battery-grade		23,565	21,772	—	India 4,700; Republic of Korea 4,340; Kenya 2,756.
Oxides		976	2,018	—	Malaysia 1,646; Bangladesh 200.
Mercury	76-pound flasks	174	622	—	Australia 100.
Molybdenum: Metal including alloys, all forms		—	5	—	Mainly to Malaysia.
Nickel:					
Ore and concentrate		—	25	—	Hong Kong 18; Philippines 6.
Matte and speiss		1,307	5	—	Mainly to Malaysia.
Metal including alloys:					
Scrap		280	142	70	India 39; Malaysia 20; United Kingdom 12.
Unwrought		2,399	1,483	—	India 1,073; Taiwan 225.
Semimanufactures		315	1,243	—	Taiwan 699; Thailand 179; Republic of Korea 147.
Platium-group metals: Metals including alloys, unwrought and partly wrought	troy ounces	1,800	11,864	8,584	Hong Kong 1,190; West Germany 1,061.
Silver:					
Ore and concentrate[3]		—	21	—	All to Malaysia.

See footnotes at end of table.

TABLE 19—Continued

SINGAPORE: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
METALS—Continued				
Silver—Continued				
Waste and sweepings[3] kilograms	1,477	2,428	870	United Kingdom 921; Hong Kong 428.
Metal including alloys, unwrought and partly wrought troy ounces	121,337	284,630	—	Malaysia 83,656; Thailand 81,277; United Kingdom 42,825.
Tin:				
Ore and concentrate	4,892	10,421	173	Malaysia 6,562; U.S.S.R. 2,268; Republic of Korea 1,151.
Ash and residue containing tin	571	1,378	NA	Netherlands 748; Taiwan 581; Japan 33.
Metal including alloys:				
Scrap	75	77	2	Taiwan 42; Malaysia 22; United Kingdom 10.
Unwrought	29,914	29,820	8,309	Japan 9,417; Netherlands 3,515.
Semimanufactures	243	198	—	Hong Kong 60; India 40; Republic of South Africa 38.
Titanium: Oxides	1,445	1,461	—	Malaysia 569; Taiwan 298; Philippines 161.
Tungsten:				
Ore and concentrate	732	1,166	275	India 301; Hong Kong 195; West Germany 110.
Metal including alloys, all forms	52	86	45	India 28; Taiwan 3.
Uranium and/or thorium: Ore and concentrate	—	2,113	990	Malaysia 623; China 500.
Zinc:				
Ore and concentrate	42	31	—	Thailand 19; Malaysia 11.
Oxides	625	658	—	Japan 435; United Kingdom 56.
Blue powder	91	209	3	Thailand 85; India 60; Malaysia 59.
Metal including alloys				
Scrap	651	538	—	Taiwan 336; Malaysia 96; Belgium-Luxembourg 50.
Unwrought	3,584	5,576	—	Malaysia 2,997; India 1,163; Netherlands 1,075.
Semimanufactures	434	443	332	Malaysia 64; Burma 14.
Other:				
Ores and concentrates	388	573	—	Thailand 441; Malaysia 132.
Ashes and residues	49,310	51,656	25	Malaysia 33,531; Brunei 4,488; Bahrain 3,103.
Base metals including alloys, all forms	144	49	—	North Korea 21; Malaysia 12; Japan 9.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	47	305	—	Thailand 87; Malaysia 86; Sri Lanka 86.
Artificial: Corundun kilograms	NA	480	—	All to Malaysia.
Dust and powder of precious and semiprecious stones including diamond value, thousands	$1	$22	—	India $10; Switzerland $9.

See footnotes at end of table.

TABLE 19—Continued

SINGAPORE: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Destinations, 1987	
				United States	Other (principal)
INDUSTRIAL MINERALS—Continued					
Abrasives, n.e.s.—Continued					
Grinding and polishing wheels and stones		275	394	([4])	Malaysia 250; Thailand 63.
Asbestos, crude		4,276	848	—	Malaysia 828; India 14.
Barite and witherite		12,939	12,870	—	Malaysia 8,034; Papua New Guinea 1,822; Brunei 1,065.
Boron materials:					
Crude natural borates		10	105	—	All to Malaysia.
Oxides and acids		183	269	—	Malaysia 211; North Korea 20.
Cement		66,927	97,635	—	Malaysia 38,911; Sri Lanka 14,949; Brunei 10,265.
Chalk		2,781	1,559	—	Malaysia 781; Brunei 527; Philippines 162.
Clays, crude		12,065	16,438	18	Malaysia 7,351; Thailand 2,039; Japan 1,495.
Diamond:					
Gem, not set or strung	value, thousands	$8,539	$19,277	$641	Belgium-Luxembourg $4,981; Malaysia $3,507; Hong Kong $3,061.
Industrial stones	do.	$264	$220	$20	Hong Kong $86; Malaysia $86.
Diatomite and other infusorial earth		115	223	—	Malaysia 93; Thailand 91; Sri Lanka 20.
Feldspar		3,585	1,597	—	Malaysia 1,593.
Fertilizer materials:					
Crude, n.e.s.		40,654	36,129	—	Malaysia 36,090; Brunei 31.
Manufactured:					
Ammonia		307	364	—	Malaysia 126; Thailand 110; Maldives 37.
Nitrogenous		17,877	26,663	—	Malaysia 6,522; Papua New Guinea 4,018.
Phosphatic		16,356	11,602	—	Burma 7,400; Kenya 3,000; Papua New Guinea 668.
Potassic		141,368	139,992	—	Sri Lanka 69,270; Malaysia 31,630; Thailand 13,517.
Unspecified and mixed		54,128	59,820	—	Malaysia 57,910; Brunei 1,121.
Graphite, natural		77	69	—	Malaysia 46; Italy 17.
Gypsum and plaster		2,739	5,040	—	Malaysia 4,620; Brunei 283; Thailand 81.
Lime		2,919	2,814	—	Brunei 1,671; Malaysia 929.
Magnesium compounds:					
Magnesite, crude including calcined		172	480	—	Malaysia 318; Taiwan 90.
Mica					
Crude including splittings and waste		51	298	—	Malaysia 107; Hong Kong 56.
Worked including agglomerated splittings		11	4	—	Japan 1.
Nitrates, crude		555	33	—	Brunei 32; Malaysia 1.
Phosphates, crude		2,605	898	—	Malaysia 592; Brunei 120; Hong Kong 76.

See footnotes at end of table.

TABLE 19—Continued

SINGAPORE: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
INDUSTRIAL MINERALS—Continued					
Pigments, mineral: Iron oxides and hydroxides, processed		639	706	—	Malaysia 544; Taiwan 62; Philippines 44.
Precious and semiprecious stones other than diamond:					
Natural	value, thousands	$3,559	$6,649	$387	Thailand $3,451; Switzerland $1,174; Hong Kong $1,108.
Synthetic	do.	$412	$613	$9	Malaysia $198; Thailand $191; Switzerland $104.
Pyrite, unroasted		—	1	NA	NA.
Salt and brine		9,216	9,663	—	Malaysia 7,733; Brunei 1,570.
Sodium compounds, n.e.s.:					
Carbonate, manufactured		1,387	5,946	—	Malaysia 5,401; Australia 40; Seychelles 40.
Sulfate, manufactured[5]		11,038	8,455	—	Malaysia 8,268.
Stone, sand and gravel:					
Dimension stone:					
Crude and partly worked		233	445	1	Taiwan 252; Malaysia 113; Hong Kong 40.
Worked		4,715	4,503	191	Malaysia 2,279; Hong Kong 503; Brunei 388.
Dolomite, chiefly refractory-grade		1,268	685	—	Papua New Guinea 681.
Gravel and crushed rock		390	3,614	—	Malaysia 3,321; Republic of Korea 31.
Limestone other than dimension		86	222	—	Malaysia 217; Brunei 6.
Sand other than metal-bearing		698	10,794	—	Japan 6,000; Australia 2,551; Malaysia 2,237.
Sulfur:					
Elemental:					
Crude including native and byproduct		15,885	24,815	—	Thailand 11,962; Malaysia 7,993; Philippines 4,701.
Colloidal, precipitated, sublimed		10,600	22,207	—	Malaysia 10,747; Philippines 5,026; Thailand 4,927.
Sulfuric acid		1,743	1,753	—	Malaysia 888; Sri Lanka 655; Brunei 129.
Talc, steatite, soapstone, pyrophyllite		512	890	—	Malaysia 829; Republic of South Africa 20.
Other:					
Crude		5,379	3,806	—	Philippines 2,105; Thailand 520; Sri Lanka 500.
Slag and dross, not metal-bearing		7,480	8,393	—	Japan 5,606; Malaysia 2,422; Brunei 253.
MINERAL FUELS AND RELATED MATERIALS					
Asphalt and bitumen, natural		19,387	10,854	—	Burma 3,480; China 3,001; Kenya 1,200.
Carbon:					
Carbon black		5,632	5,400	52	Malaysia 610; Pakistan 421; Thailand 396.
Gas carbon		7	2	NA	NA.

See footnotes at end of table.

TABLE 19—Continued

SINGAPORE: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
MINERAL FUELS AND RELATED MATERIALS—Continued					
Coal, all grades including briquets		r1,601	248	—	Malaysia 70; Philippines 67; Australia 44.
Coke and semicoke		17,462	14,500	—	Malaysia 12,323; Sri Lanka 873; Thailand 566.
Peat including briquets and litter		6	9	—	Malaysia 6; Brunei 3.
Petroleum:					
Crude	thousand 42-gallon barrels	649	714	—	Malaysia 421; Japan 293.
Refinery products:					
Liquefied petroleum gas	do.	2,566	2,712	—	Malaysia 1,588; Hong Kong 948.
Gasoline	do.	41,723	38,338	114	Japan 14,051; Malaysia 9,571.
Mineral jelly and wax	do.	213	([4])	—	NA.
Kerosene and jet fuel	do.	41,228	45,784	3,496	Japan 20,628; Hong Kong 8,179.
Distillate fuel oil	do.	59,673	58,114	1,273	Thailand 16,740; Malaysia 8,236.
Lubricants	do.	3,843	4,257	10	Malaysia 905; India 812; Thailand 748.
Residual fuel oil	do.	63,214	56,741	8,911	Japan 16,091; Malaysia 10,994.
Bitumen and other residues	do.	2,449	2,069	—	Malaysia 628; Japan 312, Republic of South Africa 227.
Bituminous mixtures	do.	130	7	—	Tanzania 4; Yemen, Sanaa 2.
Petroleum coke	do.	2	([4])	—	All to Malaysia.

r Revised. NA Not available.
[1] Table prepared by Audrey D. Wilkes and Peter J. Roetzel.
[2] Unreported quantities valued at $6,000 in 1986 and $1,000 in 1987.
[3] May include other precious metals.
[4] Less than 1/2 unit.
[5] Includes hydrogen sulfate and pyrosulfate.

Trade, another major domestic supplier, imported cement from such countries as Japan, Malaysia, and Taiwan. Cement manufacturers attributed the price increases to a shortage of raw materials, including clinker that had to be imported mainly from Indonesia, Japan, and Malaysia. In 1988, the building industry used 1.7 million tons of cement.

Due to higher oil and petrochemical demand by countries including Indonesia, Japan, and Thailand, Singapore's oil refining industry operated at near full capacity throughout 1988. Shell Singapore, BP Singapore, and Singapore Refining Co. (SRC) were processing up to 100,000 bbl/d each to meet the demand and China's Sinochem Corp. processed 70,000 bbl/d of its crude oil in Singapore. Shell Singapore's $480 million, long-residue-catalytic-cracker complex at Pulau Ular was being constructed. This plant, which will convert fuel oil into high value-added products like diesel, kerosene, and gasoline, was scheduled for completion by the end of 1989. SRC planned to upgrade its Pulau Merlimau refinery with an investment of $100 million on four major projects. Singapore Petroleum Co. planned to invest $30 million in the expansion of its oil storage terminal at Jurong from 20,000 to 120,000 tons. Shell Eastern Petroleum Pte. Ltd. was to add an isopropyl alcohol manufacturing plant to its refining facilities at Pulau Ular at a cost of $41 million. Esso Singapore Pte. Ltd. planned to spend $65 million for upgrading its 176,000-bbl/d refinery at Pulau Ayer.

TABLE 20

SINGAPORE: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS					
Alkali and alkaline-earth metals		—	10	1	Japan 8.
Aluminum:					
Ore and concentrate		20	10	—	Belgium-Luxembourg 7; Australia 3.
Oxides and hydroxides		103,137	75,224	630	Australia 72,417; Japan 1,822.
Metal including alloys:					
Scrap		845	1,525	15	Malaysia 551; Saudi Arabia 315; New Zealand 246.
Unwrought		15,679	40,628	5,052	Australia 18,591; United Kingdom 3,728.
Semimanufactures		29,262	40,498	1,051	Japan 8,566; Malaysia 8,013; Taiwan 4,689.
Beryllium: Metal including alloys, all forms		12	9	([2])	Japan 8.
Chromium:					
Ore and concentrate		8	23	—	Japan 13; Netherlands 10.
Oxides and hydroxides		151	364	45	United Kingdom 158; Italy 88.
Cobalt: Oxides and hydroxides		29	19	—	Canada 7; China 7; Finland 5.
Columbium and tantalum:					
Ore and concentrate		([2])	10	—	All from Thailand.
Metal including alloys, all forms, tantalum		46	5	3	Thailand 1.
Copper:					
Ore and concentrate	value, thousands	$20	$2	NA	West Germany $1.
Matte and speiss including cement copper		16	20	—	Brazil 17; Malaysia 3.
Metal including alloys:					
Scrap		7,401	7,873	1,264	Malaysia 4,130; Japan 549.
Unwrought		5,660	12,775	160	Chile 6,000; Japan 2,968; Zambia 1,501.
Semimanufactures		34,169	45,532	549	Japan 22,850; Malaysia 8,300; Taiwan 4,234.
Gold:					
Waste and sweepings	value, thousands	$3,839	$5,777	$178	Hong Kong $2,472; Malaysia $1,591; West Germany $889.
Metal including alloys, unwrought and partly wrought	troy ounces	125,002	155,931	21,284	Japan 128,956.
Iron and steel:					
Iron ore and concentrate excluding roasted pyrite		10,167	1,140	—	All from Malaysia.
Metal:					
Scrap		209,091	126,698	225	Netherlands 34,994; Malaysia 29,214; U.S.S.R. 22,176.
Pig iron, cast iron, related materials		60,015	74,140	57	U.S.S.R. 50,073; Australia 22,120.
Ferroalloys:					
Ferromanganese		3,183	1,960	—	Mozambique 1,140; China 500; West Germany 101.
Ferrosilicon		2,718	3,958	NA	Mozambique 2,600; China 714; Norway 255.

See footnotes at end of table.

TABLE 20—Continued

SINGAPORE: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987 United States	Sources, 1987 Other (principal)
METALS—Continued				
Iron and steel—Continued				
Metal—Continued				
Ferroalloys—Continued				
Unspecified	4,898	5,627	19	Mozambique 4,760; China 682.
Steel, primary forms	245,461	170,721	38	Brazil 47,167; Australia 41,633; Malaysia 34,891.
Semimanufactures:				
Bars, rods, angles, shapes, sections	337,457	439,128	656	United Kingdom 119,778; Japan 107,291; Malaysia 105,848.
Universals, plates, sheets	626,239	753,423	942	Japan 439,541; Republic of Korea 70,296; Brazil 52,004.
Hoop and strip	21,540	23,123	598	Japan 9,248; Republic of Korea 5,963; Australia 2,497.
Rails and accessories	14,792	28,261	7	United Kingdom 17,168; Republic of Korea 9,226.
Wire	27,696	31,616	109	China 10,458; Japan 8,143; Republic of Korea 3,820.
Tubes, pipes, fittings	254,827	234,197	3,180	Japan 108,058; Malaysia 36,249; West Germany 17,991.
Castings and forgings, rough	6,803	6,748	787	Japan 2,693; Australia 1,341.
Lead:				
Ore and concentrate	1	10	—	All from Morocco.
Oxides	381	322	9	Australia 120; United Kingdom 85; West Germany 38.
Metal including alloys:				
Scrap	133	1,425	33	Malaysia 659; Japan 535; Brunei 133.
Unwrought	9,673	16,206	67	Australia 4,882; Japan 3,837.
Semimanufactures	831	544	15	Australia 147; Japan 144; Ireland 77.
Magnesium: Metal including alloys:				
Scrap	2	—		
Unwrought	21	40	7	Japan 11; Malaysia 11; Norway 8.
Semimanufactures	—	141	21	Japan 116.
Manganese				
Ore and concentrate	28,846	45,512	—	Gabon 36,000; Brazil 5,000; Mexico 3,921.
Oxides	2,327	3,433	2	Japan 2,538; Malaysia 488; Australia 195.
Mercury 76-pound flasks	928	1,315	294	China 979; United Kingdom 34.
Molybdenum: Metal including alloys, all forms	1	4	1	United Kingdom 3.
Nickel:				
Ore and concentrate	—	5	—	All from Finland.
Metal including alloys:				
Scrap	182	284	—	Malaysia 114; Thailand 63; Japan 51.

See footnotes at end of table.

TABLE 20—Continued

SINGAPORE: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS—Continued				
Nickel—Continued				
Metal including alloys—Continued				
Unwrought	3,726	1,493	([2])	New Caledonia 879; Canada 464; United Kingdom 55.
Semimanufactures	1,410	4,189	128	Canada 2,061; Japan 1,314.
Platinum-group metals: Metals including alloys, unwrought and partly wrought troy ounces	17,394	43,628	17,008	Japan 9,742; West Germany 8,456.
Selenium, elemental	—	[3]189	6	China 128; Japan 23; Australia 14.
Silver:				
Ore and concentrate value, thousands	$1	—		
Waste and sweepings[4] do.	$55	$1,030	$5	West Germany $801; Taiwan $154.
Metal including alloys, unwrought and partly wrought thousand troy ounces	3,145	4,509	198	West Germany 2,029; Australia 924; Japan 410.
Tin:				
Ore and concentrate	5,501	12,064	—	China 10,788; Malaysia 681; Bolivia 407.
Ash and residue containing tin	9,585	9,749	—	Malaysia 9,748.
Metal including alloys:				
Scrap	281	536	—	Malaysia 521; Philippines 8; Thailand 7.
Unwrought	12,742	11,021	15	Malaysia 5,745; Thailand 4,562.
Semimanufactures	288	93	([2])	Japan 44; Malaysia 19; Taiwan 10.
Titanium: Oxides	8,725	8,508	1,511	Japan 2,605; Australia 1,224.
Tungsten:				
Ore and concentrate	1,235	1,175	—	Burma 618; Japan 254; China 248.
Metal including alloys, all forms	101	105	2	China 83; Austria 5.
Uranium and/or thorium:				
Oxides and other compounds value, thousands	$130	$159	$22	France $103; Austria $13.
Metal including alloys, all forms, kilograms	2	303	—	All from United Kingdom.
Zinc:				
Ore and concentrate	40	40	—	Thailand 20; Australia 14.
Oxides	957	763	176	China 180; Thailand 95.
Blue powder	221	1,510	373	Norway 852; United Kingdom 179.
Metal including alloys:				
Scrap	221	574	—	Malaysia 464; Australia 39.
Unwrought	11,763	26,496	3	North Korea 12,148; Australia 5,057; Canada 4,821.
Semimanufactures	414	357	24	Australia 137; Belgium-Luxembourg 43.
Other:				
Ores and concentrates	605	1,861	—	Malaysia 1,057; Bolivia 413; Burma 220.
Ashes and residues	177,613	246,952	2	Japan 198,119; Philippines 26,248; Australia 21,871.
Base metals including alloys, all forms	31	212	18	United Kingdom 39; Mozambique 37; Japan 32.

See footnotes at end of table.

TABLE 20—Continued

SINGAPORE: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987 United States	Sources, 1987 Other (principal)
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	516	400	113	China 174; Japan 28.
Artificial: Corundum	30	12	—	Japan 11.
Dust and powder of precious and semiprecious stones including diamond value, thousands	$406	$172	$8	U.S.S.R. $68; Ireland $49; China $16.
Grinding and polishing wheels and stones	2,350	2,333	60	China 803; Japan 572; Taiwan 328.
Asbestos, crude	3,987	2,194	51	Canada 730; Cyprus 278; Italy 252.
Barite and witherite	14,382	12,766	211	Malaysia 7,808; Thailand 1,830; China 1,470.
Boron materials:				
Crude natural borates	109	—		
Oxides and acids	498	975	397	Italy 486; China 60.
Cement thousand tons	2,103	1,933	([2])	Malaysia 560; Japan 546; Taiwan 498.
Chalk	5,735	8,313	—	Malaysia 2,837; Thailand 1,437; Australia 1,399.
Clays, crude:				
Bentonite	36,360	9,431	8,643	United Kingdom 327; China 170.
Fuller's earth	5,301	1,467	420	Japan 427; Malaysia 197.
Unspecified	18,963	12,293	901	Malaysia 7,018; United Kingdom 1,490; Australia 1,171.
Cryolite and chiolite	5	2	—	All from Japan.
Diamond:				
Gem, not set or strung value, thousands	$39,843	$50,567	$5,371	India $14,917; Israel $10,983; Belgium-Luxembourg $10,815.
Industrial stones do.	$644	$376	$71	Ireland $208; India $81.
Diatomite and other infusorial earth	963	1,139	1,017	Philippines 50; France 49.
Feldspar, fluorspar, related materials	4,413	1,613	—	China 1,057; Thailand 298; India 190.
Fertilizer materials:				
Crude, n.e.s.	778	629	—	Australia 247; China 141.
Manufactured:				
Ammonia	621	809	1	Malaysia 551; Belgium-Luxembourg 112; West Germany 87.
Nitrogenous	5,256	21,527	55	Malaysia 10,398; Canada 7,046; West Germany 2,321.
Phosphatic	22,456	16,493	15,389	China 942; Malaysia 163.
Potassic	155,536	127,861	2,974	Canada 90,594; Jordan 17,400; West Germany 10,168.
Unspecified and mixed	42,091	62,231	258	West Germany 57,454; Belgium-Luxembourg 2,233.
Graphite, natural	407	314	1	Japan 136; China 51; Republic of Korea 51.

See footnotes at end of table.

TABLE 20—Continued

SINGAPORE: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987	
				United States	Other (principal)
INDUSTRIAL MINERALS—Continued					
Gypsum and plaster		56,130	77,647	192	Thailand 52,926; Australia 18,803.
Iodine including bromine and fluorine	value, thousands	—	$116	$74	Japan $19; West Germany $8.
Lime		5,010	3,339	—	Malaysia 2,604; China 399; United Kingdom 301.
Magnesium compounds: Magnesite, crude including calcined		472	1,781	34	China 940; Japan 657.
Mica:					
Crude including splittings and waste		496	382	15	India 151; China 150.
Worked including agglomerated splittings		17	148	1	Japan 108; Malaysia 17.
Nitrates, crude		—	1	NA	NA.
Phosphates, crude		4,920	3,445	50	Malaysia 1,968; India 1,000.
Pigments, mineral: Iron oxides and hydroxides, processed		3,058	4,035	165	West Germany 1,413; Japan 1,108; China 720.
Potassium salts, crude		30	500	—	All from West Germany.
Precious and semiprecious stones other than diamond:					
Natural	value, thousands	$2,834	$6,845	$815	Thailand $1,442; Switzerland $1,155; Sri Lanka $972.
Synthetic	do.	$737	$1,674	$260	U.S.S.R. $464; Ireland $367.
Pyrite, unroasted		43	—		
Salt and brine		36,700	47,136	89	Australia 22,106; Thailand 10,895; China 5,861.
Sodium compounds, n.e.s.:					
Carbonate, manufactured		347	2,366	3	Poland 800; Sri Lanka 488; Malaysia 373.
Sulfate, manufactured[5]		20,748	8,800	2,053	China 4,440; Taiwan 1,015.
Stone, sand and gravel:					
Dimension stone:					
Crude and partly worked		1,228	1,873	9	China 815; Italy 643.
Worked		34,529	39,722	11	Italy 21,918; China 6,625.
Dolomite, chiefly refractory-grade		127	519	—	China 308; Norway 152; France 40.
Gravel and crushed rock		697,463	758,267	44	Malaysia 756,815.
Limestone other than dimension		72,178	69,257	—	Malaysia 69,210.
Quartz and quartzite		172	187	([2])	China 160; West Germany 22.
Sand other than metal-bearing	thousand tons	1,205	1,298	3	Malaysia 1,274; Thailand 18.
Sulfur:					
Elemental:					
Crude including native and byproduct		142	168	3	Poland 90; China 37; West Germany 21.
Colloidal, precipitated, sublimed		510	216	3	Poland 126; Republic of Korea 34.
Sulfuric acid		302	387	38	Malaysia 123; West Germany 111.

See footnotes at end of table.

TABLE 20—Continued

SINGAPORE: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987 United States	Sources, 1987 Other (principal)
INDUSTRIAL MINERALS—Continued					
Talc, steatite, soapstone, pyrophyllite		6,205	5,163	141	China 2,721; Republic of Korea 589; Norway 478.
Other:					
Crude		32,489	56,563	17	West Germany 55,024; Mozambique 522; Malaysia 509.
Slag and dross, not metal-bearing		12,818	20,987	1	Taiwan 19,737.
MINERAL FUELS AND RELATED MATERIALS					
Asphalt and bitumen, natural		2,186	2,569	282	Taiwan 942; Japan 713; Republic of Korea 566.
Carbon:					
Carbon black		4,621	4,808	348	Republic of Korea 1,157; Malaysia 884; West Germany 568.
Gas carbon		—	7	NA	NA.
Coal, all grades including briquets		1,825	1,157	453	United Kingdom 321; India 172.
Coke and semicoke		27,434	32,392	—	Japan 23,287; Australia 8,617.
Peat including briquets and litter		182	208	—	Netherlands 80; New Zealand 36; United Kingdom 32.
Petroleum:					
Crude	thousand 42-gallon barrels	236,830	231,108	—	Saudi Arabia 38,453; Malaysia 38,120; China 34,553.
Refinery products:					
Liquefied petroleum gas	do.	17	75	([2])	Malaysia 31; Philippines 26.
Gasoline	do.	13,209	16,318	477	Saudi Arabia 4,217; Malaysia 3,649; Bahrain 1,863.
Mineral jelly and wax	do.	170	144	2	China 121; Burma 9.
Kerosene and jet fuel	do.	3,975	4,678	255	Malaysia 1,411; United Arab Emirates 925; Saudi Arabia 800.
Distillate fuel oil	do.	9,066	10,380	269	Saudi Arabia 4,039; Malaysia 2,072; China 2,042.
Lubricants	do.	927	1,085	90	Japan 332; China 186; Netherlands Antilles 73.
Residual fuel oil	do.	54,797	74,512	4,044	Saudi Arabia 28,002; Kuwait 14,802; Bahrain 11,983.
Bitumen and other residues	do.	1	6	—	Mainly from Burma.
Bituminous mixtures	do.	37	20	1	United Kingdom 10; Spain 3.
Petroleum coke	do.	28	25	24	China ([2]).

NA Not available.
[1] Table prepared by Audrey D. Wilkes and Peter Roetzel.
[2] Less than 1/2 unit.
[3] May include tellurinum and phosphorus.
[4] May include other precious metals.
[5] Includes hydrogen sulfate and pyrosulfate.

THAILAND[70]

Production of all mineral commodities in Thailand increased substantially, rising from $417 million[71] in 1987 to a little over $500 million in 1988. This increase reflected an expanding mineral industry in the midst of an even greater expansion of the overall economy.[72] The value of all minerals produced amounted to slightly under 1% of the Thai gross national product (GNP).

Long one of the world's principal sources of tin, which was still its leading export mineral commodity in 1988, Thailand and other tin producers have been nursing their industry back to some degree of profitability since the 1985 collapse of the world tin market. It seemed clear that in Thailand as well as other countries the marginal operators probably would not come back. Both lignite and zinc exceeded tin in value of 1988 production. Lignite was consumed entirely in the domestic generation of electricity, and zinc was used increasingly for domestic galvanizing, which led to a decrease in zinc exports. Gypsum continued to increase significantly in both production and export to a growing Asian market. Other Thai minerals of potential importance to the world market were a large undeveloped potash resource and a chromite resource in the very early stages of development.

After firmer prices for petroleum on world markets, drilling activity increased both onshore and offshore. Amidst adjustments in ownership, size, and taxation of petroleum concessions, new discoveries of crude in central Thailand, as well as in the Gulf of Thailand, lent encouragement to exploration for hydrocarbons within the notable structural complexity of the country's geology.

Thai mineral-commodity export earnings were up almost 20% at $205 million. However, the country's booming economic growth, up 11% (in baht terms) over that of the previous year and the best in two decades, absorbed imports on a rapidly increasing scale. The resulting negative balance of trade was estimated to have more than doubled at about $3,363 million, tentatively estimated to be 3.2% to 5.9% of the GNP. Per capita GNP surpassed the $1000 mark for the first time at an estimated $1,045. With these changes came increasing energy consumption and heavier demand on power generation. This led to concerted expansion of the electric power grid of Thailand, the consumption of more natural gas and more lignite for fuel, and an ever-increasing stimulus to the search for mineral fuels. Thailand clearly was a leading participant in the industrialization of Asia, in obvious contrast to surrounding centrally planned economies.

Government Policies and Programs

The Provincial Electric Authority of Thailand (PEA) planned to be able to offer electricity to 95% of the nation's villages, which would not only require power generation on a somewhat larger scale but also require dependable sources of fuel at prices that would not impose an unrealistic rate structure on the rural areas. PEA replaced outmoded equipment as it expanded its grid, but did not attract capital investment on the scale needed. This was largely due to a need for better regulatory authority in relation to large industrial users as well as for purposes of health and safety. Better definition of statutory authority was needed where PEA's interest conflicted with other Government agencies such as the highway department. It was clear that domestic lignite was the most economical fuel, but Thai Government officials were eyeing clean-coal technology and the possibility of fluidized-bed combustion adapted to blends of lignite and coal.

Airborne magnetic and radiometric surveys were completed for the entire country, and the airborne electromagnetic survey neared completion. Kenting Earth Sciences International Ltd. of Canada with funding by the Asian Development Bank and the Canadian International Development Agency (CIDA), performed the airborne surveys and recorded many anomalies thought to indicate mineralization. Followup studies on the ground were planned for pinpointing mineral prospects.

The National Resources Policy Committee was reactivated in 1988 in order to encourage private investment in exploration and mining development as intended in the Sixth National Economic and Social Development Plan. For purposes of encouraging foreign investment in minerals by circumventing bureaucratic obstacles, the work of the committee was concerned with (1) the elimination of unnecessary steps in the application for mining concessions, (2) establishment of one-stop clerical service units, (3) the restructuring of mineral royalty rates, (4) amendment of the Mineral Act 04 B.E. 2510 (1967), and (5) designation of Mineral Deposit Zones for mineral development. Although much remained to be accomplished, particularly in the effort to attract interest and investment in Thailand's gold and potash resources, sympathetic treatment was accorded industries such as petroleum, lead, and zinc. In particular, the Thai tin industry was specially controlled following the 1985 collapse of the world tin market, but more recently subsidized by low royalties in an effort to keep it competitive as the world tin markets slowly improved.

Production

The total value of mineral production in Thailand for 1988 was over $500 million, an increase of 20% from $417 million in 1987. Lignite exceeded all other minerals in value of production, reaching a value of about $150 million for 7 million tons mined. Tin output continued its slump in the light of Government constraints on the issuance of new tin-mining licenses. Although royalties were eased in an effort to get production high enough to enable Thailand to meet its 1988 ATPC quota of 19,000 tons, the quota was not reached. Production of tin concentrates reached about 20,000 tons worth $101 million, while exports fell slightly to 13,400 tons, worth $86 million. Zinc surpassed tin for the first time with an output of almost 400,000 tons of ore worth $108 million, becoming second only to lignite. Added capacity at the Padaeng refinery was a contributing factor. Gypsum production reached 4.5 million tons worth $44 million. Limestone production, 14 million tons worth $47 million, went almost completely to the domestic cement industry to satisfy the expanding requirements for construction in Thailand.

Natural gas production exceeded 200 billion cubic feet for the first time at 212 billion cubic feet, most of which was earmarked for the generation of electric power and industrial fuel. Petroleum crude reached 7,437 million barrels in 1988, not quite as high as 1985 and 1986 but substantially above the 1987 output of slightly more than 6,100 million barrels.

The use of mechanical equipment has enabled an impressive revival in sapphire mining[73] in the vicinity of Bo Ploi and Kanchanaburi starting in August of 1988. Operations were said to run 20 hours per day, 365 days per year, recovering about 500 carats per plant per day. Although the term "plant" was neither defined nor described, nor was the number of such plants, the volume of sapphire in Bangkok markets had visibly increased.

Two significant nonproductive categories were gold and potash, minerals known to occur in Thailand but for which the Thai Government had, as of the end of 1988, still not worked out investment arrangements.

Trade

Trade increased at a greater rate than in 1987 and reflected the vigor of the Thai economy. Although the value of all exports for 1988 was a little over $16 billion, up 35.9%, imports were up 46.5% at slightly more than $19.8 billion. This increased the negative balance of trade, inexactly called the trade "deficit." The value of Thai mineral exports was approximately $205 million,[74] or a little over 1% of total exports, and up 19% over 1987.

Although lignite led all other Thai minerals in value produced, export of lignite was prohibited in favor of domestic requirements for electric power generation. Tin again led in mineral export revenues but, even so, it did not fulfill Thailand's agreed ATPC quota. Other major mineral exports for 1988 were gypsum, $38 million, up 189%; tin slag, over $18 million, up 236%; and lead, over $13 million, up 37%. Zinc exports, worth $13 million, were down one-third in tonnage and 16% in value, mostly as a consequence of the continued increase in domestic use for galvanizing. Barite exports, valued at less than $5 million, were up sharply from the previous year but, nonetheless, were still trying to recover from the lack of demand for drilling muds in the petroleum industry. Fluorite exports, at slightly under $5 million, were down about 21% as the result of competition from China.

Other mineral exports, each accounting for $4 million or less in 1988, were antimony and tungsten, as well as the industrial minerals dolomite, granite, and marble. The latter three, in some cases, reflected production by operators formerly producing barite. A newly burgeoning commodity, feldspar, accounted for nearly $5 million revenue on 185,000 tons, up 118% in tonnage from that of 1987.

Representatives of the Thai Mining Industry Council negotiated a price agreement on tungsten in 1988 and planned to discuss a price pact on antimony, barite, and fluorite before the end of the fiscal year.

Chromite, intended for export, was mined in Thailand, but it was withdrawn after it was recognized that the material offered did not meet specifications.

Commodity Review

***Metals.*—Antimony.**—Thai antimony metal production continued its climb to another record high in 1988 by nearly doubling the output of 1987, despite a very modest increase in actual mine production. The antimony content of mined ore increased from 409 tons in 1987 to 445 tons in 1988 while metal production increased, respectively, from 959 to 1,769 tons. Exports of antimony metal likewise increased from 720 to approximately 2,500 tons; therefore, the question arose as to the source of the antimony. Production and export data from past years did not support the idea of large stockpiles providing carryover from year to year. One possibility was the smuggling of antimony concentrates and antimony metal from Burma into Thailand for processing and export.

Chromite.—Chromite appeared for the first time in the mineral production data for Thailand, more for its potential significance than its production volume. After a small start in 1985 with the production of 30 tons of ore from a small mine near Nan, a second mine was opened in 1986 near Utteradit in northern Thailand. The 1988 mine production of 776 tons of chromite ore, of unspecified grade, suggested a continuing effort to locate and exploit this strategic metal. The geology was believed favorable in several places in Thailand for typical mineralization associated with ultrabasic rocks including chromium, nickel, and platinum. The Thai Department of Mineral Resources has added chromite to its official mineral statistics publications.

Columbium and Tantalum.—Construction of the proposed tantalum-processing plant at Map Ta Put, which was intended to replace the one consumed by fire at Phuket several years ago, has not gone forward in spite of the Government's acknowledged commitment to see it through. The availability of tantalum-extraction technology originally offered by Hermann C. Starck, now owned by Bayer AG, of the Federal Republic of Germany, is very doubtful. The Thai Government posi-

TABLE 21

THAILAND: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987	1988[p]
METALS						
Antimony:						
Ore and concentrate:						
Gross weight		4,636	2,917	2,397	962	1,048
Sb content[e]		1,970	1,240	1,019	409	445
Metal, smelter		—	135	386	959	1,769
Columbium and tantalum ores and concentrates, gross weight:[2]						
Columbite and tantalite:						
Gross weight	kilograms	477,000	432,000	121,000	183,000	124,000
Cb content	do.	81,000	73,400	20,600	31,110	21,080
Ta content	do.	128,800	116,640	32,670	49,410	33,480
Struverite:						
Gross weight	do.	30,000	309,000	241,000	423,000	788,000
Cb content	do.	2,400	24,800	19,400	34,003	63,343
Ta content		2,300	24,000	18,800	32,912	61,310
Iron and steel:						
Iron ore:						
Gross weight		60,670	93,800	37,330	97,026	99,257
Fe content		33,369	51,590	20,532	53,364	54,591
Metal: Steel:						
Crude		380,971	447,035	463,393	534,172	552,000
Semimanufactures (selected):						
Bars		281,934	319,330	303,652	319,835	356,000
Galvanized iron sheets		151,537	131,520	144,444	165,445	189,996
Tinned plates		91,991	68,175	104,433	119,342	147,337
Lead:						
Mine output, Pb content of 42.5% Pb concentrate		16,662	19,654	26,301	23,503	29,474
Metal: Ingot, secondary		6,198	7,536	9,122	11,366	15,614
Manganese ore:						
Chemical-grade, over 75% MnO_2		8	27	—	50	—
Battery- and chemical-grade, 75% MnO_2		6,110	3,930	4,001	5,062	3,247
Metallurgical-grade, 46% to 50% MnO_2		2,577	455	887	4,086	4,417
Total, gross weight		**8,695**	**4,412**	**4,888**	**9,148**	**7,664**
Total, Mn content		**4,174**	**2,118**	**2,346**	**4,391**	**3,679**
Rare-earth metals:						
Monazite concentrate, gross weight		298	663	1,609	458	590
Xenotime		28	158	28	30	101
Tin:						
Mine output, Sn content		21,607	16,593	16,800	14,852	14,225
Metal, smelter, primary		19,729	17,996	19,672	15,438	14,675
Titanium: Ilmenite concentrate, gross weight		148	1,078	13,489	26,278	16,455

See footnotes at end of table.

TABLE 21—Continued

THAILAND: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1984	1985	1986	1987	1988[p]
METALS—Continued					
Titanium—Continued					
Leucoxine concentrate, gross weight	388	488	797	800	1,799
Rutile concentrate, gross weight	—	110	48	92	128
Tungsten concentrate:					
Mine output, gross weight	1,439	1,137	922	1,269	1,173
Mine output, W content	741	586	[r]475	705	651
Zinc:					
Mine output, gross weight	147,993	276,909	373,833	341,145	420,102
Mine output, Zn content	41,438	77,535	97,197	88,698	78,000
Metal, smelter, primary	—	62,108	58,552	66,868	68,600
Zirconium ore and concentrate, gross weight	290	1,292	1,705	1,532	5,098
INDUSTRIAL MINERALS					
Barite	174,918	230,970	142,232	33,370	40,587
Cement, hydraulic thousand tons	8,271	7,916	7,940	9,850	11,514
Clays:					
Ball clay	2,520	7,988	11,203	57,719	86,890
Kaolin, beneficiated	58,616	106,704	116,037	184,179	222,964
Kaolin, nonbeneficiated	—	—	16,118	22,389	46,724
Diatomite	471	410	204	177	470
Feldspar	74,404	104,586	115,163	168,881	293,678
Fluorspar:					
Crude mine output:					
High-grade	230,228	263,059	156,409	102,398	76,321
Low-grade	64,995	91,500	40,715	2,154	20
Total	**295,223**	**354,559**	**197,124**	**104,552**	**76,341**
Salable product:					
Acid-grade (beneficiated low-grade)	57,151	35,840	11,500	—	—
Metallurgical-grade	230,228	263,059	156,409	102,398	76,321
Total	**287,379**	**298,899**	**167,909**	**102,398**	**76,321**
Gypsum	1,110,660	1,273,459	1,665,557	3,030,919	4,549,011
Phosphate rock, crude	3,075	4,072	4,940	4,502	8,348
Salt:					
Rock	9,850	12,786	2,000	3,268	5,670
Other[e]	165,000	165,000	165,000	165,000	165,000
Sand, silica	166,787	152,133	153,565	153,516	242,385
Stone:					
Calcite	1,272	1,040	230	2,170	171
Dolomite	10,364	16,160	13,771	50,767	140,455
Limestone for cement manufacture only thousand tons	9,223	9,845	9,605	11,391	14,101
Marble	37,927	21,479	14,718	22,786	42,553

See footnotes at end of table.

TABLE 21—Continued

THAILAND: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987	1988[p]
INDUSTRIAL MINERALS—Continued						
Stone—Continued						
Marl for cement manufacture only	thousand tons	—	—	—	296	136
Quartz, not further described		20,687	27,305	18,068	27,459	28,449
Shale for cement manufacture only	thousand tons	1,564	1,448	1,013	1,403	2,283
Talc and related materials:						
Pyrophyllite		26,851	42,002	36,165	37,749	37,285
Talc		1,628	1,476	2,886	4,101	4,843
MINERAL FUELS AND RELATED MATERIALS						
Coal: Lignite	thousand tons	2,337	5,149	5,545	6,929	7,274
Natural gas (gross production)	million standard cubic feet	85,506	132,275	127,765	178,658	211,641
Petroleum:						
Crude	thousand 42-gallon barrels	5,387	7,918	7,738	6,108	7,437
Natural gas condensate	do.	3,008	5,202	5,207	5,541	5,433
Refinery products:						
Gasoline	do.	12,620	12,836	13,837	[e]13,900	15,781
Jet fuel	do.	6,432	6,474	7,227	[e]7,200	8,183
Kerosene	do.	1,539	1,036	931	[e]1,000	811
Distillate fuel oil	do.	17,409	21,127	23,115	[e]23,200	22,021
Residual fuel oil	do.	15,494	13,353	13,768	[e]13,800	15,907
Liquefied petroleum gas	do.	1,541	1,555	1,566	[e]1,600	1,931
Refinery fuel and losses and unspecified	do.	2,671	2,467	1,264	[e]2,000	2,447
Total	**do.**	**57,706**	**58,848**	**61,708**	**[e]62,700**	**67,081**

[e]Estimated. [p]Preliminary. [r]Revised.
[1]Includes data available through Aug. 4, 1989.
[2]Excludes columbium- and tantalum-bearing tin slags, which make Thailand the world's largest source of newly mined tantalum.

tion was that new technology and new financing would be required. The amount of tin slag exported for processing elsewhere soared to 2,110 tons, an increase of 236% over that of 1987. Such an increase indicated the potential availability of this material for domestic processing when, or if, the Map Ta Put plant can be constructed and put onstream. For the first time, struverite clearly and substantially exceeded higher grade ores and their concentrates as a source of tantalum (by a factor of 2) and columbium (by a factor of 3).

Gold.—The Thai Government continued to struggle with its own sponsorship and regulation of a gold-mining industry. With signficant publicity, the Government announced on several occasions the reception of bids for gold-prospecting concessions in several parts of the country. Shortly thereafter, the offered concessions were revoked by the industry minister, elections were held, and his successor entertained new submittals for concessions in five areas: Loei, Udon Thani, and Nong Khai in northeast Thailand, and in Chonburi and Prachinburi east and south of Bangkok. By November 1988, in a second effort, two overseas investors and three joint Thai-foreign bids were submitted. As of the end of 1988, no new concessions had been granted. In the meantime, the reported production of gold for that year amounted to 564 grams, or a little more than 18 troy ounces. At a time of infirm gold prices in world markets, the Thai gold-prospecting concessions, more stringent than in many countries, were watched with interest.

Lead.—Mine output of lead concentrates as well as production of metallic lead substantially exceeded the old highs of 1986, after a sag in both concentrates

TABLE 22

THAILAND: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
METALS				
Aluminum:				
Oxides and hydroxides	1	56	—	Bangladesh 24; Malaysia 21.
Metal including alloys:				
Unwrought	—	8	—	Mainly to Malaysia.
Semimanufactures	1,738	1,443	—	Singapore 373; Hong Kong 317; Indonesia 250.
Antimony: Ore and concentrate	2,774	NA		
Chromium: Oxides and hydroxides value, thousands	—	$1	—	All to Singapore.
Columbium and tantalum: Ore and concentrate	13	NA		
Copper:				
Sulfate	192	NA		
Metal including alloys:				
Scrap	—	280	—	NA.
Semimanufactures	205	593	543	Japan 29.
Gold:				
Waste and sweepings kilograms	393	NA		
Metal including alloys, unwrought and partly wrought troy ounces	18,277	NA		
Iron and steel: Metal:				
Scrap	5,701	4,925	3	Japan 4,118; Singapore 188.
Pig iron, cast iron, related materials	—	100	—	NA.
Ferroalloys, unspecified	31	12	—	Australia 11.
Steel, primary forms	75	1	—	All to Oman.
Semimanufactures:				
Bars, rods, angles, shapes, sections	61,638	19,803	4,856	Hong Kong 7,369; Singapore 3,782.
Universals, plates, sheets	1,155	9,296	88	Hong Kong 4,484; Singapore 2,765.
Hoop and strip	—	7	—	Mainly to Singapore.
Rails and accessories	443	—		
Wire	1,022	329	9	India 174; Laos 49.
Tubes, pipes, fittings	167,673	195,911	127,715	Hong Kong 15,237; United Arab Emirates 10,394.
Castings and forgings, rough	—	44	—	All to Japan.
Lead:				
Ore and concentrate	54,110	51,247	—	Netherlands 17,200; Japan 16,894; Australia 5,733.
Metal including alloys:				
Unwrought	18	—		
Semimanufactures	95	19	—	Japan 15; Laos 2.
Manganese: Oxides kilograms	295	NA		

See footnotes at end of table.

TABLE 22—Continued

THAILAND: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
METALS—Continued				
Nickel: Metal including alloys, semimanufactures	1	[2]1	—	Mainly to Laos.
Silver:				
Ore and concentrate kilograms	—	36,000	—	All to Malaysia.
Waste and sweepings[3] do.	158	201	—	NA.
Metal including alloys, unwrought and partly wrought value, thousands	$2	$477	—	Singapore $476.
Tin:				
Ore and concentrate	426	895	—	Republic of Korea 560; Malaysia 268.
Metal including alloys:				
Unwrought	15,029	13,670	210	Japan 5,052; Singapore 4,384.
Semimanufactures	4,090	1	—	All to Malaysia.
Titanium:				
Ore and concentrate	1,700	NA		
Oxides	—	1	—	All to Laos.
Tungsten: Ore and concentrate	922	1,179	736	West Germany 216; India 90.
Zinc:				
Ore and concentrate	110	2,396	—	Laos 650; Republic of Korea 200; Indonesia 196.
Oxides	167	298	—	Japan 109; Singapore 85; Sri Lanka 62.
Metal including alloys:				
Unwrought	27,825	17,616	—	China 7,869; Malaysia 1,728; Philippines 1,366.
Semimanufactures	808	1,053	—	Laos 957; Singapore 67.
Other:				
Ores and concentrates	5,509	35,477	632	Malaysia 27,126; Republic of Korea 5,660.
Ashes and residues	8,879	7,505	111	West Germany 2,868; India 2,028.
Base metals including alloys, all forms	96	124	—	Malaysia 60; Singapore 31.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Dust and powder of precious and semiprecious stones including diamond value, thousands	$6	$12	—	Italy $8; United Kingdom $3.
Grinding and polishing wheels and stones	54	103	44	Malaysia 31; Hong Kong 10.
Asbestos, crude	7	6	—	All to Malaysia.
Barite and witherite	79,680	47,706	—	Indonesia 23,510; Singapore 9,069.
Cement	41,534	172,333	500	Philippines 53,700; Vietnam 41,900.
Chalk	—	42	—	All to Saudi Arabia.
Clays, crude	4,965	10,821	2	Malaysia 1,636; Indonesia 360; unspecified 8,477.
Diamond: Gem, not set or strung value, thousands	$37,736	$68,547	$6,639	Hong Kong $18,062; Belgium-Luxembourg $17,070.
Diatomite and other infusorial earth	30	—		

See footnotes at end of table.

TABLE 22—Continued

THAILAND: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
INDUSTRIAL MINERALS—Continued					
Feldspar, fluorspar, related materials		183,683	211,186	—	Japan 74,376; Republic of Korea 29,510; Malaysia 9,884.
Fertilizer materials:					
Crude, n.e.s.		30	—		
Manufactured:					
Ammonia		5	3	—	Laos 1.
Nitrogenous		800	106	36	Laos 70.
Phosphatic		—	8	—	All to Laos.
Potassic		([4])	400	—	All to West Germany.
Unspecified and mixed	value, thousands	$82	$186	$3	Italy $112; Netherlands $21.
Gypsum and plaster		1,317,372	1,472,163	—	Japan 405,481; Indonesia 235,067; Hong Kong 100,050.
Phosphates, crude		1	72	—	All to Japan.
Precious and semiprecious stones other than diamond:					
Natural	value, thousands	$270,988	$380,589	$84,846	Japan $100,861; Hong Kong $62,859.
Synthetic	do.	$10,063	$15,104	$3,383	Switzerland $3,846; Italy $3,318.
Salt and brine		54,489	60,578	—	Malaysia 46,320; Singapore 13,236.
Sodium compounds, n.e.s.: Carbonate, manufactured	kilograms	26,600	NA		
Stone, sand and gravel:					
Dimension stone:					
Crude and partly worked		177	4,026	—	Bangladesh 510; Belgium-Luxembourg 39.
Worked		570	418	20	Fiji 84; Laos 51; Japan 37.
Dolomite, chiefly refractory-grade		—	20,167	—	Japan 20,000.
Gravel and crushed rock		1	268	—	Burma 229; Singapore 36.
Limestone other than dimension		7,490	5,877	—	Malaysia 4,771; Bangladesh 783; Singapore 282.
Quartz and quartzite		18,803	22,307	—	All to Japan.
Sand other than metal-bearing		8	—		
Sulfur:					
Elemental:					
Crude including native and byproduct		1,562	2,635	—	Philippines 1,923; Bangladesh 600.
Colloidal, precipitated, sublimed		406	27	—	Burma 24; Laos 3.
Sulfuric acid		53	202	—	Burma 144; Singapore 50.
Talc, steatite, soapstone, pyrophyllite		2,364	105	—	Malaysia 38; Indonesia 36.
Other:					
Crude		3,775	3,867	—	Philippines 3,200; France 378.
Slag and dross, not metal-bearing		4,656	5,826	—	West Germany 3,193; Netherlands 1,604; Japan 552.

See footnotes at end of table.

TABLE 22—Continued

THAILAND: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Destinations, 1987	
				United States	Other (principal)
MINERAL FUELS AND RELATED MATERIALS					
Asphalt and bitumen, natural		—	5	—	All to Indonesia.
Carbon black		7,385	7,456	—	India 4,330; Indonesia 1,965; Japan 412.
Coal: Anthracite and bituminous		756	1,170	—	Malaysia 900; Pakistan 162; Indonesia 72.
Petroleum refinery products:					
Liquefied petroleum gas	thousand 42-gallon barrels	5,571	4,019	3,642	Unspecified 376.
Mineral jelly and wax	value, thousands	—	$1	—	All to Singapore.
Kerosene and jet fuel	thousand 42-gallon barrels	472	1,999	—	Malaysia 11; Singapore 9; unspecified 1,171.
Distillate fuel oil	do.	(4)	145	—	All to Singapore.
Lubricants	do.	5	12	—	Indonesia 6; Hong Kong 2.
Residual fuel oil	do.	91	186	—	Japan 139; Singapore 47.
Bitumen and other residues	do.	(4)	(4)	—	All to Indonesia.
Bituminous mixtures	do.	(4)	(4)	—	All to Hong Kong.

NA Not available.
[1] Table prepared by Audrey D. Wilkes.
[2] Excludes unreported quantity exported to United Kingdom valued at $3,000.
[3] May include other precious metals.
[4] Less than 1/2 unit.

and the metal in 1987. During 1987, Metallgesellschaft AG of the Federal Republic of Germany planned to reduce production of lead and mixed bulk concentrate, after operating losses in 1985. The company, meanwhile, pressed the Thai Government for easier treatment on royalties and taxes, which had been raised by 87% at the beginning of 1987. With the reduction of taxes and the coming on-stream of the Thai Lead Metal Co. 12,000-ton-per-year lead smelter in Kanchanaburi, rescheduled for April 1988 after an environmental dispute, the outlook for the lead industry in Thailand improved markedly.

Tin.—The 1985 collapse of the world tin market continued to exert its depressing effect on the tin producers of the world, including Thailand. As the direct result of the International Tin Council's (ITC) support of prices at artificially high levels, production escalated, demand shrank, stockpiles and inventories grew and, in October 1985, the ITC was unable to continue its support of unrealistic pricing. Free-market forces immediately came into play, and tin production dwindled. Producers disappeared as world consumption gradually absorbed the available excess at much lower prices, the latter having dropped from a peak of approximately $17,000 per ton in 1985 to about $6,000 per ton in 1986. A better tin market emerged in 1988 in the form of a significant increase in world demand for tin, greatly reduced inventories, the absence of many former producers, and a consequent firmer tone in prices. Some quotes were entered in the $10,000 per ton range in a market that was expected to recover further.

Thailand's participation in market improvement, in support of the ATPC's broader effort to restore the world market, included a moratorium on the issuance of tin-mining licenses in order to reduce the overhang of inventories while consumption proceeded apace. By the end of 1988, the number of Thai tin mines still open, 225, represented fewer than one-half the total operating mines before the 1985 crash. Apprehension concerning future market strength, high startup costs for mines, and attractive investment opportunities in other sectors such as real estate, tourism, rubber, oil palms, and shrimp farming, were primary causes of the sluggishness in production and exports. A burgeoning tourist industry in such areas as Phuket generated environmental complaints and brought tin miners into contention with the Government over constraints on offshore dredging for cassiterite. Not wanting to destroy

TABLE 23

THAILAND: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS				
Alkali and alkaline-earth metals value, thousands	—	$2	$1	NA.
Aluminum:				
Ore and concentrate	11,491	21,714	—	China 21,676.
Oxides and hydroxides	17,605	19,960	239	Japan 14,670; China 1,775.
Ash and residue containing aluminum	51,523	NA		
Metal including alloys:				
Scrap	420	1,499	—	Laos 926; Singapore 335; Kuwait 102.
Unwrought	47,461	53,735	836	Australia 24,319; Canada 13,785.
Semimanufactures	3,641	5,516	1,189	Japan 1,780; West Germany 562.
Antimony:				
Ore and concentrate	3,002	NA		
Metal including alloys, all forms	12	NA		
Arsenic: Oxides and acids	79	NA		
Chromium:				
Ore and concentrate	2,755	174	—	Netherlands 90; Belgium-Luxembourg 84.
Oxides and hydroxides	419	549	100	West Germany 253; U.S.S.R. 89.
Metal including alloys, all forms kilograms	129	NA		
Cobalt				
Oxides and hydroxides	7	13	3	Belgium-Luxembourg 7.
Metal including alloys, all forms kilograms	229	NA		
Columbium and tantalum: Metal including alloys, all forms, tantalum value, thousands	$10	$21	—	All from Japan.
Copper:				
Matte and speiss including cement copper	149	50	—	All from Chile.
Metal including alloys:				
Scrap	10	531	3	Laos 398; Kuwait 76.
Unwrought	20,080	27,303	5	Zambia 14,391; Japan 5,012.
Semimanufactures	6,707	13,765	296	Japan 6,034; Indonesia 2,643.
Gold: Metal including alloys, unwrought and partly wrought troy ounces	130,649	NA		
Iron and steel:				
Iron ore and concentrate excluding roasted pyrite	81	120	—	All from Malaysia.
Metal:				
Scrap	555,114	903,323	99,669	Brazil 106,755; West Germany 97,893.
Pig iron, cast iron, related materials	16,910	44,751	—	China 33,490; Japan 5,797; Indonesia 4,500.
Ferroalloys:				
Ferrochromium	197	NA		
Ferromanganese	2,980	3,586	—	France 2,693; Japan 374; China 230.

See footnotes at end of table.

TABLE 23—Continued

THAILAND: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987	
				United States	Other (principal)
METALS—Continued					
Iron and steel—Continued					
Metal—Continued					
Ferroalloys—Continued					
Ferrosilicomanganese		2,265	NA		
Ferrosilicon		3,525	NA		
Silicon metal		9	NA		
Unspecified		515	6,748	79	China 3,093; Norway 2,557.
Steel, primary forms		430,325	878,170	607	Mexico 125,854; Algeria 120; Brazil 86,045.
Semimanufactures:					
Bars, rods, angles, shapes, sections		204,984	308,644	651	Japan 165,370; United Kingdom 26,164; Republic of Korea 18,766.
Universals, plates, sheets		933,501	1,225,942	11,656	Japan 747,769; East Germany 131,187; West Germany 65,597.
Hoop and strip		14,754	99,977	40	Japan 92,278; West Germany 1,035.
Rails and accessories		413	2,459	—	Poland 1,728; Republic of Korea 438; Belgium-Luxembourg 50.
Wire		8,670	18,238	38	Japan 10,884; Republic of Korea 2,911.
Tubes, pipes, fittings		31,345	30,554	543	Japan 21,497; United Kingdom 2,820.
Castings and forgings, rough		45	35	—	Japan 18; Republic of Korea 17.
Lead:					
Oxides		393	585	—	Australia 304; China 123; West Germany 117.
Metal including alloys:					
Scrap		1,095	3,686	19	Kuwait 2,115; Japan 588.
Unwrought		9,613	13,453	—	Australia 7,935; Japan 1,377; Republic of Korea 1,374.
Semimanufactures		226	44	([2])	Peru 26; Australia 6.
Magnesium: Metal including alloys, all forms		59	115	10	France 25; Norway 20.
Manganese:					
Oxides		933	1,207	—	Japan 446; China 443; Australia 256.
Metal including alloys, all forms		10	—		
Mercury	76-pound flasks	402	319	([2])	West Germany 203.
Molybdenum: Metal including alloys, all forms	value, thousands	$56	$32	—	Belgium-Luxembourg $11; West Germany $8.
Nickel:					
Matte and speiss		8	18	—	All from Canada.
Metal including alloys:					
Scrap		149	—		
Unwrought		517	776	5	Canada 329; Norway 218.
Semimanufactures		438	1,398	459	West Germany 472; Republic of Korea 335.

See footnotes at end of table.

TABLE 23—Continued

THAILAND: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS—Continued				
Platinum-group metals: Metals including alloys, unwrought and partly wrought value, thousands	$860	$1,164	—	Japan $1,157.
Silver:				
Ore and concentrate[3]	100	350	—	All from China.
Waste and sweepings[3] value, thousands	—	$1	—	All from United Kingdom.
Metal including alloys, unwrought and partly wrought do.	$11,993	$8,973	$109	Australia $2,515; Hong Kong $2,290.
Tin: Metal including alloys, all forms	11	10	—	Japan 9.
Titanium:				
Ore and concentrate	485	NA		
Oxides	1,708	2,210	22	Australia 612; United Kingdom 452; Japan 424.
Tungsten: Metal including alloys, all forms	4	3	—	Japan 1; West Germany 1.
Zinc:				
Oxides	376	640	2	China 263; Japan 69.
Blue powder	70	NA		
Metal including alloys:				
Unwrought	4,695	4,792	—	Australia 4,252; Belgium-Luxembourg 318.
Semimanufactures	340	647	5	Norway 207; United Kingdom 169.
Other:				
Ores and concentrates	2,221	13,818	—	Malaysia 7,001; Burma 4,245; Australia 1,324.
Ashes and residues	70	278	224	Singapore 54.
Base metals including alloys, all forms	31	74	2	Japan 39; China 10.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	1,997	7,287	63	Indonesia 4,030; Netherlands 1,599; India 695.
Artificial:				
Corundum	40	63	—	Italy 44; Japan 18.
Silicon carbide	605	NA		
Dust and powder of precious and semiprecious stones including diamond value, thousands	$94	$137	$13	Belgium-Luxembourg $62; Ghana $20.
Grinding and polishing wheels and stones	1,388	1,701	7	Japan 468; Chile 341.
Asbestos, crude	49,663	71,407	12,409	Canada 30,491; Zimbabwe 7,516; Greece 4,368.
Barite and witherite	—	8	—	China 5; Japan 3.
Boron materials: Oxides and acids	181	200	154	West Germany 30; United Kingdom 14.
Cement	3,486	3,248	10	Singapore 2,124; France 897.
Chalk kilograms	1,725	1	1	
Clays, crude	28,254	25,939	9,192	Indonesia 6,364; United Kingdom 3,365.

See footnotes at end of table.

TABLE 23—Continued

THAILAND: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
INDUSTRIAL MINERALS—Continued					
Cryolite and chiolite		13	11	—	All from Japan.
Diamond:					
Gem, not set or strung	value, thousands	$95,614	$172,184	$13,393	Belgium-Luxembourg $58,173; India $45,711.
Industrial stones	do.	—	$23	—	All from Belgium-Luxembourg.
Diatomite and other infusorial earth		153	372	352	China 20.
Feldspar, fluorspar, related materials		1,122	4,039	—	Japan 533; Canada 401; Italy 331.
Fertilizer materials:					
Crude, n.e.s.		43	338	17	Unspecified 320.
Manufactured:					
Ammonia		5,506	8,593	—	Malaysia 7,097; Indonesia 1,171.
Nitrogenous		446,554	428,378	27,512	Japan 273,475; Belgium-Luxembourg 40,500.
Phosphatic		500	5,754	3,100	Netherlands 1,097; Belgium-Luxembourg 1,000.
Potassic		62,970	89,189	8,675	U.S.S.R. 39,024; West Germany 12,480.
Unspecified and mixed		808,341	788,543	35,948	Republic of Korea 240,091; Philippines 129,510.
Graphite, natural		827	1,138	(2)	China 641; Republic of Korea 232; Sri Lanka 170.
Gypsum and plaster		933	22,231	390	Hong Kong 15,401; Japan 5,545.
Iodine	kilograms	3,022	NA		
Lime		60	72	—	United Kingdom 60.
Magnesium compounds:					
Magnesite, crude		5,916	[4] 22,051	—	China 17,199; Japan 4,258.
Oxides and hydroxides		8,522	NA		
Mica:					
Crude including splittings and waste		176	274	20	India 111; Malaysia 60.
Worked including agglomerated splittings		34	46	(2)	Japan 30; Belgium-Luxembourg 12.
Phosphorous, elemental		35	NA		
Pigments, mineral:					
Natural, crude		155	NA		
Iron oxides and hydroxides, processed		2,417	3,141	274	West Germany 1,652; Japan 362.
Precious and semiprecious stones other than diamond:					
Natural	value, thousands	$40,888	$78,063	$8,953	Australia $17,698; Sri Lanka $16,319.
Synthetic	do.	$6,088	$10,415	$2,345	Switzerland $1,603; India $303.
Pyrite, unroasted		8	16	(2)	Italy 8.
Salt and brine		937	1,160	99	United Kingdom 571; West Germany 243.

See footnotes at end of table.

TABLE 23—Continued

THAILAND: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
INDUSTRIAL MINERALS—Continued				
Sodium compounds, n.e.s.:				
Carbonate, manufactured	110,410	97,366	22,978	Romania 22,723; Belgium-Luxembourg 15,989.
Sulfate, manufactured	27,440	NA		
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked	1,868	1,067	—	China 491; Italy 383; Republic of Korea 90.
Worked	962	1,419	1	Italy 1,318; Belgium-Luxembourg 55.
Dolomite, chiefly refractory-grade	237	468	—	All from Norway.
Gravel and crushed rock	773	1,827	—	France 1,244; China 558.
Limestone other than dimension	(2)	35	—	Unspecified 35.
Quartz and quartzite	340	209	—	Italy 128; China 50.
Sand other than metal-bearing	166	241	109	Japan 127.
Sulfur:				
Elemental:				
Crude including native and byproduct	59,895	59,013	—	Canada 25,627; Singapore 18,994; China 13,798.
Colloidal, precipitated, sublimed	120	224	(2)	West Germany 140.
Dioxide	19	—		
Sulfuric acid	3,047	3,139	38	Japan 2,990; United Kingdom 57.
Talc, steatite, soapstone, pyrophyllite	22,117	26,518	98	China 15,722; Republic of Korea 9,978.
Other:				
Crude	12,368	12,887	—	China 2,943; West Germany 1,168; unspecified 7,350.
Slag and dross, not metal-bearing	38	1,324	—	Japan 1,217; United Kingdom 100.
MINERAL FUELS AND RELATED MATERIALS				
Asphalt and bitumen, natural	33	42	42	
Carbon black	4,105	4,748	159	China 690; Philippines 466; Singapore 413.
Coal: Anthracite and bituminous	182,584	254,415	—	Australia 171,923; Indonesia 43,251; China 35,034.
Coke and semicoke	39,115	57,088	—	Japan 41,850; China 14,162.
Peat including briquets and litter	—	2	—	All from West Germany.
Petroleum:				
Crude thousand 42-gallon barrels	51,880	54,685	—	Malaysia 16,046; Brunei 12,150; United Arab Emirates 7,818.
Partly refined do.	r1,237	NA		
Refinery products:				
Liquefied petroleum gas do.	660	1,429	(2)	Kuwait 539; Venezuela 309; Indonesia 226.
Gasoline do.	107	2,533	—	Singapore 2,379; Philippines 112.
Mineral jelly and wax do.	94	101	11	China 62; Japan 9.

See footnotes at end of table.

TABLE 23—Continued

THAILAND: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
MINERAL FUELS AND RELATED MATERIALS—Continued					
Petroleum—Continued					
Refinery products—Continued					
Kerosene and jet fuel	thousand 42-gallon barrels	1,273	2,737	19	Singapore 2,626; Philippines 91.
Distillate fuel oil	do.	14,239	19,843	—	Singapore 17,385; Malaysia 1,577.
Lubricants	do.	1,383	1,888	35	Singapore 1,030; China 357.
Residual fuel oil	do.	521	3,709	([2])	Singapore 1,880; Kuwait 1,344.
Bitumen and other residues	do.	51	40	—	Singapore 28; Japan 7.
Bituminous mixtures	do.	10	23	([2])	United Kingdom 19; Republic of Korea 3.
Petroleum coke	do.	28	31	([2])	Burma 30.

[r] Revised. NA Not available.
[1] Table prepared by Audrey D. Wilkes.
[2] Less than 1/2 unit.
[3] May include other precious metals.
[4] Includes oxides and hydroxides.

its leading metals industry and source of export earnings, the Thai Government maintained low royalties on tin in order to encourage further production from the remaining mines. By yearend, however, these measures were not successful enough to meet the export quota of 19,000 tons for Thailand under the ATPC supply rationalization scheme.

Meanwhile, small tin-mining companies in northern Thailand in the vicinity of Chiang Mai were watching market prices intently. One operation producing about 5 tons per month, by hydraulic techniques and gravity separation, stated that it would not be profitable at current prices until it achieved an output of at least 10 tons per month. In this area, 20 tons per month would have ranked as a large mine. Because production was insufficient to support a smelter in northern Thailand, tin concentrates from as many as 24 mines in this region were taken to Chiang Mai for grading and stockpiling and then shipped in 13-ton loads by 10-wheeled truck to Phuket, roughly 1,000 kilometers to the south.

Zinc.—In 1988, for the first time, the value of Thai zinc production exceeded that of tin, the longtime leader in the mineral industries of Thailand. The production of zinc ore at the Mae Sod Mine for Padaeng Industry Co.'s (PDI) ultramodern zinc refinery was about 420,000 tons, valued at more than $108 million for 1988, a 15% increase over that of 1987. Tin, however, still represented the largest share of Thailand's export revenues.

The PDI refinery, the world's first electrolytic zinc refinery to treat silicate zinc ores[75] (hemimorphite), was operated in conjunction with the only economic zinc deposit known in Thailand. Such a refinery, by using chemical rather than thermal methods for reduction and processing of the ore, avoided the problems of smokestack effluent and the release of sulfur compounds into the atmosphere. This zinc mine and refinery, a milestone in engineering design, process technology, and minimal environmental impact, set a standard for the industry, and reflected credit on the Thai-Belgian team that brought it into being.

Although originally announced to have a designed capacity of 60,000 tons of refined zinc per year, the capacity was increased by approximately 10,000 tons per year. This expansion resulted in the production of approximately 68,600 tons of zinc in 1988.

Another new feature of the PDI operation was the establishment of a zinc-alloy plant in 1988. During the year, 4,086 tons of Zamag No. 3 zinc alloy was reported to have been produced, all for domestic consumption.

Because of the good grade of their smithsonite-hemimorphite ore and agreeably high zinc prices, PDI's only problem seemed to have been the quantity of reserves, at about 4.5 million tons. Further exploration was warranted for determination of further reserves. PDI also contemplated a cadmium-recovery operation utilizing their zinc tailings to extract as much as 1,000 tons per year of refined cadmium for marketing to the nickel-cadmium battery manufacturers.

Other Metals.—The mineral rutile, composed of titanium dioxide, is added to Table 1 for 1988 because of its increasing (up 39%) production along with leucoxene (up 125%) at the expense of ilmenite production, down sharply (37%). This shift of emphasis in the production of titanium minerals, in all probability, simply reflected an attempt to exploit all possible sources for a strong market in titanium-based pigments for paint, in that production of ilmenite itself had been up manyfold in 1987 compared to that of 1986. As byproducts of tin mining in offshore dredging, the value of these titanium minerals became apparent as various methods of separation and classification were applied.

Xenotime production increased nearly 240% as output of this source of yttrium, also a detrital mineral like cassiterite (tin), ilmenite, leucoxene, and rutile, swung upward again. Although not approaching the 1985 high of 158 tons, the 1988 value of 101 tons suggested that superconductivity research had encouraged interest in this phosphate of yttrium.

Zirconium ore and concentrate production climbed from 199 tons in 1983 to 5,098 tons in 1988. This rise reflected the steadily increasing interest in zircon metal as a material suited to specialized uses in nuclear reactors and other high-temperature applications. Zircon, as a fairly common detrital mineral, was a byproduct of tin dredging that could be separated in response to demand.

Industrial Minerals.—**Barite.**—Production of barite was up about 22%, a modest recovery from the extreme low output of 1987. At a little over 40,000 tons, the 1988 production was nowhere near the 1985 high of about 231,000 tons, which was aimed primarily at satisfying the demand for drilling muds for the petroleum industry. Although some forecasts implied a sharp increase in export demand for Thai barite, the world market for crude oil has demonstrated a price instability of notorious proportions. However, petroleum exploration and development in China, Thailand, Vietnam, and other Asian areas, both offshore and onshore, was probably as vigorous as in any other part of the world, so Thai barite mining stood to gain as drilling requirements increased.

Total recovery of the Thai barite industry had a long way to go in 1988. From 51 active mines, employing more than 1,700 workers in 1985, the number of active mines decreased to 31, employing 361 workers. Some mines were worked by small family groups who endeavored to maintain a subsistence-level standard of living.

Some sources conceded that China preempted a part of the Thai barite export market by offerings at lower prices, but these sources believed that China could not compete on small-scale orders in the region.

Cement.—For all practical purposes, a bellweather of the mushrooming development and expansion of Thailand was cement production, which once again registered a new high, and broke through the 10-million mark to more than 11.5 million tons, up 17% from 1987. In the past, exports have been very small in comparison to domestic consumption of hydraulic cement. Preliminary information is that no cement was exported in 1988.

The Thai cement industry depended heavily on petroleum fuel (mostly natural gas) from domestic production for this energy-intensive product. The Thai Minister of Science, Technology, and Energy was quoted as believing that if the cement industry could switch to lignite fuel, it could produce the lowest cost cement in the world.

Fertilizer Materials.—There were no significant developments in 1988 in the ongoing struggle to construct Thailand's first nitrogen and compound fertilizer plant at Map Ta Put, in Rayong Province. It was planned to have yen-loan financing and construction by a consortium led by Chiyoda Chemical and Engineering and Construction Co. of Japan. In 1987, the reason given for delay was the continuing strengthening of the yen in the face of low market pricing of urea and the relatively high cost of domestic natural gas as a raw material. No significant relief from the combination of these factors occurred in 1988, therefore, the postponement may have been permanent. Total renegotiation remained a possibility in the light of further demand analysis for fertilizers and reconciliation of costs of raw materials and financing.

Phosphate rock production climbed sharply to an output of about 8,350 tons for the year, up 85% over that of 1987. It was not exported in the past because of the severity of domestic demand, so that such an upsurge in production boded well for Thai agriculture.

Although Southeast Asia was generally very much in need of potassium fertilizers, potash (and accompanying phosphate) deposits in northeast Thailand still awaited consummation of agreements on exploration and exploitation. Protracted discussions with potential foreign joint venturers have reached no conclusion after several years. Both Placer Dome of Canada and DHP-Utah International of the United States were interested in acquiring the right to explore for, and subsequently produce, potash deposits in Udon Thani and, toward the east, in Sakon Nakhon and Nakhon Phanom Provinces of the northeast. A press release by the Thai Department of Mineral Resources broached the possibility of an ASEAN project to develop potash resources in Chaiyapum Province, also in the northeast but not contiguous with the aforementioned three provinces.

Gypsum.—The production of gypsum climbed steadily over the past few years, and it was emerging as one of the first-rank industries of Thailand. Export demand as well as domestic requirements pushed gypsum production up 50% over that of 1987 to 4.5 million tons in 1988. Between 400,000 and 500,000 tons of the mineral was to go to gypsum board for the domestic market, and a small amount of board was exported to Japan. Based on competitive pricing, gypsum products rose to second place among mineral exports in order of value, exceeded only by tin.

Other Industrial Minerals.—Fluorspar production declined about 25% to 76,000 tons from 102,000 tons in the midst of competition from China. Feldspar output was up sharply to almost 294,000 tons, an increase of 74% over that of 1987, as export demand for ceramic use increased. The proportion of potassium to sodium feldspar diminished steadily to less than 2% since 1983. Limestone to feed Thailand's flourishing cement industry was up 24% to more than 14 million tons in 1988.

***Mineral Fuels.*—Anthracite.**—A discovery of anthracite deposits in Loei Province in the northeast made Thailand the second nation in Southeast Asia, with Vietnam, to locate deposits of this high-rank coal. The material was mined and marketed to water authorities for use in removing impurities by filtration (and possibly chemical reduction) of drinking water.

Lignite.—After surpassing tin in 1986 as Thailand's highest value mineral commodity, the gap widened in 1987 as lignite climbed to a new high, up 5% to 7.3 million tons in 1988, worth about $150 million. During the same period tin production more or less stagnated. The Thai Government prohibited the export of lignite, and directed instead that it go to support the generation of power in Thailand.

Lignite was mined chiefly at Mae Moh in Lampang Province, where it fueled seven on-site electric powerplants. Another seven plants were under construction or scheduled for completion by 1995. Lignite mining was also under development on a smaller scale in Krabi Province, and lignite deposits, including substantial reserves, were under study far to the south at Sabai Yoi in Songkhla Province. By the year 1990, lignite production in Thailand was expected to be close to 11 million tons.

Thai Government policy endorsed natural gas as fuel for the generation of electric power, but the increased demand for electricity created the necessity for using both fuels. Environmental considerations have begun to affect the development and burning of lignite in parts of the country.

Natural Gas.—The Thai Government continued to encourage exploration for new gas reserves, along with the interest in crude, as the inevitable decline curves came into significance on earlier discoveries. Gas was a convenient fuel for electric-power generation as well as for industry in general, and the prospect of still undiscovered reservoirs, especially in the Gulf of Thailand, focused attention on the so-called "B" structure a little more than 161 kilometers southeast of the Erawan and Baanpot Fields. On the premise that the original conditions of offering of the "B" structure were too stringent, the Petroleum Authority of Thailand (PTT), bought back the tract from Texas Pacific in 1987 and prepared in 1988 to revise these conditions to attract serious negotiations.[76]

Although concern has been expressed about natural gas availability, actual gross production in 1988 reached a new high of almost 212 billion cubic feet, with an official estimate of 14.7 trillion cubic feet of gas reserves identified. These reserves were mostly offshore in tracts controlled by Unocal and PTT but also included acreage in northeast Thailand controlled by Esso Exploration. A comparison[77] of the composition of Thai onshore with offshore natural gas is presented in the text table.

Constituent		Offshore	Onshore
C1	Methane	65.95	95.33
C2	Ethane	8.35	.64
C3	Propane	5.12	.3
C4	Butane	2.65	.1
C5/C5+	Pentane, etc.	1.81	.02
CO_2	Carbon dioxide	14.6	1.84
N_2	Nitrogen	1.48	1.75
H_2S	Hydrogen sulfide	.00	.02
TOTALS:		**99.96**	**100.00**

Time and temperature have provided for the maturation of onshore gas to a composition essentially of methane, having no obvious potential for production of condensates. Offshore gas from the Gulf of Thailand was clearly strong in the higher molecular weight hydrocarbons, indicating a relatively high proportion of condensates, and was also high in carbon dioxide. Taken together, these data showed a distinctly poorer degree of maturation and suggested, at least, the presence of crude in the geological vicinity.

Crude Petroleum.—Production of crude in Thailand increased to 7.4 million barrels in 1988 along with another 5.4 million barrels of natural gas condensates, neither figure representing the high value for the past 5 years. Reserves were placed at about 283 million barrels of crude and natural gas liquids.

Exploration for new pools and new fields proceeded apace. Appraisal or development wells were drilled in several locations, while the Thai Government grappled with problems of definition and terms of concessions for exploration and production.[78] The permissible area of onshore concession blocks was reduced from 10,000 to 4,000 square kilometers, with certain exceptions for high-cost fields. The maximum area allowed any specific concessionaire was to be reduced from 50,000 to 20,000 square kilometers, except for offshore areas in depths greater than 200 meters. The maximum exploration period was to be decreased from 8 to 6 years, and renewals were to be reduced from 4 to 3 years. The maximum production period after the end of the exploration period was to be reduced from 30 to 20 years. Other changes with respect to relinquishment, production obligations, and royalties (the latter on a new sliding scale) were to go into effect. In general, the new rules were more stringent but would seem to allow for more flexibility on a case-by-case basis where warranted. Other changes were anticipated by direction of the PTT.

Trade papers report[79] that in April Unocal gauged its Surat No. 2 well in the Gulf of Thailand at 1,900 bbl/d of crude and condensate plus nearly 25 million cubic feet per day of gas. Additional drilling was scheduled for the coming months. In July, in its first wildcat, Petrocorp Exploration Thailand Ltd. (New Zealand) found 480 bbl/d of crude in its Vichienburi No. 1 well in Petchabun Province in central Thailand. This company restructured the ownership of this block, SW1, retaining 57.5% ownership as operator, and assigned 15% each to Mimex Co. and Kirkland Resources PLC of the United Kingdom and 12.5% to Northern Michigan Electric Corp. (NOMECO) of the United States. In December, Premier Oil Pacific Ltd.'s Songkhla No. 1 well in the Gulf of Thailand tested at 1,400 bbl/d of crude.

Because of higher oil prices on world markets at the conclusion of 1988, interest in petroleum exploration in Thailand was keen.

VIETNAM[80]

Introduction

Continued successful development of the fledgling petroleum industry far outweighed the other mineral sectors. Three years ago all of Vietnam's petroleum needs were imported at considerable cost, both politically and directly, to the economy. It appeared that offshore oil production should furnish the country's total petroleum needs by the early 1990's and could leave a small surplus to help pay for expensive imports.

Placer gold mining became an interesting item in the press during the year. Apparently a policy change in the purchasing regulations for gold by the Government's Precious Metals Corp. sparked a minigoldrush in the highlands of the north and central provinces.

The coal sector has continued to have problems in production, quality, transportation, and administration.

In the December session of the National Assembly, the Vice Premier painted a bleak picture of the economy and called for the abolition of free health care and education as well as further expansion of the private sector. The country's social, economic, and financial positions did not improve in 1988.[81] Inflation remained serious in 1988, although it was lower than in 1987. The Government did not divulge the inflation rate, but a top Vietnamese economic adviser from Ho Chi Minh City stated inflation was running between 700% and 1,000% per year. However, a banking reform was underway, after which the central bank would retain control of the money supply, and smaller commercial banks would be established to administer credits.[82]

There were some encouraging developments. GNP in 1988 increased 5.4% over 1987. Industrial output was up 8.9%. Production of electricity and cement rose 15%, sulfuric acid 39%, and chemical fertilizer 15%. Export value increased by 13.5%. Official plans for 1989 were as follows: GNP to increase 7.6%; national income to increase 8.2%; industrial output to increase 10%; and export value to increase 15% over that of 1988.

The most important mineral exports, in descending order of value, were coal, tin, phosphate rock, and a small amount of chromite. About 700,000 tons of crude oil was exported for credit toward imports and to repay debts.

The major mineral imports were refined petroleum products, fertilizers, semifinished and finished metals, equipment, and machinery, also gypsum for the cement industry.

Commodity Review

Metals.—**Gold.**—Reports of widespread placer gold mining in Bac Thai, Cao Bang, Lai Chau, Ha Son Binh, and Hoang Lien Son Provinces were prevalent in the press during the year. A Hanoi newspaper reported that tens of thousands of people in Bac Thai Province were prospecting for gold. The General Department of Mines and Minerals reportedly estimated that 700,000 persons were panning for gold in Vietnam.

The sudden interest in gold prospecting and panning was probably caused by a Government policy change, which essentially allowed the Precious Metals Corp. to buy gold without regard to the sources or amount of gold involved. Gold production and sales were to be controlled and taxed by a variety of regulations. In Bac Thai, the center of most of the activity, persons from outside the province were not allowed to mine gold, and a person from one district or village was not permitted to go to another district to mine gold. Individuals and groups in the localities must pay a license tax of $0.75 to $1.00[83] per month, as well as other kinds of taxes, and must sell to the state 20% to 25% of the gold mined, at the prescribed prices. The remainder was to be sold at a price between 5% and 10% below market.

In a country with serious underemployment and a precarious economy, the Government's rules were not being strictly adhered to. The press complained of the disruptive effects of the prospecting. These effects included people leaving their jobs and neglecting

TABLE 24

VIETNAM: PRODUCTION OF MINERAL COMMODITIES[1 2 3]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987[e]	1988[p]
Bauxite: Gross weight[e]		5,000	6,000	6,000	6,000	6,000
Cement, hydraulic[e]	thousand tons	1,100	1,300	1,540	[4]1,512	1,500
Chromium: Chromite[e]		16,000	15,000	15,000	15,000	14,000
Clays: Kaolin[e]		1,000	1,000	1,000	1,000	1,000
Coal: Anthracite	thousand tons	5,840	6,200	6,007	6,500	[e]5,000
Gypsum[e]		25,000	25,000	25,000	25,000	25,000
Iron and steel: Metal:[e]						
Steel, ingot	thousand tons	100	110	110	110	115
Steel, rolled	do.	40	50	50	50	50
Nitrogen: N content of ammonia		([5])	([5])	([5])	([5])	([5])
Petroleum: Crude[e]	thousand 42-gallon barrels	—	—	200	600	5,475
Phosphate rock:[e]						
Gross weight	thousand tons	200	[5]516	530	300	330
P_2O_5 content	do.	66	170	175	105	115
Salt	do.	[e]800	379	[e]450	[e]229	[e]300
Tin:[e]						
Mine output, Sn content		500	600	650	680	700
Metal, smelter		475	570	620	645	600
Zinc:[e]						
Mine output, Zn content		7,000	5,000	5,000	5,000	5,000
Metal, smelter, primary		6,000	4,200	4,200	4,200	4,200

[e]Estimated. [p]Preliminary.
[1]Table includes data available through Aug. 18, 1989.
[2]In addition to the commodities listed, other crude construction materials such as sand and gravel and other varieties of stone presumably are produced, but available information is inadequate to make reliable estimates of output levels.
[3]In addition to the commodities listed, iron ore was mined in the past and pig iron was produced at industrial facilities, but the status of these industries under prevailing conditions is not sufficiently clear to allow formulation of reliable estimates of output levels. Similarly, data on output of crude construction materials and natural gas are not available, and no basis is available to make reliable estimates of output levels.
[4]Reported figure.
[5]Nitrogen (N content of ammonia) production capacity of the country's only known plant is 54,000 tons per year; it is not known at what output level the plant is operating.

their farming duties. "The evils of gambling, prostitution, fighting, speculation, and black marketeering have developed." Government cadres were reportedly bribed and corrupted.[84] Despite the apparent disruptions to local economies and the somewhat chaotic conditions, the Council of Ministers issued a directive to all localities concerned to step up placer mining in order to increase production in 1989 by several times over that of 1988.[85]

Production of gold in recent years has apparently been approximately 36 ounces per year. This increased to 842 ounces in 1987 and 2,407 ounces in 1988. The latter figure is the reported purchase by the Precious Metals Corp. It was generally assumed that somewhat more was actually recovered during the period. The panned material averaged 93% Au content.

On the more official end of the mining ladder, the Australian company Covictory Investment Ltd. reportedly acquired 100% interest in the former Bong Mieu gold mine, 75 kilometers south of Da Nang. The Bong Mieu deposit consists of three parallel veins of nearly solid auriferous pyrite. The reserves were estimated at 160,000 ounces of gold and had excellent potential for more than that. The property was first mined in the 7th century; however, the Vietnamese entered the area in the 15th century and mined intermittently until the 19th century. The French took over in 1885 and operated it until World War II. Due to the military and political situation, it has been abandoned since then. During the French tenure, 112,425 ounces of gold were extracted at an average grade of about 0.23 ounce per ton. The new company planned to operate at a rate of 16,000 troy ounces per year after an initial investment of $5 to $6 million.[86]

Iron and Steel.—The Gia Sang rolling plant at Thai Nguyen steel complex was producing finished products at a 33,000-ton-per-year rate after 12 technical innovations were introduced through August 1988. At the same location, an Indian-Vietnamese cooperative project was in the early stages of development. The work was apparently part or all of an electric-arc-furnace steel facility planned for Thai Nguyen. The Government dropped plans for a blast furnace several years ago because of the prohibitively high capital cost and lack of domestic coking coal.

Tin.—The tin industry was getting help from two sources during the year. The United Nations Development Program was assisting the Ministry of Mechanical Engineering and Metallurgy to establish and operate a laboratory for developing tin-ore-processing technology for the different types of tin deposits in Vietnam. Total budget for the project was $910,000.

The Vietnamese radio carried a news item on the Soviet assistance being given to the tin industry at Qui Hop in Nghe Tinh Province. The main facility was to be a 650-ton-per-year tin smelter. The broadcast stated that a hospital, housing, road improvements, and cultural facilities for the Vietnamese and Soviet workers had been built. Although announced in a positive vein, the story, in effect, admits to a serious delay in a project started long ago. The support facilities were first reported as under construction in 1981, and an agreement for the construction of the smelter was signed with the U.S.S.R. in 1984.[87]

Industrial Minerals.—The country's second superphosphate fertilizer plant was being constructed on schedule in Long Thanh, east of Ho Chi Minh City. The 45,000-ton-per-year plant was scheduled to begin production by the end of 1990.

The Council of Ministers issued a directive urging that all quarries in the country be operated for the good of the entire country and not just their local areas. The Ministry of Building indicated that intensive investment would be needed to meet the plan of increasing the 1988 production of 4.9 million tons to 5.5 million tons in 1990.

The Institute of Industrial Chemistry has reportedly begun producing rutile concentrate from the mineral sands deposits along the coasts of Binh Tri Thien, Nghia Binh, and Phu Khanh Provinces. Zircon was already being separated on a limited trial basis for the metal casting and ceramics industry.

Mineral Fuels.—**Coal.**—The coal sector has continued to have serious problems which persisted despite urgent and varied efforts to correct them, during the last several years. According to the Ministry of Energy, "the coal sector's activities have met with great difficulties and is operating at a great loss." Production quotas were frequently not met. Costs have increased to the point where some consumers can no longer afford the grade of coal they need. Transportation inadequacies have left huge piles of washed coal deteriorating at the mines while customers experience shortages. The quality of the coal delivered was often well below that needed for a particular use.

In October, the Council of Ministers directed the Minister of Energy to, "closely guide various units of the coal sector in reorganizing production, renovating management, and promptly improving production output, quality, and efficiency of the entire sector." Several corrections were to be tried. Only the most critical industries would be entitled to the special reduced price, such as powerplants, trains, and medical glassware. Even those would be eliminated as soon as possible. Income from coal exports would be repaid to the coal industry rather than foreign debts. Cost accounting was to be strict and every effort made to ensure that the coal industry did not operate at a loss as it has for the past several years. Some of the coal-dedicated sections of railroad roadbed and tracks were improved, but additional work was urgently needed.

Policy changes in the management of the mines were being tried in order to put the responsibility for operations squarely on the mine director. At the 500,000-ton-per-year Nui Hong coal mine, the choice of a new director was made in June by a competitive examination. The five candidates were ranked on the basis of their individual ideas for running the mine and improving the working conditions and morale of the miners. The board of examiners was headed by a Vice Minister of Energy, and the choice was made by secret ballot. Selections in the past have been made on less than objective and impersonal grounds and have probably been a major factor in the industry's problems. In the future, it was announced, directors of enterprises that fail to fulfull production plans for 2 consecutive years will be relieved of their posts and replaced by new ones to be selected through similar tests but developed by the individual companies concerned.[88]

Natural Gas.—The small natural gas field discovered several years ago in Thai Binh Province, southwest of Hanoi, has spawned a number of mineral related industries that are beginning to yield positive results to the economy. The field produced 175 million cubic feet of gas in 1988 under the Oil and Natural Gas General Department.

All of the new plants were in Tien Hai District. The Tien Hai Pottery Enterprise began production of household china, insulators, and art and handcraft pottery for export. Capital investment was $100,000, and the plant employed more than 110 workers. The Glass Enterprise apparently started production early in the year. Its output consisted of glasses, bottles, vases, and light bulbs. Costs using natural gas instead of coal were reduced from $0.15 to $0.006 per kilogram of molten glass and the quality was considerably improved as well. The Long Hau Brick and Tile Enterprise tripled production of basic bricks after changing from wood and coal to natural gas. It also introduced a new glass enamel construction brick, which was not feasible when using coal as fuel. The Thai Binh Cement Plant placed a 3,000- to 5,000-ton-per-year white cement production shop into operation, apparently also gas fired.

Shakedown problems, most of which were related to early startups before all the supporting and shortage facilities were completed,were being encountered in some of the plants.[89]

Petroleum.—Activity in the petroleum sector continued to increase and entered a new stage in 1988. The Government oil company, Vietnamese National Oil and Gas Co. (Petrovietnam), signed an exploration and production contract with British Petroleum Development Ltd. (BP) making the fourth such agreement since the Law on Foreign Investment was adopted by the National Assembly in December 1987. Under the contract, BP furnished all capital needed and assumed all risks during the surveying and exploration drilling in a 15,000-square-kilometer area off the coast of Da Nang in central Vietnam.

Hydrocarbons India Ltd. (HIL), a subsidiary of an Indian Government-owned oil company, signed the first production-sharing contract under the Foreign Investment Law in June 1988. HIL was to survey 6,000 line kilometers and drill two wells over 4 years in a 14,000-square-kilometer area along the southern continental shelf.

The first Western company to sign a contract was a consortium of Shell Exploration B.V. and the Belgian firm Petrofina S.A. Shell was to conduct 10,000 line kilometers of seismic survey in a 15,000-square-kilometer concession off the coast near Hue, north of the BP block.

The French petroleum company Total was the third company to sign an exploration contract during the year. Contract conditions were similar to the others. Its exploration block was in the northern Gulf of Tonkin.

TABLE 25

VIETNAM: APPARENT EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987[p]	Principal destinations, 1987
METALS			
Aluminum: Metal including alloys, all forms	17	—	
Chromium: Ore and concentrate	198	2,122	All to Japan.
Copper: Metal including alloys, all forms	1,185	—	
Iron and steel: Metal:			
Scrap	87,031	84,582	Do.
Semimanufactures	2,068	NA	
Lead: Metal including alloys, unwrought	—	103	All to Italy.
Tin: Metal including alloys, unwrought	70	35	All to Hong Kong.
INDUSTRIAL MINERALS			
Feldspar, fluorspar, related materials	42	—	
Mica: Crude including splittings and waste	—	29	All to Japan.
Precious and semiprecious stones other than diamond: Natural value, thousands	$42	—	
Salt and brine	310	610	All to Hong Kong.
Stone, sand and gravel: Dimension stone, all forms	1,433	NA	
MINERAL FUELS AND RELATED MATERIALS			
Coal: Anthracite and bituminous	131,093	86,743	Japan 80,315; Thailand 4,180; Hong Kong 2,248.
Petroleum: Crude 42-gallon barrels	—	1,745,941	All to Japan.

[p] Preliminary. NA Not available.

[1] Table prepared by Audrey D. Wilkes. Owing to a lack of official trade data published by Vietnam, this table should not be taken as a complete presentation of this country's mineral exports. These data have been compiled from United Nations information and data published by the partner trade countries. The United States did not report any imports of mineral commodities from Vietnam during 1987.

TABLE 26

VIETNAM: APPARENT IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987[p]	Principal sources, 1987
METALS			
Alkali and alkaline-earth metals	—	2	All from Italy.
Aluminum: Metal including alloys, all forms	1,216	62	Japan 55; Belgium-Luxembourg 5.
Arsenic: Oxides and acids	—	1	All from Hong Kong.
Chromium: Oxides and hydroxides	22	91	Japan 89; Hong Kong 2.
Cobalt: Oxides and hydroxides	13	5	All from Japan.
Copper: Metal including alloys, all forms	522	19	Japan 17; Hong Kong 2.
Iron and steel: Metal:			
Ferroalloys	483	470	All from Japan.
Steel, primary forms	9	—	
Semimanufactures:			
Bars, rods, angles, shapes, sections	10,616	2,836	Japan 1,531; Hong Kong 1,199; Finland 101.
Universals, plates, sheets	9,655	6,253	Japan 3,816; Hong Kong 1,892; Australia 500.
Hoop and strip	588	213	Japan 195; Australia 11.
Rails and accessories	23	—	
Wire	1,028	406	Japan 365; Finland 20.
Tubes, pipes, fittings	11,670	2,049	Japan 1,758; Finland 248.
Castings and forgings, rough	—	2	All from Netherlands.
Lead:			
Oxides	20	30	All from Japan.
Metal including alloys, all forms	54	12	Do.
Manganese: Oxides	194	750	Japan 520; Hong Kong 230.
Mercury 76-pound flasks	—	58	All from Japan.
Nickel: Metal including alloys, all forms	7	11	Do.
Silver: Metal including alloys, unwrought and partly wrought value, thousands	\$93	\$11	Do.
Titanium: Oxides	463	263	Japan 215; Hong Kong 48.
Tungsten: Metal including alloys, all forms kilograms	52	—	
Zinc:			
Oxides	586	191	Japan 139; Hong Kong 52.
Metal including alloys:			
Unwrought	300	188	All from Japan.
Semimanufactures	—	1	Do.
Other: Base metals including alloys, all forms	—	1	Do.
INDUSTRIAL MINERALS			
Abrasives, n.e.s.:			
Natural: Corundum, emery, pumice, etc.	89	21	All from Netherlands.
Artificial: Corundum	31	—	
Grinding and polishing wheels and stones	3	1	All from Japan.
Asbestos, crude	105	—	

See footnotes at end of table.

TABLE 26—Continued

VIETNAM: APPARENT IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987[p]	Principal sources, 1987
INDUSTRIAL MINERALS—Continued				
Cement		3,765	62,277	Thailand 41,900; Philippines 11,900; Hong Kong 8,477.
Clays, crude		1,096	—	
Cryolite and chiolite		—	5	All from Japan.
Diatomite and other infusorial earth		60	—	
Fertilizer materials: Manufactured:				
Ammonia		13	10	Do.
Nitrogenous		365,273	98,814	Indonesia 98,804.
Phosphatic		10,000	5,825	Philippines 5,800.
Potassic		81,603	—	
Unspecified and mixed		366	2	All from Belgium-Luxembourg.
Gypsum and plaster		1	—	
Magnesium compounds: Oxides and hydroxides		20	20	All from Hong Kong.
Mica: Worked including agglomerated splittings		3	1	All from Japan.
Pigments, mineral: Iron oxides and hydroxides, processed		76	15	Japan 11; Hong Kong 4.
Pyrite, unroasted		60,000	—	
Sodium compounds, n.e.s.:				
Carbonate, natural and manufactured		4,980	547	Japan 320; Hong Kong 227.
Sulfate, natural and manufactured		3,128	220	All from Hong Kong.
Stone, sand and gravel: Dimension stone, all forms		40	12	Italy 11; Japan 1.
Sulfur:				
Elemental, all forms		7,020	40	All from Japan.
Sulfuric acid		5	5	Do.
Talc, steatite, soapstone, pyrophyllite		2	96	Hong Kong 89; Japan 7.
Other: Metalloids, unspecified[2]		—	2	All from Hong Kong.
MINERAL FUELS AND RELATED MATERIALS				
Asphalt and bitumen, natural		—	1	All from Finland.
Carbon black		459	609	Japan 504; Hong Kong 105.
Coal: Anthracite and bituminous		36,044	38,149	All from Australia.
Coke and semicoke		2,400	—	
Petroleum refinery products:				
Gasoline	42-gallon barrels	—	51	All from Belgium-Luxembourg.
Mineral jelly and wax	do.	2,267	2,686	Hong Kong 2,560.
Kerosene and jet fuel	do.	19,656	1,000	All from Hong Kong.
Distillate fuel oil	do.	119	30	Do.
Lubricants	do.	39,242	73,941	Italy 73,052; Belgium-Luxembourg 525.
Bitumen and other residues	do.	3,531	61	All from Hong Kong.
Bituminous mixtures	do.	12	—	

[p] Preliminary.
[1] Table prepared by Audrey D. Wilkes. Owing to a lack of official trade data published by Vietnam, this table should not be taken as a complete presentation of this country's mineral imports. These data have been compiled from United Nations information and data published by the partner trade countries. The United States did not report any exports of mineral commodities to Vietnam during 1987.
[2] Reported under SITC item number as "selenium, tellurium, phosphorus, arsenic, etc."

Vietnam's first petroleum refinery was completed in the fall and came on-stream December 15th. The 1,000-barrel-per-day topping plant, Saigon Petro Refinery, was in Thu Duc District on the southeast outskirts of Ho Chi Minh City. The Bach Ho Oilfield crude should yield 8% straight-run gasoline, 7% kerosene, and 27% diesel oil. The remaining heavy fraction would probably be exported for cracking and reforming into lighter products.

Construction continued on the 60,000-barrel-per-day Tuy Ha oil refinery between Vung Tau and Ho Chi Minh City. Completion was scheduled for the early 1990's.[90]

The joint-venture Soviet and Vietnamese oil company has proven to be the most successful industrial undertaking in the country. The company has discovered the Bach Ho Oilfield and two additional fields not yet in production. Bach Ho has produced over 7,200,000 barrels in 2½ years from five offshore platforms. Two additional platforms were being installed. Production was planned to increase to several times the 7-million-barrel level by 1990. If that production level was achieved, Vietnam would become self-sufficient in petroleum for the first time.

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[1] Prepared by Gordon L. Kinney, physical scientist, Division of International Minerals.

[2] Where necessary, values have been converted from Brunei dollars (B$) to U.S. dollars at the rate of B$2.20 = US$1.00.

[3] Petroleum Economist. V. 56, No. 2, Feb. 1989, p. 70.

[4] ———. V. 55, No. 6, June 1988, p. 213.

[5] Prepared by Gordon L. Kinney, physical scientist, Division of International Minerals.

[6] Ministry of Planning and Finance. Report to the Pyithu Hluttaw on the Economic and Social Condition of the Socialist Republic of the Union of Burma for 1988-89. P. 122.

[7] The Burmese financial year begins Apr. 1 of the year stated.

[8] Where necessary, values have been converted from Burmese kyats (K) to U.S. dollars at the rate of K6.42 = US$1.00. The unofficial or black market rate is several to many times the official conversion rate and varied greatly depending on geographic location and time of year.

[9] Page 124 of work cited in footnote 6.

[10] TEX Report. V. 21, No. 4870, Mar. 2, 1989, p. 2.

[11] Tanjug (radio broadcast) in English. 1946 GMT, Mar. 22, 1988.

[12] Mining Journal (London). V. 311, No. 7985, Sept. 9, 1988, p. 5.

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[15] Prepared by Gordon L. Kinney, physical scientist, Division of International Minerals.

[16] Erlanger, S. The Endless War. The New York Times Magazine. Section 6, Mar. 1989, p. 24.

[17] The New York Times. Feb. 12, 1989, p. 25.

[18] Voice of the National Army of Democratic Kampuchea (in Cambodian). Radio Broadcast (Clandestine). 2315 GMT, Mar. 3, 1989.

[19] Prepared by Travis Q. Lyday, physical scientist, Division of International Minerals.

[20] Prepared by John C. Wu, economist, Division of International Minerals.

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[22] U.S. Embassy, Jakarta, Indonesia. State Dep. Airgram A-018, Dec. 9, 1988, p. 2.

[23] The Asian Wall Street Journal (Hong Kong). V. 12, No. 184, May 20, 1988, p. 3.

[24] ———. V. 13, No. 21, Sept. 29, 1988, p. 1; No. 29, Oct. 9, 1988, p. 1; No. 50, Nov. 9, 1988, p. 3.

[25] ———. V. 13, No. 55, Nov. 16, 1988, p. 1.

[26] Metal Bulletin Monthly (London). No. 208, Apr. 1988, p. 11.

[27] Freeport-McMoRan Inc. 1988 Annual Report. pp. 6, 24, 25, 27, 32, and 71.

[28] U.S. Embassy, Jakarta, Indonesia. State Dep. Telegram 01647, Feb. 3, 1989, p. 1.

[29] ———. State Dep. Telegram 01742, Feb. 6, 1989, pp. 1-4.

[30] ———. State Dep. Telegram 01582, Feb. 2, 1989, pp. 1-2.

[31] Inco Ltd. 1988 Annual Report. P. 10.

[32] U.S. Embassy, Jakarta, Indonesia. State Dep. Telegram 01581, Feb. 2, 1989, pp. 1-2.

[33] Mining Journal (London). V. 311, No. 7983, Aug. 26, 1988, p. 161.

[34] U.S. Embassy, Jakarta, Indonesia. State Dep. Telegram 06059, Apr. 27, 1989, pp. 3-7.

[35] ———. State Dep. Telegram 02560, Feb. 21, 1989, pp. 1-2.

[36] ———. State Dep. Telegram 06064, Apr. 27, 1989, pp. 1-2.

[37] ———. State Dep. Telegram 11839, Aug. 5, 1988, p. 1.

[38] Oil & Gas Journal (Tulsa). V. 86, No. 23, June 6, 1988, p. 24.

[39] Prepared by Gordon L. Kinney, physical scientist, Division of International Minerals.

[40] Values supplied in U.S. dollars.

[41] U.S. Embassy, Manila, Philippines. State Dep. Telegram Manila 14059, Dtd. R040936z, May 1988, p. 1.

[42] Prepared by John C. Wu, economist, Division of International Minerals.

[43] Where necessary, values have been converted from Malaysian ringgists (M$) to U.S. dollars at the rates of M$2.61 = US$1.00 in 1988 and M$2.52 = US$1.00 in 1987.

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[45] ———. State Dep. Telegram 09191, Nov. 2, 1988, p. 1.

[46] ———. State Dep. Telegram 01127, Feb. 9, 1989, p. 1.

[47] Far Eastern Economic Review (Hong Kong). V. 141, No. 29, July 21, 1988, p. 10.

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[51] U.S. Embassy, Kuala Lumpur, Malaysia. State Dep. Telegram 10392, Dec. 15, 1988, p. 1.

[52] Berita Harian (Kuala Lumpur). July 15, 1988, p. 8.

[53] The Journal of Commerce. V. 376, No. 26,718, May 2, 1988, p. 9B.

[54] Far Eastern Economic Review (Hong Kong). V. 141, No. 28, July 11, 1988, p. 58.

[55] Berita Harian (Kuala Lumpur). June 29, 1988, p. 7.

[56] U.S. Embassy, Kuala Lumpur, Malaysia. State Dep. Telegram 10328, Dec. 13, 1988, p. 1.

[57] ———. State Dep. Telegram 03445, Apr. 20, 1988, p.1.

[58] Prepared by Travis Q. Lyday, physical scientist, Division of International Minerals.

[59] Where necessary, values have been converted from the Philippine peso (P) to U.S. dollars at the rate of P21.10 = US$1.00.

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[62] ———. V. 96, No. 246, Dec. 20, 1988, p. 4.

[63] Chamber of Mines of the Philippines. CMP Newsletter. V. 13, No. 11, Nov. 1988, p. 1.

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[66] Page 4 of work cited in footnote 63.

[67] Chamber of Mines of the Philippines. CMP Newsletter. V. 13, No. 11, Nov. 1988, p. 1.

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[78] ———. V. 19, No. 12, Mar. 1989, pp. 4-5.

[79] Mining Journal (London). 1988 Mining Annual Review, page proof, unnumbered.

[80] Prepared by Gordon L. Kinney, physical scientist, Division of International Minerals.

[81] Vo Van Kiet Speech on Economy. Hong Kong AFP (in English). 1103 GMT, Dec. 13, 1988.

[82] Bangkok Voice of Free Asia (in English). 1500 GMT, Nov. 17, 1988.

[83] During the year, the value of the dong (D) varied between D386=US\$1.00 to D3,300=US\$1.00. The yearend black market rate was about D4,500=US\$1.00. An arbitrary conversion rate of D2,000=US\$1.00 is used throughout this report.

[84] Hanoi, NHAN DAN (in Vietnamese). May 12, 1988, p. 3.

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[89] Hanoi Domestic Service, Broadcast (in Vietnamese). 2300 hrs GMT, June 6, 1988.

[90] Ho Chi Minh City, SAIGON GIAI PHONG (in Vietnamese). Aug. 25, 1988, p. 3.

THE MINERAL INDUSTRIES OF

AUSTRALIA AND OCEANIA

By Travis Q. Lyday[1]

AUSTRALIA

Australia was one of the world's principal producers of minerals and metals, and its minerals industry was a leading catalyst in promoting growth of the country. Australia was the world's largest producer of alumina, bauxite, diamond, ilmenite, monazite, opal, rutile, sapphire, and zircon. It was the premier exporter of alumina, coal, ilmenite, refined lead, monazite, rutile, and zircon, and was the second leading exporter of iron ore, after Brazil. Ranking behind China, the United States, the U.S.S.R., the German Democratic Republic, Poland, and the Federal Republic of Germany, Australia was the seventh largest producer of coal (all grades) in the world. Australia was the fourth largest gold producer in 1988, after the Republic of South Africa, the Soviet Union, and the United States. It was the second largest producer of zinc, the third largest producer of nickel, the fourth largest producer of uranium, and the seventh largest producer of copper.[2] The country's mineral wealth was so extraordinary that it was virtually self-sufficient in most mineral commodities. Endowed with abundant resources of coal, natural gas, liquefied petroleum gas, and uranium, Australia was one of the few market economy countries that was a net exporter of mineral fuels. About 90% of Australia's consumption of crude oil was supplied by domestic production; this was expected to decline significantly about 1990, unless significant new oilfields were discovered.

Government Policies and Programs

In May, the Government outlined its plan to reinstate the taxation of companies on their profits earned from gold mining. The policy of exempting gold-mining income from taxation was begun in 1924 and reaffirmed in 1986. The tax was to become effective January 1, 1991, at the normal corporate rate of 39%. To ease the tax's impact, mining companies will be allowed to deduct capital expenditures, including exploration costs, incurred after 1991 from taxable income.

The Australian Government tightened the controls on the country's coal exports. The move came less than 2 years after the controls were relaxed. It was precipitated by the disappointing coking coal prices achieved by the industry early in the year in negotiations with Japan for contracts that began on April 1.

Production

The value of minerals produced in Australia in 1987, the latest year for which official data were available, was \$15.9 billion,[3] about 8% of the gross domestic product (GDP). Petroleum (crude oil, natural gas, and natural gas liquids) contributed 33% of this total, with a value of \$5.3 billion. This was followed by black coal, 22%; gold bullion, 10%; and iron ore and concentrate, 10%. Other major contributors included, in descending order of magnitude, construction materials, 4%; bauxite, value confidential; lead, including the value of silver contained in concentrate, 2%; copper, 2%; uranium, 2%; nickel, 2%; lignite, 1%; zinc, 1%; and diamond, 1%. These were followed, in descending order, by rutile, salt, ilmenite, manganese ore, zircon, opal, tin, limestone, and clays.

Trade

Australian exports were based primarily on mineral resources and primary commodities. The Australian mining industry was adversely affected in 1988 by the rise in the value of the Australian dollar, which made exports more expensive on the world market and thus less competitive. However, the mineral industry remained important for its contribution to exports.

The value of Australia's mineral primary exports in 1987, the latest year for which official data were available, rose 10% over that of 1986, setting a new record high of \$12.2 billion. The growth in 1987 was facilitated to an extent by the continued depressed level of the Australian dollar against most major currencies throughout the year and by a partial recovery in mineral commodity prices.

The commodity that showed the largest export value gain in 1987 was gold, which increased by 74% to \$1.2 billion. Other major contributors to the increase in 1987 included alumina, up 8% to \$1.2 billion; refined aluminum, up 46% to \$1.1 billion; lead (including silver bullion and concentrate), up 42% to \$384 million; and petroleum, up 49% to \$745 million. The export value of bauxite, diamond, beneficiated ilmenite, manganese, and salt, all of which were confidential on an individual commodity basis, also rose substantially in 1987.

The value of black coal exports decreased 6% in 1987, to \$3.8 billion. Black coal remained Australia's largest export earner, accounting for 13% of the value of total merchandise exports. Other major mineral commodities to record decreases in 1987 were iron ore, down 13% to \$1.3 billion; nickel, down 13% to \$287 million; liquefied petroleum gas, down 17% to \$186 million; and uranium, down 8% to \$256 million.

The value of imports of primary mineral products increased 24% in 1987 to \$1.4 billion. A substantial proportion of the increase was due to petroleum, which increased in value by 29% to \$938 million. Increases in oil prices accounted for most of the rise, for the volume of oil imports increased by only 8%. Petroleum dominated mineral imports and accounted for 65% of the value of total primary mineral imports.

Other major mineral import commodities that increased in value in 1987 were diamond, up 21% to \$58 million; gold bullion, up 14% to \$79 million; iron and steel, up 73% to \$53 million; and platinum-group metals, up 46% to \$20 million. Additional substantial import items were clays, limestone, magnesium, phosphate rock, and potassium fertilizers.

TABLE 1

AUSTRALIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987[p]	1988[e]
METALS						
Aluminum:						
Bauxite, gross weight	thousand tons	31,537	31,839	32,384	34,102	[2]36,192
Alumina	do.	8,781	8,792	9,423	10,109	[2]10,518
Metal, refined:						
Primary		757,798	851,286	881,910	1,003,947	[2]1,149,525
Secondary		[r]51,300	[r]45,600	[e]55,000	55,000	55,000
Antimony, Sb content of ores and concentrates		1,149	1,458	1,131	1,231	1,200
Bismuth, mine output, Bi content[e 3]		[4]1,350	[4]1,400	1,000	[r]350	400
Cadmium:						
Mine output, Cd content		2,311	2,776	2,079	2,249	2,200
Metal, smelter (refined)		1,082	[r]910	915	950	900
Cobalt:						
Mine output, analytic content of:						
Nickel ore		1,551	2,456	2,389	2,274	2,300
Nickel concentrate		520	508	484	368	400
Zinc concentrate		54	72	41	73	75
Total		**2,125**	**3,036**	**2,914**	**2,715**	**2,775**
Recoverable cobalt		936	1,134	[r e]1,237	[r e]1,261	1,200
Columbium-tantalum concentrate, gross weight		145	110	88	159	[2]226
Copper:						
Mine output, Cu content		235,671	259,765	248,368	232,695	246,000
Metal:						
Smelter:						
Primary		179,822	167,669	169,622	172,873	[2]177,769
Secondary		8,138	7,687	9,178	[e]8,500	9,000
Refined:						
Primary		171,180	163,833	163,958	178,925	[2]191,185
Secondary		26,037	30,506	21,113	28,843	[2]26,667
Gold:						
Mine output, Au content	troy ounces	[5]1,295,963	[6]1,881,491	2,413,842	3,558,954	4,887,000
Metal:						
Refined:						
Primary	do.	1,189,672	1,743,307	2,642,337	3,738,226	[2]4,513,444
Secondary	do.	85,746	56,907	61,440	[e]100,000	75,000
Iron and steel:						
Iron ore:						
Gross weight	thousand tons	[r]89,046	[r]97,447	94,015	101,748	97,000
Fe content	do.	[r]56,885	[r]62,042	60,082	64,798	61,900
Metal:						
Pig iron	do.	5,329	5,607	5,889	5,569	5,710

See footnotes at end of table.

TABLE 1—Continued

AUSTRALIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987[p]	1988[e]
METALS—Continued						
Iron and steel—Continued						
Metal—Continued						
Ferroalloys:[7]						
Ferromanganese		70,883	70,368	61,000	51,000	[2]58,000
Ferrosilicon		18,313	18,951	19,000	18,000	18,000
Silicomanganese		31,795	25,669	[e]23,000	43,000	[2]44,000
Total		**120,991**	**114,988**	**103,000**	**112,000**	**120,000**
Steel, crude	thousand tons	6,303	6,578	6,703	6,129	6,350
Semimanufactures[e]		6,000	6,000	6,250	6,000	6,000
Lead:						
Mine output, Pb content		440,620	497,954	447,673	489,150	475,000
Metal:						
Primary:						
Bullion, for export		179,491	183,161	188,403	197,171	[2]191,218
Refined		198,847	200,147	156,239	201,660	[2]162,729
Total		**378,338**	**383,308**	**344,642**	**398,488**	**[2]353,947**
Secondary excluding remelt[e]		21,500	15,600	14,800	[r]15,000	15,000
Manganese ore (metallurgical):						
Gross weight	thousand tons	1,849	2,003	1,649	1,853	[2]1,985
Mn content	do.	879	958	786	886	945
Nickel:						
Mine output, Ni content		76,923	85,757	76,739	74,554	[2]62,358
Metal, smelter (refined Ni and Ni content of oxide)		38,660	40,807	42,097	44,529	42,000
Platinum-group metals:[8]						
Palladium, Pd content	troy ounces	16,815	15,304	13,760	15,754	13,250
Platinum, Pt content	do.	2,122	3,054	3,697	4,180	3,450
Total	**do.**	**18,937**	**18,358**	**17,457**	**19,934**	**16,700**
Rare-earth metals, monazite concentrate:						
Gross weight		16,260	18,735	14,822	12,813	13,500
Monazite content		15,101	17,394	13,783	[r e]11,900	12,500
Silver:						
Mine output, Ag content	thousand troy ounces	31,260	34,914	32,882	35,986	35,850
Metal, refined	do.	9,476	10,578	10,809	9,948	9,247
Tin:						
Mine output, Sn content[9]		[r]7,923	6,363	8,508	7,691	7,247
Metal, refined:						
Primary		2,899	2,683	1,399	563	434
Secondary		450	409	320	300	300
Titanium concentrates, gross weight:						
Ilmenite	thousand tons	[r]1,493	1,419	1,238	1,498	1,510
Leucoxene		32,110	13,809	14,143	11,290	15,000

See footnotes at end of table.

TABLE 1—Continued

AUSTRALIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987[p]	1988[e]
METALS—Continued						
Titanium concentrates, gross weight—Continued						
Rutile		170,424	211,615	215,774	246,263	254,000
Tungsten, mine output, W content		1,709	1,971	1,600	1,150	1,261
Uranium, mine output, U content		4,324	3,206	4,154	3,780	[2]3,532
Zinc:						
Mine output, Zn content		676,532	759,083	711,958	778,389	765,700
Metal, smelter:						
Primary		301,940	288,686	303,115	307,575	[2]302,472
Secondary[e]		4,500	4,500	4,500	4,500	4,500
Zirconium concentrates, gross weight		457,599	501,440	451,824	456,590	490,000
INDUSTRIAL MINERALS						
Abrasives, natural:						
Beach pebble		1,655	972	1,127	1,036	1,000
Garnet		3,287	5,835	9,724	16,837	10,000
Barite		19,511	22,423	5,819	10,363	10,000
Cement, hydraulic	thousand tons	5,463	5,887	5,928	5,869	6,400
Clays:						
Bentonite and bentonitic clay		39,172	29,070	39,933	30,392	35,000
Brick clay and shale[3]	thousand tons	[r] [10]5,242	[r] [10]6,196	6,918	[10]6,105	6,000
Cement clay and shale[3]	do.	[10]385	[10]419	460	[10]450	450
Damourite clay		2,164	1,574	24	106	100
Fire clay[3 10]		32,686	39,482	30,547	24,215	25,000
Kaolin and ball clay[10]		218,885	165,827	187,617	176,958	180,000
Other[10]	thousand tons	1,847	1,750	1,746	717	1,000
Diamond:						
Gem	thousand carats	3,415	4,242	13,145	13,650	17,517
Industrial	do.	2,277	2,828	16,066	16,683	17,517
Total	**do.**	**5,692**	**7,070**	**29,211**	**30,333**	**[2]35,034**
Diatomite		6,430	7,587	9,048	13,512	11,000
Feldspar including nepheline syenite		3,898	6,704	10,006	11,418	10,500
Gem stones, other than diamond:[e]						
Opal	value, thousands	$35,358	$32,305	$36,914	[r]$62,010	$50,000
Sapphire	do.	$7,846	$5,342	$8,359	$13,500	$15,000
Other	do.	$3,196	$3,326	$2,316	$2,500	$2,500
Total	**do.**	**$46,400**	**$40,973**	**$47,589**	**[r]$78,010**	**$67,500**
Gypsum	thousand tons	1,931	1,744	1,671	1,580	1,600
Kyanite		1,255	[r]222	768	[r e]65	500
Lime[3]		1,101,000	1,203,000	[e]1,100,000	[e]1,100,000	1,100,000
Magnesite		67,041	57,535	41,441	53,941	55,500
Nitrogen: N content of ammonia		375,600	404,500	340,000	413,400	[2]385,800
Perlite, crude		3,708	[e]2,740	3,838	[e]3,500	3,500

See footnotes at end of table.

TABLE 1—Continued

AUSTRALIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987[p]	1988[e]
INDUSTRIAL MINERALS—Continued						
Phosphate rock		15,345	33,116	33,659	11,294	8,000
Salt	thousand tons	5,695	5,835	6,130	6,486	6,500
Sillimanite[11]		507	[r]428	133	77	75
Sodium compounds, n.e.s.: Carbonate	thousand tons	([12])	([12])	([12])	([12])	—
Spodumene, concentrate		[r]9,955	[r]11,835	12,703	22,279	23,000
Stone, sand and gravel:						
Construction sand[13]	thousand tons	24,675	26,640	27,892	28,067	28,000
Gravel[13]	do.	15,031	18,393	15,900	15,365	15,000
Dolomite	do.	595	[r]626	720	788	800
Limestone:[e]						
For cement	do.	[r]6,400	[r]5,750	[r]7,200	[r]7,250	7,200
For other uses	do.	[r]3,200	[r]2,800	[r]3,550	[r]3,550	3,600
Silica in the form of quartz, quartzite, glass sand	do.	2,242	2,091	2,091	2,361	2,100
Other:[13]						
Crushed and broken stone	do.	56,331	67,474	70,255	65,278	65,000
Dimension stone	do.	102	167	106	99	100
Unspecified	do.	28,986	33,808	30,663	29,203	30,000
Sulfur: Byproduct:						
Metallurgy		[r]386,047	435,313	453,012	507,357	500,000
Petroleum		13,058	11,718	10,285	8,697	9,000
Total		**[r]399,105**	**447,031**	**463,297**	**516,054**	**509,000**
Talc, chlorite, pyrophyllite, steatite		186,760	139,391	188,055	212,901	200,000
MINERAL FUELS AND RELATED MATERIALS						
Coal:						
Bituminous and subbituminous	thousand tons	139,094	158,256	170,031	178,567	[2]173,532
Lignite	do.	34,756	37,320	37,637	43,517	40,000
Total	**do.**	**173,850**	**195,576**	**207,668**	**222,084**	**213,532**
Coke, metallurgical	do.	3,606	3,610	3,745	3,778	3,800
Fuel briquets	do.	810	789	833	814	825
Gas, natural, marketed	million cubic feet	445,966	475,481	519,426	530,543	[2]543,281
Natural gas liquids	thousand 42-gallon barrels	21,175	25,939	24,723	24,426	[2]24,649
Peat[13]		14,010	15,707	7,265	9,042	9,000
Petroleum:						
Crude	thousand 42-gallon barrels	181,868	209,939	187,196	200,478	[2]189,564
Refinery products:						
Gasoline:						
Aviation	do.	1,281	1,177	1,077	1,437	[2]1,210
Motor	do.	96,642	99,702	96,456	97,636	[2]100,529
Jet fuel	do.	16,452	16,373	17,225	18,387	[2]20,627

See footnotes at end of table.

TABLE 1—Continued

AUSTRALIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987[p]	1988[e]
MINERAL FUELS AND RELATED MATERIALS—Continued						
Petroleum—Continued						
Refinery products—Continued						
Kerosene	thousand 42-gallon barrels	812	611	597	382	[2]456
Distillate fuel oil	do.	55,273	54,673	53,896	58,104	[2]62,424
Residual fuel oil	do.	18,086	18,019	13,162	14,031	[2]13,237
Lubricants	do.	3,753	3,692	3,358	3,873	[2]3,902
Liquefied petroleum gas	do.	4,600	6,069	4,848	4,844	[2]4,942
Bitumen	do.	3,171	3,220	3,412	3,157	[2]3,372
Unspecified	do.	9,943	7,476	5,716	7,013	[2]7,078
Refinery fuel and losses	do.	11,872	11,739	10,976	9,569	9,500
Total	**do.**	**221,885**	**222,751**	**210,723**	**218,433**	**227,277**

[e]Estimated. [p]Preliminary. [r]Revised.
[1] Includes data available through Aug. 22, 1989.
[2] Reported figure.
[3] Data are for years ending June 30 of that stated.
[4] Bismuth-rich residues reportedly were stockpiled owing to weak demand and low prices.
[5] Excludes gold in bismuth concentrate.
[6] Excludes gold in gold ore and concentrate for South Australia.
[7] Data are for years ending Nov. 30 of that stated for plants owned by The Broken Hill Pty. Co. Ltd.
[8] Western Australia only. Platinum-group metals content of nickel ore.
[9] Excludes tin content of copper-tin and tin-tungsten concentrates.
[10] Excludes production from Western Australia.
[11] In addition, about 7,000 tons of sillimanite clay, also known as kaolinized sillimanite, is produced, containing 40%–48% Al_2O_3.
[12] Revised to zero.
[13] Excludes data from some States.

Commodity Review

Metals.—**Alumina, Aluminum, and Bauxite.**—The production of alumina, aluminum, and bauxite all increased to new record highs for the third successive year for alumina and aluminum and the second for bauxite. Aluminum production increased 15% over that of 1987. Alumina production increased 4%, and bauxite production increased 3% during 1988. The increase in aluminum occurred primarily because the five established smelters operated at nearly 100% of capacity. The smelters were at Bell Bay in Tasmania; Boyne Island, Queensland; Kurri Kurri, New South Wales; Point Henry, Victoria; and Tomago, New South Wales. Production increased to nearly 300,000 tons of ingot per year at the sixth smelter, in Portland, Victoria, where a second potline began operating in April. Increased alumina production resulted from increased production at all the refineries, namely, Gladstone in Queensland, Gove in the Northern Territory, and Kwinana, Pinjarra, Wagerup, and Worsley in Western Australia. The increase in bauxite occurred primarily as a result of increased output from the mines at Gove in Arnhem Land, Northern Territory, and Weipa on the Cape York Peninsula in the far north of Queensland. Australia was the fourth largest producer of aluminum and the leading producer of alumina and bauxite in the world.

Exports of aluminum and alumina attained record highs once again, increasing by 12% and 4%, respectively. Bauxite exports rose for the first time since 1984, increasing 11% over that of 1987. The contribution of alumina, aluminum, and bauxite to Australia's export income was second only to coal and accounted for about 20% of the income derived from the export of mineral products.

BHP-Utah Minerals International Inc. completed the sale of its share in the 1.1-million-ton-per-year alumina refinery and associated bauxite mine at Worsley in midyear to the other members of the joint venture; each purchased in proportion to their holdings. The owners were Reynolds Australia Alumina Ltd., 50%; Shell Australia Ltd., 37.5%; and Kobe Alumina Associates, 12.5%. BHP earlier had agreed

TABLE 2

AUSTRALIA: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
METALS				
Aluminum:				
Oxides and hydroxides[2] thousand tons	7,698	8,304	3,361	Canada 893; New Zealand 470; Indonesia 409.
Metal including alloys:				
Scrap	48,022	44,643	553	Japan 35,948; Republic of Korea 814.
Unwrought	582,509	715,824	13,491	Japan 441,486; Republic of Korea 85,499.
Semimanufactures	58,810	65,317	6,865	Hong Kong 12,173; New Zealand 7,813.
Antimony: Ore and concentrate	1,549	1,427	NA	NA.
Chromium: Ore and concentrate	—	2	—	All to Papua New Guinea.
Columbium and tantalum: Ore and concentrate	198	440	132	U.S.S.R. 270; Netherlands 14.
Copper:				
Ore and concentrate	247,687	150,742	2,749	Japan 145,964.
Metal including alloys:				
Scrap	177	441	—	India 81; New Zealand 81; Japan 17.
Unwrought	68,421	88,322	2,543	United Kingdom 30,097; Japan 28,421.
Semimanufactures	13,474	14,657	1,844	New Zealand 7,148; Singapore 1,305.
Gold:[3]				
Ores and concentrates, Au content troy ounces	89,893	45,107	NA	NA.
Metal including alloys, unwrought and partly wrought do.	1,796,870	2,732,777	—	Japan 1,190,444; Hong Kong 897,905; United Kingdom 461,748.
Iron and steel:				
Iron ore and concentrate excluding roasted pyrite thousand tons	82,735	81,551	181	China 7,893; Republic of Korea 6,503.
Metal:				
Scrap	565,535	875,767	684	Hong Kong 8,673; unspecified 858,681.
Pig iron, cast iron, related materials	26,756	155,038	—	Japan 90,939; Malaysia 31,039; Singapore 22,144.
Ferroalloys:				
Ferromanganese	44,345	47,536	19,300	Indonesia 18,013; Qatar 5,994.
Unspecified	42,189	37,581	17,801	Indonesia 7,770; Saudi Arabia 6,800.
Steel, primary forms	514,008	528,708	49,382	Republic of Korea 104,512; Japan 85,216.
Semimanufactures:				
Bars, rods, angles, shapes, sections	202,040	145,014	13,237	China 71,873; New Zealand 35,509.
Universals, plates, sheets	363,389	321,763	134,657	New Zealand 34,781; Papua New Guinea 17,579.
Hoop and strip	16,269	17,580	2,217	New Zealand 10,287; Singapore 3,009.
Rails and accessories	1,661	22,277	34	China 20,958; Canada 812.
Wire	16,598	19,484	4,695	New Zealand 5,479; Papua New Guinea 2,758.
Tubes, pipes, fittings	71,836	61,216	61	Singapore 5,908; Malaysia 2,993; unspecified 47,257.
Castings and forgings, rough	18,239	27,311	13	Malaysia 12,128; Papua New Guinea 9,745.

See footnotes at end of table.

TABLE 2—Continued

AUSTRALIA: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
METALS—Continued					
Lead:					
Ore and concentrate		230,780	134,026	14,856	Japan 51,826; Belgium-Luxembourg 30,505.
Oxides		3,823	3,017	—	Thailand 260; unspecified 2,447.
Metal including alloys:					
Scrap		26,993	37,342	—	Republic of Korea 11,358; Philippines 7,022.
Unwrought		304,901	315,462	—	United Kingdom 152,633; India 41,098; Republic of Korea 39,221.
Semimanufactures		404	518	20	Philippines 262; Singapore 92.
Manganese: Ore and concentrate[3]	thousand tons	1,145	1,306	NA	Japan 457.
Nickel:					
Ore and concentrate	value, thousands	$112	$195	$194	Japan $1.
Matte and speiss	do.	$212,454	$168,594	—	NA.
Metal including alloys:					
Scrap		328	327	([4])	United Kingdom 158; Japan 116.
Unwrought and semimanufactures	value, thousands	$81,551	$103,767	NA	NA.
Platinum-group metals: Metals including alloys, unwrought and partly wrought	do.	$2,681	$3,338	$1,552	United Kingdom $1,379; Hong Kong $147.
Rare-earth metals: Monazite concentrate[3]		14,100	10,491	—	All to France.
Silver:					
Ore and concentrate[5]	value, thousands	$5,463	$12,628	$16	Japan $12,137.
Waste and sweepings[5]	do.	$3,920	$3,837	—	United Kingdom $2,983; West Germany $385.
Metal including alloys, unwrought and partly wrought	do.	$42,572	$52,243	$6	United Kingdom $25,760; Japan $4,828.
Tin:					
Ore and concentrate		15,810	14,820	—	Malaysia 14,776.
Metal including alloys:					
Scrap		1,381	258	9	Malaysia 159; United Kingdom 21.
Unwrought		229	276	—	New Zealand 193; Japan 80.
Semimanufactures		1,392	153	149	New Zealand 3.
Titanium: Ore and concentrate[3]	thousand tons	1,277	1,313	471	United Kingdom 268; Japan 180.
Tungsten:					
Ore and concentrate		2,654	2,184	110	West Germany 844; Japan 394.
Metal including alloys, all forms		157	2	—	New Zealand 1.
Uranium and/or thorium: Ore and concentrate	value, thousands	$254,829	$244,746	$87,709	France $83,498; West Germany $45,708.
Zinc:					
Ore and concentrate	thousand tons	936	926	—	Japan 404; Republic of Korea 196; West Germany 121.

See footnotes at end of table.

TABLE 2—Continued

AUSTRALIA: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
METALS—Continued				
Zinc—Continued				
Oxides	510	494	—	New Zealand 421; Papua New Guinea 27.
Metal including alloys:				
Scrap	1,249	1,774	—	India 315; unspecified 1,387.
Unwrought	236,969	208,310	41,873	Indonesia 36,152; Japan 12,942.
Semimanufactures	502	651	—	New Zealand 272; India 152.
Zirconium: Ore and concentrate[3]	445,690	465,003	58,586	Japan 170,552; Italy 56,417.
Other:				
Ores and concentrates	—	3,401	NA	NA.
Ashes and residues	854,967	42,467	1,597	Japan 17,089; United Kingdom 6,217.
Base metals including alloys, all forms	955	2,560	567	Brazil 1,098; New Zealand 355.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	2,572	4,541	2,866	Japan 686; Netherlands 560.
Artificial: Corundum	19	2	—	Japan 1; Thailand 1.
Dust and powder of precious and semiprecious stones including diamond value, thousands	$61	$148	$79	Japan $36; New Zealand $19.
Grinding and polishing wheels and stones	188	135	([4])	New Zealand 104; Singapore 9.
Barite and witherite	1,242	406	—	New Zealand 231; Republic of South Africa 75.
Cement	18,490	30,234	—	Papua New Guinea 29,220; Hong Kong 289.
Clays, crude	16,615	31,518	—	Japan 15,007; Finland 6,705; New Zealand 4,010.
Diamond:				
Gem, not set or strung value, thousands	$18,893	$12,655	$522	Belgium-Luxembourg $4,243; United Kingdom $700.
Industrial stones do.	$6,852	$414	—	New Zealand $184; Philippines $99.
Diatomite and other infusorial earth	189	591	36	New Zealand 326; Singapore 36.
Fertilizer materials:				
Crude, n.e.s.	4,937	4,486	18	Japan 3,289; Philippines 410.
Manufactured:				
Ammonia	79,283	53,728	—	India 38,676; Philippines 15,009.
Nitrogenous	14,343	16,272	—	Malaysia 5,382; New Zealand 2,818; Papua New Guinea 1,857.
Phosphatic	10,748	90	—	Papua New Guinea 72; French Polynesia 8.
Potassic	6	352	—	Samoa 285; New Zealand 39.
Unspecified and mixed	1,032	5,670	—	Philippines 2,799; Papua New Guinea 1,417.
Graphite, natural	49	34	12	New Zealand 18.
Gypsum and plaster	428,588	200,081	37,450	New Zealand 122,518; Oman 16,611.

See footnotes at end of table.

TABLE 2—Continued

AUSTRALIA: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
INDUSTRIAL MINERALS—Continued				
Lime	233	199	—	Papua New Guinea 145; Singapore 20.
Magnesium compounds: Magnesite, crude	2,679	4,094	88	New Zealand 2,907; West Germany 500.
Mica: Worked including agglomerated splittings	16	44	—	New Zealand 42.
Nitrates, crude	9	—		
Phosphates, crude	22,846	15,000	—	All to Japan.
Pigments, mineral: Iron oxides and hydroxides, processed	167	1,032	—	Republic of Korea 737; Thailand 122.
Precious and semiprecious stones other than diamond: Synthetic value, thousands	$27,251	$50,865	$2,907	Japan $16,277; Thailand $12,545.
Salt and brine thousand tons	5,272	2,746	—	Japan 1,725; Republic of Korea 460.
Sodium compounds, n.e.s.: Carbonate, manufactured	7,207	12,326	10	Indonesia 5,917; New Zealand 1,805; Fiji 1,032.
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked	5,235	2,989	—	Italy 1,903; Japan 155.
Worked	5	97	6	New Zealand 52; Japan 22.
Dolomite, chiefly refractory-grade	43,555	33,006	—	All to Japan.
Gravel and crushed rock	1,139,464	1,056,000	24	Hong Kong 1,225; unspecified 1,053,666.
Limestone other than dimension	21	63	—	Papua New Guinea 49; New Zealand 14.
Sulfur:				
Elemental: Crude including native and byproduct	1,180	66,673	—	Japan 66,064.
Sulfuric acid	209	978	1	Papua New Guinea 718; Fiji 78.
Talc, steatite, soapstone, pyrophyllite	183,376	129,678	15,474	Japan 84,715; Belgium-Luxembourg 8,085.
Other:				
Crude	52,275	32,150	5,628	Netherlands 15,243; Japan 3,432.
Slag and dross, not metal-bearing	13,340	13,372	82	Singapore 13,278.
MINERAL FUELS AND RELATED MATERIALS				
Carbon black	27,766	29,759	—	Indonesia 12,404; New Zealand 5,365; China 1,578.
Coal:				
Anthracite and bituminous thousand tons	92,256	100,882	214	Japan 46,562; Republic of Korea 7,456; Netherlands 5,906.
Lignite including briquets do.	53	55	—	Yugoslavia 23; Republic of Korea 21.
Coke and semicoke do.	471	466	182	Indonesia 65; India 61; Brazil 55.
Petroleum:				
Crude thousand 42-gallon barrels	24,019	37,773	19,002	Singapore 6,922; New Zealand 3,685.
Refinery products:				
Liquefied petroleum gas do.	19,570	16,399	—	NA.
Gasoline do.	2,093	3,297	308	New Zealand 1,141; Papua New Guinea 645.
Mineral jelly and wax do.	18	18	NA	New Zealand 10; Indonesia 4.

See footnotes at end of table.

TABLE 2—Continued

AUSTRALIA: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
MINERAL FUELS AND RELATED MATERIALS—Continued				
Petroleum—Continued				
Refinery products—Continued				
Kerosene and jet fuel thousand 42-gallon barrels	6,093	6,352	205	French Polynesia 495; Papua New Guinea 388; bunkers 4,160.
Distillate fuel oil do.	4,697	5,136	123	Papua New Guinea 1,632; French Polynesia 665.
Lubricants do.	1,238	1,374	267	New Zealand 191; Saudi Arabia 183.
Residual fuel oil do.	10,075	9,538	1,416	Singapore 1,976; Papua New Guinea 833; bunkers 4,376.
Bitumen and other residues do.	1	1	—	Mainly to Tonga.
Bituminous mixtures do.	3	17	—	Tonga 13.

NA Not available.
[1] Table prepared by Audrey D. Wilkes. Import data were not available at the time of publication.
[2] Source of destinations: International Bauxite Association Review, Jan.-Mar. 1989, Kingston, Jamaica.
[3] Data from Australian Mineral Industry Annual Review Preliminary Summary 1988.
[4] Less than 1/2 unit.
[5] May include platinum-group metals.

to sell its holding to Hydro Aluminium A/S of Norway, but the other partners exercised their rights of first refusal.

The feasibility study for the proposed two-potline aluminum smelter and associated 600-megawatt coal-fired power station in southwestern Western Australia was awarded to the French company Aluminium Pechiney S.A. at midyear. The study, which was expected to be completed in early 1989, was based on a phased construction of two potlines at Kemerton, north of Bunbury. Each of the potlines was expected to have a capacity of 185,000 tons of aluminum per year.

A 3-year contract between Gove Aluminium Ltd., which operated the Nabalco Mine at Gove with a 30% share in joint venture with 70% shareholder Swiss Aluminium Ltd. (Alusuise), and the China National Nonferrous Metals Import and Export Corp. was signed in November for the export of 100,000 tons of aluminum oxide (Al_2O_3) to China.

The Victoria government-owned company Aluvic planned the construction of an aluminum casting plant at Portland to enable industry to use aluminum from the Portland smelter. The aluminum was exported as nonalloyed aluminum ingots.

Copper.—Copper production increased by 6% over that of 1987. Production declined at the Mount Isa Mine, Queensland; Mount Lyell Mine, Tasmania; and Woodlawn Mine, New South Wales. New production commenced at the mines at Horseshoe Lights, Western Australia; Olympic Dam, South Australia; Selwyn (Starra), Queensland; and Telfer, Western Australia. Production was reactivated at the Warrego Mine at Tennant Creek in the Northern Territory. The established Cobar Mine in New South Wales increased production in 1988.

Primary blister copper production increased slightly at the two operating plants. The smelter at Mount Isa was owned by Mount Isa Mines Ltd. (MIM). The smelter at Port Kembla, New South Wales, was owned by the Electrolytic Refining and Smelting Co. of Australia Pty. Ltd. (ER&S). Production of refined copper increased by 5% over that of the previous year, to a new record high, primarily because production increased at the Townsville, Queensland, refinery; a secondary refinery had been added to the Townsville primary refining facility during the year. The Townsville refinery was owned by Copper Refineries Pty. Ltd., a wholly owned subsidiary of MIM. Production of refined copper, using the ISASMELT process developed by Copper Refineries, began in the third quarter. Secondary copper was also produced at the Port Kembla Refinery.

Barrack Mines Ltd., the operator holding a 66% interest with joint-venture partners Eastern Petroleum Australia Ltd., 28.5%, and Samantha

Exploration NL, 5.5%, began byproduct copper production at its Horseshoe Lights polymetallic mine, 135 kilometers north of Meekatharra, Western Australia. The 225,000-ton-per-year copper flotation plant was completed at the end of January. The first ore was fed to the plant in February; production was expected to be 17,000 tons of copper-in-concentrate per year. Near yearend 1987, Barrack Mines signed a 1-year contract with Nippon Mining Co. Ltd. of Japan for the delivery of 66,000 tons of copper concentrates from Horseshoe Lights.

Ore production began in June at the huge Olympic Dam copper-gold-silver-uranium mine at Roxby Downs Station, South Australia. The mine was owned by Roxby Mining Corp. Pty. Ltd., a wholly owned subsidiary of Western Mining Corp. Holdings Ltd. (WMCH), 51%, and BP Australia Ltd., 49%. The first copper metal pour at the on-site refinery was in the third quarter. During the first year of operation, the refinery was expected to produce 45,000 tons of refined copper per year, with about 80% expected to be exported.

Byproduct copper production began early in 1988 at the Selwyn gold mine in the Starra project, 150 kilometers southeast of Mount Isa in central Queensland. The mine was owned by Cyprus Minerals Australia Co., 37.5%; Arimco NL, 37%; and Elders Resources Ltd., 25%. Elders Resources also acted as operator. Commissioning problems occurred early in the year, but output proceeded at the planned rate of 10,000 tons of copper-in-concentrate per year during the second-half of the year.

In Western Australia, the Telfer Mine, which was owned and operated by Newmont Holdings Pty. Ltd., 70%, and BHP Gold Mines Ltd., 30%, produced byproduct copper from its gold operation. Production began in late 1987. A supergene-sulfide flotation circuit had been added to the treatment plant in 1987 to treat the copper-rich lenses in the ore body. Output in 1988 was estimated to be 3,700 tons of copper in concentrate.

North Broken Hill Peko Ltd., which was formed when Peko-Wallsend Ltd. merged with North Broken Hill Holdings Ltd. in February, began producing copper at the small Warrego Mine. The mine, formerly Peko-Wallsend's, at Tennant Creek, Northern Territory, had ceased operations in 1987. Dewatering of North Broken Hill Peko Ltd.'s nearby Gecko Mine was begun in preparation for production in 1989. With both mines on-stream, combined output was expected to be 15,000 tons of copper in concentrate per year.

Toward yearend, the development of the Scuddles (Golden Grove) zinc-copper deposit at Golden Grove, Western Australia, 220 kilometers east of Geraldton, was announced by the joint venture of Murchison Zinc Co., 45%, acting as operator and jointly owned by Australian Consolidated Minerals Ltd. (ACM) and Armada Resources Ltd.; Esso Exploration and Production Australia Ltd., 35%; and Aztec Mining Co. Ltd., 20%. Mining was scheduled to commence in mid-1990 at a rate of 800,000 tons of ore per year. A highly mechanized underground mining operation was planned. A compact treatment plant was planned to treat ore by grinding and flotation, producing separate copper and precious metals and zinc concentrates.

Late in the year, CRA Ltd. agreed to sell 40% of its ER&S subsidiary, the operator of the Port Kembla copper smelter and refinery, to a Japanese group led by Furukawa Co. Ltd. In conjunction with this transaction, CRA announced a $120 million redevelopment program to double the smelting and refining capacity to 80,000 tons of electrolytic copper per year at the ER&S plant, to build a sulfuric acid plant with an annual capacity of 175,000 tons, and to modernize the anode-casting plant and tankhouse. The redevelopment involved replacing the existing two-step blast furnace with a flash smelter reactor, which would produce high-grade matte in one step. The expansion and modernization program was scheduled to begin in March 1989 and be completed in the second-half of 1990.

Macquarie Resources NL planned to develop the Benambra copper-lead-zinc-silver deposit 270 kilometers northeast of Melbourne, Victoria. Production was scheduled to start in July 1989. The project was previously a joint venture between Western Mining Corp. Ltd. (WMC) and BP Minerals, which discovered the deposit in the late 1970's. Production in the first 12 months of operation was scheduled to be 45,000 tons of copper concentrate. Production was expected to be 115,000 tons per year in the early 1990's.

Gold.—Australia's gold production, which increased for the eighth consecutive year, was estimated to be almost 4.9 million ounces, an increase of 37%, which surpassed the previous record of 3.8 million ounces set in 1903. The Boddington Mine in Western Australia, which began production in late 1986, was Australia's largest producer with an output of almost 282,000 ounces. The mine was owned by the Worsley Joint Venture Partners: Reynolds Australia, 40%; Shell Australia, 30%; BHP Gold, 20%; and Kobe Alumina, 10%. The Temora Mine (Paragon Resources Ltd.) remained New South Wales' leading producer. The Granites Mine (North Flinders Mines Ltd.) was the leader in the Northern Territory. The Kidston Mine (Canada's Placer Development Ltd., 70%; Elders IXL Ltd., 15%; and Australian public shares, 15%) was the leading producer in Queensland. The Stawell Mine (WMC, 75%, and Central Norseman Gold Corp., 25%) remained the major producer in Victoria. Gold production in South Australia increased substantially because of the start of mining at Olympic Dam, where gold ore treatment began in August. Gold output from Tasmania remained almost entirely a byproduct of base metal mining.

Over 20 new mines were commissioned during the year. These ranged in capacity from the Hedges Mine's planned output of 110,000 ounces of gold per year to numerous operations with planned capacities of about 3,000 ounces of gold per year. Several mines, such as Boddington, reached full capacity during the year. More than 21 small, gold-producing operations, including mines and tailings retreatment workings, closed during the year.

Exploration for gold continued to increase and accounted for about 70% of the total amount the private sector spent for exploration for nonfuel minerals. Exploration led to the discovery or delineation of additional reserves at a number of known mineral deposits, and to at least 13 new discoveries of gold mineralization.

Of the larger mines commissioned in 1988, nine were in Western Australia, six were in northern Queensland, and one each was in New South Wales, the Northern Territory, South Australia, and Victoria. Norgold Ltd. officially opened the Bottle Creek Mine, Western Australia, in June, with planned production of 40,000 ounces of gold per year. White Gold Mines Ltd. and partners commenced mining at Cement Hill, Queensland. Broken Hill Holdings Ltd. and partner poured the first gold from the Corinthian and Hopes Hill Mines, Western Australia. The Croydon Mine, Queensland, owned by Central Coast Exploration NL, was officially opened in April. Mount Carrington Mines Ltd. poured the first gold at the Drake Mine, New South Wales, in July. Broken Hill Holdings started treatment of ore from the Gaffney's Creek Mine, Victoria, during the first quarter.

WMCH and partner commenced production at the Goodall Mine near the Adelaide River, Northern Territory, with production planned to peak at 55,000 ounces of gold per year. Alcoa of Australia Ltd. poured the first gold from the Hedges Mine, Western Australia, in October. Giant Resources Ltd. and partner started production at the Horn Island Mine, Queensland, and the first gold was poured in July. Freeport-McMoRan Australia Ltd. and partners opened the Karonie Mine, Western Australia. In October, the Laverton Mine, Western Australia, was opened by Hill Minerals NL and partners, with planned production of 40,000 ounces of gold per year.

BHP Gold commissioned the London-Victoria Mine at Parkes, New South Wales, in November. Austwhim Resources NL and partner poured the first gold at the Mount Morgans Mine, Western Australia, in March. The partners planned initially to produce 10,000 ounces of gold per year and to almost double that amount in the future. Southern Resources Ltd. and partners poured the first gold from the Mount Pleasant Mine, Western Australia, in March. Projected production was planned to be 65,000 ounces of gold per year. Roxby Mining and BP Australia commenced mining the giant polymetallic deposit at Roxby Downs Station with planned output to include 90,000 ounces of gold per year. Grants Patch Mining Ltd. and partners poured the first gold from the Peak Hill Mine, Western Australia, in May, with planned production of 40,000 ounces of gold per year.

Carpentaria Gold Pty. Ltd. started production at Ravenswood, Queensland, with a planned production of 15,000 ounces of gold per year. After delays, full production at the Starra Mine, Queensland, was begun by Elders Resources early in the year. Production of more than 95,000 ounces per year was planned. ACM started production at Wirralie, Queensland, in May, with a planned output of 50,000 ounces of gold per year.

Reynolds Australia Mines Ltd., 50%, and Forsayth NL, 50%, completed a major capacity expansion at their Mount Gibson, Western Australia, mine. Ore mining and processing capacity was increased to 1.1 million tons per year.

Construction proceeded ahead of schedule at the Big Bell open pit gold project, which is near Cue in Western Australia. The mine was owned equally by Placer Pacific Ltd. and ACM. The mine was expected to come on-stream ahead of the April 1, 1989, target date. Plans for 1989 were for a mined tonnage of 33 million tons, of which 2.5 million tons was expected to be ore, producing about 160,000 ounces of gold.

With a plan to develop a "super pit" along the Golden Mile at Kalgoorlie, Western Australia, Bond Corp. obtained full ownership or controlling interest of the mining companies active at Kalgoorlie: Gold Mines of Kalgoorlie (Australia) Ltd., Kalgoorlie Lake View Pty. Ltd., Kalgoorlie Mining Associates, and North Kalgurli Mines Ltd. The super pit was planned to be about 250 meters deep and 2.5 kilometers long, with a treatment plant capable of handling 2 million tons of ore per year to produce 500,000 ounces of gold.

In August, Australian Gold Refineries opened a gold refinery at Kalgoorlie, the Kalgoorlie Gold Refinery, in Western Australia. Australian Gold Refineries was a division of the Western Australian Mint, which in turn was a subsidiary of Gold Corp. of Australia (GoldCorp), an agency of the Western Australian State government. The Kalgoorlie Refinery, the eastern goldfields' first after more than 95 years of gold production, initially was to function as a melting and assaying facility. The first full-scale refining was expected in early 1989, with an annual design capacity of 1 million ounces per year on a single-shift basis. The first gold was poured at Kalgoorlie in August. The complex also included a carbon-stripping plant. The Western Australian Mint at Perth, the Perth Mint, was scheduled to be relocated. Its capacity was expected to be about 2.5 million ounces of fine gold per year on a single-shift basis. Perth's second major gold refinery, the Perth International Refinery, was established at Kewdale at midyear. Projected output was planned to be about 400,000 ounces per year.

Pacific Precious Metals Ltd., a joint

venture comprised of MIM and Noranda Minerals Inc., each with 40%, and Tolltreck Systems Ltd., 20%, began construction of a precious metals refinery at Alexandria in Sydney in August. The refinery was expected to produce gold and silver bullion from a variety of materials, including electronic scrap, residues, and the output from mining. The refinery was scheduled to begin operating in the second quarter of 1989.

A plant for the production of sodium cyanide (NaCN), an essential chemical in gold extraction, was commissioned at Kwinana in December. The plant, which is the first of its kind in Australia, had a capacity of 50,000 tons per year NaCN in 30% solution, the form used in the gold extraction process. Plans were formulated by yearend to double the output. Participants in the joint venture, operated by Australian Gold Reagents Pty. Ltd., were CSBP and Farmers Ltd., 60%; Coogee Chemicals Pty. Ltd., 20%; and the Australian Industry Development Corp., 20%. The plant used locally produced natural gas, ammonia, and caustic soda in the production process. ICI Australia Ltd. planned to construct a NaCN plant near Gladstone, Queensland, for the production of 20,000 tons of NaCN per year. The plant was expected to be completed in 1989.

Iron and Steel.—Production of iron ore in 1988 was estimated to have decreased 5% from that of 1987, mainly owing to lower output by Australia's largest producer, Hamersley Iron Pty. Ltd., a wholly owned subsidiary of CRA, and the effects of industrial disputes at Mount Newman Mining Co. Pty. Ltd. The decrease by Hamersley Iron resulted from a decision made the previous year to reduce production and stocks. Hamersley Iron had an 8-million-ton drawdown in stocks. However, iron ore exports increased 20% because of the growth in world steel output, including that of Japan, Australia's major market and one in which Australia gained a greater share of the market than it had in 1987. Shipments to Western Europe and the Republic of Korea also increased substantially. The substantial increase in exports was supplied partly from stocks, which were reduced significantly. Hamersley Iron and Mount Newman accounted for about two-thirds of Australia's iron ore exports.

Iron ore contract prices negotiated early in the year were generally down from the previous year for both European and Japanese deliveries. This resulted from expectations early in 1988 of lower world economic growth and steel output for the year.

Production of pig iron and steel were adversely affected by blast furnace operational problems at the Port Kembla Steelworks, Wollongong, New South Wales, early in the year. The facility recovered and increased production by 3% and 4%, respectively. Output of steel produced by BHP Steel International Group, Australia's only major steelmaker, increased at all three major steelmaking centers: Newcastle Steelworks, New South Wales; Port Kembla; and Whyalla Steelworks, South Australia.

Because of a strong demand for lump iron ore during the year, Hamersley Iron and Mount Newman installed facilities to start small-scale production from detrital scree ore deposits. Hamersley Iron planned to begin production early in 1989, at the rate of 1.5 million tons of ore per year from scree deposits in the Mount Tom Price area of the Pilbara District of Western Australia. Mount Newman began production in October from deposits at Orebody 25, 17 kilometers east of the Mount Whaleback Mine in the Pilbara, at a rate of 1 million tons of ore per year. A 4-kilometer spur railway was constructed to join with the main railway from Newman to Port Hedland. The railway will be used to transport the ore back to the main loading facilities at Mount Whaleback for shipment to Port Hedland.

Production of lump ore, from scree deposits at Hancock Mining Pty. Ltd.'s McCameys Monster iron ore mine, 35 kilometers southeast of Newman, was expected to begin in early 1989 at a rate of 800,000 tons of ore per year. A 30-kilometer spur railway was being constructed to connect with the main Newman to Port Hedland railway for shipments to Port Hedland.

A contract for the sale of 15 million tons of iron ore, to be supplied from McCameys Monster, to Romania reportedly was signed by Hancock and Romanian steel representatives. The contract, which was in addition to the existing 15-year contract for the export of 53 million tons of iron ore to Romania from McCameys Monster, resulted from the rapid expansion of the Romanian steel industry.

Construction of the Channar iron ore mine, 20 kilometers east of Hamersley Iron's Paraburdoo Mine in the Pilbara, was started early in the year. Channar, the first new mine development in the Pilbara since 1973, was expected to come on-stream in January 1990 at an initial production rate of 3 million tons of iron ore per year. It was expected that the mine would achieve a full capacity of 10 million tons of iron ore per year during a 9-year period. Production was expected to increase slowly to meet the supply requirements of the Chinese steel industry. The project was owned by Hamersley Iron through its wholly owned subsidiary Channar Mining Pty. Ltd., 60%, and the China Metallurgical Import and Export Corp. (CMIEC) through CMIEC (Channar) Pty. Ltd., 40%. The iron ore was to be sold to CMIEC through long-term contracts.

Crushed ore from the Channar open pit was to be transported on a 20-kilometer conveyor system to Paraburdoo for tertiary crushing, railed to Dampier, and blended with ore from Hamersley Iron's Mount Tom Price, prior to shipment to China.

BHP Steel announced at midyear that it planned to develop the iron ore deposits at Iron Duke in the South Middleback Range, South Australia, for the production of 1 million to 1.5 million tons of ore per year, starting near yearend 1989. This was planned to replace production from deposits, which were nearing exhaustion, in the Iron Baron area, 30 kilometers to the north. The development of the Iron Duke deposits ensured long-term iron ore supplies for the Whyalla Steelworks.

BHP Steel also announced plans to increase steel production capacity at the Port Kembla Steelworks from 3.8 million to 4.5 million tons per year by mid-1989. Plant improvements and the release for carbon steel production of an electric furnace, previously used for primary stainless steel manufacture, were expected to increase production to 4 million tons per year. The upgrading and recommissioning of the No. 2 blast furnace was expected to increase production another 500,000 tons per year.

In August, BHP Steel acquired CSR Ltd.'s Aquila Steel Co. Ltd., one of Australia's leading suppliers of steel reinforcing products and welded-wire fencing.

Lead and Zinc.—Estimated mine production of lead and zinc decreased 3% and 2%, respectively; however, Australia remained the world's leading producer of mined lead and the third leading producer of mined zinc, after Canada and the U.S.S.R. Mined lead and zinc production declined at ZC Ltd.'s mines at Broken Hill, New South Wales, because of a major shaft refurbishment. Production also decreased at Aberfoyle Ltd.'s Que River Mine, Tasmania; at North Broken Hill Peko Ltd.'s, formerly North Broken Hill Holdings', North Mine at Broken Hill, and Rosebery and Hercules Mines on the west coast of Tasmania; and at Cobar Mines Pty. Ltd.'s Cobar Mine, New South Wales. Production commenced at BHP Minerals Ltd.'s Cadjebut Mine, Western Australia, and increased at Aberfoyle's Hellyer Mine, Tasmania.

Lead bullion production declined by 30%. Lead bullion was produced at MIM's on-site smelter at Mount Isa and at the Cockle Creek smelter, New South Wales, owned by the Sulphide Corp. Pty. Ltd., a wholly owned subsidiary of CRA. Production of primary refined lead declined 19% at Broken Hill Associated Smelters Pty. Ltd.'s (BHAS) refinery at Port Pirie, South Australia. Production at the refinery, Australia's sole producer, decreased because a fire in the sinter plant control room, at yearend 1987, caused a 6-week closure of the plant, and a blast furnace was scheduled to be shutdown. However, stocks of refined metal were adequate to ensure continuing deliveries. Estimated production of refined lead from secondary sources, produced at Australian Refined Alloy Ltd.'s plants in Melbourne, Victoria, and Sydney, New South Wales, remained at the same level as in 1987.

Production of primary refined zinc declined slightly. Primary refined zinc was produced at three plants: Sulphide Corp.'s Cockle Creek refinery, BHAS' Port Pirie refinery, and Electrolytic Zinc Co. of Australasia Ltd.'s refinery at Risdon, Tasmania.

North Broken Hill Holdings Ltd. and CRA Ltd. announced in June the merging of their lead-zinc mining, smelting, and international marketing operations to form Pacific Mining and Smelting Ltd. (Pasminco). Both companies continued to market lead and zinc separately in Australia. Pasminco was expected to be one of the largest lead-zinc mining and smelting groups in the world. The merger was approved by the Trade Practices Commission, Australia's antitrust agency, in November. Pasminco planned to undertake substantial capital investment over the next 5 years to modernize its base metal mining and smelting operations to increase output, improve productivity, and be more effective in the international market. The mining operations that were expected to be upgraded included the North and ZC Mines at Broken Hill; the Elura, New South Wales, underground mine; and the Cockle Creek, Port Pirie, and Risdon smelters.

The Cadjebut underground lead-zinc mine in the Kimberley region of Western Australia came on-stream early in the year. The mine was owned by BHP-Utah Minerals, 58%, acting as operator, and Billiton Australia Ltd., 42%. The highly mechanized mine had an initial annual production rate of 320,000 tons of ore, producing 15,000 tons of lead concentrate and 65,000 tons of zinc concentrate. Plans were made to increase production to 450,000 tons of ore per year. BHP-Utah Minerals considered building a smelter to handle its zinc concentrate production, which was expected to reach 150,000 tons per year in the early 1990's, but no definite plans were formulated by yearend. BHP-Utah Minerals trucked output from Cadjebut in concentrate form 500 kilometers to the northwestern port of Wyndham; from there it was sent to other Australian ports and Southeast Asian and European countries.

It was announced near yearend that the Lady Loretta and Thalanga deposits in Queensland would be developed. The deposits were owned by Pancontinental Mining Ltd., 51%, and Outokumpu Australia Pty. Ltd., 49%, a wholly owned subsidiary of Outokumpu Oy of Finland. The treatment plant from the depleted Teutonic Bore Mine, Western Australia, was purchased and was to be refurbished and recommissioned at Thalanga. High-grade ore from Lady Loretta initially was to be trucked 800 kilometers to Thalanga for treatment in campaigns. Production was scheduled to commence at Thalanga in late 1989 and at Lady Loretta in mid-1990, with combined output in the initial stages of 5,000 tons of lead and 30,000 tons of zinc in concentrates per year.

Murchison Zinc announced near yearend that it planned to develop the Scuddles (Golden Grove) zinc-copper deposit at Golden Grove. Production of zinc was expected to commence in 1990 at the rate of 95,000 tons of zinc in concentrate per year. The deposit was owned 45% by ACM and Armada Resources, through jointly owned Murchison Zinc acting as operator; Esso Exploration and Production Australia, 35%; and Aztec Mining, 20%.

Aberfoyle commenced expansion of its Hellyer Mine in Tasmania from 250,000 to 1 million tons of ore per year. A treatment plant was constructed at the mine site. It was expected that the plant expansion would be completed in early 1989, and that production would be 45,000 tons of lead concentrate, 170,000 tons of zinc concentrate, 100,000 tons of bulk lead-zinc concentrate, and 10,000 tons of copper-silver concentrate. Output had previously been processed at the company's old Cleveland tin mill, which was modified to treat 250,000 tons of polymetallic ore from Hellyer.

MIM announced plans to bring its Hilton Mine at Mount Isa, which had been operating only on a trial basis, into large-scale production by installing a concentrator to treat 750,000 tons of ore per year. The installation was scheduled to be completed by the end of 1989. Full production was planned to be reached during 1990. The Hilton production was expected to replace the lead-zinc output from the Mount Isa Mine, because that ore body was gradually being depleted. MIM also planned the installation of a 60,000-ton-per-year high-technology ISASMELT lead smelter at Mount Isa to enable an increased tonnage of lead concentrates to be smelted. The existing sinter plant and blast furnace complex was to be derated to 140,000 tons per year, thus relieving production pressure on the older plant. Combined annual production from the two mines was to be increased from 180,000 to 200,000 tons of lead and from 200,000 to 250,000 tons of zinc.

MIM was the world's largest producer of mined lead and was among the 10 largest producers of zinc. The large Mount Isa complex produced lead-containing silver and zinc concentrates and smelted anode copper. The lead was refined at the company's refinery in the United Kingdom; the zinc concentrates were sold to international refiners, including 50%-owned Ruhr-Zinc GmbH in the Federal Republic of Germany.

In August, ZC Mines at Broken Hill completed a major renovation, which was begun in December 1987, of the shaft at the North Broken Hill Mine. From August on, all the ore was hauled through the new shaft, which had an operating capacity of 2.9 million tons of ore per year.

Modernization of the Risdon smelter, which was expected to be completed in 1991, continued during the year. A proposed expansion of the plant, from 220,000 tons per year to 350,000 tons per year, continued.

Manganese.—Production of manganese ore, all from Groote Eylandt, in the Northern Territory, by Groote Eylandt Mining Co. Pty. Ltd., a wholly owned subsidiary of BHP, increased 7%.

Manganese alloy (ferromanganese and silicomanganese) production increased 8% at the Bell Bay, Tasmania, plant by Tasmanian Electro Metallurgical Co. Pty. Ltd., which was also wholly owned by BHP. However, this was less than had been planned, because of furnace difficulties, which occurred after a major expansion program was completed in 1987.

After months of negotiations, Japanese steel producers agreed at midyear to an increase in manganese ore prices, the first increase in over a decade. The increase, from about $70 to approximately $100 per ton, was retroactive to the beginning of the contractual year, which began in March.

An electrolytic manganese production plant was being constructed at Newcastle, New South Wales, to produce electrolytic manganese dioxide (EMD) for use in the manufacture of dry cell batteries. Commissioning of the plant was expected to be in late 1989. At full production, the plant was expected to produce 15,000 tons of EMD, about 10% of world output. Ninety percent of production was to be exported. The plant was expected to provide for further processing of Groote Eylandt manganese ore in Australia and also further diversify sales in the 1990's. The plant was expected to be managed by the Asia/Pacific Division of BHP-Utah Minerals.

Mineral Sands.—Australia's mineral sands industry, which included the mining and processing of high concentrations of the heavy-minerals ilmenite, leucoxene, monazite, rutile, and zircon, operated at full mining capacity throughout the year; estimated production of concentrates increased by almost 3%. Australia remained the world's leading producer and exporter of mineral sands minerals and produced an estimated 49% of world production of ilmenite and rutile, 55% of monazite, and 56% of zircon. Estimated production of mineral sands increased 1% for ilmenite, 33% for leucoxene, 5% for monazite, 3% for rutile, and 7% for zircon. Production of synthetic rutile (SR), or beneficiated ilmenite, increased by an estimated 40%. Most of Australia's mineral sands production was exported and sold under long-term contracts. Spot sales comprised a small part of the total market.

The principal producers of mineral sands in Australia were AMC, Westralian Sands Ltd., and Cable Sands (WA) Pty. Ltd. AMC, which absorbed Allied Eneabba Ltd. in 1986, was the world leader, contributing 25% of rutile and 40% of monazite, SR, and zircon.

During the year, a number of mineral sands developments began or were planned. Ravensthorpe Mining and Investment Co. Ltd. commenced construction of a dry plant at Picton, near Bunbury, Western Australia, to process mineral sands from its Waroona Mine. At a later date, Ravensthorpe planned to process the heavy-mineral sands from the nearby deposit at Capel. Cable Sands, a wholly owned subsidiary of Kathleen Investments (Australia)

Ltd., planned to develop a mineral sands mine at Jangardup, south of Bunbury, with production scheduled to begin in 1990.

Consolidated Rutile Ltd. (CRL) announced plans to develop a fourth dredging operation on central North Stradbroke Island, off the coast of Queensland near Brisbane. CRL, eastern Australia's largest producer, was the sole operator on the island. Subject to Government approval, Mineral Deposits Ltd., a subsidiary of BHP, planned to start mining its deposit at Rocky Point on the central Queensland coast by late 1990. Initial output was expected to be 220,000 tons of ilmenite, 25,000 tons of rutile, and 30,000 tons of zircon per year. Murphyores Inc. Pty. Ltd., a wholly owned subsidiary of Pivot Group Ltd., submitted for Government approval a draft of an Environmental Impact Statement for its proposal to mine five leases in the Clinton area of Queensland, 100 kilometers northeast of Rockhampton. The leases were within the Shoalwater Bay military training area.

Late in the year, Wimmera Industrial Minerals Ltd. (WIM) began commissioning a 120-ton-per-day pilot plant at Horsham, Victoria. WIM, a wholly owned subsidiary of CRA was formed in 1987 to develop the large mineral sands deposit at Horsham.

SCM Chemicals Ltd., a subsidiary of Hanson Industries of the U. S., began production at its titanium dioxide (TiO_2) plant at Kemerton, north of Bunbury, Western Australia, near yearend. Capacity of the new plant was 70,000 tons of TiO_2 per year. Construction of the facility involved converting and expanding an existing sulfate-process plant to the chloride-process to produce TiO_2. SCM planned to continue operation of its nearby 35,000-ton TiO_2 sulfate-process plant until late 1990. The new plant was the first chloride-process plant in Australia.

In October, ICI Australia Ltd. commissioned the world's largest high-purity zirconia (ZrO_2) plant at Rockingham, 20 kilometers south of Perth, to meet demand for zirconia powders and zirconium chemicals. The capacity of the plant was 700 tons of ZrO_2 per year.

Kerr McGee Chemical Corp. of the United States and Minproc Holdings Ltd.'s TiO2 Corp. NL, in an equal joint venture, planned to develop the world's first fully integrated heavy-mineral mining project at Cooljarloo, 170 kilometers north of Perth, in Western Australia. The project involved mining the deposit and upgrading the concentrates to SR and TiO_2 pigment. It was expected that the processing plant would produce 507,000 tons of heavy mineral concentrate per year by early 1990. The project also included a SR plant with a 130,000-ton-per-year capacity and a 54,000-ton-per-year chloride-process TiO_2 plant, scheduled to be on-stream in mid-1990 and early 1991, respectively.

The commercial production of gallium chloride, gallium sulfate, and low-grade gallium metal, derived from processing monazite, commenced in the fourth quarter at Rhône-Poulenc's facility at Pinjarra, 90 kilometers south of Perth. The plant had a nominal capacity of 50 tons of gallium content per year. The plant was fed with byproduct Bayer liquor from the nearby alumina refinery operated by Alcoa of Australia. Rhône-Poulenc supplied gallium chloride for a solar neutrino experiment in Italy with low-grade gallium, which was shipped to the company's gallium plant in Salindres, France, for purification. The purification produced an intermediate product, which was shipped to Rhône-Poulenc's plant in France for final purification.

Nickel.—Australian mine production of nickel decreased 16%, mainly as a result of the treatment of lower grade ores at WMCH's mines in the Kambalda-St. Ives areas of the Kalgoorlie District, Western Australia, during underground development. All development was completed during the year.

Nickel content of nickel matte produced at WMCH's Kalgoorlie nickel smelter decreased 6%. The nickel content of nickel oxide sinter, produced at Queensland Nickel's Yabulu, Queensland, refinery near Townsville, decreased an estimated 5%. Refined nickel from WMCH's Kwinana, Western Australia, nickel refinery decreased 7%.

WMC purchased, in October, Seltrust Mining Corp. Pty. Ltd.'s, a subsidiary of BP Australia, 60% share in the Agnew nickel mine, Western Australia. The mine had been on care and maintenance since August 1986. In December, WMC purchased MIM's 40% interest in the mine and thus became the sole owner. WMC planned to reopen the mine during the first-half of 1989 because of relatively high nickel prices during the year. The target production rate was 10,000 tons of nickel in concentrate per year, the previous production level, by the end of 1989. Production was expected to double within 2 years. The mine was expected to operate under the new name of Leinster Nickel Operations.

Queensland Nickel Pty. Ltd. announced in November its plans to increase the capacity of its nickel processing plant at Greenvale, Queensland. Queensland Nickel planned to process nickel concentrates imported from New Caledonia and the Philippines at its Yabulu nickel refinery. The reserves at the Greenvale Mine were expected to be exhausted within 2 years. Nickel concentrates were to continue to be imported from Indonesia. The Queensland government, through State-owned Nickel Resources North Queensland, purchased a 12.5% interest in the project at yearend.

ACM acquired 50% of the large, low-grade, nickel sulfide Mount Keith project in Western Australia by buying BP Australia's 30% and MIM's 20% shares. The remaining 50% interest was held by ACM associate Armada Resources.

WMC purchased Paragon Nickel Pty. Ltd., which had held the right to purchase 9.5% of all nickel produced by the temporarily idled Agnew Mine, at cost, from Seltrust Mining.

Platinum-Group Metals.—GoldCorp began the sale of the Australian Koala legal tender platinum bullion coins in September; this marked the first time that platinum coins were minted by a major precious metals producing nation. The coins, of 99.95% purity, were minted with nominal face values of A$100, containing not less than 1 ounce platinum; A$50, containing 0.5 ounce; A$25, 0.25 ounce; and A$15, 0.10 ounce. The Koala coins featured likenesses of Queen Elizabeth II on the obverse and the Koala, the internationally recognized symbol of Australia, on the reverse.

Silver.—Most of Australia's mine output of silver was a coproduct with lead and zinc and was recovered mainly in lead concentrate. The largest producer was the Mount Isa Mine. Silver was also a mine coproduct with lead and zinc at the Broken Hill Mine and the Elura Mine, New South Wales; with lead, zinc, and copper at the Woodlawn Mine and Rosebery-Hercules-Que River Mines. It was a mine byproduct of copper, gold, and bismuth at Tennant Creek. Silver was also a byproduct of gold mining in Western Australia and Queensland. A very small amount was a byproduct of nickel refining in Western Australia.

Australia issued near yearend its first ounce-denominated silver Holey Dollar and Dump, which commemorated the first official Australian coinage issued 175 years ago. The Holey Dollar has a hole in the middle; it was the first Australian coin to have its center punched out since the original Holey Dollars were made in 1813. The new coin contained 1 ounce of .999 fine silver and had a face value of A$1.

The Dump, which fits neatly into the center of the Holey Dollar, contained 0.25 ounce of silver with a face value of 25 Australian cents.

The coins, issued by GoldCorp, were Australia's first legal tender silver coins and featured a likeness of Queen Elizabeth II on the obverse and illustrations of the Aboriginal myth of the Wagilag Sisters on the reverse. The Holey Dollar pictured the Rainbow Serpent that swallowed one of the sisters; the two sisters were depicted on the Dump.

Tin.—Production of tin-in-concentrate decreased a further 6% in 1988 from that of 1987. Because of the continued shortage of suitable concentrate, Tolltreck Metal Products Ltd.'s tin smelter at Alexandria in Sydney was closed in June. Only Greenbushes Ltd.'s smelter at its tin-tantalum mine south of Perth was operating, and only on a part-time basis. Tolltreck had experienced a dwindling supply of tin concentrate since purchasing the operation from Associated Tin Smelters Ltd. in mid-1986. Production of primary refined tin decreased 23%.

Concentrate production at Renison Goldfields Consolidated Ltd.'s large, hard-rock, underground Renison Bell Mine in Tasmania increased slightly, despite equipment malfunctions and industrial disputes. In response to improved tantalum prices during the year, mill tailings retreatment was renewed at Greenbushes' operations in Western Australia in midyear. Although overall throughput of all ore types was increased, output of tin decreased almost 29% because of lower grade materials.

Oakbridge Ltd. reduced production at its alluvial tin operation in north Queensland during the year because of continued low tin prices. The tin mining operations of Great Northern Mining Corp. NL, also in Queensland, remained closed throughout the year, although exploration for tin, and other metals, was accelerated. Tin production resumed briefly at the Ardlethan Mine in central New South Wales when Republic Resources NL began retreating old tailings purchased from Ardlethan Tin Ltd.

Spectrum Resources Australia Ltd. was granted a mining lease to re-open the old Anchor Mine at Lottah in northeastern Tasmania. The mine was expected to come on-stream in April 1989, at a rate of 10,000 tons of ore per year to produce 400 to 500 tons of tin concentrate per year. The Anchor, which previously had been worked as an open pit in the 1930's, was expected to be an underground operation.

Australia, as a member of the Association of Tin Producing Countries, had its export quota of tin increased from 7,000 tons to 7,700 tons for the year to March 1989. Although Australia agreed to this quota, it was not binding on Australian producers because the total production for 1988 amounted to only 7,247 tons and exports were only 5,654 tons.

***Industrial Minerals.*—Diamond.**—Argyle Diamond Mines Pty. Ltd.'s diamond production increased by nearly 14% to a record high. The company easily retained its position as the world's preeminent diamond producer for the third consecutive year. Argyle was a joint venture of CRA (56.8%), Ashton Mining Ltd. (38.2%), and the Western Australian government-owned West Australian Diamond Trust (5%). Argyle's annual production exceeded that of any country in the world and accounted for about 36% of the world's output of natural diamonds from its AK–1 lamproite pipe mine in the Kimberley District.

Argyle announced in September the discovery of an additional resource of alluvial diamonds in the lower reaches of the Smoke and Limestone Creeks that drain the AK–1 pipe. The preliminary estimate of the tonnage and grade of the alluvial deposits was 164 million tons of ore grading 0.37 carat per ton, which added about 60 million carats to Argyle's resources. Reportedly, the alluvial deposits contained a higher proportion of gem-quality material than Argyle's.

A second diamond operation, the Bow River Mine 25 kilometers northeast of Argyle, owned by Freeport-

McMoRan Australia Ltd., 80%, and Gem Exploration and Minerals Ltd., 20%, began production in February, with a planned production of 625,000 carats per year. Of this amount, it was expected that 18% to 25% were of gem quality, 65% to 72% near gem, with the remainder as boart. Estimated reserves were almost 11 million tons of diamondiferous gravels grading 0.43 carat per ton. The diamonds from Bow River were scheduled to be marketed through Bow River Diamond Sales Pty. Ltd., mostly to customers in Antwerp, Belgium. Two dealers in Antwerp were to assist with the marketing. The remaining diamonds were to be sold directly by the two partners.

Freeport-McMoRan Australia and Triad Minerals NL commissioned a heavy metals separation plant on a kimberlite pipe at the Phillips Range diamond venture in the Kimberley District. The plant planned to sample the underlying kimberlite at selected points across its surface after the crusher and trommel were installed.

Gem Stones.—Australia remained the world's leading producer of natural sapphire, which was mined in the New England (Inverell-Glen Innes) District of New South Wales and near the town of Anakie in Queensland. About 80% of the uncut gems were exported to Thailand, the recognized world leader, for cutting and marketing.

Australia produced between 80% and 90% of the world's natural opal, mostly from three fields in South Australia at Andamooka, Coober Pedy, and Mintabie. In New South Wales, Lightening Ridge was the world's sole source of black opal. A small quantity of opal was produced in central Queensland.

The world's largest resource of nephrite jade was at Cowell on the Eyre Peninsula in South Australia. Other gem stones produced in Australia included amethyst, chrysoprase, emerald, garnet, rhodonite, topaz, and zircon.

***Mineral Fuels.*—Coal.**—After five successive years of record-high levels of production and exports, the black coal industry leveled off in 1988, mainly because of industrial disputes and the closing of uneconomical properties. Domestic consumption, however, continued its record growth. The coal industry remained Australia's largest foreign-exchange earner and accounted for more than 30% of export revenues from the minerals sector and about 15% of the country's export earnings. It also remained the country's largest employer. Both raw and salable coal output in New South Wales decreased substantially. Raw coal production, at an estimated 78.4 million tons, was down 6%, while salable coal production was 65.3 million tons, a reduction of 7%. In Queensland, the estimated production for both raw and salable coal increased by less than 1%, to 88.2 million tons and 68.6 million tons, respectively. New South Wales and Queensland accounted for more than 96% of the country's coal production and virtually all of the country's coal exports.

Domestic coal consumption increased 5% to an estimated 47 million tons. Major consumers remained the electricity and iron and steel industries, which again consumed over 90% of all coal used. The increase was due mostly to increased consumption by these two industries and the cement industry.

Following a record-high level of coal exports in 1987, estimated exports decreased slightly, about 2%, in 1988. Japan remained the largest importer of Australian coals.

The Coal Industry Tribunal (CIT) announced in September a package of reforms in industry organization and staffing practices, which involved a major restructuring of the coal industry. CIT's reforms implemented a move for production operations from 7-hour shifts to 8-hour shifts, which included travel time to the face and cleanup time, and spanned 6 days of production per week for underground mines and 5 days per week for opencast mines. Nonproduction operations, such as overburden removal and development work, were to continue for 7 days per week for both underground and surface mines. The reforms provided for a 52-week production year and eliminated the mandatory Christmas 3-week shutdown period and the New South Wales' 1-week shutdown at Easter. The standard 35-hour week remained at the core of the new arrangements; overtime work required a high bonus rate.

A pilot plant designed to produce ultraclean coal, with an ash content of less than 1%, began operating at Ulan, New South Wales, late in 1988. The plant used local coal from the Ulan Mine. These coals typically had an ash content before washing of 35%. Normal washing reduced this only to about 6% ash. The trial production and utilization testing was conducted by AUSCOAL, a joint venture involving White Industries Ltd., the Commonwealth Scientific and Industrial Research Organization's Coal Technology Division, and the Australian Coal Industry Research Laboratories. Ultraclean coal was expected to be suitable as a substitute for heavy fuel oils in many applications and should attract a much higher value than most energy coals that contained 10% to 20% ash.

Southland Mining Ltd., a wholly owned subsidiary of Devex Ltd., and Toyota Tsusho Corp. of Japan announced plans for the development of a new opencast mine in the Hunter Valley of New South Wales. The equally owned joint-venture mine was expected to be operational by early 1991 at the rate of 1 million tons of coal per year, all for export.

Petroleum and Natural Gas.—Australia's self-sufficiency in petroleum was expected to decline from about 90% in 1988 to about 55% by 1992. Production from the Gippsland Basin in Bass Strait, the major indigenous source of petroleum, peaked in 1986 and has declined steadily since that time. Most of Australia's petroleum has been obtained from offshore fields, principally fields in the Gippsland Basin. The main exploration effort continued to be directed toward finding new fields in offshore areas. The main areas of exploration were off the coasts of west and northwest Australia, in the North West Shelf, and the Timor Sea, respectively.

Australia and Indonesia agreed in September to establish a zone of cooperation between Timor and Australia. The agreement made possible petroleum exploration and development prior to the establishment of a permanent seabed boundary between the two countries.

The proposed zone was composed of three areas, the largest of which, Area A, was subject to joint Australian-Indonesian administration of petroleum activity. A second area, Area B, south of the joint development area, was to be administered by Australia and was to be subject to Australian laws governing petroleum exploration and development. A third and northernmost area, Area C, was to be controlled by Indonesia and was to be subject to its regime. Both countries planned to share the tax revenues from each of the areas.

Despite low oil prices throughout 1988, the level of Australian offshore exploration drilling continued to rise steadily to the highest level recorded for several years. Thirty-three wells were drilled, more than doubling the amount drilled in 1987. The high level reflected the belief that the best prospects for large oil discoveries were offshore. The total number of onshore exploration wells drilled, 213, remained about the same as that of the previous year.

Forty-five development wells were drilled during the year; 15 were offshore and 30 onshore. The total was about 20% less than the number drilled in the previous year.

Uranium.—Production of uranium oxide (U_3O_8) in Australia decreased more than 6%. Australia remained the fourth largest market economy producer of uranium, ranking behind Canada, the United States, and the Republic of South Africa. Production increased about 4%, to 3,231 tons of U_3O_8, at the Ranger opencut mine owned by Energy Resources of Australia Ltd. (ERA), in the Alligator River region of the Northern Territory. At Nabarlek, also in the Alligator River region, all of the remaining high-grade stockpiled ore was processed; all production occurred during the first half of the year. Total production for the year at Nabarlek was 481 tons of U_3O_8, a decrease of more than 64% from the 1987 level.

Queensland Mines Ltd. (QML), the owner and operator of Nabarlek, announced plans to maintain uranium production by processing low-grade ore previously extracted from Nabarlek 1, and proposed to seek approval from the Government and the Northern Land Council (NLC) to supplement this with material from Nabarlek 2. QML reported that the resources at Nabarlek 2 were at least 2,500 tons of U_3O_8 and that previous exploration drilling had not delineated the limits of the ore body.

ERA planned to accelerate production of U_3O_8 from the Ranger Mine to 4,500 tons per year by 1991, with a further increase to 6,000 tons per year by yearend 1992.

Production of U_3O_8 from the Olympic Dam project commenced in August. Total production for the year was 452 tons of U_3O_8. Although annual capacity at Olympic Dam was 1,900 tons of U_3O_8, initial production was at the rate of 1,550 tons of U_3O_8 per year.

Olympic Dam Marketing Pty. Ltd. (ODM) signed sales contracts for the supply of U_3O_8 with Japan's Kansai Electric Power Co. Inc. and Kyushu Electric Power Co. Inc. ODM had previously signed long-term contracts to supply U_3O_8 to the Swedish State Power Board, the Central Electricity Generating Board of the United Kingdom, and the Korea Electric Power Corp.

ERA signed four new long-term contracts with U.S. utilities, and one each with a Japanese utility and a French company. ERA had a total of 13 contracts with utilities in the United States.

Exploration continued in the northern part of the Ranger Project area during the year. ERA reported that the exploration to date had not identified additional reserves. QML concluded an agreement in June with the NLC to conduct an exploration program in a 568-square-kilometer area surrounding the Nabarlek Mine; exploration commenced in mid-August.

The evaluation drilling program at the Kintyre Prospect, which was inside the northern boundary of the Rudall River National Park in Western Australia, and a feasibility study continued during the year. A 3-ton-per-hour radiometric ore sorter was commissioned and ore sorting test work was undertaken during the year. CRA, the owner, reported ore resources as of September 1988, using a cutoff grade of 0.5 kilogram U_3O_8 per ton, to be 22,000 tons of probable reserves of U_3O_8, 11,000 tons of indicated resources of U_3O_8, and 3,000 tons of inferred resources of U_3O_8.

INTRODUCTION TO OCEANIA

The Other South Pacific Islands included in this chapter extend from Papua New Guinea, east of the Indonesian province of Irian Jaya on the island of New Guinea, to Fiji, which is crossed by the 180th meridian. A number of islands have been omitted from this chapter because their only mineral production remained insignificant to the economy of the respective country or territory. These include the French overseas territories of French Polynesia and Wallis and Futuna Islands; independent states including the Federated States of Micronesia, Marshall Islands, Palau, Tonga, Tuvalu, and Vanuatu; the New Zealand freely associated state of the Cook Islands, and the New Zealand dependency of Niue. The mineral production that existed in these islands was limited to construction materials such as coral reef limestone, crushed stone, and sand and gravel in minor quantities used solely for domestic consumption.

FIJI

Fiji's economy continued to be basically agrarian, depending mainly on the sugar industry and a large subsistence sector. The mineral industry remained small, contributing less than 1% to the GDP of the country. Active mining in Fiji was limited to the extraction of industrial materials, such as coral and river sands, limestone, and stone and crushed gravel, for domestic use, and metallic mineral production, such as gold and silver, for export.

Metallic mineralization was widespread in Fiji, occurring as polymetallic base metal sulfide deposits, disseminated porphyry copper deposits, epithermal precious metals deposits, residual bauxite deposits, and manganese and heavy-mineral sands deposits. The Emperor Mine, at Vatukoula in the north of the main island of Viti Levu, remained the only metallic mineral producer. The mine produced gold and silver. The Emperor Mine previously also had produced significant amounts of tellurium. The Emperor Mine was owned by Emperor Gold Mining Co. Ltd., 80%, and Western Mining Corp. (Fiji) Ltd. (WMCF), 20%. WMCF also managed the operation.

The Emperor Mine was expanded; underground mine production was augmented by increasing crushing and milling capacity and replacing the roaster. Over one-half the ore produced came from the underground workings.

Australia's Paragon Resources Ltd. reached agreement with Solpac (Fiji) Ltd., a wholly owned subsidiary of Australia's Solomon Pacific Resources NL, and Geopacific Ltd. to enter into a joint venture and manage the Wainivesi gold-silver-zinc prospect, 70 kilometers north of Suva. Paragon planned to earn a minimum 51% interest in the project by spending $1.45 million[4] for further exploration and development.[5]

KIRIBATI

The Kiribati Government was considering a plan submitted by Australian-based Roche Brothers Ltd. for the resumption of phosphate mining on Banaba Island, formerly Ocean Island, in the western Gilbert Islands. Phosphate mining on Banaba Island ceased at the end of 1979. The plan proposed that a new suction technique replace the old open pit mining method and indicated that 300,000 to 400,000 tons of phosphate rock could still be recovered from the supposedly worked out deposit. The feasibility study began in early 1987.

NAURU

The economy of Nauru continued to be based on the mining of the world's highest grade of phosphate rock. The Nauruan phosphate, mined from deposits on the central plateau of the island, had a guaranteed content of 84% BPL (bone phosphate of lime or

TABLE 3

FIJI: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987[p]	1988[e]
Cement, hydraulic		97,900	93,200	92,278	—	—
Gold, mine output, Au content	troy ounces	48,515	60,707	94,902	95,230	[2]137,380
Lime[3]		[e]2,500	3,261	2,305	—	—
Silver, mine output, Ag content	troy ounces	15,207	14,198	17,062	27,093	[2]32,006
Stone, sand and gravel:[e]						
Coral sand for cement manufacture		95,000	126,500	160,900	85,585	[2]65,114
River sand for cement manufacture		25,000	40,000	39,500	24,250	[2]14,157
River sand and gravel, n.e.s.	cubic meters	350,000	1,200,000	577,500	[2]254,713	[2]1,219,800
Quarried stone	do.	225,000	105,030	160,000	[2]66,832	[2]49,711

[e]Estimated. [p]Preliminary.
[1]Table includes data available through Aug. 1, 1989.
[2]Reported figure.
[3]Produced from an unreported amount of domestically quarried limestone.

TABLE 4

NAURU: PRODUCTION OF MINERAL COMMODITIES[1 2]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987[p]	1988[e]
Phosphate rock	thousand tons	1,358	1,508	1,494	1,376	[3]1,541

[e] Estimated. [p] Preliminary.
[1] Table includes data available through Aug. 1, 1989.
[2] In addition to the commodities listed, crude construction materials (common clays, sand and gravel, and stone) are produced, but output is not reported quantitatively, and available general information is inadequate to make reliable estimates of output levels.
[3] Reported figure.

tricalcium phosphate), equivalent to 38.5% phosphorous pentoxide, P_2O_5). The calcination plant treated rock that had a content of as much as 91% BPL (41.7% P_2O_5) and averaged 89% BPL (40.8% P_2O_5).

The phosphate was mined and marketed by the Nauru Phosphate Corp. (NPC), an agency of the Government. Phosphate remained Nauru's sole export.

At yearend, Nauru petitioned Australia, New Zealand, and the United Kingdom to pay $60 million to Nauru in compensation for mining the island's phosphate rock deposits. Australia, New Zealand, and the United Kingdom had been partners for 50 years in the British Phosphate Commission (BPC) until the NPC assumed control of the phosphate industry shortly after Nauru's independence was achieved in 1968.

The Government formed an independent Commission of Inquiry, in February 1987, to determine who was responsibile for the rehabilitation of the land worked out by phosphate mining before independence and the feasibility and costs of any proposed rehabilitation. The Commission found that the Governments of the former BPC members should accept a share of the responsibility for the mining on the island, which had left more than 80% of the 21-square-kilometer island devastated and uninhabitable. The Commission determined that rehabilitation of the island would cost $180 million, and called upon the three nations to pay one-third of the cost.

TABLE 5

NAURU: EXPORTS OF PHOSPHATE ROCK, BY DESTINATION

(Thousand metric tons)

Destination	1986	1987	1988
Australia	869.4	1,061.9	1,253.3
Japan	—	4.3	—
Korea, Republic of	22.1	38.2	40.5
New Zealand	132.7	202.9	188.8
Philippines	469.3	68.2	57.9
Total	**1,493.5**	**1,375.5**	**[1]1,540.4**

[1] Data do not add to total shown because of independent rounding.

Source: Phosphate Rock Statistics 1988, International Fertilizer Industry Association Ltd.

NEW CALEDONIA

The mining industry in the French Territory of New Caledonia consisted predominantly of two commodities: nickeliferous laterite ore, which is used for the production of ferronickel products of various grades and of nickel matte, and high-quality chromite ore, which is produced from extensive ultramafic rock and used for the production of concentrates. Cobalt, which is recovered in France from exported nickel matte, and certain pit and quarry construction materials also were produced.

There were 12 nickel operations on the main island after the reopening of 3 mines during the year. Nickel accounted for about 95% of the country's exports. Le Nickel-SLN (SLN), a wholly owned subsidiary of Metropolitan France's Société Métallurgique le Nickel, supplied about 64% of the metal. SLN produced ferronickel and nickel matte at its Doniambo smelter at Noumea at slightly more than its rated capacity of 45,000 tons per year. Production totaled 47,822 tons of contained nickel-cobalt in ferronickel and matte products.

A proposed joint venture between the French Bureau de Recherches Géologiques et Minières (BRGM) and Australia's Dallhold Investments Ltd. planned development of a new nickel mine at Goro, which is at the extreme south of the main island of New Cale-

TABLE 6

NEW CALEDONIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987[p]	1988[e]
Cement		[e]60,000	[e]60,000	40,000	50,000	60,000
Chromite, gross weight		84,152	149,476	163,325	152,756	[2]112,236
Cobalt, mine output:						
Co content[e 3]		[r]4,094	[r]5,186	5,000	5,800	6,000
Recovered[e]		[r]500	[r]675	700	750	800
Nickel:						
Ore:						
Gross weight	thousand tons	2,886	3,600	3,125	2,842	[2]3,385
Ni content		58,326	72,360	61,800	56,850	67,700
Metallurgical products:						
Ferronickel:						
Gross weight[e]		113,700	140,800	[2]130,500	115,600	146,300
Metal content (nickel plus cobalt)		29,158	36,103	33,001	29,531	[2]37,352
Nickel matte:						
Gross weight[e]		7,600	12,100	12,260	11,300	14,300
Metal content (nickel plus cobalt)		5,462	8,905	9,160	8,283	[2]10,470
Stone, sand and gravel:[e]						
Stone:						
Crude (unspecified)	cubic meters	20,000	20,000	20,000	20,000	20,000
Crushed	do.	90,000	90,000	100,000	100,000	100,000
Sand	do.	60,000	60,000	75,000	75,000	75,000
Silica (for metallurgical use)	do.	15,000	15,000	15,000	15,000	15,000

[e]Estimated. [p]Preliminary. [r]Revised.
[1]Table includes data available through Aug. 1, 1989.
[2]Reported figure.
[3]Series reflects recovery from ores and intermediate metallurgical products exported from New Caledonia to France and Japan.

donia. BRGM's stake in the project would be 51%, held both directly and through its 51% owned subsidiary Societe de Projets Miniers; Dallhold held a 49% share.

Although the partners had not received a development permit, a pilot plant was built and the ore had been tested by yearend. It was envisaged that the ore, projected to be mined at 2.6 million tons per year, was to be shipped to the Yabulu Refinery in Townsville, Australia. Dallhold's wholly owned subsidiary, MEQ Nickel Ltd., held an 87% interest in the Yabulu Refinery.

In the northern part of New Caledonia, the underground Tiebaghi Mine, which was opened in 1981 by French-owned Chromical S.A., produced chromite ore averaging 60% lumpy metallurgical-grade, 30% fines for the ferrochrome industry, and 10% refractory-grade. The refractory-grade material contained a minimum 55.5% chromic oxide (Cr_2O_3), with 10.5% alumina (Al_2O_3); silica (SiO_2) content varied between 2.7% and 3%.[6]

The 90,000-ton-per-year Tiebaghi Mine operated by Cromical was owned by Canada's Inco Metals Ltd. through

TABLE 7

NEW CALEDONIA: EXPORTS OF NICKEL, BY TYPE AND DESTINATION

(Metric tons)

Type	1986	1987	Destinations, 1987
Ore	1,074,502	1,019,729	All to Japan.
Matte	9,549	7,354	All to France.
Ferronickel, gross weight	32,613	30,348	Australia 21,893; France 8,455.

Source: Annales Des Mines (Paris), Feb. 1989.

its French subsidiary International Nickel France, which had a 55% controlling interest. The remaining 45% was split evenly between Sococal, a subsidiary of the Banque de Paris et des Pays-Bas, and Comines, a subsidiary of Coframines, which is a part of the BRGM.

Chromical initiated an intensive exploration program for chromite, on its own land as well as adjacent properties, during the year. The work was expected to be completed in 1990.

At yearend, Australmin Pacific NL of Australia was seeking a partner for its undeveloped chromite property at Bae des Pirogues. The property had an indicated alluvial resource of 80 to 100 million cubic meters grading 3.5% Cr_2O_3, or about 5% to 7% chromite. The company planned to mine by dredging to produce between 100,000 and 200,000 tons of chromium concentrates annually. The company planned to extract the chromium by gravity, magnetic, and electrostatic methods.[7]

NEW ZEALAND

Mining has been an integral component in the New Zealand economy since the early days of European settlement, although the country's small size has not enabled it to match the mining output of larger countries such as Australia, Canada, and the United States. New Zealand's mineral production has included a number of mining operations of world-class size. For almost a century from the 1850's, gold and silver production dominated New Zealand's mineral production, injecting substantial wealth into the economy and providing investment funds for the development of agriculture and other natural resources industries such as coal and timber.

Today's extractive mineral industry in New Zealand forms only a small segment of the economy, contributing on the order of 1% to 2% to the GDP of the country. The GDP was almost $37 billion[8] in fiscal year 1988,[9] a 0.2% decrease in real terms from the previous fiscal year. The GDP was projected to fall another 0.3% in real terms in fiscal year 1989. The mineral processing sector provided an estimated 4% to 5% to the GDP, based to a significant extent on imported alumina, crude oil raw materials, and fertilizer, raising the mineral industry total to about 5% to 6% of GDP. The major mineral industry and mining activities during the year continued to be coal extraction, both by open pit and underground methods; quarrying of raw materials for use primarily in the domestic construction and agricultural industries, and for road building; alluvial gold and silver mining; and recovering and refining petroleum products.

Government Policies and Programs

The ongoing shift of the Government from a highly regulated to a market-oriented system while reducing the rate of inflation has been harsh for many sectors of the economy, including the coal, electrical generation, and petroleum industries over the past 3 to 4 years.

In early March, the Government concluded the sale of its share of Petroleum Corp. of New Zealand (Petrocorp), the state-owned oil and gas exploration and distribution enterprise, to Fletcher Challenge Ltd., a domestic company. The sale enabled the country to secure a promised budget surplus for the fiscal year and permitted it to reduce some of its foreign debt.

Production and Trade

The minerals industry continued to consist mainly of the mining of coal; construction materials (clays, sand and gravel, and stone); limestone and marble for agriculture, chemical, and construction uses; and gold mining. The latter consisted mainly of alluvial dredging operations on South Island and epithermal gold deposits on the Coromandel Peninsula of North Island. Crude mineral production also included natural gas, natural gas liquids, and petroleum (condensate).

The mineral processing sector consisted chiefly of the production of primary aluminum from the Tiwai Point smelter; manufactured fertilizers and petrochemicals (ammonium-urea and methanol) using natural gas feedstocks; petroleum refinery products from the Marsden Point Refinery and the New Zealand Synthetic Fuels Corp. Ltd. fuel plant at Motonui; and crude steel produced from imported raw materials at the Glenbrook Steelworks.

Among mineral commodity imports, crude petroleum, partly refined petroleum, and petroleum refinery products dominated. Other mineral commodity imports were alumina, fertilizer materials, and steel semimanufactures. Aluminum ingots continued to be the dominant mineral commodity export, followed by steel products, mainly semimanufactures.

Reliable statistical information on production and trade was unavailable. Production levels have been estimated on the basis of the best available information.

Commodity Review

***Metals.*—Aluminum.**—Comalco Ltd. of Australia announced in midyear that it was restructuring its business activities in New Zealand by holding all its interests through a single, wholly owned New Zealand subsidiary, Comalco New Zealand Ltd. Comalco's activities in New Zealand included a 79.4% interest in and management of New Zealand Aluminium Smelters Ltd., which, along with joint-venture partner Sumitomo Aluminium Smelting Co. Ltd. of Japan, 20.6%, owned the Tiwai Point aluminum smelter; a 50% interest in and management of Comalco Extrusions Ltd.; and a 50% interest in Carter Holt Harvey Aluminium Ltd. In addition, Comalco was increasingly active in the New Zealand rolled products markets, the recycling of aluminum beverage cans, and in the sale

TABLE 8

NEW ZEALAND: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987[p]	1988[e]
METALS						
Aluminum metal, smelter:						
Primary		242,851	[r]240,835	236,332	252,000	[2]264,398
Secondary		3,700	1,500	4,000	4,000	[2]4,000
Total		**246,551**	**[r]242,335**	**240,332**	**256,000**	**[2]268,398**
Gold, mine output, Au content	troy ounces	21,605	[r]28,486	40,671	36,909	55,000
Iron and steel:						
Iron ore, gross weight[3]		2,645	[e]2,000	[e]2,000	[e]2,000	1,500
Iron sand (titaniferous magnetite):						
Gross weight	thousand tons	2,414	2,520	2,580	2,290	2,000
Fe content	do.	1,376	[e]1,425	[e]1,425	[e]1,300	1,150
Pig iron (sponge iron)[e]	do.	170	170	200	200	200
Steel, crude	do.	274	228	291	[e]300	250
Lead, refinery output, secondary[e]		6,000	6,000	4,000	[2]4,000	3,600
Tungsten, mine output (scheelite):						
Gross weight		13	15	([4])	[e]10	10
W content		6	7	([4])	[e]5	5
INDUSTRIAL MINERALS						
Cement, hydraulic	thousand tons	823	863	906	880	900
Clays:						
Bentonite		6,418	7,400	3,140	—	—
Kaolin (pottery)		25,098	24,471	28,464	25,548	25,000
For brick and tile		146,840	[e]145,000	[e]145,000	[e]145,000	145,000
Lime[e]		150,000	160,000	160,000	160,000	150,000
Nitrogen: N content of ammonia		58,000	[r]60,000	[e]60,000	73,000	75,000
Pumice		15,182	[e]20,000	[e]20,000	15,000	20,000
Salt		57,000	51,500	—	[e]60,000	60,000
Sand and gravel:						
Silica sand (glass sand)		133,235	[e]50,000	[e]50,000	[e]50,000	50,000
Other industrial sand		387,209	[e]350,000	[e]350,000	[e]350,000	350,000
For roads and ballast	thousand tons	16,501	[e]15,000	[e]15,000	[e]15,000	15,000
For building aggregate	do.	5,029	[e]5,000	[e]5,000	[e]5,000	5,000
Stone:						
Dolomite		18,124	[e]18,000	[e]18,000	[e]18,000	18,000
Greenstone	kilograms	3,052	[e]3,000	[e]3,000	[e]3,000	3,000
Limestone and marl:						
For agriculture	thousand tons	1,524	[e]1,500	[e]1,500	[e]1,500	1,500
For cement	do.	1,621	[e]1,500	[e]1,500	[e]1,500	1,500
For other industrial uses	do.	214	[e]215	[e]215	[e]215	215
For roads	do.	359	[e]350	[e]350	[e]350	350
Serpentine		76,900	[e]75,000	[e]75,000	[e]75,000	75,000

See footnotes at end of table.

TABLE 8—Continued

NEW ZEALAND: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987[p]	1988[e]
METALS—Continued						
Stone—Continued						
Unspecified:						
Dimension		36,359	[e]35,000	[e]35,000	[e]35,000	35,000
Rock for harbor work	thousand tons	2,520	[e]2,500	[e]2,500	[e]2,500	2,500
Sulfur		862	—	—	—	—
MINERAL FUELS AND RELATED MATERIALS						
Carbon dioxide, liquefied[e]		10,000	10,000	10,000	10,000	10,000
Coal:						
Anthracite[e]	thousand tons	—	([4])	([4])	([4])	([4])
Bituminous	do.	582	651	679	[e]600	650
Subbituminous	do.	1,709	1,669	1,767	[e]1,500	1,600
Lignite	do.	235	228	195	[e]200	200
Total	**do.**	**2,526**	**2,548**	**2,641**	**[e]2,300**	**2,450**
Coke:[e]						
Coke oven		2,100	2,000	2,000	2,000	2,000
Gashouse		6,200	6,000	6,000	6,000	6,000
Total		**8,300**	**8,000**	**8,000**	**8,000**	**8,000**
Fuel briquets[e]		4,500	5,000	5,000	5,000	5,000
Gas:						
Manufactured (from gasworks)[e]	million cubic feet	609	517	356	350	350
Natural:						
Gross production	do.	135,000	170,900	191,700	189,700	190,000
Marketed production	do.	110,817	137,162	164,283	[e]165,000	165,000
Natural gas liquids:[e]						
Liquefied petroleum gas	thousand 42-gallon barrels	483	910	976	[r]1,201	1,000
Natural gasoline	do.	85	160	172	[r]157	200
Total	**do.**	**568**	**1,070**	**[2]1,148**	**[r]1,358**	**1,200**
Petroleum:						
Crude	do.	[r]6,114	[r]6,844	10,585	10,220	[2]10,220
Refinery products:						
Gasoline	do.	10,965	6,001	13,150	11,492	14,000
Distillate fuel oil	do.	4,588	2,462	4,588	7,467	5,000
Residual fuel oil	do.	2,311	1,998	1,512	2,131	2,000
Other	do.	931	637	679	938	1,000
Refinery fuel and losses	do.	798	525	784	1,799	1,000
Total	**do.**	**19,593**	**11,623**	**20,713**	**23,827**	**23,000**

[e]Estimated. [p]Preliminary.
[1]Table includes data available through June 13, 1989.
[2]Reported figure.
[3]Not used for manufacture of iron; reportedly consumed for gas purification, preparation of stock licks, and manufacture of brick. Because of these uses, iron content is not reported.
[4]Less than 1/2 unit.

TABLE 9

NEW ZEALAND: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Destinations, 1987 United States	Destinations, 1987 Other (principal)
METALS					
Aluminum:					
Oxides and hydroxides		([2])	65	—	Australia 55; Hong Kong 10.
Metal including alloys:					
Scrap		4,594	7,976	—	Japan 5,709; Australia 785; Singapore 395.
Unwrought		199,963	227,713	974	Japan 198,533; Taiwan 9,080; China 6,802.
Semimanufactures		7,079	7,732	232	Australia 4,153; Singapore 607; Indonesia 528.
Chromium: Oxides and hydroxides		—	1	—	All to Australia.
Copper: Metal including alloys:					
Scrap		653	1,889	—	Australia 786; India 356; Spain 221.
Unwrought	value, thousands	$4	$5	—	Fiji $3; New Caledonia $2.
Semimanufactures	do.	$10,188	$14,922	$2,035	Australia $10,323; Canada $586.
Iron and steel:					
Iron ore and concentrate excluding roasted pyrite	thousand tons	2,217	1,794	—	Mainly to Japan.
Metal:					
Scrap		3,315	2,839	—	Japan 2,218; Australia 116; Italy 86.
Pig Iron, cast iron, related materials		4	5	—	All to Australia.
Steel, primary forms		102,957	100,251	53,466	Japan 23,133; Taiwan 11,585.
Semimanufactures:					
Bars, rods, angles, shapes, sections		46,283	15,879	3,186	China 3,934; New Caledonia 1,715.
Universals, plates, sheets		49,849	36,096	5,921	Australia 10,505; Canada 2,718.
Hoop and strip		112	53	—	Australia 38; Fiji 13; Samoa 2.
Wire		3,277	4,028	89	Australia 2,477; Hong Kong 827; Fiji 257.
Tubes, pipes, fittings		4,476	4,185	930	Papua New Guinea 1,476; Australia 466.
Castings and forgings, rough		121	90	—	Australia 60; Singapore 13; American Samoa 10.
Lead:					
Oxides		—	1	—	All to Fiji.
Metal including alloys:					
Scrap		161	295	—	Republic of Korea 103; Taiwan 82; Australia 33.
Unwrought and semimanufactures		118	263	—	Australia 220; United Kingdom 18; Tonga 9.
Magnesium: Metal including alloys, scrap		NA	6	6	
Mercury	value, thousands	$1	$3	—	Fiji $2; Australia $1.
Nickel: Metal including alloys:					
Scrap		42	182	—	West Germany 132; India 20; Republic of Korea 19.
Semimanufactures		31	47	—	Australia 42; Japan 5.
Platinum-group metals: Metals including alloys, unwrought and partly wrought	value, thousands	$28	$7	—	Australia $5; Fiji $2.

See footnotes at end of table.

TABLE 9—Continued

NEW ZEALAND: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987 United States	Destinations, 1987 Other (principal)
METALS—Continued				
Silver:				
Waste and sweepings value, thousands	$147	$130	—	United Kingdom $111; Australia $19.
Metal including alloys, unwrought and partly wrought do.	$855	$9	—	Italy $5; Papua New Guinea $4.
Tin: Metal including alloys:				
Scrap	103	169	—	United Kingdom 154; West Germany 15.
Unwrought value, thousands	—	$2	—	Australia $1; Fiji 1.
Semimanufactures	178	42	5	French Polynesia 34; Tonga 2.
Titanium: Oxides	3	11	—	Australia 10; Malaysia 1.
Tungsten: Metal including alloys, all forms	$57	$44	—	Australia $35; Netherlands $7; United Kingdom $2.
Zinc:				
Oxides	NA	17	—	Mainly to Republic of South Africa.
Metal including alloys:				
Scrap	NA	871	—	Australia 426; India 69; Japan 15.
Semimanufactures	NA	9	—	Australia 5; Papua New Guinea 2; New Caledonia 1.
Other:				
Ores and concentrates	26	192	—	All to Australia.
Ashes and residues	2,638	1,675	—	India 846; Australia 256; Japan 169.
Base metals including alloys, all forms value, thousands	$5	$2	—	Mainly to Fiji.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	154	776	—	Australia 769; United Kingdom 6; Fiji 1.
Grinding and polishing wheels and stones value, thousands	$183	$165	$4	Australia $107; Fiji $20; Papua New Guinea $13.
Asbestos, crude do.	$2	$1	—	All to Samoa.
Barite and witherite	1,345	12	—	All to Singapore.
Boron materials: Oxides and acids	1	2	—	All to Fiji.
Cement	91,386	48,184	—	French Polynesia 9,685; Papua New Guinea 7,283; American Samoa 7,263.
Chalk	4	5	—	Australia 1; United Kingdom 1.
Clays, crude	15,423	18,588	—	Japan 10,018; Republic of Korea 2,657; United Kingdom 823.
Diamond:				
Gem, not set or strung value, thousands	$861	$1,052	$115	Australia $891; Hong Kong $26.
Industrial stones do.	$60	$34	$8	Hong Kong $15; Australia $6.
Diatomite and other infusorial earth	([3])	5	—	Fiji 3; Samoa 2.
Fertilizer materials:				
Crude, n.e.s.	116	203	—	Singapore 182; Malaysia 17; Fiji 2.

See footnotes at end of table.

TABLE 9—Continued

NEW ZEALAND: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
INDUSTRIAL MINERALS—Continued					
Fertilizer materials—Continued					
Manufactured:					
Ammonia		7	5	—	Tonga 4; Cook Islands 1.
Nitrogenous		69,725	([4])	NA	NA.
Phosphatic		226	103	—	Fiji 77; Cook Islands 19; French Polynesia 5.
Potassic	value, thousands	$24	$11	—	Cook Islands $7; Fiji $2; Niue $2.
Unspecified and mixed		1,145	([5])	NA	NA.
Gypsum and plaster		156	59	—	Australia 23; Papua New Guinea 17; Fiji 12.
Lime		1,963	1,937	—	Fiji 1,402; Papua New Guinea 210; French Polynesia 181.
Phosphates, crude		8	99	—	French Polynesia 63; Australia 17; Singapore 16.
Pigments, mineral: Iron oxides and hydroxides, processed		6	2	—	All to Fiji.
Potassium salts, crude	value, thousands	—	$1	—	All to Norfolk Island.
Precious and semiprecious stones other than diamond:					
Natural	value, thousands	$426	$626	$6	Australia $547; United Kingdom $36; Thailand $18.
Synthetic	do.	$6	$49	$47	Australia $2.
Salt and brine		3,123	3,907	—	Australia 3,151; Papua New Guinea 200; Fiji 173.
Sodium compounds, n.e.s. Carbonate, manufactured		57	3	—	All to Fiji.
Stone, sand and gravel:					
Dimension stone:					
Crude and partly worked	value, thousands	$5	$5	—	Fiji $3; Norfolk Island $3.
Worked	do.	$69	$70	—	Samoa $37; Cook Islands $24; Fiji $2.
Dolomite, chiefly refractory-grade	do.	$6	$9	—	Australia $4; French Polynesia $4; United Kingdom $1.
Gravel and crushed rock		454	789	28	Malaysia 705; Indonesia 45.
Limestone other than dimension		301	421	—	New Caledonia 280; Fiji 77; French Polynesia 64.
Quartz and quartzite	value, thousands	—	$1	—	All to Australia.
Sand other than metal-bearing		256	415	—	Australia 212; Fiji 132; Papua New Guinea 30.
Sulfur:					
Elemental: Colloidal, precipitated, sublimed		—	8	—	All to Australia.
Sulfuric acid		218	145	—	Papua New Guinea 56; Fiji 53; Solomon Islands 13.
Talc, steatite, soapstone, pyrophyllite		2	15	—	All to Australia.
Other: Crude		610	499	—	Fiji 237; Australia 128; French Polynesia 65.

See footnotes at end of table.

TABLE 9—Continued

NEW ZEALAND: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
MINERAL FUELS AND RELATED MATERIALS					
Asphalt and bitumen, natural		46	473	—	French Polynesia 396; Samoa 43; Tonga 34.
Carbon black		—	2	—	All to Australia.
Coal: Anthracite and bituminous		281,650	299,675	—	Japan 294,270; Republic of Korea 4,916; United Kingdom 489.
Peat including briquets and litter		4,231	4,246	12	Australia 3,981; French Polynesia 125; Papua New Guinea 28.
Petroleum:					
Crude	thousand 42-gallon barrels	1,810	370	—	All to Australia.
Refinery products:					
Liquified petroleum gas	value, thousands	$125	$152	—	Australia $151; Cook Islands $1.
Gasoline, motor	42-gallon barrels	435,582	1,435,166	—	Japan 517,421; Australia 474,793; Singapore 442,740.
Mineral jelly and wax	do.	71	71	—	Fiji 24; American Samoa 16; Samoa 16.
Kerosene and jet fuel	do.	2,829	180,474	—	Japan 130,394; French Polynesia 46,748;
Distillate fuel oil	do.	425	261,346	—	Japan 181,323; French Polynesia 79,949.
Lubricants	value, thousands	$1,405	$1,174	—	Fiji $514; Australia $210; Tonga $102.
Residual fuel oil	42-gallon barrels	7	27	—	All to Australia.
Bitumen and other residues	do.	291	224	—	Solomon Islands 218.
Bituminous mixtures	do.	5,236	6,593	—	Vanuatu 1,648; Fiji 1,624; Samoa 788.

NA Not available.
[1] Table prepared by G. Jacarepaqua. Data for Taiwan in this table are official imports as reported by the Government of Taiwan.
[2] Unreported quantity valued at $4,000.
[3] Unreported quantity valued at $3,000.
[4] Unreported quantity valued at $9,689,000.
[5] Unreported quantity valued at $352,000.

of primary aluminum from the Tiwai Point Smelter to New Zealand domestic customers.

Gold and Silver.—At the beginning of the year, D. K. Platinum Corp. of Canada announced plans for a 50-50 joint venture with Merlin Mining NL of Australia on the latter's Garibaldi Prospect near Ranfurly, South Island. The joint venture will conduct an exploration program for a minimum target of 50,000 ounces of alluvial gold, which can be recovered by dry mining methods.

Waihi Gold Mining Co. Ltd. signed a 5-year contract with Downer Mining Ltd. during the first quarter to conduct open pit mining and transporting of ore-bearing material and waste rock using a 2-kilometer conveyor system at the Martha Hill gold and silver mine at Waihi, Coromandel Peninsula, North Island. During the period of the contract, Downer Mining will move about 10 million cubic meters of ore and waste. The Martha Hill Mine was officially opened in mid-June and planned to produce 57,000 ounces of gold and 300,000 ounces of silver per year. Minable reserves were estimated to be 8.2 million tons of ore grading 2.9 grams of gold per ton, sufficient for a 12-year mine life.[10] Interest in the project was held by Amax Gold Mines (New Zealand), 28.35%; Australian Consolidated Minerals Ltd., 28.35%; Mineral Resources (N.Z.) Ltd., 27.84%; and Goodman Mining, 15.46%.

BHP Gold Mines (NZ), 70%, and Home Reef Mining, 30%, announced plans to develop New Zealand's second largest gold mine at its Round Hill Deposit at Macraes Flat, north of Dunedin on South Island. Initially, the open pit planned to process 500,000 tons of ore per year, yielding about 32,000 ounces of gold annually. After 2

TABLE 10

NEW ZEALAND: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS				
Alkali and rare-earth metals value, thousands	$17	$13	$6	Japan $2; Australia $1.
Aluminum:				
Ore and concentrate	1,550	1,114	—	Guyana 1,014; Japan 100.
Oxides and hydroxides	445,789	507,712	70	Australia 499,461; Japan 7,273; United Kingdom 612.
Metal including alloys:				
Scrap	42	752	—	Australia 693; Samoa 17; Fiji 12.
Unwrought	288	2,726	5	Australia 2,497; Netherlands 140; United Kingdom 83.
Semimanufactures	6,505	10,817	144	Australia 7,675; Canada 1,063; Japan 509.
Chromium:				
Ore and concentrate	18	116	—	All from Republic of South Africa.
Oxides and hydroxides	163	112	16	West Germany 65; United Kingdom 18.
Cobalt: Oxides and hydroxides	5	13	1	Finland 6; Australia 4.
Columbium and tantalum: Metal including alloys, all forms: Tantalum value, thousands	NA	$1	—	All from Canada.
Copper: Metal including alloys:				
Unwrought	1,487	2,451	3	Australia 1,679; West Germany 738; Finland 17.
Semimanufactures[2]	16,989	16,261	184	Australia 6,884; Japan 711.
Iron and steel:				
Iron ore and concentrate excluding roasted pyrite	41	36	—	All from Australia.
Metal:				
Scrap value, thousands	$766	$413	—	French Polynesia $255; New Caledonia $115; Fiji $43.
Pig iron, cast iron, related materials	929	935	6	Australia 607; United Kingdom 182; Sweden 96.
Ferroalloys:				
Ferromanganese	923	570	—	West Germany 369; Australia 168; Belgium-Luxembourg 22.
Unspecified	2,754	3,504	167	Australia 3,139; United Kingdom 46.
Steel, primary forms	38	123	11	Australia 103; United Kingdom 6.
Semimanufactures:				
Bars, rods, angles, shapes, sections	73,703	91,102	43	Australia 41,106; United Kingdom 23,538; Japan 19,534.
Universals, plates, sheets	347,548	369,267	373	Japan 291,140; Australia 36,695; Republic of Korea 18,534.
Hoop and strip	16,599	15,099	51	Australia 9,426; Japan 3,829; Republic of Korea 592.
Rails and accessories	6,821	1,504	2	Australia 654; Japan 385; United Kingdom 379.

See footnotes at end of table.

TABLE 10—Continued

NEW ZEALAND: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS—Continued				
Iron and steel—Continued				
Metal—Continued				
Semimanufactures—Continued				
Wire	14,512	16,242	63	Australia 6,665; Republic of Korea 4,036; United Kingdom 1,684.
Tubes, pipes, fittings	24,317	36,499	1,165	Australia 16,365; Japan 11,982; Republic of Korea 2,907.
Castings and forgings, rough	68	15	—	Australia 10; Italy 3.
Lead:				
Oxides	105	81	9	United Kingdom 41; Australia 27.
Metal including alloys:				
Scrap	123	82	—	Australia 40; Fiji 38.
Unwrought	3,699	4,091	1	Australia 4,085; United Kingdom 4.
Semimanufactures	123	113	([3])	Australia 108.
Magnesium: Metal including alloys:				
Unwrought value, thousands	$796	$880	$84	Norway $741; United Kingdom $30.
Semimanufactures	14	28	2	Japan 13; Canada 11.
Manganese:				
Ore and concentrate: Metallurgical-grade	27	102	3	Singapore 85; Republic of South Africa 10.
Oxides	712	574	1	Japan 361; Australia 197; Republic of South Africa 12.
Mercury value, thousands	$11	$11	—	Australia $4; Japan $2; Spain $2.
Molybdenum: Metal including alloys, all forms do.	$95	$83	$16	United Kingdom $23; Australia $9.
Nickel:				
Metal including alloys:				
Scrap	—	2	—	Australia 1; Canada 1.
Unwrought	19	52	—	Canada 21; Norway 18; Australia 6.
Semimanufactures	169	245	157	Canada 41; Australia 26.
Platinum-group metals: Metals including alloys, unwrought and partly wrought value, thousands	$308	$389	$9	United Kingdom $257; West Germany $63; Australia $34.
Silver:				
Waste and sweepings[4] do.	$100	$63	—	All from Australia.
Metal including alloys, unwrought and partly wrought do.	$1,391	$1,960	$18	Australia $1,805; United Kingdom $90; West Germany $32.
Tin: Metal including alloys, all forms	194	1,086	1	Republic of Korea 733; Australia 264; Malaysia 72.
Titanium: Oxides	1,274	1,015	69	Finland 447; Australia 346; Japan 86.
Tungsten: Metal including alloys, all forms value, thousands	$448	$687	$60	Belgium-Luxembourg $212; Netherlands $170; United Kingdom $140.

See footnotes at end of table.

TABLE 10—Continued

NEW ZEALAND: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS—Continued				
Zinc:				
Oxides	362	522	—	Australia 365; China 63; Republic of South Africa 36.
Metal including alloys:				
Unwrought	17,871	18,293	—	Australia 11,272; Canada 7,019.
Semimanufactures[5]	42	395	3	Australia 367; West Germany 12; United Kingdom 10.
Other:				
Ores and concentrates	612	455	2	Australia 208; Japan 200; Republic of South Africa 22.
Base metals including alloys, all forms value, thousands	$376	$457	$26	United Kingdom $177; Australia $137; China $44.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	240	123	67	Australia 24; Italy 20.
Artificial: Corundum	278	130	66	Australia 52; Italy 8.
Dust and powder of precious and semiprecious stones including diamond value, thousands	$197	$196	$69	Ireland $110; United Kingdom $13.
Grinding and polishing wheels and stones do.	$2,063	$2,633	$331	Australia $494; United Kingdom $363.
Asbestos, crude	896	22	—	Canada 19; United Kingdom 3.
Barite and witherite	2,833	2,877	—	Singapore 1,114; Thailand 773; China 713.
Boron materials:				
Crude natural borates value, thousands	$170	$276	$51	Netherlands $224.
Oxides and acids	1,795	994	902	Italy 73; Australia 17.
Cement	2,727	14,506	33	Republic of Korea 11,335; Singapore 1,489; Australia 472.
Chalk	769	648	2	United Kingdom 567; Australia 53; Spain 20.
Clays, crude	13,277	17,307	3,416	Australia 9,118; Republic of South Africa 2,418.
Cryolite and chiolite	59	693	—	All from Denmark.
Diamond:				
Gem, not set or strung value, thousands	$5,383	$7,374	$327	India $3,778; Israel $1,163; Australia $783.
Industrial stones do.	$356	$222	$3	Australia $207; Hong Kong $5; Zaire $4.
Diatomite and other infusorial earth	1,612	2,115	1,412	Australia 376; Philippines 169.
Feldspar, fluorspar, related materials	684	933	5	Norway 408; Canada 326; Australia 82.
Fertilizer materials:				
Crude, n.e.s.	10,325	6,630	6,598	United Kingdom 32.
Manufactured:				
Ammonia	44	2	([3])	United Kingdom 1.
Nitrogenous value, thousands	$6,554	$7,902	$2,902	West Germany $2,150; Japan $1,195.

See footnotes at end of table.

TABLE 10—Continued

NEW ZEALAND: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987 United States	Sources, 1987 Other (principal)
INDUSTRIAL MINERALS—Continued				
Fertilizer materials—Continued				
Manufactured—Continued				
Phosphatic	39,340	223,679	90,819	Morocco 50,485; Israel 419,767.
Potassic	71,715	123,686	52,516	Canada 37,702; Jordan 14,584.
Unspecified and mixed value, thousands	$3,801	$8,124	$970	West Germany $4,139; Canada $2,356.
Graphite, natural	143	55	([3])	Sri Lanka 36; United Kingdom 17; Australia 1.
Gypsum and plaster	171,862	130,523	31	Australia 114,151, Thailand 16,000; West Germany 181.
Lime	5	7	5	Australia 2.
Magnesite, all forms	4,276	4,591	55	China 4,178; United Kingdom 133; Australia 115.
Mica:				
Crude including splittings and waste value, thousands	$162	$214	$14	China $51; Australia $25; India $25.
Worked including agglomerated splittings do.	$181	$142	$12	United Kingdom $50; Belgium-Luxembourg $31; Australia $23.
Phosphates, crude	278,132	489,916	51,152	Nauru 203,184; Christmas Island 149,279; Israel 69,153.
Pigments, mineral: Iron oxides and hydroxides, processed	1,610	1,788	13	West Germany 1,614; United Kingdom 57; Spain 36.
Potassium salts, crude	96	7,019	—	All from Israel.
Precious and semiprecious stones other than diamond:				
Natural value, thousands	$2,457	$3,853	$38	Australia $1,348; Thailand $1,301; Hong Kong $586.
Synthetic do.	$106	$152	$100	West Germany $25; Thailand $16.
Pyrite, unroasted	23	9	—	All from Italy.
Salt and brine	88,221	62,719	1	Netherlands Antilles 32,739; Australia 29,733; Pakistan 242.
Sodium compounds, n.e.s.: Carbonate, manufactured	35,866	30,609	28,672	Australia 1,733; United Kingdom 112.
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked	2,896	3,697	7	Italy 1,284; Republic of South Africa 1,127; Zimbabwe 271.
Worked value, thousands	$2,686	$4,792	$47	Italy $1,863; China $655; Republic of South Africa $599.
Dolomite, chiefly refractory-grade	14	14	1	West Germany 12.
Gravel and crushed rock	100	80	—	Australia 30; France 21; United Kingdom 18.
Quartz and quartzite	170	262	2	Australia 173; Sweden 45; Zimbabwe 17.
Sand other than metal-bearing	409	432	79	Australia 203; Japan 89.

See footnotes at end of table.

TABLE 10—Continued

NEW ZEALAND: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987	
				United States	Other (principal)
INDUSTRIAL MINERALS—Continued					
Sulfur:					
Elemental:					
Crude including native and byproduct		95,964	84,121	28,051	Canada 55,109; Saudi Arabia 936.
Colloidal, precipitated, sublimed		843	278	—	Australia 260; Canada 18.
Sulfuric acid		29	56	([3])	United Kingdom 17; Australia 14; China 2.
Talc, steatite, soapstone, pyrophyllite		1,931	2,308	25	Australia 1,199; China 1,036; United Kingdom 40.
Other:					
Crude	value, thousands	$417	$480	$15	Republic of South Africa $140; Austria $131; China $52.
Slag and dross, not metal-bearing		746	820	3	Australia 546; West Germany 271.
MINERAL FUELS AND RELATED MATERIALS					
Asphalt and bitumen, natural		115	22	NA	Trinidad and Tabago 20.
Carbon black		6,175	6,357	107	Australia 5,891; Japan 163.
Coal:					
Anthracite and bituminous		339	875	11	United Kingdom 602; Japan 100; Australia 94.
Briquets of anthracite and bituminous coal		292	259	—	All from Australia.
Lignite including briquets		8	36	—	Do.
Coke and semicoke	value, thousands	$262	$434	$29	Australia $387; West Germany $18.
Peat including briquets and litter	do.	—	$1	$1	
Petroleum:					
Crude	thousand 42-gallon barrels	8,472	15,565	588	Saudi Arabia 8,917; Australia 3,175; Indonesia 1,644.
Refinery products:					
Liquified petroleum gas	value, thousands	$421	$51	$10	Netherlands $17; Sweden $13.
Gasoline, motor	do.	$110,371	$105,271	$31,856	Australia $23,399; Saudi Arabia $20,738.
Mineral jelly and wax	do.	$2,623	$3,374	$666	China $1,244; Japan $542.
Kerosene and jet fuel	do.	$85,226	$17,621	$361	Singapore $12,637; Australia $4,482.
Distillate fuel oil	do.	$96,732	$19,742	$723	China $5,110; Singapore $4,969; Venezuela $4,762.
Lubricants	do.	$22,617	$27,071	$3,608	Australia $13,889; Singapore $5,953.
Residual fuel oil	do.	$14,776	$2,685	—	All from Australia.
Bitumen and other residues	42-gallon barrels	1,157	279	—	Mainly for Belgium-Luxembourg.
Bituminous mixtures	do.	90,761	1,182	152	Australia 551; United Kingdom 479.
Petroleum coke	do.	588,230	475,788	469,210	Australia 6,512; Japan 66.

NA Not available.

[1] Table prepared by Giovanni Jacarepaqua.

[2] Excludes unreported quantities valued at $3,055,000 in 1986 and $2,367,000 in 1987.

[3] Less than 1/2 unit.

[4] May include other precious metals.

[5] Excludes unreported quantities valued at $561,000 in 1986 and $534,000 in 1987.

years of production, throughput is expected to increase to 750,000 tons per year, with output of gold rising to about 48,000 ounces per year. The project was expected to have an 8-year mine life. The operation will consist of a main open pit located on Round Hill, a process plant and two tailings dams; a second pit will also be developed at the site. BHP Gold acquired its interest in the project as part of its purchase of Homestake New Zealand Exploration in 1987.

L&M Mining Ltd., 84% owned by Aur NL, commissioned the plant on its Rimu gold project and poured its first gold bar in June, both ahead of schedule. The project is near Hokitika on the west coast of South Island and was designed to treat 1.6 million cubic meters of alluvial material to recover 10,000 ounces of gold per year; however, initial trials indicated that the throughput should be well above this. The Rimu feasibility study projected a mine life of 4 years. L&M Mining also entered into a joint venture with Austpac Gold Exploration (N.Z.) Ltd. and Spectrum Resources Ltd. to conduct exploration drilling at the Ohui gold and silver prospect, eastern Coromandel Peninsula. Austpac Gold will remain project manager during this phase. L&M Mining also mined alluvial gold from plants on the Shotover River, Kawarau River, and Kennedy Creek, all on the west coast of South Island.

Golden Shamrock Mines Ltd. of Australia entered into an agreement with CRA Exploration Ltd. to reopen the historic Blackwater gold mine near Reefton on South Island. The Blackwater Mine, New Zealand's historically second largest gold producer, mined over 680,000 ounces of gold at a recovered grade of 14 grams per ton between 1908 and 1951. The mine was closed owing to postwar materials and worker shortages even though proven ore reserves still existed. Golden Shamrock will earn a 49% interest in the project from CRA Exploration, which owns the Prospecting License covering the area, by reopening the old mine workings, conducting a short-term drilling program, and completing a mine feasibility study. Target production was planned to be 25,000 ounces of gold per year.[11]

Iron and Steel.—Equiticorp, the diversified manufacturing and financial group which took an 80% interest in New Zealand Steel Ltd. late in 1987 and operator of the Glenbrook Steelworks, transferred this holding to its 78% subsidiary Feltrax International, whose main business was floor coverings. However, the steel company was expected to continue to operate under its own board of directors and its own management. Near yearend, Equiticorp put its 80% share in New Zealand Steel up for sale. It was widely speculated that Fletcher Challenge was the leading contender to purchase this share as well as Fisher & Paykel Ltd.'s 20% share. The Government's Commerce Commission granted conditional approval for Fletcher Challenge to buy up the whole of New Zealand Steel's shares on the condition that Fletcher Challenge dispose of its wholly owned coil-coating subsidiary, Pacific Coil Coaters Ltd., within 6 months. New Zealand Steel was the country's only other producer of coated coil. Fletcher Challenge also had a majority stake in Pacific Steel Ltd., a minimill making wire rod, bar, and light sections including angles and channels, but which had no major product overlap with New Zealand Steel.

New Zealand Steel brought its hot-strip mill on-stream and began commercial production in February. All of the company's planned plant expansion was completed and fully on-stream during the year. The rolling mills were running nearly 8 months ahead of target and achieving yields significantly better than previously planned. Total steelmaking capacity was planned to be 750,000 tons per year, up from 350,000 tons per year, with full production expected in late 1991 or early 1992.

Titanium.—A new process for titanium dioxide production entirely distinct from either the conventional chloride or sulfate route processes, reportedly was being developed by Fletcher Titanium Products Ltd., a wholly owned subsidiary of Fletcher Challenge. Fletcher Challenge had been operating a simplified pilot plant, but was planning to build a 3,000-ton-per-year demonstration plant in Wellington. The plant was scheduled for commissioning in early 1990. Fletcher Challenge also was developing a major ilmenite resource on the west coast of South Island, with a pilot mine expected to start production in mid-1989 to provide bulk samples for the demonstration plant as well as for potential customers.

Mineral Fuels.—**Natural Gas and Petroleum.**—The Government sold its 70% share of Petrocorp to Fletcher Challenge on March 3 for $531.6 million.[12] The proceeds of the sale were to be used to retire some of the country's overseas debt. The agreement will enable the Government to demand to buy 100 million shares of Fletcher Challenge within 4 years time at $4.15 a share. This would allow the Government to get back into the oil industry if it so desires, e.g., if there were another oil shock sending prices skyrocketing. Conversely, Fletcher Challenge can force the Government to buy 100 million shares of its stock, exercisable within 4 years at $2.66 per share, should, e.g., the bottom drop out of the oil market. The New Zealand investment group, Brierley Investments, had previously bought 15% of Petrocorp directly from the Government in 1987, and another 15% had been floated to the public that year. Since the Fletcher Challenge-New Zealand Government deal in March, Fletcher Challenge bought Brierley's holding and made an offer for the remainder of the public shares; whether or not these were obtained by yearend was not available.

Petrocorp, plus its subsidiaries, was

New Zealand's leading oil and natural gas producer in 1988. It held a 50% interest in the offshore Maui gas-condensate field and 100% of the onshore McKee Oilfield. Maui provided almost 90% of New Zealand's gas supply, while its condensate production, along with crude oil from McKee, provided about 30% of New Zealand's liquid fuel requirements. Natural gas from the Maui Field and the onshore Kapuni Field was distributed throughout North Island by a network of underground pipelines operated by Petrocorp.

The Government's petroleum sector reform bill, proposed near yearend 1987, was enacted early in the year, becoming law on April 1. The deregulation came after decades of strict Government control of prices, ownership of service stations, and all other aspects of gasoline distribution and retailing in the country.

PAPUA NEW GUINEA

Papua New Guinea's economy remained agrarian, relying on such crops as coffee, copra, and copra and palm oils for export earnings, and relying domestically upon subsistence agriculture. Mining was the only large scale industry. The estimated GDP was $3.3 billion,[13] which was about evenly divided among agriculture, industry, and services. The mineral industry of the country accounted for about 20% of the GDP.

Rich mineral and petroleum deposits were in Papua New Guinea. The country had two of the world's largest mines, Ok Tedi and Panguna (Bougainville). It was the 7th largest gold-producing and 11th largest copper-producing country in the world in 1987. Petroleum exploration increased dramatically in recent years; more than 100 exploration wells were expected to be drilled during the next several years.

Government Policies and Programs

The Government decided in midyear to establish the Mineral Resource Development Co. (MRDC), a holding company, to purchase state equity in mining projects. The Cabinet approved a state guarantee for MRDC to obtain loans totaling about $42 million for the purchase of a 20% equity in the Misima project. MRDC purchased the 20% equity in the Misima project later in the year. MRDC also was to accept the state's 10% option on the Porgera project, but had not done so by yearend.

Early in the year, mining companies lost their exemption from registration, according to the investment laws administered by the National Investment and Development Authority (NIDA). The exemption originally was to encourage investment in a new industry in a newly independent country. The exemption had been granted only to Bougainville Copper Ltd. and Ok Tedi Mining Ltd. The exempted companies dealt directly with the Department of Minerals and Energy, not the NIDA.

Commodity Review

Metals.—**Copper.**—Although violence and industrial disputes caused disruptions to mining operations at the Ok Tedi and Panguna (Bougainville) copper-gold-silver mines, both operations increased their net profits for the year. The work stoppages at Ok Tedi were predominantly concerned with housing conditions, eligibility requirements, and job grading structures. The troubles at Panguna centered on the demands of local landowners for the equivalent of almost $4 billion in compensation for the environmental effects of mining activity on the area, the "loss" of their land, and their objection to the presence of immigrant tribal highlanders from the main island of New Guinea.

Healthy copper prices throughout the year compensated for a decline, from about 173,000 to about 171,000 tons, in sales of concentrates of contained copper at the Panguna open pit. The mine at Panguna was owned 53.6% by Australia's CRA Ltd.'s wholly owned subsidiary Bougainville Copper Ltd. (BCL), 26.4% by public shareholders, and 20% by the Government. The Panguna Mine, one of the world's largest copper producers, was on Bougainville Island in North Solomons Province. Since its commissioning in 1972, the mine produced 45% of the country's export earnings, which is three times higher than the next export earner, coffee.[14] The mine also accounted for about 16% of the country's internal revenue.

During the year, BCL expanded its ore milling, crushing, and flotation throughput rates and achieved design capacity at the preconcentration screening plant installed in 1987. As a result, an additional 200 million tons of ore, at 0.34% copper and 0.01 ounce of gold per short ton, became recoverable reserves available for milling. The total mill feed reserves at the end of the year were an estimated 710 million tons averaging 0.40% copper and 0.01 ounce of gold per short ton. Milling capacity was expanded to 52,000 tons of ore per year by the addition of a 15th ball mill.

Ok Tedi Mining Ltd. (OTML), in addition to the effect of buoyant copper prices, attained its net earnings increase by an improved operating performance and by the commencement of copper concentrate production after the commissioning of its second mill. OTML was the operator of the large open pit operation, and Australia's BHP-Utah Minerals International Inc. was the managing shareholder with 30%. The other shareholders were Amoco Minerals Co. (Standard Oil Co., Indiana, United States), 30%; the Government, 20%; and a consortium of Metallgesellschaft AG, Degussa AG, and the state-owned West German Development Co., 20%. The Ok Tedi Mine was on Mount Fubilan in the Star Mountains of Western Province, 25 kilometers from the Indonesian Province of Irian Jaya.

As a result of the work stoppages, Ok Tedi ceased processing gold prematurely, which hastened the company's conversion from being a copper and gold producer to being a producer of copper that had a high gold value in the concentrate. The expansion of mine capacity to 70,000 tons per day was delayed several weeks.

Gold.—A feasibility study for development of the Porgera gold-silver mine was submitted to the Government in midyear by the partners in the Porgera joint venture. The Porgera prospect was situated in the central highlands region of Enga Province, approximately 100 kilometers northeast of Mount Hagen. Partners in the joint venture were Placer (PNG) Pty. Ltd. (acting as manager), wholly owned by Placer Pacific Pty. Ltd.; Highlands Gold Properties Ltd., a wholly owned subsidiary of MIM Holdings Ltd. of Australia; and RGC (Papua New Guinea) Pty. Ltd., wholly owned by Renison Goldfields Consolidated Ltd. Each had a one-third interest in the venture, although the Government had the option to acquire up to a 10% share in the project.

The study covered an open pit operation of an estimated 50.6 million tons of ore, grading 0.12 ounce of gold per short ton and 0.29 ounce of silver per short ton, and an underground operation of about 3.6 million tons of ore grading 0.66 ounce of gold per short ton and 0.84 ounce of silver per short ton. The project was expected to produce 800,000 ounces of gold per year during its first 6 years of operation and 9 million ounces during the 19-year life of the mine.

The feasibility study for the 43-million-ounce gold deposit on Lihir Island, off New Ireland in the Bismarck Archipelago, was planned to be completed by mid-1989, by the Kennecott Niugini Mining Ltd. partners. The study was to be submitted to the Government a few months later. Partners in the Kennecott Niugini joint venture were Kennecott Explorations (Australia) Ltd., 80% (acting as manager), and Niugini Mining Ltd. of Australia, 20%. The Lihir deposit, at 43 million ounces of gold at a nominal cutoff grade of 0.03 ounce per short ton, was the largest deposit outside of the Republic of South Africa. It was estimated that 26 million ounces of gold could be recovered.

Development of the Misima Mine began in January and proceeded as planned, with construction underway on roads, a plant site, ancillary buildings, and airstrip surfacing. Fabrication was begun on all major mining and processing equipment, including the power-generating plant.

Misima, managed by Misima Mines Pty. Ltd., a wholly owned subsidiary of Placer Pacific Ltd., was situated on eastern Misima Island off the southeastern coast of the mainland, about 600 kilometers from Port Moresby, in Milne Bay Province. Placer Pacific held an 80% share and the Government held a 20% share in the project, which had minable ore reserves of 60 million tons grading 0.04 ounce of gold per short ton and 0.61 ounce of silver per short ton. Plant commissioning was scheduled to begin in mid-1989. Production during the 2-month commissioning period and the first 12 months of commercial operation was expected to be more than 400,000 ounces of gold and 2.6 million ounces of silver. Average annual production during the estimated 10-year life of the mine was to be 210,000 ounces of gold and 2.1 million ounces of silver.

Near yearend, Highlands Gold acquired eight additional prospecting authorities through the purchase of the domestic mineral exploration firm Fortune Mining NL.

At yearend, Seamet Ltd., an Australian mineral exploration company, combined in a joint venture with landowners at Porgera to develop alluvial gold deposits in the area. Seamet acquired a 55% interest in Porgera Gold Dredging Pty. Ltd., which, along with local partners, was to develop gold-dredging tenements for 6 kilometers along both sides of the Kogai and Porgera River systems.

Minerals Fuels.**—Petroleum.**—The Government owned all the petroleum resources in the country but was expected to license the right to others to explore, extract, and sell petroleum resources through petroleum prospecting

TABLE 11

PAPUA NEW GUINEA: PRODUCTION OF MINERAL COMMODITIES[1] [2]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987[p]	1988[e]
Copper, mine output, Cu content		164,447	175,048	178,211	217,699	[3]218,634
Gold, mine output, Au content	troy ounces	[e]835,000	1,186,618	1,127,686	1,069,011	[3] [4]1,225,874
Silver, mine output, Ag content	do.	1,427,491	1,482,533	1,787,000	1,963,315	[3]2,263,666

[e] Estimated. [p] Preliminary.
[1] Table includes data available through Aug. 1, 1989.
[2] In addition to the commodities listed, crude construction materials (common clays, sand and gravel, and stone) are produced, but output is not reported quantitatively, and available general information is inadequate to make reliable estimates of output levels.
[3] Reported figure.
[4] Figure does not include an estimated 300,000 troy ounces of alluvial gold not legally reported from Mount Kare.

TABLE 12

PAPUA NEW GUINEA: EXPORTS OF COPPER IN CONCENTRATES, BY DESTINATION

(Metric tons of copper content)

Destination	1987	1988
China	9,296	7,436
Germany, Federal Republic of	r60,283	45,657
Japan	r74,358	108,938
Korea, Republic of	r51,473	22,754
Spain	15,095	7,413
Unspecified	6,226	29,693
Total	**r216,731**	**221,891**

r Revised.

Source: World Metal Statistics, July 1989.

and developing licenses.

Meaningful petroleum exploration in the country was concentrated in the prospecting license operated by Chevron Niugini. Chevron, acting as manager, held a 25% equity. Its partners were British Petroleum, 25%; and the Australian firms Pioneer Concrete Services Ltd., 15%; BHP Ltd., 12.5%; Oil Search Ltd., 10%; Ampol Exploration Ltd., 6.25%; and Merlin Petroleum NL, 6.25%. Chevron's license was in the potentially large Iagifu Field, which the company discovered in the Papuan Basin in 1986. The Iagifu Field contained an estimated 100 million barrels of recoverable oil. At yearend, development work had not begun because of large associated infrastructural costs; these included the cost of building a 700-kilometer pipeline from the Field and a marine terminal 40 kilometers offshore in the shallow Gulf of Papua.

Giant Resources Ltd., the Australian petroleum company, began exploration drilling at Wabau 1 in Southern Highlands Province at yearend. Wabau 1 was on a linear trend with the large petroleum prospects at Iagifu and Hedinia, about 100 kilometers to the northwest, and the Puri discovery to the southeast.

SOLOMON ISLANDS

The mineral sector of the Solomon Islands historically has had an insignificant role in the nation's economy. Production was limited to only small quantities of clays, crushed stone, and sand and gravel used in domestic construction, and minor amounts of alluvial gold, which was exported.

However, a large-scale gold mine, the country's first, commenced operating late in 1985 at Mavu on the island of Guadalcanal, 30 kilometers southeast of the capital city of Honiara. The mine recovered gold from alluvial gravel on the upper reaches of the Chovohio River. It was operated by the Australian firm Zanex Ltd. (70%) and the local firm Mavu Gold Development Ltd. (30%) through a joint venture named Zanex Mavu. Production was suspended late in 1986 when the recovery plant was destroyed by a tropical cyclone. Operations resumed in mid-1987, but the facility was plagued with low grade ores near yearend and closed in early 1988.

Arimco (Solomon Islands) Ltd., an equal joint venture of Cyprus Minerals (Solomon) Ltd., a subsidiary of Cyprus Minerals Australia Co., and Arimco NL, continued its assessment for development of the large low-grade epithermal gold deposit at Gold Ridge in the Central Highland Range on Guadalcanal. Reportedly, sufficient reserves had been identified to support an 8-year surface operation. Cyprus began exploration work on this project in 1983. Early in 1987, Arimco agreed to spend \$3.5 million[15] over a 3-year period for exploration and development in exchange for a 50% interest. The bedrock and eluvium gold deposit at Gold Ridge was upstream from and the source material for the Mavu alluvial deposit.

Most of the country was covered by applications for prospecting licenses or by issued licenses. In addition to the companies already mentioned, at least two other companies were actively conducting exploration programs within the country; these included programs

TABLE 13

SOLOMON ISLANDS: PRODUCTION OF MINERAL COMMODITIES[1 2]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987p	1988e
Gold, mine output, Au content	troy ounces	2,572	2,100	3,150	e4,000	31,511
Silver, mine output, Ag content	do.	—	—	—	—	3257

e Estimated. p Preliminary.

1 Table includes data available through Aug. 1, 1989.

2 In addition to the commodities listed, crude construction materials (common clays, sand and gravel, and stone) are produced, but output is not reported quantitatively, and available general information is inadequate to make reliable estimates of output levels.

3 Reported figure.

by Newmont Pty. Ltd. on Vangunu and New Georgia Islands and by BHP Ltd. on Guadalcanal and several of the lesser islands.

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[1] Physical scientist, Division of International Minerals.

[2] Excluding the centrally planned economy countries.

[3] Converted from Australian dollars (A$) to U.S. dollars at the rate of A$1.00 = US$0.7009 in 1987 and A$1.00 = US$0.7842 in 1988.

[4] Where necessary, values have been converted from Fijian dollars (F$) to U.S. dollars at the rate of F$1.6 = US$1.00.

[5] Mining Journal (London). V. 311, No. 7980. Aug. 5, 1988, p. 100.

[6] Industrial Minerals (London). Chromite: Ladles Refine Demand. No. 257, Feb. 1989, p. 36.

[7] Mining Journal (London). V. 311, No. 7999. Dec. 16, 1988, p. 480.

[8] Where necessary, values have been converted from New Zealand dollars (NZ$) to U.S. dollars at the rate of NZ$1.61 = US$1.00.

[9] The New Zealand fiscal year ends on Mar. 31 of the year stated.

[10] Mining Journal (London). V. 310, No. 7974, June 24, 1988, p. 512.

[11] ———. V. 159, No. 6, Dec. 1988, p. 464.

[12] Far Eastern Economic Review (Hong Kong). V. 136, No. 11, Mar. 17, 1988, p. 66.

[13] Where necessary, values have been converted from the Papua New Guinean kina (K) to U.S. dollars at the rate of K0.85 = US$1.00.

[14] Mining Journal (London). V. 312, No. 8015. Apr. 14, 1989, p. 266.

[15] Where necessary, values have been converted from the Solomon Islander dollars (S$) to U.S. dollars at the rate of S$2.06 = US$1.00.

THE MINERAL INDUSTRIES OF

THE BALKAN COUNTRIES

By Donald E. Buck, Jr., John G. Panulas, and Walter G. Steblez

ALBANIA[1]

Introduction

In 1988, Albania's centrally planned economy continued to decline. The country's officially published yearend economic report did not contain concrete results such as the growth of national income or industrial output.[2] The shortfall for central budget earnings for 1988 amounted to 9% below the planned target. Losses in industry were attributed to poor management and organization, as well as to low technical standards and excessive consumption of fuels and raw materials. The construction, energy, and mining sectors of industry did not meet their annual production plans. As in 1987, within these sectors, the chromite and petroleum extracting and processing industries continued to lag in output. Both chromite and petroleum remained Albania's chief sources of foreign exchange; the production downturn of these commodities continued to negatively affect the country's foreign trade position, especially in view of constitutional prohibitions against using foreign credit to finance trade. The chief events in the minerals industry in 1988 included the construction startup of the first of four planned new concentrators at the Bulqize chromite mine, as well as the construction startup of new ferrochromium capacities at Elbasan. Also, the copper mining industry reported the completion of facility expansion at the Perlat mine in the Midrite district. Albania began new facility construction at the Dinamo heavy-equipment enterprise at Tirana to maximize self-sufficiency in mining equipment production. Upon completion, the new factory would double the output of mining equipment at the enterprise and would introduce new designs for electric trucks and pneumatic drills for the mining industry. The new facility would also increase the production of new machinery and equipment for the country's beneficiation plants.

Government Policies and Programs

The Albanian Government continued to expand commercial and diplomatic contacts with Western European countries to end its self-imposed isolation in Europe. In 1988, Albania participated for the first time in a regional conference of Balkan countries on political and economic issues in Belgrade, Yugoslavia. Also, discussions were held during the year with French Government representatives at the first session of the Albanian-French Joint Commission of Economic, Industrial and Technical Cooperation in Tirana, concerning a French Government offer of technical assistance to increase Albania's production of chromite and petroleum.

The central economic draft plan for 1989 set the growth rate of industrial production at 6% and that of exports at 19.6% compared with those of 1988. Planned targets for the growth rates of national income and individual branches of industry were not provided.

Production

Albania's mineral industry was entirely state-owned and operated and subject to strict central planning. In 1988, severe drought caused significant water reduction to the country's hydroelectric powerplants and industrial facilities, which slowed industrial activity during the year. The chromite mining and processing industry was among a number of industrial branches that were affected by shortages of electricity. Reportedly, the completion of unfinished construction projects, such as the nickel-cobalt plant at Elbasan was partly held up because of a lack of electricity. Albania's other industrial and economic bottlenecks were systemic, caused by the central planning usage of gross output indicators to measure industrial output, rather than by setting production goals to meet the needs of end users.

Trade

Although Albania continued to expand its commercial agreements with Western European market economies, most of the country's foreign trade was conducted with the centrally planned economy countries in Eastern Europe, as well as with China, North Korea, and Vietnam. Albania exported crude minerals and semimanufactures such as bitumen, chromite, and copper cable in exchange for capital equipment, spare parts, coal, and semimanufactures. Because Albania's foreign commercial policy forbade credit borrowing from international lending institutions to finance trade, foreign commerce was largely transacted on a barter basis. Trade with the United States and the Soviet Union was conducted through transshipment by intermediaries because of Albania's long-term policy of avoiding political contact and/or diplomatic relations with these countries. The United States has routinely shipped coking coal to Albania, which, in 1987, amounted to 75,553 short tons.

Commodity Review

Metals.—**Chromite.**—Chromite, copper, and nickel and cobalt-bearing iron ores were Albania's most important mined metallic mineral commodities. The country remained a leading producer and exporter of chromite, which constituted a major portion of Albania's hard-currency income. Albania also recently had begun to develop and exploit its bauxite deposits in the country's northern alpine region and at Kruja; exports of bauxite began in 1986. Although little information was available on Albania's gold deposits, the country's chalcopyrite and chalcocite copper ores were reported to contain from 2 to 3 grams of gold per ton.[3] Reportedly, Albania had numerous alluvial deposits containing ilmenite, rare earths, rutile, and zirconium.

In August, Albania announced the discovery of a new chromite deposit at Pojske in the Pogredec district, but no details were provided regarding the size of the deposit or the grade of ore. In conjunction with the continuing expansion of facilities at the Bulqize mine,

TABLE 1

ALBANIA: ESTIMATED PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1984	1985	1986	1987	1988
Asphalt and bitumen, natural[3]	thousand tons	900	900	950	950	900
Cement, hydraulic	do.	840	850	850	860	800
Chromium:						
Chromite, gross weight	do.	[4]960	[4]1,100	1,200	1,200	1,000
Marketable ore	do.	720	825	850	830	750
Coal: Lignite	do.	[4]2,010	2,195	2,200	2,100	2,100
Cobalt, mine output, Co content[5]		600	600	650	650	650
Copper:						
Ore:						
Gross weight	thousand tons	[4]1,007	1,010	1,100	1,100	1,100
Cu content		16,100	16,200	17,600	17,800	17,800
Metal, primary:						
Smelter		[4]12,600	12,600	13,700	14,000	14,500
Refined		11,500	11,500	11,700	12,000	13,000
Gas, natural, gross production[6]	million cubic feet	17,500	13,500	16,000	16,000	15,000
Iron and steel:						
Iron ore, nickeliferous:						
Gross weight		[4]1,082,000	1,130,000	1,200,000	1,200,000	1,200,000
Iron content		360,000	376,000	400,000	400,000	400,000
Ferroalloys, ferrochromium		40,000	43,000	45,000	46,000	46,000
Nickel, mine output, Ni content		9,200	9,600	9,700	9,000	9,000
Nitrogen: N content of ammonia		80,000	80,000	80,000	80,000	80,000
Petroleum:						
Crude:						
Weight	thousand tons	1,400	1,400	1,500	1,500	1,600
Converted	thousand 42-gallon barrels	9,800	9,800	9,900	9,900	9,900
Refinery products		9,000	9,000	9,000	9,000	9,000
Salt		70,000	70,000	70,000	75,000	70,000
Sodium compounds, n.e.s.: Carbonate, calcined (soda ash)		25,000	31,000	33,000	31,000	30,000

[1] Table includes data available through July 1988.
[2] In addition to the commodities listed, a variety of industrial minerals and crude construction materials (bauxite, common clay, quartz, olivinite, dolomite, titanomagnetite, sand and gravel, and stone) are produced, but output is not reported quantitively and available information is inadequate to make reliable estimates of output levels. Also, metallic nickel production reportedly began in 1978, but data on the level of production are not available.
[3] Includes petroleum refinery-produced asphalt and bitumen.
[4] Reported figure.
[5] Calculated from reported and estimated weight of nickeliferous ore; the amount of cobalt recovered, if any, is conjectural.
[6] Separate data on marketable production are not available, but gross and marketed output are regarded as nearly equal.

Albania announced plans to build four new beneficiation plants near the mine to double the production of concentrate. The Bulquize mine was the largest producer of Albania's marketable metallurgical-grade chromite. To reduce ore transportation costs, the construction of a 3,300-meter-long tunnel began early in the year that would link the Kalimash 1 and Kalimash 2 mines to their concentrator. Late in the year, construction was started of a second ferrochromium plant at Elbasan. Upon completion, the new plant would process 100,000 tons of ore per year to produce 38,000 tons of ferrochromium. Albania's entire output of chromite and ferrochromium was designated for the export market. In 1988, Albania was unable to meet its export commitment to Japan, amounting to 50,000 to 60,000 tons of metallurgical-grade concentrate. One of the consignments of chromite that was received by Japan contained a substantial amount of lower grade friable chrome ore. Japanese importers suspended negotiations for new contracts pending Albania's fulfillment of its 1988 obligations.

Copper.—The construction of a new copper beneficiation plant at Gulaj in the Kukes district continued during the year. Located near the Nikoliq and Pus copper mines, the plant, when completed, would produce annually 9,000 tons of copper concentrate. Facility expansion at the Perlat copper mine in the Mirdite district was completed during the year; the new shaft began operations, equipped with a power and two pumping stations. The grade of Albanian ore ranged from 1.5% to 4% copper, and reserves were estimated to contain about 1 million tons of contained metal.

Nickel and Cobalt.—Albania's nickeliferous iron ores were found in the ultramafic massifs in the Mirdita region, near Kukes, Libradzh, and Pogradec, as well as in the Korce region. Reserves were estimated at 300 million tons, containing 17.6% iron, 1.4% nickel, and 0.05% cobalt. The recoverable metal content of the reserve base amounted to about 150,000 tons of cobalt and 4.2 million tons of nickel. The startup of operations at Albania's nickel-cobalt refinery at Elbasan, scheduled for the second half of 1988, was again delayed owing to technical difficulties.

Industrial Minerals.—Albania's deposits of industrial minerals included asbestos, chalk, dolomite, magnesite, phosphate rock, and salt and native sulfur. Although most of the country's industrial mineral deposits are in an early stage of development, phosphates from the Fushe-Barda and Nivike deposits were processed at the Lac fertilizer plant primarily for domestic use. The content at these deposits was generally low grade.

Mineral Fuels.—**Petroleum.**—The petroleum industry continued to show overall decline in 1988, owing to declining reserves as well as to low productivity in the industry. Albania's petroleum was heavy, with a high tar and sulfur content. At the Patos deposit, the sulfur content was found to exceed 6%. In 1988, Albania put on-stream a new Romanian-designed lubricants plant at the Ballsh refinery at Fier. Albania's petroleum deposits were found in the east-central part of the country at Marineze, Patos, and Stalin. Albania's chief priority in the petroleum sector was to bring back most of the wells on-line with the addition of new technology. Romania remained the most promising source of new oil field equipment for Albania's industry.

BULGARIA[4]

Introduction

Bulgaria continued to be a modest producer of mineral commodities and fuels, which were sufficient for domestic needs as well as for exports. In 1988, industrial production rose 5.1% and national income by 6.2% compared with those of 1987. Bulgaria continued to streamline its economy in 1988 by decentralizing economic planning. The efficiency of the country's mineral fabricating industries was increased by reducing inputs of energy and metals.[5] The total output of metals and other mineral raw materials in 1988 rose by 3.4% compared with that of 1987, while cumulative losses during processing and fabricating were reduced by 46.4%. Despite these results, a number of enterprises in the industrial minerals, fuel, and steel sectors failed to meet 1988 centrally planned output targets. Projects that were completed during the year included the reconstruction of an electric steel furnace at the Lenin iron and steel works and the installation of the No. 3 coke battery at the Kremikovtsi steel works.

The Government's published central economic plan for 1989 lacked specific data on planned targets for individual mineral commodities. The plan called for a 6.1% increase in industrial production for 1989 compared with that of 1988 and a 6.2% growth in national income. Greater emphasis was placed on increasing the output of higher value added goods. Investment priorities would be aimed largely at high-tech electronics, industrial robotics, and computerized machine tools. The range of new and improved products was to be increased by 10% compared with that of 1988. Inefficient mining capacities would be closed down, and the anticipated growth rate of metals and energy production would be below the total industry average.[6] Mineral industry projects scheduled to come on-stream in 1989 included the "300" rolling mill at the Burgas steel works, a new mine and concentrator at the Medet-Asarel Copper Mining and Beneficiation Complex, and a new concentrator at the Osogovo lead and zinc mining and beneficiation facility.[7]

Production and Trade

Despite reforms such as management

autonomy and decentralization of economic decisionmaking at the enterprise level, the majority of Bulgaria's heavy industrial enterprises continued to be centrally planned. Gross weight output as a measure of production remained the industrial norm, allowing industry to produce goods that did not necessarily meet consumer needs. This type of inefficiency, endemic to most centrally planned economies, coupled with transportation bottlenecks, resulted in the dual problem of shortages, on the one hand, and stockpiles of unusable spare parts, machinery, and equipment, on the other. In the mining sector, the often repeated complaint was either the lack or late delivery of spare parts needed for scheduled equipment maintenance or downtime.

The Soviet Union remained Bulgaria's principal trading partner, accounting for about 60% of the country's foreign trade turnover. About 20% of the country's trade was with other centrally planned economy countries, and the balance was with developed market economy and developing countries. The Soviet Union met almost all of Bulgaria's import needs of ferroalloys, fossil fuels, iron ore, iron and steel products, and nonferrous metals. In exchange, Bulgaria has provided labor and engineering support to various mineral and mining projects in the U.S.S.R. The Soviet Union also played a major role in the development of Bulgaria's nuclear power industry, as well as the modernization of the Kremikovtsi iron and steelworks and the development of the Asarel copper deposit within the Medet-Asarel copper mining and beneficiation complex.

Within the Balkan area, Bulgaria's mineral trade with Albania was reportedly of the highest value. In 1988, Bulgaria exported chemicals, nonferrous metals, machine tools, and steel and steel products to Albania in exchange for bauxite, chromite concentrate, copper cable and wire, electricity, and nickeliferous iron ore. Bulgaria's foreign trade organization (FTO), Bulgargeomin, was responsible for all foreign commercial agreements and activities in the areas of geology, mining, and mineral processing. In early 1988, the Zimbabwe Mining Development Corp. (ZMDC) and FTO Bulgargeomin formed a joint mining venture, Zimbabwe-Bulgaria Mining Co. with a nominal capitalization of $3.4 million. According to ZMDC management, the joint venture, in the Mutoko area of Zimbabwe, would prospect for and mine pegmatites containing rare metals. The joint company would be fully responsible for mining, processing, and marketing, as well as for providing consulting services to other related businesses in the country.

In midyear, the Bulgarian FTO Chimimport was charged with alleged dumping of sodium sulfate before the European Commission by the European Council of Chemical manufacturers' Associations (CEFIC). Although the FTO Chimimport indicated to the Commission that the United States was to be the intended ultimate receiver of the sodium sulfate cargoes, the Commission showed that it had sufficient proof to open formal proceedings against Bulgaria as well as the Soviet Union. In the meantime, FTO Chimimport agreed to suspend all copper sulfate shipments to the European Community (EC).

Commodity Review

Metals.—**Copper.**—The development of the Asarel copper deposit at the Asarel-Medet Copper Mining and Beneficiation Complex remained the most significant issue in the industry. The development work was done with Soviet technical assistance through a joint Soviet-Bulgarian engineering enterprise. The open pit mine was to go on-stream in 1989 and would initially supply 50% of the ore at the Complex. Ore production from the Medet Mine would continue to decline, and the slack would be taken up by the new Asarel operation. To maximize the extraction of copper and other associated components from the low-grade ore, an experimental bacterial leaching installation was reported to be under construction at the Asarel-Medet Complex.

Iron and Steel.—Apart from a small domestic iron ore mining operation, Bulgaria's needs for iron ore and steel products were met almost entirely from Soviet exports. Soviet-Bulgarian cooperation in the field of iron and steel came under an agreement that was to be in effect from 1979 through 1990. The U.S.S.R. supplied Bulgaria with ore, fuel including coking coal, and intermediate products that included ferroalloys, pig iron, and steel ingots and slabs. The U.S.S.R. also supplied Bulgaria with varieties of pipe and plate. In turn, Bulgaria provided the Soviet Union with high-alloy sheet and plate, pipes, and galvanized sheet. Bulgaria's steel industry planned to continue the modernization of its existing facilities rather than build new plants. New facilities that were under construction in 1988 included the "300" rolling mill at the Bourgas steelworks with an 800,000-ton-per-year capacity for the production of structural steel and semimanufactures and a 110,000-ton-per-year rolling mill at the Lenin steelworks at Pernik, with a thermomechanically controlled cooling system. Planned projects for the modernization of the L. I. Brezhnev steelworks at Kremikovtsi would include a new "1700" hot strip mill, as well as a new cold sheet rolling mill. Reportedly, Voest Alpine AG of Austria would be among several foreign commercial organization active in the modernization studies at the L. I. Brezhnev works.

Manganese.—At yearend, Bulgaria announced that the Obrochishte Manganese Mining and Beneficiation Complex would be developed with the assistance of a number of Council for Mutual Economic Assistance (CMEA) countries. Part of the manganese produced at Obrochishte would be supplied to the CMEA as payment for

TABLE 2

BULGARIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]	1984	1985	1986	1987[p]	1988[e]
METALS					
Cadmium metal, smelter[e]	200	200	200	180	180
Copper:[e]					
Mine output, Cu content	80,000	80,000	80,000	80,000	80,000
Metal, primary and secondary:					
Smelter	60,000	90,000	90,000	91,000	92,000
Refined	62,000	93,000	95,000	95,000	97,000
Iron and steel:					
Iron ore:					
Gross weight thousand tons	2,063	1,985	2,179	1,850	1,900
Fe content do.	622	607	661	559	600
Iron concentrates do.	913	917	986	990	900
Metal:					
Pig iron do.	1,578	1,702	1,597	1,652	1,600
Ferroalloys, electric furnace, all types[e] do.	49	41	48	42	48
Steel, crude do.	2,878	2,944	2,965	3,045	3,000
Semimanufactures, rolled do.	3,354	3,325	3,347	3,350	3,400
Lead:[e]					
Mine output, Pb content	95,000	95,000	95,000	97,000	97,000
Metal, smelter, primary and secondary	116,000	116,000	115,000	115,000	110,000
Manganese ore:					
Gross weight	45,000	38,000	37,000	38,000	40,000
Mn content	13,000	11,300	11,200	10,900	11,000
Molydenum, mine output, Mo content[e]	190	190	190	200	200
Silver, mine output, Ag content[e] thousand troy ounces	930	930	910	910	900
Zinc:[e]					
Mine output, Zn content	68,000	68,000	70,000	70,000	70,000
Metal, smelter, primary and secondary	91,000	91,000	90,000	92,000	90,000
INDUSTRIAL MINERALS					
Asbestos	500	400	300	400	400
Cement, hydraulic thousand tons	5,717	5,296	5,702	5,494	5,500
Clays: Kaolin do.	256	257	265	281	285
Gypsum and anhydrite:					
Crude do.	393	388	395	306	350
Calcined	115	113	99	103	100
Lime: Quicklime thousand tons	1,526	1,331	1,632	1,278	1,300
Nitrogen: N content of ammonia do.	1,138	1,138	1,091	1,070	1,050
Pyrites, gross weight[e] do.	177	153	187	185	185
Salt, all types do.	89	89	91	92	91
Sodium carbonate, calcined do.	1,212	1,037	1,054	1,070	1,100

See footnotes at end of table.

TABLE 2—Continued

BULGARIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1984	1985	1986	1987[p]	1988[e]
INDUSTRIAL MINERALS—Continued						
Sulfur:[e]						
S content of pyrites		75,000	65,000	80,000	80,000	70,000
Byproduct, all sources		62,000	53,000	62,000	65,000	60,000
Total		**137,000**	**118,000**	**142,000**	**145,000**	**130,000**
MINERAL FUELS AND RELATED MATERIALS						
Coal, marketable:						
Anthracite	thousand tons	84	83	80	79	80
Bituminous	do.	139	140	127	128	130
Brown	do.	5,519	5,385	5,119	[e]5,200	5,000
Lignite	do.	26,617	25,272	29,896	[e]30,000	30,000
Total	**do.**	**32,359**	**30,880**	**35,222**	**35,407**	**35,210**
Coke	do.	1,186	1,087	1,156	[e]1,200	1,200
Gas, natural, marketed[e]	million cubic feet	[3]4,800	4,600	4,600	4,500	4,500
Petroleum, crude: As reported[e]	thousand tons	1,314	1,300	1,080	1,000	1,000

[e]Estimated. [p]Preliminary. [r]Revised.
[1]Table includes data available through August 1989.
[2]In addition to the commodities listed, bismuth, chromite, gold, palladium, platinum, tellurium, uranium, barite, fluorspar, magnesite, and a variety of crude construction materials (common clays, sand and gravel, dimension stone, and crushed stone) are produced, but available information is inadequate to make reliable estimates of output levels.
[3]Reported figure.

development assistance.

Industrial Minerals.—Bulgaria produced about 4 million tons of bentonite, dolomite, fluorite, gypsum, kaolin, marble, perlite, and other industrial minerals, largely for domestic consumption.

Mineral Fuels.—**Nuclear Power.**—Czechoslovakia's Skoda Plzen works announced a commercial agreement with Bulgaria to supply a 1,000-megawatt reactor to Bulgaria's second nuclear powerplant, under construction at Belene on the Danube River. Bulgaria's Kozloduy nuclear powerplant produced 30% of the country's electric power with four 440-megawatt reactor blocks. The Belene plant, upon completion, would have two 1,000-megawatt units.

Petroleum.—Bulgaria's Committee for Geology came under severe criticism during the year for wasting 20 years of effort on offshore drilling in the Black Sea, based on scientifically unsubstantiated claims.[8]

GREECE[9]

Introduction

Greece continued to be a significant European source of bauxite, chromium, magnesite, and nickel. The Official Industrial Production Index indicated that during the first 10 months of 1988, production of mineral ores increased 5.2% over the same period in 1987. Overall industrial production posted a gain of 6.1%. Production of mineral ores and manufactures accounted for 5% of the gross domestic product.

Government Policies and Programs

In 1988, the Greek Government continued to encourage the private sector to play a major role in the national economy. The Greek Government sought to relinquish control of the mining enterprises it took over during the nationalization effort of 1985. This was done in order to sustain employment levels and to accommodate the EC requirement to establish a free, unified market of all EC states by 1992. To facilitate the transition from public to private control of the minerals industry, the Greek Government offered to reduce the corporate income tax for mining and quarrying companies from 49% to 39%. To qualify for the tax deduction, companies must agree to publicly trade shares and stock exchanges and to invest amounts greater than $350,000 in the plant, property, and equipment required to operate the enterprise. Mining companies that invested either $350,000 toward plant improvements or $1 million overall also would be entitled to have income tax rates frozen at present levels on undistributed profits of the company until full payment of the company's long-term (i.e., 10-year) loans. Local tax rates would also be frozen.

Production

The mineral industry of Greece was composed of privately owned and state-owned enterprises. The major private sector companies included Aluminum de Grèce S.A., a subsidiary of Pechiney of France, which produced aluminum; the Bodossakis Group, an important producer of mixed sulfides and lead and zinc concentrates; Eliopoulos Kyriacopoulous Group, which continued its output of barite, bauxite, bentonite, and perlite; Magnomin General Mining Co. S.A., a significant producer of magnesite; and Titan Cement Co. S.A., a cement producer.

Trade

The text table outlines the impact of selected classes of minerals commodities on Greece's balance-of-payments position in relation to other EC member nations and the world. The figures, stated in thousand U.S. dollars, are for 1987, the latest year for which data were available.

Raw minerals and minerals products accounted for 21.3% of all Greek exports and 21.7% of all Greek imports.

Commodity Review

Metals.— **Aluminum and Bauxite.**— Greek bauxite producers asked the EC to adopt several measures to offset chronic difficulties encountered by the Greek bauxite industry. The first measure called for EC funding of research and development, exploration, and extraction efforts. This would offset the relatively high costs of mining bauxite in Greece. Unlike the other major world producers of bauxite, Greek mining companies must utilize expensive underground mining methods because of the geologic and morphologic nature of the bauxite deposits. The underground method accounts for 50% of total Greek mine production. Moreover, Greek bauxite operations must incur the added expense of compliance with laws requiring restoration of lands on which open pit mining took place. Few other world producers are subject to such laws for compliance costs.

The second proposal stipulated financing for technological adaptation of EC alumina refineries to enable the processing of Greek bauxite to be a significant percentage of their feed. This would correct the inability of EC alumina plants to meet the more intense temperature and pressure requirements associated with producing high-grade aluminum from monohydrate-type bauxite mined in Greece. The EC plants were capable of treating only aluminum trihydrate bauxite ores.

The third proposal would designate Greek bauxite as a product preferentially purchased by Romania and the U.S.S.R. This would address the problem of competing producers, such as Guinea and Jamaica, undercutting

Mineral Commodity	Balance of Payments in Greece's Minerals Industry					
	Exports to EC	Imports from EC	Net gain or (loss)	Exports to the world	Imports from the world	Net gain or (loss)
Crude industrial minerals:						
Sulfur	9	3,937	(3,928)	934	18,680	(17,746)
Other	64,151	86,467	(22,316)	105,558	17,063	88,495
Total	**64,160**	**90,404**	**26,244**	**106,492**	**35,743**	**70,749**
Metalliferous ores:						
Bauxite	8,474	107	8,367	36,698	643	36,055
Copper	270	5,342	(5,072)	271	9,263	(8,992)
Nickel	12	11	1	12	11	1
Other	20,409	8,435	11,974	29,901	69,244	(39,343)
Total	**29,165**	**13,895**	**15,270**	**66,882**	**79,161**	**(12,279)**
Nonmetallic mineral manufactures:						
Cement	13,341	270	13,071	156,629	465	156,164
Other	25,833	137,172	(111,339)	95,438	171,920	(76,482)
Total	**39,174**	**137,442**	**(98,268)**	**252,067**	**172,385**	**79,682**
Mineral fuels:						
Coal	—	4,284	(4,284)	—	51,661	(51,661)
Other	237,754	112,459	125,295	436,265	1,734	(1,349,591)
Total	**237,754**	**116,743**	**121,011**	**436,265**	**1,785,856**	**(1,349,591)**

TABLE 3

GREECE: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1984	1985	1986	1987[p]	1988[e]
METALS						
Aluminum:						
Bauxite, gross weight	thousand tons	2,296	[r]2,341	2,230	2,472	2,500
Alumina, gross weight	do.	482	380	470	578	[3]515
Metal:						
Primary		136,244	125,222	124,400	126,750	[3]150,801
Secondary[e]		7,000	7,000	7,000	7,000	7,000
Chromite:						
Run-of-mine ore		123,186	214,031	217,979	211,599	220,000
Marketable products:						
Direct-shipping ore[e]		11,000	15,000	16,000	16,000	16,000
Concentrate		50,364	58,948	60,063	63,825	60,000
Iron and steel:						
Iron ore and concentrate, nickeliferous:[4]						
Gross weight	thousand tons	1,929	2,245	[e]2,200	[e]2,200	2,300
Fe content	do.	810	920	[e]900	[e]900	900
Metal:						
Pig iron[e]	do.	[3]138	140	160	160	160
Ferrochromium		32,974	34,436	38,260	40,000	44,000
Ferronickel[e]		53,000	63,800	[3]10,324	5,000	2,500
Steel, crude	thousand tons	895	985	[e]890	950	900
Lead:						
Mine output, Pb content		22,154	19,752	20,873	[r e]20,600	20,000
Metal, refined, primary[5]		11,600	13,700	19,300	[r e]2,700	1,000
Manganese:						
Ore, crude:						
Gross weight		28,170	29,820	32,585	[e]35,000	33,000
Mn content		8,451	8,946	10,759	[e]11,500	11,000
Concentrate:						
Gross weight		5,447	5,085	4,560	[e]5,000	5,000
Mn content		2,669	2,478	2,234	[e]2,450	2,500
Nickel:						
Ni content of nickeliferous iron ore[e 6]		16,700	22,000	14,400	9,202	[3]13,200
Ni content of alloys		15,829	15,952	2,581	1,100	1,000
Silver: Mine output, Ag content	thousand troy ounces	1,814	1,622	1,718	1,660	1,700
Tin metal, secondary[e]		40	40	40	40	40
Zinc mine output, Zn content		22,550	21,107	22,257	20,700	21,000
INDUSTRIAL MINERALS						
Abrasives, natural: Emery		8,100	7,729	7,500	[e]8,000	2,000
Asbestos:						
Ore	thousand tons	3,766	3,705	3,927	3,384	4,000
Processed		45,376	46,811	51,355	60,134	71,000

See footnotes at end of table.

TABLE 3—Continued

GREECE: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1984	1985	1986	1987[p]	1988[e]
INDUSTRIAL MINERALS—Continued						
Barite:						
Crude ore		24,822	3,283	2,227	4,800	5,000
Concentrate		2,423	3,283	2,305	2,300	2,300
Cement, hydraulic	thousand tons	13,521	13,669	13,341	13,168	[3]13,053
Clays:						
Bentonite:						
Crude		778,722	[r]1,054,234	1,317,825	1,250,000	1,200,000
Processed		260,941	239,861	352,587	[e]300,000	300,000
Kaolin:						
Crude		92,407	[r]89,833	141,210	150,000	150,000
Processed		10,376	7,449	3,532	[e]3,700	3,800
Fluorspar, grade unspecified		83	35	150	[r e]200	200
Gypsum and anhydrite		582,741	467,794	[r e]500,000	[r e]500,000	500,000
Magnesite:						
Crude	thousand tons	1,064	846	944	841	930
Dead-burned		316,119	239,837	248,114	222,807	255,000
Caustic-calcined		121,227	94,866	126,069	119,096	115,000
Nitrogen: N content of ammonia[e]		230,000	230,000	230,000	230,000	230,000
Perlite:						
Crude		274,360	239,768	357,347	360,831	370,000
Screened		177,571	161,161	184,148	208,352	210,000
Pozzolan (Santorin earth)	thousand tons	908	938	1,005	814	900
Pumice		626,971	620,328	860,047	779,885	750,000
Pyrites, gross weight		164,949	173,262	150,245	148,972	149,000
Salt, all types	thousand tons	[r]126	[r]195	[e]150	[e]150	150
Silica (probably silica sand)[e]		[3]38,892	38,000	38,000	38,000	38,000
Sodium compounds:[e]						
Carbonate		1,000	1,000	1,000	1,000	1,000
Sulfate		9,000	9,000	8,000	7,000	7,000
Stone: Marble[e]	cubic meters	[3]132,332	150,000	150,000	150,000	150,000
Sulfur:						
S content of pyrites	thousand tons	[r]74	77	66	[e]70	70
Byproduct of petroleum[e]	do.	[3]5	5	5	5	5
Natural gas[e]	do.	[r]130	[r]125	[r]135	[r]135	135
Total[e]	**do.**	**[r]209**	**[r]207**	**[r]206**	**[r]210**	**210**
Talc and steatite		1,712	1,725	17,310	1,507	1,600
MINERAL FUELS AND RELATED MATERIALS						
Coal including briquets:						
Lignite	thousand tons	31,576	35,962	37,976	43,100	[3]47,311
Lignite briquets[e]	do.	120	120	110	120	120

See footnotes at end of table.

TABLE 3—Continued

GREECE: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1984	1985	1986	1987[p]	1988[e]
MINERAL FUELS AND RELATED MATERIALS—Continued						
Coke:[e]						
Coke oven	thousand tons	300	300	305	305	305
Gashouse	do.	15	15	16	18	19
Gas:						
Manufactured, gasworks[e]	million cubic feet	15	15	15	15	63
Natural	do.	3,224	2,195	[e]2,200	[e]2,200	2,200
Petroleum:						
Crude	thousand 42-gallon barrels	9,688	9,655	[e]9,500	[e]9,600	[3]8,043
Refinery products:						
Gasoline	do.	14,136	16,592	[e]15,000	[e]16,000	[3]20,596
Jet fuel	do.	11,696	10,984	[e]11,000	[e]11,000	[3]15,968
Kerosene	do.	217	302	[e]300	[e]300	[3]202
Distillate fuel oil	do.	28,378	24,521	[e]25,000	[e]26,000	[3]28,407
Residual fuel oil	do.	29,417	27,279	[e]28,000	[e]28,000	[3]40,080
Lubricants	do.	630	822	[e]800	[e]800	[3]1,281
Other	do.	3,852	3,461	[e]3,500	[e]3,500	[3]3,700
Refinery fuel and losses	do.	3,521	3,899	[e]4,000	[e]4,000	[3]4,620
Total	**do.**	**91,847**	**87,860**	**[e]87,600**	**89,600**	**[3]114,854**

[e]Estimate. [p]Preliminary. [r]Revised.
[1] Table includes data available through July 1989.
[2] In addition to the commodities listed, a variety of other crude construction materials (clays, sand and gravel, and stone) is produced, but output is not reported, and available information is inadequate to make reliable estimates of output levels. Cobalt is also produced and is included with "Nickel."
[3] Reported figure.
[4] Ni content is also reported under "Nickel."
[5] Includes antimonial lead and hard lead.
[6] Also includes Co content.

Greek prices for bauxite sold to Romania and the U.S.S.R.

Aluminum de Grece S.A., owned by Pechiney (France), the only aluminum producer in Greece, posted a gain in profits from $17.4 million to an estimated $40 million. This gain was attributed to increased international demand, high prices in international markets, and a revival of construction activity in Greece.

Chromite.—Hellenic Ferroalloys S.A. set forth plans to construct a new concentrator that would raise chromite concentrate production capacity from 60,000 to 120,000 tons per year. Mine capacity was to be increased in early 1989 to accommodate increased feed requirements. Actual startup, however, was contingent on the unresolved issue of whether to convert Larco's idle ferronickel capacity to ferrochromium production, or to add entirely new ferrochromium furnaces at the Tsingali ferrochromium plant.

Gold.—The Aegean Metallurgical Industries, a Government-owned mining company, proceeded with construction of a gold-production unit at Olympias, Halkidiki in northern Greece. The $75 million facility will produce annually 2.5 tons of gold bars, beginning in 1990. The company chose to utilize the Sherrit-Gordon (Canada) pressure-leaching method to recover the gold. This method differs from the conventional roast-leach approach in that the step converting oxides to sulfates is eliminated, and sulfate is obtained using one reactor. In addition, since all reactions occur in a closed vessel, plant hygiene is improved because hot gases and dusty solids are not in open air. Capital investment in this technology would be 25% less than for the roast-leach method.

Continued financing of capital acquisitions and new employees was to come from the EC's Integrated Mediterranean Programs funds. It was expected that the gold-production unit would employ 200 people at the start of operations.

Iron and Steel.—In conjunction with the U.S.S.R., the Greek Government retained Krupp Stahl AG, a West German firm, to examine the feasibility of building a 160,000-ton-per-year stainless steel mill. The study concluded that construction costs would amount to at least $220 million, a sum higher than those included in the Greek Government's capital budget.

Financing problems were also central to the difficulties encountered by Metallurgiki-Halyps S.A. in Volos. The company suspended operations in December until it could be restructured to service its $230 million debt to Manufacturers Hanover Trust Co. of New York and the National Bank of Greece. A permanent shutdown would result in the loss of 700 jobs for the company's workers.

Nickel.—In December, the Greek Government's Industrial Reconstruction Organization bought Larco, Greece's only nickel producer, for $170 million. The purchase was made in light of two developments. First, over 900 workers were laid off thereby cutting the company's expenses. Second, the increase in nickel prices generated revenues sufficient to make the company profitable. The company produced 10,000 tons of ferronickel, out of an annual capacity of 12,500 tons. Sustained output at that level, assuming no price decrease, would enable the company to service its debt to the National Bank of Greece, the Commercial Bank of Greece, and the Public Power Corp.

***Industrial Minerals*—Cement.**—In February 1988, the EC's Economic Commission planned to investigate allegations that the Greek Government provided financial assistance to the state-owned Heracles General Cement Co. by large-scale capitalization of the company's debt. The Commission noted earlier complaints by British cement producers concerning Greek cement dumping in the United Kingdom. The EC also cited the Greek Government's decision the previous year to convert the Heracles General Cement Co.'s debts into publicly owned shares. The EC noted that such action could distort intra-Community competition in a sector where EC production had fallen in recent years.

In late 1988, the EC also raised objections to the proposed capitalization of a significant debt incurred by Halkis Cement, Greece's third largest cement producer. The EC argued that the Government's restructuring plan for the company was tantamount to an unreasonably high level of subsidization that could not be permitted.

Titan Cement Co. increased its exports to Canada, the United Kingdom, and the United States, and penetrated the Italian market. Titan also enjoyed improved financial results because of increased domestic sales to Greece's construction sector, which showed considerable growth in 1988.

***Mineral Fuels.*—Coal.**—The Institute of Geological and Mineral Exploration and the Project Studies and Mining Development Co., which are controlled by the Greek Government, agreed with the Hellenic Industrial Development Bank to develop feasibility studies on the exploitation of a 4-million-ton deposit of lignite in the Kalavryta area of the Peloponnesus. The project is subject to authority of the EC Valoren program, through which Greece will receive $55 million to develop domestic energy sources. The EC would pay approximately $1.5 million of the $6.6 million costs to complete the Kalavryta project.

Natural Gas.—Test drilling at Epanomi near Thessaloniki was concluded. Results that indicated that the well yielded approximately 200,000 cubic meters per day of natural gas. On that basis, it was projected that the total natural gas production of the field would amount to 1 million cubic meters per day. The natural gas source was sufficiently close to the location of a planned Greek and Soviet gas pipeline to permit the gas to be transported through the pipeline.

In July, Greece and the Soviet Union signed an agreement wherein the Soviet Union would supply Greece with natural gas via the planned cross-country pipeline beginning in 1992. Terms of the agreement, for which details were not available, included basic commercial and technical specifications for the product, supply volume, delivery procedures, purchase price, and payment terms.

A preliminary agreement was signed by Greece and the U.S.S.R. in December outlining classes of Greek products that the U.S.S.R. will purchase to offset the supply of Soviet natural gas. The agreement provides that an average 60% of the offsets would be covered by industrial products, 20% by agricultural products, and 20% by ship repairs. Greek exports to the Soviet Union were expected to double under the offset arrangement.

ROMANIA[10]

Introduction

The economic hardships endured by the country was the result of the Government's planned economy and the emphasis to pay off the foreign debt that had affected all segments of the Romanian industry and society. The insufficient capital for development and expansion had been a limiting factor for economic growth. Only a few targeted projects that were identified as important by the head of state progressed, while the population endured shortages and curtailments. Domestic output of energy and mineral commodities continued at declining levels. As a result, Romania's reliance on imports of mineral commodities for its industrial needs increased.

With the output of energy on the decline, due to dwindling petroleum production, some emphasis had been placed on projects to broaden the sources of energy and to increase energy supplies. For example, hydroelectric dam projects were given priority in an effort to relieve the shortage of electricity. The shortage severely hindered industrial expansion. The country, once among the leading world petroleum producers, had to import substantial amounts of crude petroleum to meet the needs of its refineries. Romania's centrally planned economy was continually affected by shortfalls, both in terms of industrial production and growth in national income. This led to isolation and further dependence on the Soviet Union for basic resources.

Government Policies and Programs

Again in 1988, the rapid repayment of Romania's convertible currency foreign debt remained the central Government economic policy. The Romanian Government's emphasis on the accumulation of hard currency from trade surpluses further restricted hard-currency import items, while accelerating exports of all goods and commodities marketable on a hard-currency basis. Allegedly, steel semimanufactures were sold below production costs to acquire the hard currency. Also, agricultural goods were exported despite the necessity for domestic consumption, which resulted in food shortages and contributed to dislocations in the industrial sector. Although Romania claimed to be a leading world producer and exporter of mining equipment, the country's mining industry was reportedly perennially short of spare parts for its capital equipment.

The third annual plan in the current 5-year plan parallels the 1987 plan growth rates; however, the ambitious goals of the 1986 and 1987 plans were not met. Instead of addressing the deficiencies of past years, the new plan operated on the presumption that targets had been achieved for the previous years. The Government's domestic social policies also had impacted relations with other countries, which resulted in strained economic conditions and political relationships.

Production

Romania's mineral industry, state-owned and operated, used wages and prices only to determine hard-currency export prices for mineral and fuel commodities. Apart from shortages of spare parts in the mining and processing sectors, production declines for many mineral commodities were attributable to severe fuel and energy shortages.

Trade

One of the remarkable accomplishments of the Romanian economy was a 6% overall growth in trade. This growth was attained by an increase of 10.5% in exports, which reflected an imbalance of 47% more export trade than import trade. This activity in foreign export trade resulted in an account balance of about $4 billion of convertible currency, and this facilitated the paydown of the foreign debt. Romania continued to barter trade to obtain badly needed iron and nonferrous ores, thus reserving its badly needed hard currency. For example, an agreement was reached with Australian Hancock Mining to exchange iron ore for railroad and mining equipment. The Romanians secured the commitment for 53 million tons of iron ore over a 12-year period. The original deal was reported to be worth $1,500 million, and an additional 15 million tons was apparently agreed to in the fall of 1988 worth another $500 million. The ore was to be shipped to the Port of Constantsa in ships built by the Romanians; the first ship built was the 165,000 dry weight tonnage, Comanesti. However, commercial relations with the CMEA remained the cornerstone of the country's mineral trade. Within the CMEA, the Soviet Union played a dominant role in supplying Romania with fuels and mineral commodities.

During the year, an agreement was secured with the Iranians worth $1,200 million; of this, $560 million was for petroleum products to be delivered over the next 4 years. Conversely, Romanians were encouraged to invest in the reconstruction of the war-torn Iranian economy.

A stable relationship in trade with the United States was threatened by the cancellation of the most-favored-nation status by the United States. This was a result of Romania's human rights conditions and policies. Therefore, tariffs on Romanian products were to be increased from 5% to 70% as a consequence of this change in trade status. Coal shipments of 500,000 metric tons per year were exported to Romania. Coal was only one of the commodities possibly affected. Romanian cash exports to the United States were needed to pay for the coal shipments, which were not likely to be as competitive under the higher tariffs. The United States' hard-currency trade with the Romanians dropped in recent years to third place in relation to other Western World countries. The dollar value of the trade also decreased with U.S. exports and imports, down 4% and 2%, respectively.

Commodity Review

Metals.—**Copper.**—Production started at the Rosia Poieni copper mining and beneficiation complex in the Apuseni Mountains. The design and construction of the concentrator was by Romanian specialists and used domestic equipment exclusively. When fully operational, the complex was anticipated to produce about 9 million tons of ore per year. It was estimated that 30,000 tons per year of copper and 200,000 tons per year of sulfuric acid would be produced from the plant.

Iron and Steel.—In addition to the Hancock iron ore deal, the Romanians completed an agreement with the Indian Government to increase the ore shipment from 4 to 6 million tons per

TABLE 4

ROMANIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1984	1985	1986	1987[p]	1988[e]
METALS						
Aluminum:						
Bauxite, gross weight[e]		620,000	600,000	600,000	600,000	600,000
Alumina, calcined, gross weight		552,000	548,000	555,000	[e]500,000	500,000
Ingot including alloys:						
Primary		244,000	247,000	253,000	260,000	260,000
Secondary		20,000	18,000	16,000	[e]15,000	15,000
Total		**264,000**	**265,000**	**269,000**	**275,000**	**275,000**
Bismuth, mine output, Bi content[e]		80	80	80	[r]75	65
Cadmium metal, smelter[e]		75	75	75	75	75
Copper:[e]						
Mine output, Cu content		25,000	26,000	27,000	26,000	30,000
Smelter:						
Primary		32,000	[3]32,963	32,000	30,000	30,000
Secondary		6,000	7,000	7,000	8,000	8,000
Total		**38,000**	**39,963**	**39,000**	**38,000**	**38,000**
Refined, primary and secondary[e]		45,000	46,000	43,000	42,000	42,000
Gold, mine output, Au content[e]	troy ounces	65,000	65,000	60,000	60,000	60,000
Iron and steel:						
Iron ore:						
Gross weight	thousand tons	1,916	2,287	2,431	2,281	2,300
Content (26% Fe)	do.	498	595	632	595	596
Metal:						
Pig iron	do.	9,557	9,212	9,329	8,673	8,500
Crude steel	do.	14,437	13,975	14,276	13,885	14,300
Ferroalloys:[e]						
Ferrochromium		45,000	44,000	44,000	42,000	42,000
Ferrosilicon		52,000	50,000	51,000	50,000	50,000
Ferromanganese		87,000	80,000	82,000	81,000	80,000
Silicomanganese		41,000	39,000	40,000	39,000	40,500
Silicon metal		4,100	3,800	4,500	4,500	4,500
Semimanufactures:						
Castings and forgings, finished[e]	thousand tons	1,200	1,200	1,300	1,400	1,300
Pipes and tubes	do.	1,507	1,513	1,565	1,600	1,500
Rolled products	do.	10,329	9,900	10,207	9,700	9,500
Lead:						
Mine output, Pb content[e]		30,000	30,000	28,000	28,000	26,000
Metal, smelter:						
Primary[e]		35,900	38,600	35,000	[3]33,186	30,000
Secondary[e]		10,000	10,000	16,500	[r]10,000	10,000
Total		**45,900**	**48,600**	**51,500**	**43,186**	**40,000**

See footnotes at end of table.

TABLE 4—Continued

ROMANIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1984	1985	1986	1987[p]	1988[e]
METALS—Continued						
Manganese:[4]						
Ore, gross weight[e]	thousand tons	264	250	250	250	250
Concentrate:						
Gross weight	do.	66	68	67	68	65
Mn content[e]	do.	20	19	19	19	20
Silver, mine output, Ag content[e]	thousand troy ounces	810	810	800	750	725
Zinc:[e]						
Mine output, Zn content		44,000	43,000	43,000	41,000	40,000
Metal, smelter, primary and secondary		41,000	40,000	39,000	37,000	36,000
INDUSTRIAL MINERALS						
Barite[e]		75,000	75,000	75,000	72,000	72,000
Cement, hydraulic	thousand tons	14,016	12,238	14,216	14,300	14,000
Clays:[e]						
Bentonite		180,000	180,000	185,000	180,000	180,000
Kaolin		410,000	410,000	410,000	400,000	400,000
Diamonds, synthetic industrial	thousand carats	—	—	—	—	5,000
Diatomite[e]		300,000	290,000	300,000	280,000	280,000
Feldspar[e]		85,000	86,000	86,000	82,000	82,000
Fluorspar[e]		20,000	20,000	20,000	18,000	18,000
Graphite[e]		12,500	12,000	12,000	12,000	12,000
Gypsum[e]		1,650	1,620	1,600	1,600	1,600
Lime	thousand tons	3,848	3,717	3,959	[e]4,000	4,000
Nitrogen: N content of ammonia	do.	2,861	2,880	3,041	2,788	2,800
Pyrites, gross weight[e]	do.	930	930	900	900	900
Salt:						
Rock salt[e]	do.	[3]1,874	1,900	2,000	2,000	2,000
Other	do.	3,000	[e]3,119	3,355	[e]3,400	3,400
Total	**do.**	**4,874**	**5,019**	**5,355**	**[e]5,400**	**5,400**
Sand[e]	do.	2,500	2,500	2,500	2,500	2,450
Sodium compounds, n.e.s.:						
Caustic soda	do.	805	814	846	817	820
Sodium carbonate, manufactured, 100% Na_2CO_3 basis	do.	912	836	895	894	890
Sulfur:[e]						
S content of pyrites	do.	200	200	150	150	150
Byproduct, all sources	do.	150	150	140	130	120
Total	**do.**	**350**	**350**	**290**	**280**	**270**
Sulfuric acid	do.	1,915	1,835	1,971	[r]1,693	1,700
Talc[e]		66,000	65,000	64,000	60,000	60,000

See footnotes at end of table.

TABLE 4—Continued

ROMANIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1984	1985	1986	1987[p]	1988[e]
MINERAL FUELS AND RELATED MATERIALS						
Carbon black		106,900	108,593	105,802	88,790	90,000
Coal:						
Run-of-mine:						
Anthracite and bituminous	thousand tons	10,653	10,472	11,074	11,693	11,400
Brown	do.	827	834	858	897	800
Lignite	do.	36,319	38,513	39,400	43,109	46,600
Total	**do.**	**47,799**	**49,819**	**51,332**	**55,699**	**58,800**
Washed (produced from above):						
Anthracite and bituminous:						
For coke and semicoke production	do.	2,903	2,963	3,276	3,474	4,000
For other uses	do.	5,555	5,694	5,420	5,625	7,400
Brown	do.	782	784	810	846	800
Lignite	do.	35,040	37,140	38,012	41,579	46,600
Total	**do.**	**44,280**	**46,581**	**47,518**	**51,524**	**58,800**
Coke:						
Metallurgical	do.	4,849	4,743	5,088	5,326	5,000
Other	do.	[e]450	439	582	500	500
Total	**do.**	**5,299**	**5,182**	**5,670**	**5,826**	**5,500**
Fuel briquets (from brown coal)[e]	do.	750	750	750	750	750
Gas, natural:						
Gross:						
Associated	million cubic feet	387,437	413,464	445,247	[e]400,000	350,000
Nonassociated	do.	991,743	960,417	945,126	[e]945,000	825,000
Total	**do.**	**1,379,180**	**1,373,881**	**1,390,373**	**[e]1,345,000**	**1,175,000**
Marketed[e]	do.	1,127,000	1,126,000	1,120,000	1,120,000	1,000,000
Petroleum:						
Crude:						
As reported	thousand tons	11,453	10,718	10,125	[e]10,000	9,400
Converted	thousand 42-gallon barrels	86,585	81,028	76,545	[e]75,000	70,500
Refinery products[e]	do.	167,300	169,300	185,500	184,000	185,000

[e]Estimated. [p]Preliminary. [r]Revised.
[1]Includes data available through Sept. 16, 1989.
[2]In addition to the commodities listed, antimony, asbestos, and a variety of crude construction materials are produced, but output is not reported quantitatively, and available information is inadequate to make reliable estimates of output levels.
[3]Reported figure.
[4]Estimated series were based on published data on concentrate production.

year, and to supplement ore supplies for its 16-million-ton-per-year steel industry. The centrally planned Government dedicated capital for the renovation and enlargement of the No. 6 blast furnace at the Galati steelworks, although there was an excess of steel on the world market. Steel output increased almost 3% during 1988, despite the domestic mining of only 2,000 tons per year of 26% iron content in the ore.

Lead and Zinc.—Romania continued to mine low-grade lead and zinc ores in the Baia Mare area. Mine output of lead and zinc had been on a declining trend in recent years, requiring substantial imports of concentrates from abroad. Approximately 30,000 tons of zinc and 10,000 tons of lead concentrates were imported from Iran during the year. Concentrates were smelted at the Uxina Chimica Metalurgia Imperial Smelter in Copsa Mica.

Industrial Minerals.—Romania's production of barite, bentonite, diatomite, feldspar, graphite, gypsum, kaolin, and limestone was sufficient to meet most domestic needs. Research had lead to the technology for micronized kaolin and several types of roasted kaolin. This Romanian effort led to greater use of home-produced kaolin in local industries. Industrial minerals were mined throughout the country at about 60 deposits, the total production of which reportedly increased about sixfold in recent years.

Mineral Fuels.—**Coal.**—Mechanized units were utilized in the operations at Alunu and Copaceni, a large coal unit at North Berbesti. Also, at the Motru-Jilt mining combine new equipment was utilized to increase production capacity, now approximately one-third of the country's total capacity. The new Pinoasa opencast mine in Romania's southern Motru Rovinari coalfield was completed 2 years ahead of schedule and was expected to produce 1 million tons its first year of operation. The Motru-Vestmin Mine, opened in 1987, was expected to produce more than 300,000 tons. Other mine expansions were underway at Medinti, Vilcea, and Valea de Bramighere (a coking coal mine). Most of Romania's coal was substandard and caused extensive problems at coal-fired electric power stations by clogging filters and damaging furnaces.

Petroleum.—Although there were 350 rigs exploring and developing reserves, the production continued to decline from 75.3 million barrels of oil in 1987 to 70.1 million barrels in 1988. The "Gloria" platform, the first offshore platform in the Romanian Black Sea, was installed last year and began production at the rate of 4,300 barrels per day from Lebada East Field. A seventh platform "Saturn" was set and was to begin drilling in 1989. Other platforms were engaged in operations with the hopes of increasing production from the Continental Shelf. Production from the "Fortuna" platform was estimated to increase offshore production 33% upon completion, with all offshore production piped to the petrochemical complex at Mida.

The remaining reserves, estimated at 1.4 billion barrels, were mostly at Pitesti and Ploesti in the southern portion of Romania. The production in 1988 was only 173,000 barrels per day as compared to the 294,000 barrels per day in 1976. This decline resulted in the importation of 42 million barrels of oil and gas deliveries of 120 billion cubic feet of gas from the Soviet Union, in addition to the oil in the Iranian barter agreement. The gas purchased from the Soviet Union was in addition to the 850 billion cubic feet produced at the Cluij gasfield in Transylvania with reserves estimated at 10 trillion cubic feet of gas.

YUGOSLAVIA[11]

Introduction

In 1988, Yugoslavia's economy continued to decline from the already low levels set in 1987. Although most economic indicators for the year were not available by yearend, industrial production was estimated to have declined by between 1% and 1.7% compared with that of 1987. Inflation continued to worsen, and, by the end of thè year, it reportedly reached a 250% annual rate. Yugoslavia remained an important producer of mineral commodities that included iron ore and nonferrous metals, and a wide assortment of industrial minerals such as barite, clays, magnesite, and volcanic materials. Production of mineral fuels supplied the country with lignite, and relatively small quantities of petroleum and natural gas. The main mineral industry project in 1988 included facility expansion at the Smederevo steelworks and the Topola cast iron foundry. A gold mine at Kucevo, which was closed for about 25 years, was to be put back into operation.

Government Policies and Programs

The Government rolled back wage and price controls that were instituted in 1987 to break the country's rising inflation. Wage and price controls were less effective in stemming inflation than in slowing down needed imports. In May, the Government reached an agreement with the International Monetary Fund (IMF) on procedures for rescheduling Yugoslavia's foreign debt. The terms of the agreement with the IMF included a requirement to liberalize Government policies on imports and access to foreign exchange by domestic commercial organizations. The agreement also set strict limits on the growth of wages, public consumption, and bank lending. Late in the year, the Yugoslav Government began the development of a number of legislative reforms to further orient the economy to a free market basis. The proposed legislation covered such issues as expanded private property rights, foreign investment, tax and monetary policy, and new labor regulations allowing the right to strike. Yugoslavia's mine labor unions raised the issue of reducing the work week from 42 hours to 36 hours to increase health and safety as well as mining productivity.

Production

In 1988, the production of most minerals and mineral fuels was either below or at 1987 output levels. Measured in physical units, the production of iron ore declined by 2% and remained the same in the iron and steel industry. The output of nonferrous ores declined by 3%, and metals declined by 2%. The output of semimanufactures remained at the level of 1987. The production of crude and processed industrial minerals each declined by 3% and quarrying products by 6%. The output of petroleum and natural gas remained at about the level of 1987, but total coal production increased by 3%, while that of coal products declined slightly. Electric power generation rose by 4%. Late in the year, disputes between Serbian and Albanian national elements in Serbia's Kosovo Province reached a crisis, causing widespread public disturbances within the Serbian Republic. Although the Trepca lead and zinc mining and processing operations in Kosovo were not seriously affected by yearend, operations at the Niksic steelworks in Montenegro were temporarily disrupted by protesting steelworkers.

Trade

Yugoslavia's balance of payments showed improvement in 1988 as both exports and imports increased substantially compared with those of 1987. Industrial exports in 1988 increased by 370% and total exports by 356%. In 1988, Yugoslavia was a net exporter of coal products, electricity, nonferrous metals and nonferrous metal products, and steel; the country was a net importer of coal, industrial minerals, industrial mineral products, iron ore, nonferrous metals' ores, petroleum and natural gas and refinery products. Compared with 1987, exports of coal products increased by 291%, and those of refinery products, iron and steel, nonferrous metals, and industrial mineral products, by 229%, 291%, 331%, 415%, and 387%, respectively. Mineral imports also showed substantial gains. Coal imports rose by 384%, petroleum and natural gas by 351%, iron and steel by 328%, nonferrous metal ores by 552%, and industrial minerals by 482%.

The U.S.S.R. remained one of Yugoslavia's main trading partners. The Soviet Union largely provided Yugoslavia with fuels and raw materials in exchange for producer durables. In 1988, Soviet and Yugoslav Government representatives called for greater cooperation in joint scientific and economic ventures to reduce the $1 billion[12] Yugoslav trade surplus with the Soviet Union. The Soviet Union agreed to participate in a number of industrial modernization projects in Yugoslavia that would include the Smederevo steelworks. Commercial transactions with the German Democratic Republic included an exchange of heavy industrial goods such as mining equipment and rolling mills. The German Democratic Republic and Yugoslavia also agreed to form a joint venture to build a pump plant and foundry in Algeria. Earlier in the year, Yugoslavia's Monteks enterprise and the Niksic bauxite mines signed a contract with Romania to supply bauxite to Romania's Oradea alumina plant. Romania would supply Monteks with chemical products in exchange for the bauxite. Commerce with the United States included an agreement between Yugoslavia's Trepca enterprise of Gnjilane and the Battery Engineering Co. of Los Angeles, California to export the entire output of lithium-thionyl-chloride batteries from Trepca's new battery plant to the United States in 1989. The battery plant was completed in 1988 as a joint venture between Battery Engineering Co. and Trepca.

Commodity Review

Metals. —**Aluminum and Bauxite.**— Unial-TGA's Boris Kidric alumina refining and aluminum smelting enterprise began to gradually put into operation its 80 new Pechiney electrolytic cells. When fully operational, the new electrolytic cells would raise the smelter's capacity to 90,000 tons of aluminum per year. The old smelter was to be taken out of service; however, since aluminum demand was high, Unial's management decided to allow the plant to continue operations. In midyear, a $2.4 million aluminum foundry was put on trial service at the Tam motor enterprise to produce aluminum components for the motor works. Owing to a good aluminum market, the Titograd aluminum-smelting complex planned to market 100,000 tons of metal, of which one-half was to be exported. Titograd's earnings from exports amounted to $89 million, a 27% increase. The Mostar aluminum enterprise exported about $108 million worth of aluminum products and was expected to earn $120 million on domestic and foreign sales of 92,000 tons of aluminum in 1989. The company intended to pay off $40 million of its rescheduled foreign debt in 1989, a quarter of the company's total debt, thus saving about $5 million in interest payments.

Copper.—Modernization at the Bor copper mining and smelting complex continued. Approximately $80 million would be allocated by 1990 to raise copper output. The planned total reconstruction of Bor's electrolytic refinery by 1989 would raise the production of cathode copper by 35,000 tons to 175,000 tons per year. The modernization of the Bor smelter by 1990 would increase the production of anode copper to 190,000 tons per year. The planned second stage of development at Bor would include the construction of a second autogenous copper smelter and the installation of new reactors within the plants that produce sulfuric acid. The Bor copper complex invested about $10 million for the modernization of mining and beneficiation facil-

TABLE 5

YUGOSLAVIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1984	1985	1986	1987[p]	1988[e]
METALS						
Aluminum:						
Bauxite	thousand tons	3,347	3,250	3,459	3,394	[3]3,034
Alumina	do.	1,135	1,138	1,117	1,113	[3]1,051
Metal ingot:						
Primary[e]		270,000	280,000	282,000	244,000	[3]260,120
Remelted[4]		31,567	36,092	37,670	37,084	63,349
Total		**301,567**	**316,092**	**319,670**	**281,084**	**[3]313,349**
Antimony:						
Mine and concentrator output:						
Ore, gross weight		[r]51,155	[r]70,825	61,376	48,449	[3]37,903
Sb content of ore		945	1,088	859	834	[3]725
Concentrate, gross weight		2,844	[r]4,952	2,746	1,227	[3]1,105
Metal (regulus)		1,263	1,502	1,842	1,002	[3]1,145
Bismuth, smelter output		30	68	21	73	[3]23
Cadmium, smelter output		270	279	259	305	[3]405
Chromite:						
Mine and concentrator output:						
Ore, gross weight		9,570	10,015	8,780	13,172	[3]11,538
Concentrate (produced largely from imported ores)		110,022	101,937	57,593	59,482	[3]46,063
Copper:						
Mine and concentrator output:						
Ore, gross weight	thousand tons	25,279	26,166	27,864	27,745	[3]30,056
Cu content of ores		137,575	142,479	138,544	130,470	[3]103,523
Concentrate, gross weight		609,419	581,620	537,504	513,971	[3]560,192
Metal:						
Blister and anodes:						
Primary		84,657	137,037	196,358	103,399	[3]106,457
Remelted[4]		91,679	52,160	31,525	62,384	[3]65,519
Total		**176,336**	**[r]189,197**	**227,883**	**165,783**	**171,976**
Refined:						
Primary		80,259	101,673	99,152	98,805	[3]105,595
Remelted[4]		47,352	33,769	849	40,062	[3]39,781
Total		**127,611**	**135,442**	**100,001**	**138,867**	**[3]145,376**
Gold refined	troy ounces	125,130	156,772	141,398	171,941	[3]148,536
Iron and steel:						
Iron ore:						
Gross weight	thousand tons	5,321	5,478	6,618	5,983	[3]5,545
Fe content	do.	1,837	1,685	1,983	1,764	[3]1,844
Iron concentrate, gross weight	do.	2,503	2,482	2,995	3,247	[3]3,332

See footnotes at end of table.

TABLE 5—Continued

YUGOSLAVIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1984	1985	1986	1987[p]	1988[e]
METALS—Continued						
Iron and steel—Continued						
Metal:						
Pig iron	thousand tons	2,855	3,120	3,063	2,867	2,916
Ferroalloys:						
Ferrochromium		75,441	73,308	68,604	56,276	[3]93,349
Ferromanganese		47,375	35,775	40,051	38,041	[3]45,078
Ferronickel		6,087	9,248	8,647	9,556	[3]15,047
Ferrosilicon		94,875	91,702	99,574	98,843	[3]120,522
Silicon metal		28,428	33,094	31,312	31,915	[3]25,830
Ferrosilicomanganese		37,214	43,374	41,330	42,528	[3]46,804
Ferrosilicocalcium		—	149	—	487	[3]772
Ferrosilicochromium		10,721	7,199	7,513	6,240	[3]3,668
Other		[r]4,484	[r]5,390	6,715	7,584	[3]10,678
Total		**[r]304,625**	**[r]299,239**	**303,746**	**291,470**	**[3]361,768**
Crude steel:						
From oxygen converters	thousand tons	1,644	1,801	1,769	1,715	[3]1,913
From Siemens-Martin furnaces	do.	1,440	1,524	1,509	1,301	[3]1,158
From electric furnaces	do.	1,152	1,155	1,241	1,351	[3]1,416
Total	**do.**	**4,236**	**4,480**	**4,519**	**4,367**	**[3]4,487**
Semimanufactures	do.	5,667	5,694	5,411	6,260	[3]6,066
Lead:						
Mine and concentrator output:						
Ore, gross weight (lead-zinc ore)	do.	4,634	4,590	4,558	3,908	[3]3,847
Pb content of ores		113,648	115,115	114,633	106,670	[3]103,286
Concentrate, gross weight		148,026	147,079	101,033	109,119	[3]104,596
Metal:						
Smelter:						
Primary		109,719	116,500	39,650	118,185	[3]121,607
Secondary[5]		11,548	13,436	28,748	28,423	[3]30,430
Total		**121,267**	**129,936**	**68,398**	**146,608**	**152,037**
Refined:						
Primary, for domestic use and export[e 6]		[3]45,415	59,954	74,963	76,417	70,888
Secondary[e]		[3]37,400	40,000	38,000	[r]36,000	39,000
Subtotal		**82,815**	**[r]99,954**	**112,963**	**112,417**	**[3]109,888**
Primary, toll refining		62,000	83,000	99,000	92,000	92,000
Total		**144,815**	**182,954**	**211,963**	**204,417**	**201,888**
Magnesium metal		5,139	4,978	4,897	5,932	[3]6,176
Manganese ore:						
Gross weight		21,079	31,800	41,283	41,297	[3]40,100
Mn content		6,736	11,119	14,448	14,452	[3]14,036
Mercury	76 pound flasks	2,089	2,553	2,176	1,944	[3]2,030

See footnotes at end of table.

TABLE 5—Continued

YUGOSLAVIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1984	1985	1986	1987[p]	1988[e]
METALS—Continued						
Nickel:[e]						
Mine output:						
Ore, gross weight	thousand tons	[r]261	[r]270	[r]270	[r]280	280
Ni content of ore		[r]3,700	[r]3,800	[r]3,800	[r]3,900	3,900
Concentrate		210,768	200,000	200,000	200,000	200,000
Metal:						
Ferronickel, Ni content		[r]2,000	[r]2,400	[r]2,500	[r]2,500	2,500
Refined		171	—	—	—	—
Platinum-group metals:						
Palladium	troy ounces	[r]3,472	3,058	2,732	4,243	[3]4,565
Platinum	do.	[r]417	105	1,054	773	[3]730
Selenium metal, refined	kilograms	45,211	43,720	54,400	66,362	[3]60,812
Silver metal, refined including secondary	thousand troy ounces	[r]4,121	[r]5,499	5,618	5,312	[3]4,468
Uranium:						
Mine output[e]		—	50,000	110,000	[3]110,011	[3]107,365
Concentrate		—	34	80	83	[3]93
U_3O_8 Content[e]		—	23	56	58	65
Zinc:						
Zn content of lead and zinc ore		85,761	[r]89,347	99,080	87,352	[3]91,175
Concentrator output, gross weight		149,124	149,390	98,587	118,904	[3]117,565
Smelter, primary		40,906	49,665	49,924	51,320	[3]56,316
Refined, primary and secondary:						
Smelter		16,458	15,609	14,978	9,684	[3]11,234
Electrolytic		76,193	67,789	67,063	108,383	[3]116,290
Total		**92,651**	**83,398**	**82,041**	**118,067**	**[3]127,524**
INDUSTRIAL MINERALS						
Asbestos, all kinds		8,556	[r]6,611	7,557	10,964	[3]17,030
Barite concentrate		41,098	35,488	18,250	19,270	[3]23,350
Cement, hydraulic	thousand tons	9,315	9,028	9,127	8,963	[3]8,840
Clays:						
Bentonite		139,366	148,752	148,447	154,288	[3]125,069
Ceramic clay, crude		57,666	[r]258,220	307,378	287,887	[3]283,689
Fire clay:						
Crude		249,613	[r]227,076	148,573	174,124	[3]155,718
Calcined		50,370	47,210	42,803	42,092	[3]28,188
Kaolin		201,822	244,534	204,311	218,851	[3]218,673
Feldspar, crude		33,917	[r]49,391	47,909	44,912	[3]35,614
Gypsum:						
Crude		606,636	600,152	594,704	553,372	[3]555,231
Calcined		91,809	[r]82,801	87,803	75,396	[3]21,245

See footnotes at end of table.

TABLE 5—Continued

YUGOSLAVIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]	1984	1985	1986	1987[p]	1988[e]
INDUSTRIAL MINERALS—Continued					
Lime:					
Quicklime thousand tons	1,997	1,948	1,888	1,790	[3]1,268
Hydrated do.	760	759	748	708	[3]725
Total do.	**2,757**	**2,707**	**2,636**	**2,498**	**[3]1,993**
Magnesite:					
Crude	326,099	417,407	428,791	402,976	[3]382,606
Sintered	156,487	[r]170,046	161,295	149,000	[3]136,746
Caustic calcined	13,743	14,279	14,420	10,217	[3]11,113
Mica, all grades	157	382	674	250	[3]807
Nitrogen: N content of ammonia thousand tons	609	766	814	937	[3]858
Pumice and related volcanic materials: Volcanic tuff	509,531	450,610	385,844	423,917	[3]407,988
Quartz, quartzite, glass sand:					
Quartz and quartzite thousand tons	262	301	239	260	[3]226
Glass sand do.	2,141	[r]2,334	2,427	2,258	[3]1,798
Total do.	**2,403**	**[r]2,635**	**2,666**	**2,518**	**2,024**
Salt:					
Marine	44,151	67,897	69,482	64,672	[3]58,286
From brines	188,839	193,194	282,493	282,650	[3]200,276
Rock	146,552	149,151	147,652	153,064	[3]126,650
Total	**379,542**	**[r]410,242**	**499,627**	**500,386**	**[3]385,212**
Sand and gravel excluding glass sand thousand cubic meters	21,462	22,136	21,841	19,778	[3]19,710
Sodium compounds:					
Sodium carbonate	188,291	199,629	207,968	201,539	[3]213,891
Sodium bicarbonate	16,065	15,486	20,940	19,844	[3]18,016
Sodium sulfate	42,043	40,584	42,581	37,556	[3]41,479
Stone excluding quartz and quartzite:					
Dimension:					
Crude:					
Ornamental cubic meters	88,177	265,522	100,659	97,619	100,000
Other do.	931	546	1,978	1,585	1,500
Partly worked facing thousand square meters	2,273	2,544	2,847	3,059	[3]3,253
Cobblestones, curbstones, other thousand cubic meters	5,041	6,153	4,259	4,846	5,000
Dolomite thousand tons	1,522	1,716	2,306	645	[3]709
Limestone do.	7,111	7,314	7,888	7,771	8,000
Crushed and broken n.e.s. thousand cubic meters	2,767	2,544	2,981	2,861	[3]2,833
Milled marble and other do.	4,312	4,450	5,129	4,486	5,000
Sulfur, pyrite and pyrrhotite:					
Pyrite, gross weight thousand tons	609	507	758	609	610
Pyrrhotite, gross weight do.	20	13	4	[r,e]5	6

See footnotes at end of table.

TABLE 5—Continued

YUGOSLAVIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1984	1985	1986	1987[p]	1988[e]
INDUSTRIAL MINERALS—Continued						
Sulfur, pyrite and pyrrhotite—Continued						
Sulfur:						
Sulfur content of pyrite[7]	thousand tons	255	213	319	256	250
Sulfur content of pyrrhotite[7]	do.	8	5	1	2	2
Byproduct:						
Of metallurgy[e]	do.	160	170	175	175	170
Of petroleum[e]	do.	3	3	3	3	3
Total	**do.**	**426**	**391**	**498**	**436**	**425**
Talc:						
Crude		28,547	27,500	[e]28,000	30,993	[3]29,204
Washed		22,927	27,104	27,815	28,440	[3]27,566
MINERAL FUELS AND RELATED MATERIALS						
Carbon black		28,125	29,638	31,972	35,078	[3]34,797
Coal:						
Bituminous	thousand tons	389	400	407	379	[3]363
Brown	do.	11,391	12,465	13,099	12,135	[3]11,877
Lignite	do.	53,651	56,635	56,626	59,359	[3]59,873
Total	**do.**	**65,431**	**69,500**	**70,132**	**71,873**	**72,113**
Coke:						
Metallurgical	do.	3,083	3,123	3,092	2,570	[3]2,827
Breeze	do.	269	265	253	220	[3]280
Foundry	do.	163	157	149	170	[3]151
Total	**do.**	**3,515**	**3,545**	**3,494**	**2,960**	**[3]3,208**
Gas:						
Manufactured (excluding petroleum refinery gas):						
From coke plants	million cubic feet	41,270	41,433	41,317	43,267	42,000
From lignite gasification plants	do.	2,158	2,337	2,688	822	2,000
Natural, gross production	do.	[r]70,526	[r]84,743	86,272	101,974	[3]106,474
Natural gas plant liquids: Propane and butane	thousand 42-gallon barrels	786	960	937	1,173	1,100
Petroleum:						
Crude:						
As reported	thousand tons	4,044	4,149	4,140	3,867	[3]3,681
Converted	thousand 42-gallon barrels	29,954	30,731	30,665	28,685	27,305
Refinery products:						
Gasoline	do.	33,175	31,221	34,603	34,075	[3]35,436
Liquefied petroleum gas	do.	3,063	3,039	3,424	4,424	4,000
Jet fuel	do.	2,214	3,119	1,870	2,824	3,000
Kerosene	do.	197	262	835	204	200
Middle distillate fuel oil	do.	721	1,329	558	1,218	1,200
Diesel	do.	27,273	25,341	27,766	28,062	30,288

See footnotes at end of table.

TABLE 5—Continued

YUGOSLAVIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1984	1985	1986	1987[p]	1988[e]
MINERAL FUELS AND RELATED MATERIALS—Continued						
Petroleum—Continued						
Refinery products—Continued						
Residual fuel oil	thousand 42-gallon barrels	32,560	30,156	37,409	39,423	[3]40,772
Lubricants	do.	3,171	4,228	4,494	4,830	[3]4,802
Paraffin	do.	197	166	718	227	200
White spirit	do.	201	109	50	119	100
Asphalt and bitumen	do.	4,400	4,113	3,412	3,776	4,000
Petroleum coke	do.	340	334	503	318	300
Other	do.	1,699	1,378	1,699	2,153	2,000
Total	**do.**	**109,211**	**104,795**	**117,341**	**121,653**	**126,298**

[e]Estimated. [p]Preliminary. [r]Revised. NA Not available.
[1]Table includes data available through Nov. 1989.
[2]In addition to the commodities listed, common clay and diatomite are also produced, and tellurium may be recovered as a copper refinery byproduct, but available information is inadequate to make reliable estimates of output levels.
[3]Reported figure.
[4]Includes undetermined quantity of secondary raw material.
[5]Calculated as the difference between reported total and reported primary figure.
[6]Calculated as the difference between reported total and reported secondary figure.
[7]Calculated from pyrite and pyrrhotite concentrate using 42% as average sulfur content.

ities at Majdanpek. The installation of a third ore transport system, a new grinding mill, and reconstructed flotation units were expected to increase the production of concentrate at Majdanpek from 52,000 tons per year in 1988 to 60,000 tons upon completion of the project. The planned production of copper at Bor in 1989 was to be 145,000 tons. About one-third of the copper output would be fabricated at the Bor complex; the balance would be fabricated in the country's other facilities. The planned production of sulfuric and phosphatic acids at Bor in 1989 was expected to reach 640,000 tons, and that of synthetic fertilizer 600,000 tons. Potential earnings at the Bor complex in 1989 were expected to be $175 million from the export of goods and services, a 6% increase over those in 1988.

Ferroalloys.—About 70% of the country's ferroalloy production was earmarked for export, earning $160 million. The Jugohrom enterprise in Jegunovic, which employed about 4,500 workers, announced plans to reconstruct and expand its ferrosilicon and silicon metal-producing facilities by 1990, to increase its exportable output to a value of about $50 million per year. Apart from producing about 100,000 tons of ferroalloys per year, Jugohrom also produced plastics and rubber products. Tvornica Karbida i Ferolegura Dalmacija (Dalmacija) celebrated its 80th anniversary in 1988. In 1971, the firm, founded in 1908 to produce calcium carbide and cyanamide, shifted production entirely to ferroalloys. In 1988, the company produced high-carbon ferrochromium with a chromium content between 65% and 70%. Early in the year, Dalmacija converted a second 24-megawatt furnace to ferrochromium production, which raised the firm's ferrochromium capacity to 80,000 tons per year. The conversion cost was about $2 million. Chromite feedstock for Dalmacija's ferrochromium furnaces was imported from Albania, Turkey, and the U.S.S.R. Approximately 35,000 tons of Dalmacija's total ferrochromium output was annually designated for export to the United States. Dalmaciaja's third 24-megawatt furnace produced ferromanganese and ferrosilicomanganese largely for the domestic market. The Feronikl enterprise in Glogovac in Kosovo produced 5,500 tons of ferronickel and announced plans to produce 6,500 tons in 1989. The enterprise also planned to study the feasibility of building another ferronickel facility. At yearend, Posco, the South Korean steel producer, received an offer of 6,500 tons of ferrosilicon from C. Itoh of Japan on behalf of Jugohrom at $1,150 per ton. After a number of delays in the negotiations concerning the granular size and chemical composition of the Yugoslav material, Posco was reported to have agreed to the purchase, indicating that it would pay a sizing charge of $50 per ton.

Gold.—Exploration work by specialists from the Bor copper mining and beneficiation complex and the Institute of Geology of Belgrade continued over a 10-month period in 1988 at the old Blagojev Kamen Mine in Kucevo. The work revealed several large new quartz veins with an average gold content of 15 grams per ton of ore. The mine was closed since 1964 when it was reported to have had a gold content of 8 grams per ton. Yugoslavia's annual gold production has been mainly a byproduct of copper and lead and zinc mining and processing operations.

Iron and Steel.—Since the adoption of a recovery program in late 1987 at the Smederevo iron and steelworks, a new closed system for water-cooling blast furnaces was put into trial operation. The system, designed in Yugoslavia, continuously recirculated 8,600 cubic feet of water per hour between two blast furnaces and an electric power generating unit. Solid particles in the water were removed at a special sedimentation tank, and fresh water was injected into the system at a rate of 600 cubic meters per hour. The estimated construction cost was $2 million and the equipment was supplied by Yugoslav enterprises. Management at the Smederevo iron and steelworks also announced plans to overhaul one of its blast furnaces to raise steel production capacity by 200,000 tons to 800,000 tons per year. The project would be completed by 1990. Smederevo also planned to modernize its cold-rolling mill by 1990 to increase cold-rolled sheet output from 150,000 to 650,000 tons per year.

In 1988, the Sisak iron and steel works in Croatia announced the full operation of the new agglomeration plant that was completed in 1987. The capacity of the new plant was 550,000 tons of agglomerate per year. The plant included facilities for the preparation of charge, ore agglomeration, electrostatic precipitators for pollution abatement, and central electronic controls for the entire system. The plant would produce about 464,000 tons of agglomerate per year. Ore and other bulk materials would be delivered to the plant by rail and moved to the hoppers by a conveyer system. Feedstock to the plant included 330,000 tons of limonite ore from Ljubija in Bosnia, 134,000 tons of imported iron ore, 24,200 tons of limestone, 36,000 tons of dolomite, and 36,000 tons of coke.

A new casting line, designed to produce 6,000 tons of cast iron annually, was installed at the Topola foundry. The foundry operated as part of the Crvena Zastava motor works at Kragujevac. The new line's castings would be used largely in automobile manufacturing. In 1989, a new furnace was planned for addition to the Topola operation. The Jesenice iron and steel mill introduced a new wear-resistant alloy steel during the year. The new alloy, called Nicrodur, contained higher percentages of carbon and manganese that increased the surface hardness of the steel without affecting its welding and heat treatment properties. The Nicrodur alloy steels were produced at a new 210,000-ton-per-year electric steel plant that was imported from Mann Esmann Demag of the Federal Republic of Germany and was installed at Jesenice in 1987. In 1988, the Jesenice iron and steel mill produced more than 410,000 tons of steel with heat-treated steel accounting for 70% of the total output. At yearend, the management of the Boris Kidric steelworks at Niksic approved a plan to build a modern forging plant. The plant would be designed to produce ring-form forged products that were not produced previously in Yugoslavia and would be based on imported equipment from the Federal Republic of Germany. The equipment would be delivered in the second half of 1990. The EC initiated an antidumping investigation into steel pipes exported by Yugoslavia to the EC market. In 1987, similar actions were taken regarding Yugoslavia's export of cold-rolled steel plate to the EC. In 1988, complaints were filed by European iron and steel producers concerning an 85% increase in Yugoslavia's exports to the EC market between 1984 and 1987, which represented a market share increase from 1.3% to 2.7%. Yugoslavia's sales were concentrated mainly in the Federal Republic of Germany and Italy at prices alleged at 28.4% below those of EC producers.

Lead and Zinc.—The Trepca lead and zinc mining, smelting and refining complex in Kosovo was the country's largest producer of primary lead. However, it continued to experience production difficulties owing to obsolete mining equipment and poor ore grades at its small and mostly underground mines. On the other hand, Topolnica Zletova's Titov Veles smelter operated near capacity during the year. The 35,000-ton-per-year lead smelter utilized the Imperial smelting process and obtained part of its feedstock from two small mines in Macedonia, in addition to concentrates from other areas of the country. The Titov Veles smelter set a record output of lead and zinc of 88,500. Export sales from the operation amounted to $24 million for the year.

Reportedly, two new lead and zinc deposits, the Vuckovo Leziste and Istocni Revir at the Blagodat mining enterprise, near Kriva Feja in eastern Serbia, were to be put into operation at the beginning of 1989. Mine development was done by the Rudar enterprise at Tuzla. When fully operational, the deposits would raise Blagodat's mining output by 10%.

Platinum.—The Bor copper mining and beneficiation complex began to produce platinum catalysts, making Yugoslavia one of four European producers of the material. The annual output was planned at 660 kilograms, largely for domestic use.

Industrial Minerals.—Yugoslavia produced a large number of industrial minerals that included barite, bentonite, gypsum, kaolin, magnesite, and pumice, in sufficient amounts to meet domestic and export needs.

Mineral Fuels.—**Coal.**—Yugoslavia's main coal resource was lignite, accounting for about 88.5% of known coal reserves. Subbituminous and bituminous coals accounted for 11% and 5% of the country's coal resources, respectively. Lignite has been used increasingly in power generation, accounting for more than 80% of total consumption. The country's long-range energy plans were to raise coal's share of the primary energy balance from 37% in 1988 to 44% by 2020. To achieve this, coal output would be increased from 72 million tons in 1987 to 310 million tons of mostly low-calorie lignite. Development of the country's first underwater mine was conducted at Kovin by the Danube River. Coal would be mined by a dredger, and production was planned at 5.5 million tons of coal per year. Opencast mines would also be developed along the river, and a 600-megawatt thermal-power station would be built near the mine by 1994. Total reserves at Kobin were estimated at 266 million tons. The Electrovojvodina enterprise of Novi Sad was designated as the sole contractor for the entire project.

Petroleum and Natural Gas.—Yugoslavia planned to increase gas deliveries from the Soviet Union by as much as 68% with a proposed second gas pipeline through Hungary. Naftagas of Novi Sad and Mineralimpex of the U.S.S.R. signed a preliminary agreement to build a 99-billion-cubic-foot-per-year gas pipeline to Vojvodina in the eastern part of the country. Issues of financing the project and central Government approval were still outstanding at yearend but were expected to be resolved without difficulty. All of Yugoslavia's imports of natural gas during the year came from the Soviet Union, representing 58% of total consumption. The Ina-Naftaplin enterprise of Zagreb in Croatia purchased a new drilling rig in the United States for drilling deep holes in the Dinaric Alps. The cost of the drilling rig was $10 million. A loan for this amount was granted by the International Bank for Recovery and Development under its program for the exploration and production of natural gas in Yugoslavia.

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[1] Prepared by Walter G. Steblez, foreign mineral specialist, Division of International Minerals.

[2] Zeri I Popullit. Dec. 28, 1988, pp. 1, 3–4.

[3] Gornaya Entsyklopedia (Moscow), 1986, p. 86.

[4] Prepared by Walter G. Steblez, foreign mineral specialist, Division of International Minerals.

[5] Rabotnichesko Delo. Feb. 23, 1989, pp. 1–3.

[6] Rabotnichesko Delo. Jan. 19, 1989, p. 4.

[7] Rabotnichesko Delo. Dec. 16, 1988, p. 4.

[8] Rabotnichesko Delo. Mar. 7, 1989, p. 3.

[9] Prepared by John G. Panulas, physical scientist, Division of International Minerals.

[10] Prepared by Donald E. Buck, Jr., physical scientist, Division of International Minerals.

[11] Prepared by Walter G. Steblez, foreign mineral specialist, Division of International Minerals.

[12] The dinar is a nonconvertible currency. All costs presented in the text were valued in U.S. dollars in the Yugoslav sources.

THE MINERAL INDUSTRIES OF

BELGIUM, LUXEMBOURG, AND THE NETHERLANDS

By Donald E. Buck, Jr. and George A. Rabchevsky

BELGIUM[1]

Belgium and Luxembourg together constitute the Belgo-Luxembourg Economic Union, and exchange regulations are administered by the Belgo-Luxembourg Exchange Institute. Belgium's currency unit was the Belgian franc (1 Belgian franc equals 100 centimes). It was part of the European Monetary System (EMS), floating within a fixed band against the other EMS currencies and floating freely with them against the U.S. dollar. In accordance with a Luxembourg decree, the Belgian franc was at par with the Luxembourg franc. The physical currencies were used interchangeably. Belgium boasted a sophisticated, efficient banking system that had been enhanced by the presence of a number of international banks. Brussels was the country's financial capital.

The Kingdom of Belgium, geographically a small country slightly larger than Maryland, the United States, had few indigenous metalliferous raw materials and only a small mining industry. Except for some mining of coal and industrial minerals, the production of steel and nonferrous metals from imported ores were significant contributors to the economy. The production of metals, chemicals, food, and textiles remained the country's top four sectors in terms of contribution to the gross national product (GNP). In 1988, real GNP increased by 3.9%, its best performance since 1976. Belgium's budgetary problem was a budget deficit in 1988, estimated at 8.3% of the GNP and a total cumulative debt estimated at 130% of the GNP by yearend. Except for coal, the iron and steel industry had been improving for the last 2 years. Economic growth, after averaging a 1% annual increase in 1983-85, speeded up in 1986 to an estimated rate of 2.8%. However, gross domestic product (GDP) growth slowed again in 1987 to 1.7% and was estimated to have grown only 1.3% in 1988. The unemployment rate decreased from 11.5% to 12.6% in 1986, from 11.4% to 12.1% in 1987, and from about 9.7% to 11.4% in 1988, the best result since 1982. Out of the total population of about 9.9 million people, about 3.7 to 4.1 million, or 41%, were employed, and about 414,000 were unemployed. Flanders, the northern area of Belgium, was a region that's seen high technical growth similar to that in the United States and the United Kingdom. Wallonia, on the other hand, was a traditional heavy-industry region. Cultural antagonism between the French-Walloons and the Flemish, who speak a Dutch dialect, had always influenced Belgian politics. While contained, there was an undercurrent of Flemish resentment at subsidizing Wallonia, where traditional industries such as coal, iron, steel, and textiles have been in serious trouble since the 1970's.[2]

A relatively new phenomenon in Brussels was the merger and takeover trend. In total, 12 mergers and takeovers took place since 1987. The most widely reported bid, by an Italian industrialist, was the takeover of Société Genéralé de Belgique SA (Générale), a most prestigious holding company. It controlled between 20% and 30% of the Belgian economy, including the production of cement, copper, lead, zinc, and infrared optics materials, through its subsidiaries. Eventually, the bid was blocked by an alliance of Générale and a French financial group. Some members of the Belgian establishment admitted that "La Générale," as the company was affectionally known, was due for a major shakeup.

Production

Belgium continued to rely on imported raw materials for the domestic production of antimony, bismuth, cobaltiferous materials, germanium, and selenium, in addition to the production of arsenic, cadmium, copper, gold, indium, iron, lead, nickel, niobium, palladium, platinum, rhodium, silver, steel, tantalum, tellurium, tin, and zinc. Production of almost all metal and industrial minerals increased substantially from those of 1987. Nevertheless, labor productivity, which improved in the first half of the 1980's, decreased from 2.1% in 1987 to 1.3% in 1988. Mining was an insignificant contributor to the economy. Coal and industrial minerals were the only commodities mined in significant quantities. Total productive investment rose more than 20% in 1988, compared with 11% in 1987.

Trade

Belgium was highly dependent on foreign trade, with one of the highest export-to-production ratios in Europe. Exports accounted for more than 74% of Belgium's GDP. At the end of June, the Brussels Stock Exchange listed 189 Belgian firms and 145 foreign companies. Foreign corporations reportedly supply about one-third of all employment in Belgium and U.S. investments about 10%.

Iron and steel products, petroleum products, and precious stones were the main export commodities of the mineral industry of Belgium. Imports are estimated to have increased in 1988 by 3.8% compared with 3.4% in 1987. This import growth was mainly due to an increase of raw materials imports, especially oil, and a bigger foreign share of the internal market.

Belgium was the United States 10th largest market worldwide. In the minerals industry sector, main exports to the United States were diamonds and jewelry and petroleum and motor fuel, while imports from the United States were also diamonds and jewelry. Antwerp, Belgium's main port city, was the dominant symbol in the shift of prosperity from the French-speaking southern half of the country to the Flemish north. Antwerp's economic power, as provider of 25% of Belgium's exports and just over 10% of its GNP, was because it was Europe's second largest port, after Rotterdam in the Netherlands. Antwerp retained an essential

TABLE 1

BELGIUM: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]	1984	1985	1986	1987[p]	1988[e]
METALS					
Aluminum	5,712	3,908	5,196	6,300	7,500
Arsenic, white[e]	3,000	3,000	3,000	3,500	3,500
Bismuth, metal[e]	385	610	1,000	865	795
Cadmium, smelter	1,476	1,252	1,374	1,308	1,450
Copper:					
Blister:[e]					
Primary	500	900	[r]900	[r]1,000	1,100
Secondary	75,500	114,200	[r]105,000	[r]91,200	98,700
Total	**76,000**	**115,100**	**[r]105,900**	**[r]92,200**	**99,800**
Refined, primary and secondary, including alloys	427,704	[r]455,460	457,776	476,299	511,000
Iron and steel:					
Pig iron thousand tons	8,964	[r]8,724	8,052	8,244	9,085
Ferroalloys: Electric furnace ferromanganese[e] do.	95	90	87	90	95
Steel:					
Crude do.	11,303	10,683	9,770	9,787	11,300
Semimanufactures do.	8,136	8,072	7,358	7,417	7,800
Lead:					
Smelter:[e]					
Primary[3]	71,500	[r]58,000	[r]48,100	[r]59,400	64,100
Secondary[4]	30,000	[r]30,000	[r]26,000	[r]18,500	15,000
Total	**101,500**	**[r]88,000**	**[r]74,100**	**[r]77,900**	**79,100**
Refined:					
Primary	89,600	[r]75,300	64,500	71,100	75,000
Secondary	38,116	[r]38,988	33,816	36,936	51,000
Total	**127,716**	**[r]114,288**	**98,316**	**108,036**	**126,000**
Selenium[e]	[r]180	[r]230	[r]250	[r]230	250
Tin: Secondary	[r]2,412	[r]2,304	2,712	3,900	4,950
Zinc:					
Slab:					
Primary	270,700	271,400	268,700	284,500	[5]298,100
Secondary (remelted zinc)	14,624	[r]19,132	20,092	24,080	21,000
Total	**285,324**	**[r]290,532**	**288,792**	**308,580**	**319,100**
Powder	29,652	32,568	32,196	32,556	38,000
Other, nonferrous: Precious metals, unworked n.e.s.[6] thousand troy ounces	[r]40,799	[r]41,121	40,221	32,150	40,200
INDUSTRIAL MINERALS					
Barite[e]	39,000	40,000	40,000	40,000	35,000
Cement, hydraulic thousand tons	[r]5,708	5,537	5,760	5,689	5,400
Clays: Kaolin do.	69	37	[e]40	[e]45	45
Lime and dead-burned dolomite:					
Quicklime do.	1,980	1,812	1,788	1,764	1,730
Dead-burned dolomite do.	190	—	—	—	—

See footnotes at end of table.

TABLE 1—Continued

BELGIUM: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1984	1985	1986	1987[p]	1988[e]
INDUSTRIAL MINERALS—Continued						
Nitrogen: N content of ammonia	thousand tons	452	[r]388	306	305	300
Phosphates: Thomas slag, gross weight	do.	254	143	[r e]180	[e]175	170
Sodium compounds:						
Carbonate		409,344	446,484	481,656	447,972	445,000
Sulfate[e]		250,000	260,000	265,000	260,000	255,000
Stone, sand and gravel:						
Calcareous:						
Dolomite	thousand tons	2,982	3,210	4,034	4,072	4,700
Limestone	do.	20,520	[r]20,520	21,168	23,616	25,600
Marble:						
In blocks	cubic meters	3,624	684	1,068	672	550
Crushed and other		108	84	84	72	65
Petit granite (Belgian bluestone):						
Quarried	thousand cubic meters	677	563	452	515	925
Sawed	do.	49	41	48	53	64
Worked	do.	15	8	11	12	12
Crushed and other	do.	768	588	455	414	650
Porphyry, all types	thousand tons	3,315	3,413	3,308	3,464	3,450
Quartz and quartzite		349,720	266,839	[r e]250,000	205,196	205,000
Sandstone:						
Rough stone including crushed	thousand tons	2,436	1,864	1,998	1,990	2,250
Paving		7,596	10,224	8,400	9,912	13,000
Sand and gravel:						
Construction sand	thousand tons	6,636	6,576	6,252	7,260	8,850
Foundry sand	do.	612	[r]576	552	588	590
Dredged sand	do.	1,127	1,235	913	928	800
Glass sand	do.	1,680	1,392	1,512	1,680	1,800
Other sand	do.	1,452	1,836	1,956	2,376	2,400
Gravel, dredged	do.	5,340	5,820	5,016	5,856	5,825
Sulfur, byproduct:[e]						
Elemental	do.	[r]110	[r]110	[r]150	[r]155	155
Other forms	do.	135	150	150	145	155
Total	**do.**	**[r]245**	**[r]260**	**[r]300**	**[r]300**	**310**
MINERAL FUELS AND RELATED MATERIALS						
Carbon black[e]		1,750	1,700	1,800	1,800	1,900
Coal:						
Anthracite	thousand tons	340	—	—	—	—
Bituminous	do.	5,960	6,211	5,589	4,356	2,500
Total	**do.**	**6,300**	**6,211**	**5,589**	**4,356**	**2,500**
Coke, all types	do.	5,928	5,964	5,136	5,232	5,540
Fuel briquets, all kinds		([7])	([7])	—	—	—

See footnotes at end of table.

TABLE 1—Continued

BELGIUM: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1984	1985	1986	1987[p]	1988[e]
MINERAL FUELS AND RELATED MATERIALS—Continued						
Gas:						
Manufactured	million cubic feet	25,337	[r]25,271	22,473	23,793	22,220
Natural	do.	1,648	1,847	[r e]1,300	1,350	1,400
Petroleum refinery products:						
Liquefied petroleum gas	thousand 42-gallon barrels	4,352	4,890	11,830	12,457	13,000
Gasoline	do.	31,527	32,749	41,704	41,283	42,500
Naptha	do.	11,472	11,775	8,962	12,647	12,200
Jet fuel and kerosene	do.	[r]9,640	[r]9,752	10,616	10,332	12,600
Distillate fuel oil	do.	59,889	54,727	70,742	67,687	68,100
Residual fuel oil	do.	35,208	24,230	48,726	51,771	44,210
Bitumen, asphaltic		3,192	3,127	4,034	3,953	4,250
Other	do.	r7,952	[r]7,420	[r]9,786	10,297	11,985
Refinery fuel and losses[e]	do.	[r]8,162	[r]7,434	10,320	10,516	10,442
Total	**do.**	**[r]171,394**	**[r]156,104**	**216,720**	**220,943**	**219,287**

[e]Estimated. [p]Preliminary. [r]Revised.
[1]Table includes data available through July 1989.
[2]In addition to the commodities listed, Belgium produced a number of other metals and alloys for which only aggregate output figures were available.
[3]Data not reported; derived by taking reported primary lead output, plus exports of lead bullion, minus imports of lead bullion.
[4]Data represent secondary refined lead output minus remelted lead: as such, the figures are probably high, because they include some lead that was sufficiently pure as scrap that it did not require resmelting, but data are not adequate to permit differentiation.
[5]Reported figure.
[6]Known to include gold, silver, and platinum-group metals.
[7]Revised to zero.

role as the transit center to the European hinterland. The port also handled considerable transshipments to Scandinavia and the United Kingdom. The port supplied markets inland in the Federal Republic of Germany, France, Italy, the Netherlands, Switzerland, and the United Kingdom. Antwerp retained its leading position in coal and ore transit traffic. Additional bulk traffic through the port centered on the specialized minor bulk facilities handling china clay, sulfur, and weather-sensitive commodities such as nonferrous alloys and chemical materials. In 1989, the dedicated terminals of Boran and Westerlund are expected to handle over 0.2 million tons of fine kaolin and sulfur, in liquid and dry form.[3] Also, the diamond industry, the trading exchange, and the 1,500 small cutting and polishing companies in Antwerp bought, processed, and sold about 85% of the world's rough diamonds. The diamond industry was struggling to maintain its competitiveness against often subsidized cutting and polishing industries in low-wage Southeast Asian countries.[4]

The Port of Ghent received raw materials, especially for the steel mills and processing plants. Coal and ore traffic was responsible for over one-third of port tonnage. Steam coal imports in 1987 amounted to 2.25 million tons, with over 0.25 million tons shipped from the port. Sidérurgie Maritime SA (Sidmar) received about 1.8 million tons of metallurgical coal in 1987. Although a large part of coal imports were from the United States, shipments from Australia and the Republic of South Africa, in addition to domestic coals, supplied the steelworks.[5]

The Port of Zeebrugge provided major import facilities for liquid gas supplies from Norway. Dry bulk traffic amounted to 3.4 million tons in 1987 comprising about 2.7 million tons of coal, ore, and coke material.[6]

Commodity Review

***Metals.*—Iron and Steel.**—The two biggest and most depressed employers in Liège, the giant steel group Cockerill-Sambre SA (CS) and the world famous armaments manufacturer Fabrique National SA, broke even in 1988 after years of heavy losses. Liège has been a center of armaments, mechanical engineering, and the steel industry for 400 years, because of the iron that

TABLE 2

BELGIUM-LUXEMBOURG: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
METALS				
Alkali and alkaline-earth metals:				
Alkali metals	8	39	—	France 25; Yugoslavia 10; West Germany 3.
Alkaline-earth metals	78	64	—	West Germany 47; Norway 10; Spain 5.
Aluminum:				
Ore and concentrate	2,873	2,416	—	France 2,183; Netherlands 207; West Germany 26.
Oxides and hydroxides	1,237	1,101	—	United Kingdom 570; Switzerland 155; France 148.
Ash and residue containing aluminum	10,896	14,514	—	West Germany 4,379; Netherlands 4,140; Spain 2,463.
Metal including alloys:				
Scrap	51,888	60,186	—	West Germany 22,343; France 16,653; Netherlands 14,740.
Unwrought	24,861	27,556	—	West Germany 14,306; France 4,517; Netherlands 4,352.
Semimanufactures	287,594	323,668	31,506	France 63,852; West Germany 57,611; Netherlands 43,117.
Antimony:				
Ore and concentrate	49	50	—	All to France.
Metal including alloys, all forms	17	11	—	Zaire 8; Netherlands 1.
Arsenic: Oxides and acids	—	4	—	All to Cyprus.
Beryllium: Metal including alloys, all forms	4	3	—	Mainly to France.
Cadmium: Metal including alloys, all forms	633	583	28	France 274; Japan 108; West Germany 83.
Cesium and rubidium: Metal including alloys, all forms	—	(2)	—	All to France.
Chromium:				
Ore and concentrate	(2)	85	—	Netherlands 56; West Germany 26; Spain 3.
Oxides and hydroxides	128	91	20	France 28; Canada 17.
Metal including alloys, all forms	121	123	(2)	West Germany 67; France 20; Netherlands 18.
Cobalt:				
Ore and concentrate	1	—		
Metal including alloys, all forms	58	154	(2)	Italy 93; France 22; West Germany 22.
Columbium and tantalum:				
Ore and concentrate	1	4	—	All to West Germany.
Ash and residue containing columbium and/or tantalum	858	955	—	West Germany 954.
Metal including alloys, all forms:				
Columbium (niobium)	(2)	18	—	France 12; United Kingdom 5.
Tantalum	48	4	3	France 1.
Copper:				
Ore and concentrate	573	727	—	Netherlands 358; Spain 180; France 89.

See footnotes at end of table.

TABLE 2—Continued

BELGIUM-LUXEMBOURG: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
METALS—Continued				
Copper—Continued				
Matte and speiss including cement copper	76	115	—	Italy 70; West Germany 30; Netherlands 12.
Oxides and hydroxides	1,596	1,389	116	West Germany 586; France 196.
Sulfate	6,588	7,044	NA	NA.
Ash and residue containing copper	1,261	1,421	—	West Germany 438; Italy 330; Netherlands 195.
Metal including alloys:				
Scrap	26,121	32,485	—	Netherlands 12,423; West Germany 9,215; France 3,975.
Unwrought	243,185	258,183	198	France 109,963; West Germany 39,278; Italy 33,957.
Semimanufactures	277,828	266,765	268	West Germany 99,023; France 49,949; Netherlands 31,685.
Gold:				
Waste and sweepings value, thousands	$4,955	$5,662	—	Netherlands $3,758; West Germany $1,167; United Kingdom $737.
Metal including alloys, unwrought and partly wrought troy ounces	578,718	523,386	11,365	Switzerland 245,634; United Kingdom 167,442.
Hafnium: Metal including alloys, all forms	—	(2)	—	All to Japan.
Iron and steel:				
Iron ore and concentrate:				
Excluding roasted pyrite	1,058	2,771	—	France 2,634; Spain 49; Italy 48.
Pyrite, roasted	149,628	193,874	—	Spain 122,990; France 27,744; West Germany 26,937.
Metal:				
Scrap	658,309	704,546	15	Netherlands 172,844; France 161,819; Spain 142,680.
Pig iron, cast iron, related materials	10,690	14,513	11	Netherlands 6,683; France 3,615; Portugal 2,510.
Ferroalloys:				
Ferrochromium	876	2,118	—	France 1,145; West Germany 787; Spain 80.
Ferromanganese	17,370	21,297	—	France 9,849; West Germany 5,454; Egypt 3,255.
Ferromolybdenum	16,545	26,267	NA	NA.
Ferronickel	103	55	—	All to West Germany.
Ferrosilicochromium	—	273	—	West Germany 245; France 26; Sweden 2.
Ferrosilicon	900	4,370	—	West Germany 2,681; France 1,535; Italy 76.
Silicon metal	64	98	3	France 84; Japan 11.
Unspecified	2,619	1,996	35	West Germany 670; France 439; Italy 359.

See footnotes at end of table.

TABLE 2—Continued

BELGIUM-LUXEMBOURG: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
METALS—Continued				
Iron and steel—Continued				
Metal—Continued				
Steel, primary forms thousand tons	2,907	3,420	101	France 1,130; West Germany 781; Italy 530.
Semimanufactures:				
Bars, rods, angles, shapes, sections do.	2,834	2,574	293	West Germany 668; France 477; Netherlands 331.
Universals, plates, sheets do.	4,680	5,055	220	France 1,155; West Germany 983; Netherlands 449.
Hoop and strip do.	484	485	1	West Germany 228; France 98; Netherlands 52.
Rails and accessories do.	116	98	25	France 18; Canada 11.
Wire do.	290	292	46	West Germany 62; France 50.
Tubes, pipes, fittings do.	453	401	24	U.S.S.R. 82; France 78; West Germany 64.
Casting and forgings, rough do.	13	13	(2)	Netherlands 4; France 3; West Germany 2.
Lead:				
Ore and concentrate	29	1	—	All to Zaire.
Oxides	5,574	4,103	2	West Germany 3,260; Netherlands 463; France 134.
Ash and residue containing lead	3,839	3,548	—	West Germany 1,996; France 491; Netherlands 423.
Metal including alloys:				
Scrap	7,445	23,362	—	France 11,375; East Germany 3,835; United Kingdom 3,120.
Unwrought	58,061	64,567	3,842	West Germany 13,343; Netherlands 12,366; France 6,284.
Semimanufactures	24,235	24,477	44	Netherlands 7,521; France 6,578; West Germany 2,560.
Lithium:				
Oxides and hydroxides	50	—		
Metal including alloys, all forms	—	(2)	—	Mainly to Switzerland.
Magnesium: Metal including alloys:				
Scrap	598	565	—	West Germany 314; Italy 138; Netherlands 37.
Unwrought	52	58	—	West Germany 56; United Kingdom 2.
Semimanufactures	3,300	3,671	15	West Germany 2,309; United Kingdom 1,213; France 80.
Manganese:				
Ore and concentrate, metallurgical-grade	878	737	19	United Kingdom 569; Spain 143.
Metal including alloys, all forms	1,960	1,760	24	West Germany 631; Norway 602; Poland 96.
Mercury 76-pound flasks	319	87	—	Netherlands 73; United Kingdom 14.

See footnotes at end of table.

TABLE 2—Continued

BELGIUM-LUXEMBOURG: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
METALS—Continued				
Molybdenum:				
Ore and concentrate	11,346	12,890	80	West Germany 3,912; United Kingdom 1,662; Sweden 1,632.
Oxides and hydroxides	36	53	—	United Kingdom 43; West Germany 10.
Metal including alloys:				
Scrap	1	4	—	All to Netherlands.
Unwrought	13	5	—	Switzerland 2; Greece 1; United Kingdom 1.
Semimanufactures	127	134	(2)	Netherlands 85; United Kingdom 28; France 15.
Nickel:				
Ore and concentrate	—	16	—	All to West Germany.
Matte and speiss	—	9	—	All to Netherlands.
Oxides and hydroxides	12	37	—	Finland 33; United Kingdom 3; Hungary 1.
Ash and residue containing nickel	2,276	2,209	—	West Germany 984; France 551; Austria 293.
Metal including alloys:				
Scrap	739	990	160	Netherlands 542; West Germany 153.
Unwrought	313	371	48	West Germany 95; France 58.
Semimanufactures	411	317	1	West Germany 186; United Kingdom 67; Netherlands 38.
Platinum-group metals:				
Waste and sweepings value, thousands	$6,387	$5,546	—	United Kingdom $3,321; West Germany $2,040.
Metals including alloys, unwrought and partly wrought troy ounces	353,661	298,522	191,331	United Kingdom 42,857; Japan 5,112.
Rare-earth metals including alloys, all forms	1	5	—	Finland 3; Netherlands 2.
Rhenium: Metal including alloys, all forms	21	(2)	—	Mainly to Japan.
Silicon, high-purity	1	(2)	—	Mainly to France.
Silver:				
Ore and concentrate[3] value, thousands	$5	—		
Waste and sweepings do.	$2,610	$2,727	—	Netherlands $1,128; United Kingdom $992; West Germany $607.
Metal including alloys, unwrought and partly wrought thousands troy ounces	41,636	30,614	8,187	United Kingdom 15,383; West Germany 922.
Tellurium, elemental and arsenic	53	78	2	West Germany 28; United Kingdom 28; France 9.
Tin:				
Ore and concentrate	26	—		
Oxides	(2)	(2)	—	Mainly to France.
Ash and residue containing tin	2,147	1,607	—	United Kingdom 1,491; West Germany 114.

See footnotes at end of table.

TABLE 2—Continued

BELGIUM-LUXEMBOURG: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987	
			United States	Other (principal)
METALS—Continued				
Tin—Continued				
Metal including alloys:				
Scrap	84	64	—	Canada 41; West Germany 18; Netherlands 3.
Unwrought	3,237	3,107	—	France 1,154; Netherlands 648; West Germany 452.
Semimanufactures	147	100	—	Finland 16; Egypt 12; Jordan 10.
Titanium:				
Ore and concentrate	3	875	—	West Germany 873; Argentina 2.
Oxides	44,601	45,570	16,203	West Germany 8,527; France 2,102.
Metal including alloys:				
Scrap	14	18	—	West Germany 10; United Kingdom 7; Netherlands 1.
Unwrought	9	103	—	Mexico 60; France 43.
Semimanufactures	85	92	(2)	Finland 31; Italy 21; France 10.
Tungsten:				
Ash and residue containing tungsten	—	12	—	West Germany 7; Italy 5.
Metal including alloys:				
Scrap	41	53	—	West Germany 34; Netherlands 17; France 2.
Unwrought	6	9	—	Spain 6; West Germany 1.
Semimanufactures	105	135	(2)	Netherlands 69; United Kingdom 54; France 4.
Uranium and/or thorium: Ore and concentrates	—	19	—	France 13; United Kingdom 6.
Vanadium:				
Ore and concentrate	—	(2)	—	All to Netherlands.
Oxides and hydroxides	465	290	126	West Germany 71; France 67.
Ash and residue containing vanadium	7,631	3,095	—	Sweden 2,546; Netherlands 549.
Metal including alloys:				
Unwrought	95	(2)	—	All to France.
Semimanufactures	(2)	(2)	—	Do.
Zinc:				
Ore and concentrates	11,086	21,564	—	France 15,279; Bulgaria 6,050; Netherlands 235.
Oxides	6,926	7,744	—	France 2,791; West Germany 2,123; Italy 1,175.
Blue powder	18,933	18,615	—	West Germany 9,712; France 2,641; Switzerland 1,849.
Matte	4,491	4,277	—	France 1,874; West Gemany 927; Italy 514.
Ash and residue containing zinc	62,270	46,476	—	France 22,308; Netherlands 19,327; Spain 1,957.

See footnotes at end of table.

TABLE 2—Continued

BELGIUM-LUXEMBOURG: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
METALS—Continued				
Zinc—Continued				
Metal including alloys:				
Scrap	10,155	8,408	—	France 3,645, Netherlands 2,261; West Germany 1,735.
Unwrought	185,933	213,427	15,900	West Germany 63,614; France 28,081.
Semimanufactures	7,489	7,646	25	West Germany 5,049; France 1,228; Netherlands 919.
Zirconium:				
Ore and concentrate	—	28	—	Australia 27; Italy 1.
Metal including alloys:				
Scrap	(2)	1	—	All to West Germany.
Unwrought	4	11	—	Switzerland 5; West Germany 4; Norway 1.
Semimanufactures	10	13	(2)	Finland 8; France 5.
Other:				
Ores and concentrates	115	208	—	Spain 179; France 26; West Germany 3.
Oxides and hydroxides	2,144	2,024	137	West Germany 635; France 424; Italy 365.
Ashes and residues	6,392	37,791	31,433	West Germany 479; Republic of Korea 50.
Base metals including alloys, all forms	33	28	10	Japan 6; United Kingdom 5.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	5,846	8,984	—	Netherlands 8,627; France 156; United Kingdom 129.
Artifical:				
Corundum	1,854	2,661	26	France 1,743; West Germany 630; Netherlands 243.
Silicon carbide	2,795	3,071	—	France 1,660; Italy 944; Netherlands 132.
Dust and powder of precious and semiprecious stones including diamond value, thousands	$9,552	$10,008	$1,513	Netherlands $1,263; Spain $1,195.
Grinding and polishing wheels and stones	2,708	2,812	32	France 1,622; West Germany 301; United Kingdom 283.
Asbestos, crude	659	141	—	Spain 120; United Kingdom 12; Netherlands 4.
Barite and witherite	55,379	64,985	—	West Germany 43,973; Netherlands 8,849; United Kingdom 6,075.
Boron materials:				
Crude natural borates	22,453	23,353	(2)	Netherlands 13,425; West Germany 8,395; France 465.
Elemental	1	29	—	All to France.
Oxides and acids	305	129	—	France 82; Netherlands 35; Cameroon 4.
Bromine	5	18	—	All to Netherlands.
Cement thousand tons	2,678	2,718	37	Netherlands 1,472; West Germany 601; France 373.

See footnotes at end of table.

TABLE 2—Continued

BELGIUM-LUXEMBOURG: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
INDUSTRIAL MINERALS—Continued					
Chalk		72,344	92,363	—	West Germany 44,728; Netherlands 14,216; Saudi Arabia 10,484.
Clays, crude:					
Bentonite		280	86	—	France 29; West Germany 16; Switzerland 12.
Chamotte earth		198	250	—	France 120; West Germany 116; Algeria 5.
Fuller's earth		661	82	—	All to Netherlands.
Kaolin		37,002	41,019	—	Netherlands 21,404; West Germany 9,915; France 7,881.
Unspecified		6,863	2,388	(2)	France 1,067; Netherlands 859; Italy 140.
Cryolite and chiolite		3	31	—	Netherlands 30; Argentina 1.
Diamond:					
Gem, not set or strung	value, thousands	$3,958,149	$4,839,008	$1,109,283	Israel $918,433; India $858,786.
Industrial stones	do.	$69,029	$70,666	$14,407	West Germany $6,856; Japan $5,652.
Diatomite and other infusorial earth		129,068	74,015	—	Netherlands 73,452; West Germany 161; Cameroon 94.
Feldspar, fluorspar, related materials:					
Feldspar		57	45	—	Greece 21; France 11; Spain 11.
Fluorspar		20	—		
Unspecified		28	42	—	All to Netherlands.
Fertilizer materials:					
Crude, n.e.s.		42,072	58,848	—	France 34,790; Netherlands 20,920; West Germany 2,782.
Manufactured:					
Ammonia		55,267	51,995	—	France 37,515; Netherlands 6,698; West Germany 4,481.
Nitrogenous	thousand tons	2,398	2,696	88	France 1,268; West Germany 367; Netherlands 241.
Phosphatic	do.	717	743	—	West Germany 376; France 256; Netherlands 48.
Potassic	do.	35	113	—	France 89; Netherlands 12; West Germany 8.
Unspecified and mixed	do.	1,847	1,860	3	France 877; West Germany 215; Netherlands 98.
Graphite, natural		83	8	(2)	West Germany 6; France 1; Nigeria 1.
Gypsum and plaster		94,204	131,438	—	Netherlands 90,433; France 25,499; West Germany 13,202.
Iodine		26	21	—	Italy 7; Netherlands 4; Romania 4.
Kyanite and related materials		38	43	—	Netherlands 22; France 15; West Germany 4.
Lime		601,610	607,687	—	Netherlands 532,974; West Germany 55,784; France 7,366.

See footnotes at end of table.

TABLE 2—Continued

BELGIUM-LUXEMBOURG: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
INDUSTRIAL MINERALS—Continued					
Magnesium compounds:					
Magnesite, crude		154	534	—	West Germany 314; Netherlands 220.
Oxides and hydroxides		4,922	2,445	—	France 991, West Germany 944; Netherlands 180.
Other		4,014	2,339	—	France 1,038; Netherlands 530; Cameroon 264.
Mica:					
Crude including splittings and waste		82	13	—	Italy 3; United Kingdom 3; Venezuela 2.
Worked including agglomerated splittings		25	1	—	Mainly to Netherlands.
Nitrates, crude		17,416	27,149	—	Netherlands 16,455; West Germany 3,895; France 3,439.
Phosphates, crude		17,604	30,822	—	West Germany 12,883; France 11,947; Netherlands 3,410.
Phosphorus, elemental		(2)	1	—	Mainly to France.
Pigments, mineral:					
Natural, crude		50	61	—	Philippines 41; Ecuador 13; Republic of Korea 6.
Iron oxides and hydroxides, processed		13,932	13,325	188	West Germany 4,284; France 2,393; United Kingdom 1,277.
Potassium salts, crude		2,127	1,024	—	West Germany 598; Netherlands 298; France 128.
Precious and semiprecious stones other than diamond:					
Natural	value, thousands	$18,579	$17,902	$3,314	Switzerland $2,958; Sweden $2,393.
Synthetic	do.	$2,708	$4,153	$623	Netherlands $858; Republic of Korea $712.
Pyrite, unroasted		125	130	—	All to Netherlands.
Salt and brine		164,860	83,597	65	France 80,526; Netherlands 1,495; West Germany 1,000.
Sodium compounds, n.e.s.: Carbonate, manufactured		15,606	NA		
Stone, sand and gravel:					
Dimension stone:					
Crude and partly worked	thousands tons	529	597	(2)	Netherlands 527; West Germany 41; France 28.
Worked	do.	43	50	(2)	West Germany 31; Netherlands 10; France 7.
Dolomite, chiefly refactory-grade	do.	1,431	1,313	—	Netherlands 707; France 294; West Germany 240.
Gravel and crushed rock	do.	9,404	8,745	—	Netherlands 5,773; France 2,759; West Germany 211.
Limestone other than dimension	do.	917	968	—	Netherlands 594; France 205; West Germany 167.
Quartz and quartzite	do.	294	294	—	France 285; West Germany 5; Netherlands 3.

See footnotes at end of table.

TABLE 2—Continued

BELGIUM-LUXEMBOURG: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
INDUSTRIAL MINERALS—Continued					
Stone, sand and gravel—Continued					
Sand other than metal-bearing	thousand tons	3,789	3,972	([2])	Netherlands 1,860; France 1,100; Sweden 166.
Sulfur:					
Elemental:					
Crude including native and byproduct		16,903	32,077	—	Netherlands 16,085; United Kingdom 6,662; France 3,780.
Colloidal, precipitated, sublimed		189	292	—	Mexico 140; Venezuela 66; Argentina 40.
Sulfuric acid		147,341	192,581	—	Netherlands 108,139; France 69,136; West Germany 6,845.
Talc, steatite, soapstone, pyrophyllite		39,929	53,838	170	United Kingdom 14,229; West Germany 11,571; Netherlands 5,910.
Vermiculite, perlite, chlorite		6,322	505	—	France 306; West Germany 98; Netherlands 75.
Other:					
Crude	thousand tons	351	458	([2])	Netherlands 431, France 21; West Germany 4.
Slag and dross, not metal-bearing	do.	2,248	2,244	—	France 889; Netherlands 522; West Germany 495.
MINERAL FUELS AND RELATED MATERIALS					
Asphalt and bitumen, natural		71,376	86,634	—	France 67,639; Netherlands 14,512; West Germany 4,469.
Carbon:					
Carbon black		6,414	4,877	686	West Germany 2,201; France 475; Turkey 181.
Gas carbon		—	([2])	—	All to West Germany.
Coal:					
Anthracite	thousand tons	86	113	—	France 58; United Kingdom 39.
Bituminous	do.	1,170	836	—	France 486; West Germany 138, Netherlands 120.
Briquets of anthracite and bituminous coal	do.	4	4	—	France 2; United Kingdom 1.
Lignite including briquets	do.	33	12	—	France 9; West Germany 2.
Coke and semicoke	do.	550	649	—	West Germany 300; France 208; Netherlands 39.
Gas, natural: Gaseous	million cubic feet	—	74	—	West Germany 72.
Peat including briquets and litter		26,747	31,429	—	France 25,831; Netherlands 2,346; Switzerland 1,223.
Petroleum:					
Crude	thousand 42-gallon barrels	—	41	—	Mexico 32; West Germany 9.
Refinery products:					
Liquefied petroleum gas	do.	4,774	3,809	14	Netherlands 1,755; West Germany 885; United Kingdom 437.

See footnotes at end of table.

TABLE 2—Continued

BELGIUM-LUXEMBOURG: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
MINERAL FUELS AND RELATED MATERIALS—Continued					
Petroleum—Continued					
Refinery products—Continued					
Gasoline	thousand 42-gallon barrels	36,778	37,631	5,754	West Germany 8,853; Netherlands 8,354; Switzerland 6,991.
Mineral jelly and wax	do.	17	13	(2)	Australia 2; Kenya 2; Nigeria 2.
Kerosene and jet fuel	do.	10,172	9,700	—	West Germany 2,864; Switzerland 1,143; bunkers 3,088.
Distillate fuel oil	do.	23,663	21,872	308	West Germany 9,631; France 5,062; bunkers 2,479.
Lubricants	do.	2,597	2,673	(2)	Netherlands 613; West Germany 260; France 219.
Residual fuel oil	do.	48,956	50,496	8,695	Netherlands 8,663; bunkers 14,573.
Bitumen and other residues	do.	2,506	2,466	—	West Germany 689; France 682; Netherlands 490.
Bituminous mixtures	do.	128	343	—	Netherlands 303; France 24; West Germany 7.
Petroleum coke	do.	427	347	—	France 223; Netherlands 91; West Germany 33.

NA Not available.
[1] Table prepared by staff, Branch of Geographic Data.
[2] Less than 1/2 unit.
[3] May include other precious metals.

was found along the Meuse valley. Belgium reportedly exported 20% of its steel to non-European Community (EC) countries. There was virtually one major steel producer, CS, almost wholly owned by the Government. CS ranked sixth in Europe in steel production. This was the first time in 13 years that CS had made rather than lost money, despite a slowdown in activity during the second half of the year. In 1987, the company had lost $46.8 million.[7] Overall, the production of pig iron and wide steel in Belgium improved slightly to about 4.5 million tons, but virtually remained the same for the past several decades. Most of the steel was produced in oxygen converters. More than 90% of all domestic and imported steel was exported. In 1984, there were 38,720 persons employed in the iron and steel industry, dropping to about 29,000 workers in 1988. Among individual country performance, Belgium ranked 17th place in raw steel production worldwide.

CS announced the takeover of the Liège-based Delloye Matthieu SA company, which specialized in electrogalvanizing activities. The takeover would reinforce CS's leading role as a producer of coated steel at its Phoenix Works in Liège. Restructuring CS has cost the Belgian Government almost $2.6 billion over the past 5 years, and the company's work force has been cut in half. Most CS clients in the automotive, construction, and packaging sectors were based in Europe.[8] CS management and the Belgian economic affairs minister have agreed, in principle, to raise the proportion of the state-owned steelmaker's shares currently traded on the Brussels Bourse from the current 2% to 5%.

Phoenix Works, part of CS's coated steel division, exported more than 80% of its production to Europe. To improve its product quality, the Works invested $65 million in a 240,000-ton-per-year galvanizing line at its Ivoz-Ramet Works, which will replace the existing line. Phoenix Works used about 30,000 tons per year of zinc and held stocks of about 1,800 tons by midyear.

Sidmar, the second largest steel producer in Belgium, increased its output to about 3 million tons. It sold about 65% of its output in Europe, including about 19% to the U.S.S.R., and the remaining 35% went to developing countries. Sidmar was 51% owned by

TABLE 3

BELGIUM-LUXEMBOURG: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS				
Alkali and alkaline-earth metals:				
Alkali metals	200	90	22	France 23; West Germany 16.
Alkaline-earth metals	221	203	(2)	France 135; China 32; West Germany 19.
Aluminum:				
Ore and concentrate	29,130	26,534	—	Guyana 7,445; West Germany 6,696; Netherlands 6,252.
Oxides and hydroxides	28,894	32,871	2,647	West Germany 23,564; Netherlands 3,323.
Ash and residue containing aluminum	9,134	11,099	—	West Germany 3,997; Hungary 2,372; France 2,009.
Metal including alloys:				
Scrap	71,290	90,872	519	West Germany 26,863; Netherlands 22,519; France 21,316.
Unwrought	307,421	315,514	254	Netherlands 198,861; West Germany 26,592; United Kingdom 24,310.
Semimanufactures	110,109	119,054	500	West Germany 43,651; France 26,947; Netherlands 19,881.
Antimony:				
Ore and concentrate	5,188	6,086	—	Bolivia 3,067; Turkey 900; Hong Kong 762.
Oxides	810	786	17	France 481; West Germany 94; Netherlands 66.
Metal including alloys, all forms	385	878	2	China 713; Turkey 54; Thailand 43.
Arsenic: Oxides and acids	20	61	—	Taiwan 43; West Germany 9; United Kingdom 8.
Beryllium:				
Oxides and hydroxides	25	—		
Metal including alloys, all forms	1	2	(2)	West Germany 1; Netherlands 1.
Bismuth: Metal including alloys, all forms	3	2	(2)	United Kingdom 1.
Cadmium: Metal including alloys, all forms	1,509	1,585	29	Netherlands 883; China 162; Italy 126.
Cesium and rubidum: Metal including alloys, all froms	(2)	2	—	Mainly from France.
Chromium:				
Ore and concentrate	3,846	2,581	—	Netherlands 1,985; France 252; West Germany 211.
Oxides and hydroxides	787	809	—	West Germany 467; France 114; Romania 100.
Metal including alloys, all forms	536	406	3	Netherlands 136; United Kingdom 113; West Germany 48.
Cobalt:				
Ore and concentrate	2	(2)	—	Mainly from Netherlands.
Oxides and hydroxides	64	89	(2)	United Kingdom 44; Netherlands 27; Finland 17.
Metal including alloys, all forms	161	494	444	United Kingdom 33; West Germany 6.

See footnotes at end of table.

TABLE 3—Continued

BELGIUM-LUXEMBOURG: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS—Continued				
Columbium and tantalum:				
Ore and concentrate	2,046	1,845	—	All from Canada.
Ash and residue containing columbium and/or tantalum	1	—		
Metal including alloys, all forms:				
Columbium (niobium)	6	3	—	All from West Germany.
Tantalum	40	36	1	West Germany 28; France 3; Austria 2.
Copper:				
Ore and concentrate	3,722	912	—	Australia 848; Netherlands 43; United Kingdom 21.
Oxides and hydroxides	86	82	1	Italy 68; Netherlands 5.
Sulfate	1,486	1,475	—	Netherlands 1,219; Hungary 66.
Ash and residue containing copper	43,114	80,285	10,089	Brazil 24,838; Italy 11,209; France 10,374.
Metal including alloys:				
Scrap	119,423	147,257	4,838	France 40,471; Netherlands 27,835; United Kingdom 26,159.
Unwrought	464,095	394,634	7,091	Zaire 230,006; Netherlands 51,115, Zambia 34,986.
Semimanufactures	50,069	53,123	231	West Germany 26,419; France 9,691; Italy 7,352.
Gold:				
Waste and sweepings value, thousands	$2,647	$2,398	$206	Netherlands $1,036; France $878.
Metal including alloys, unwrought and partly wrought thousand troy ounces	1,640	1,447	1	Switzerland 642; Canada 255; West Germany 148.
Hafnium: Metal including alloys, all forms	—	([2])	—	All from France.
Iron and steel:				
Iron ore and concentrate:				
Excluding roasted pyrite thousand tons	18,056	18,386	—	Brazil 4,688; France 3,749; Sweden 2,347.
Pyrite, roasted do.	52	60	—	All from West Germany.
Metal:				
Scrap do.	1,222	1,584	13	West Germany 749; France 421; Netherlands 362.
Pig iron, cast iron, related materials	136,815	142,859	464	France 91,049; West Germany 15,475; Canada 11,481.
Ferroalloys:				
Ferrochromium	45,310	41,662	5	U.S.S.R. 9,913; West Germany 7,155; Zimbabwe 6,403.
Ferromanganese	47,343	59,332	176	France 17,653; Republic of South Africa 15,584; Norway 14,549.
Ferromolybdenum	709	906	—	United Kingdom 407; Netherlands 285; Austria 176.

See footnotes at end of table.

TABLE 3—Continued

BELGIUM-LUXEMBOURG: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS—Continued					
Iron and steel—Continued					
Metal—Continued					
Ferroalloys—Continued					
Ferronickel		5,243	3,818	—	Netherlands 2,067; Colombia 723; Dominican Republic 526.
Ferrosilicochromium		2,253	2,774	—	West Germany 2,062; Netherlands 532; Italy 169.
Ferrosilicomanganese		41,049	47,411	—	Norway 24,157; Republic of South Africa 11,207; France 4,962.
Ferrosilicon		28,667	31,089	—	West Germany 10,649; Norway 8,029; France 2,977.
Silicon metal		873	684	—	France 456; United Kingdom 89.
Unspecified		4,612	5,027	—	France 2,520; West Germany 765; United Kingdom 416.
Steel, primary forms	thousand tons	1,020	1,133	(2)	France 361; West Germany 324; Netherlands 250.
Semimanufactures:					
Bars, rods, angles, shapes, sections	do.	956	985	(2)	France 274; West Germany 242; Netherlands 164.
Universals, plates, sheets	do.	995	1,156	(2)	Netherlands 403; France 294; West Germany 247.
Hoop and strip	do.	132	147	(2)	West Germany 66; France 52; Netherlands 9.
Rails and accessories	do.	5	5	(2)	France 2; Netherlands 2; West Germany 1.
Wire	do.	73	72	(2)	West Germany 10,369; Norway 8,029; France 2,977.
Tubes, pipes, fittings	do.	314	293	1	Netherland 80; West Germany 71; France 43.
Castings and forgings, rough	do.	55	46	1	West Germany 19; France 13; Netherlands 7.
Lead:					
Ore and concentrate		76,144	107,072	—	Peru 39,373; Australia 15,799; Mexico 10,755.
Oxides		7,280	5,412	1	West Germany 3,264; France 1,944; Netherlands 203.
Ash and residue containing lead		41,369	42,299	946	France 12,151; United Kingdom 8,283; Sweden 3,204.
Metal including alloys:					
Scrap		6,218	10,317	751	Netherlands 4,375, Canada 1,418; Ireland 880.
Unwrought		61,379	41,114	5	France 17,592; United Kingdom 12,404; Mexico 3,219.
Semimanufactures		4,408	6,069	35	United Kingdom 2,678; West Germany 2,156; France 601.

See footnotes at end of table.

TABLE 3—Continued

BELGIUM-LUXEMBOURG: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS—Continued				
Lithium:				
Oxides and hydroxides	187	225	20	Netherlands 105; West Germany 73,.
Metal including alloys, all forms	1	1	—	All from West Germany.
Magnesium: Metal including alloys:				
Scrap	162	105	—	West Germany 36; Italy 24; France 15.
Unwrought	2,730	3,683	22	Netherlands 1,209; Norway 766; Yugoslavia 492.
Semimanufactures	1,486	754	98	West Germany 234; Italy 219; France 149.
Manganese:				
Ore and concentrate, metallurgical grade	199,138	75,548	24	Brazil 32,506; Australia 16,372; Netherlands 14,124.
Oxides	1,484	2,371	1,195	Japan 520; France 236.
Metal including alloys, all forms	2,994	3,421	879	Republic of South Africa 1,328; Netherlands 700.
Mercury 76-pound flasks	6,148	3,341	—	Spain 1,624; Netherlands 1,044; Finland 290.
Molybdenum:				
Ore and concentrate	22,406	24,787	1,817	Canada 9,270; Netherlands 6,058; Chile 3,182.
Oxides and hydroxides	147	180	—	West Germany 103; Netherlands 26.
Metal including alloys:				
Scrap	35	68	—	West Germany 30; United Kingdom 29; Austria 7.
Unwrought	19	47	—	United Kingdom 37; France 4; West Germany 3.
Semimanufactures	157	366	7	Netherlands 293; United Kingdom 63.
Nickel:				
Ore and concentrate	1,087	2,350	2,220	Netherlands 82; United Kingdom 43.
Matte and speiss	1,943	1,791	—	Netherlands 1,648; Republic of South Africa 132; West Germany 11.
Oxides and hydroxides	746	274	([2])	Australia 163; Canada 74; West Germany 24.
Ash and residue containing nickel	2,395	1,982	108	West Germany 775; United Kingdom 446; Netherlands 390.
Metal including alloys:				
Scrap	304	628	26	France 377; West Germany 129; United Kingdom 31.
Unwrought	3,787	6,647	90	Netherlands 4,027; West Germany 1,272; Canada 731.
Semimanufactures	804	691	69	West Germany 245; Netherlands 116; United Kingdom 101.

See footnotes at end of table.

TABLE 3—Continued

BELGIUM-LUXEMBOURG: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS—Continued				
Platinum-group metals:				
Waste and sweepings value, thousands	$13,574	$13,985	—	Netherlands $7,778; Algeria $3,897; Sweden $1,054.
Metals including alloys, unwrought and partly wrought troy ounces	32,151	56,136	9,444	United Kingdom 23,154; West Germany 8,876.
Rare-earth metals including alloys, all forms	54	34	6	Austria 13; Brazil 4.
Rhenium: Metal including alloys, all forms	1	(2)	—	Mainly from United Kingdom.
Selenium, elemental	309	323	21	Netherlands 185; United Kingdom 73; West Germany 33.
Silicon, high-purity	1	86	—	China 46; Hong Kong 40.
Silver:				
Ore and concentrate[3] value, thousands	$21,270	$6,680	$2,109	Peru $3,558; Canada $1,013.
Waste and sweepings do.	$1,839	$2,185	$280	West Germany $1,407; Netherlands $190.
Metal including alloys, unwrought and partly wrought thousand troy ounces	43,918	40,198	16,756	Netherlands 17,061; West Germany 1,848.
Tellurium, elemental and arsenic	79	194	1	Netherlands 84; Sweden 79; West Germany 25.
Tin:				
Ore and concentrate	102	35	—	Bolivia 20; Nigeria 11; Congo 3.
Oxides	9	20	—	Japan 12; Netherlands 2; United Kingdom 2.
Ash and residue containing tin	728	1,006	41	Netherlands 259; United Kingdom 165; Nigeria 164.
Metal including alloys:				
Scrap	337	238	5	United Kingdom 102; Netherlands 59; France 43.
Unwrought	3,536	2,148	17	Netherlands 771; United Kingdom 724; Zimbabwe 169.
Semimanufactures	402	237	—	Netherlands 110; West Germany 83; France 32.
Titanium:				
Ore and concentrate	106,814	132,705	—	Canada 105,263; Norway 22,646; Republic of South Africa 4,007.
Oxides	5,904	5,498	375	West Germany 3,258; United Kingdom 914; France 670.
Metal including alloys:				
Scrap	713	591	305	Canada 186; West Germany 62.
Unwrought	16	43	(2)	United Kingdom 22; U.S.S.R. 20.
Semimanufactures	130	243	36	France 90; United Kingdom 35.
Tungsten:				
Ore and concentrate	54	14	—	All from United Kingdom.
Oxides and hydroxides	20	36	(2)	China 28; West Germany 8.

See footnotes at end of table.

TABLE 3—Continued

BELGIUM-LUXEMBOURG: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987 United States	Sources, 1987 Other (principal)
METALS—Continued					
Tungsten—Continued					
Ash and residue containing tungsten		5	1	—	All from France.
Metal including alloys:					
Scrap		95	76	([2])	United Kingdom 68.
Unwrought		27	21	5	United Kingdom 6; France 4.
Semimanufactures		142	135	([2])	Netherlands 125; Italy 3; France 2.
Uranium and/or thorium:					
Ore and concentrate		38	1	—	All from West Germany.
Metal including alloys, all forms:					
Uranium	do.	$2	$39	—	France $36.
Thorium	do.	$20	$2	—	All from West Germany.
Vanadium:					
Ore and concentrate		44	—		
Oxides and hydroxides		4,056	4,194	18	China 2,212; Republic of South Africa 1,245; Finland 276.
Ash and residue containing vanadium		9,123	12,087	—	Republic of South Africa 12,040; West Germany 24; United Kingdom 23.
Metal including alloys:					
Scrap		1	—		
Unwrought		131	([2])	([2])	
Semimanufactures		([2])	—		
Zinc:					
Ore and concentrate		520,277	588,803	2,920	Canada 193,299; Peru 89,709; Mexico 63,920.
Oxides		9,783	8,886	72	France 3,252; Netherlands 2,797; West Germany 1,535.
Blue powder		1,033	1,096	—	France 530; Netherlands 310; West Germany 164.
Matte		788	507	—	France 238; West Germany 174; Netherlands 95.
Ash and residue containing zinc		73,963	66,364	7,519	West Germany 23,088; France 12,641; Netherlands 8,247.
Metal including alloys:					
Scrap		7,310	14,070	499	Netherlands 6,676; West Germany 3,635; France 2,022.
Unwrought		49,091	40,535	330	Netherlands 18,651; West Germany 10,037; France 8,486.
Semimanufactures		18,762	18,932	1	France 16,357; West Germany 1,970; Netherlands 469.
Zirconium:					
Ore and concentrate		3,112	2,522	—	Netherlands 1,801; West Germany 670; Australia 256.

See footnotes at end of table.

TABLE 3—Continued

BELGIUM-LUXEMBOURG: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS—Continued				
Zirconium—Continued				
Metal including alloys:				
Scrap	52	59	6	France 46; United Kingdom 6.
Unwrought	3	3	1	Canada 2.
Semimanufactures	188	146	6	France 115; West Germany 20.
Other:				
Ores and concentrates	181,038	229,030	—	Norway 228,820; Netherlands 126.
Oxides and hydroxides	102	176	7	West Germany 86; Netherlands 23; Brazil 17.
Ashes and residues	17,686	29,613	8,123	West Germany 14,330; France 8,106; Spain 7,215.
Base metals including alloys, all forms	2	4	([2])	West Germany 3.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	8,579	15,290	78	West Germany 8,692; Iceland 2,268; Turkey 1,691.
Artifical:				
Corundum	8,011	9,727	102	West Germany 3,684; Brazil 2,636; France 1,524.
Silicon carbide	4,710	5,606	4	West Germany 2,522; Norway 1,004; Brazil 515.
Dust and powder of precious and semiprecious stones including diamond value, thousands	$22,442	$22,163	$7,366	Ireland $11,519; Romania $898.
Grinding and polishing wheels and stones	3,686	3,667	82	West Germany 1,030; Italy 588; Netherlands 507.
Asbestos, crude	25,017	27,358	2	Canada 13,868; U.S.S.R. 5,013; Republic of South Africa 2,303.
Barite and witherite	8,439	7,084	—	West Germany 6,014; France 797; Netherlands 201.
Boron materials:				
Crude natural borates	50,402	43,155	—	Turkey 37,585; Netherlands 5,382; France 188.
Elemental	1	2	—	All from France.
Oxides and acids	2,992	2,631	—	France 1,622; Italy 767; Turkey 140.
Bromine	1,689	1,843	278	Israel 1,362; United Kingdom 237.
Cement	343,889	304,490	6	Netherlands 173,834; West Germany 115,271; France 9,350.
Chalk	162,764	154,644	21	France 136,438; Netherlands 18,036.
Clays, crude:				
Bentonite	20,007	19,893	2	Netherlands 9,399; West Germany 7,680; United Kingdom 2,731.
Chamotte earth	73,552	81,742	1,023	West Germany 67,581; France 11,382; Spain 1,546.

See footnotes at end of table.

TABLE 3—Continued

BELGIUM-LUXEMBOURG: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987	
				United States	Other (principal)
INDUSTRIAL MINERALS—Continued					
Clays, crude—Continued					
Fuller's earth		1,173	800	3	West Germany 487; Spain 148; Netherlands 109.
Kaolin		311,423	369,848	3,426	United Kingdom 189,271; Netherland 112,467; West Germany 13,687.
Unspecified		203,691	241,735	1,570	West Germany 140,238; Netherlands 82,357; France 9,303.
Cryolite and chiolite		32	68	—	Denmark 65; West Germany 3.
Diamond:					
Gem, not set or strung	value, thousands	$3,819,058	$4,721,424	$267,908	United Kingdom $1,979,539; Sweden $264,689.
Industrial stones	do.	$69,980	$85,236	$26,765	Netherlands $28,691; Ireland $5,810.
Diatomite and other infusorial earth		8,304	13,252	1,322	Denmark 5,551; France 3,244; Spain 2,740.
Feldspar, fluorspar, related materials:					
Feldspar		18,372	19,853	—	France 16,176; West Germany 2,696; Italy 847.
Fluorspar		7,662	10,643	—	France 5,245; West Germany 3,183; East Germany 1,294.
Unspecified		30,005	30,086	—	Norway 26,027; Netherlands 3,655; France 195.
Fertilizer materials:					
Crude, n.e.s.		108,014	106,822	1	Netherlands 96,757; West Germany 4,370; France 4,291.
Manufactured:					
Ammonia		3,961	5,458	—	Netherlands 4,193; West Germany 1,073; France 191.
Nitrogenous	thousand tons	924	951	245	West Germany 246; Netherlands 207; Romania 74.
Phosphatic	do.	120	76	2	Tunisia 29; Netherlands 23; Morocco 10.
Potassic	do.	1,255	1,380	23	West Germany 522; France 244; U.S.S.R. 220.
Unspecified and mixed	do.	447	569	219	West Germany 229; Netherlands 60.
Graphite, natural		951	824	([2])	Brazil 543; West Germany 171; United Kingdom 49.
Gypsum and plaster		507,961	585,121	245	France 355,556; West Germany 166,857; Netherlands 62,346.
Iodine		104	129	2	Japan 45; France 33; Netherlands 26.
Kyanite and related materials		1,350	4,538	1,717	Netherlands 1,977; West Germany 411.
Lime		145,739	141,376	4	France 79,531; West Germany 59,572; Netherlands 2,206.
Magnesium compounds:					
Magnesite, crude		803	447	—	Netherlands 332; France 56; Austria 48.

See footnotes at end of table.

TABLE 3—Continued

BELGIUM-LUXEMBOURG: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987 United States	Sources, 1987 Other (principal)
INDUSTRIAL MINERALS—Continued					
Magnesium compounds—Continued					
Oxides and hydroxides		21,446	18,363	175	France 4,070; United Kingdom 2,923; Austria 2,441.
Other		24,650	27,058	—	West Germany 18,399; East Germany 8,003; Netherlands 576.
Mica:					
Crude including splittings and waste		7,348	5,963	20	India 4,716; France 418; United Kingdom 316.
Worked including agglomerated splittings		37	40	(2)	Switzerland 10; West Germany 8; France 7.
Nitrates, crude		33,662	38,547	—	Chile 38,440; Netherlands 105; France 2.
Phosphates, crude	thousand tons	2,287	2,522	362	Morocco 1,589; Republic of South Africa 354.
Phosphorus, elemental		297	265	—	China 124; France 46; United Kingdom 43.
Pigments, mineral:					
Natural, crude		202	300	—	Republic of South Africa 100; Cyprus 72; Spain 48.
Iron oxides and hydroxides, processed		8,662	9,747	352	West Germany 7,767; France 543.
Potassium salts, crude		39,460	38,646	—	West Germany 22,986; East Germany 8,874; France 6,773.
Precious and semiprecious stones other than diamond:					
Natural	value, thousands	$14,767	$16,780	$12,354	Thailand $3,236; Switzerland $2,975.
Synthetic	do.	$6,233	$8,077	$1,479	Ireland $5,760; United Kingdom $192.
Pyrite, unroasted		260,194	296,979	—	Spain 195,929; Norway 7,972; Finland 21,958.
Salt and brine	thousand tons	1,341	1,295	(2)	Netherlands 754; West Germany 459; France 37.
Sodium compounds, n.e.s.: Carbonate, manufactured		87,584	98,729	3	West Germany 39,955; France 31,763; Netherlands 26,746.
Stone, sand and gravel:					
Dimension stone:					
Crude and partly worked	thousand tons	128	226	(2)	West Germany 111; France 55; Republic of South Africa 18.
Worked	do.	121	125	—	France 29; Italy 27; Spain 20.
Dolomite, chiefly refactory-grade	do.	46	73	(2)	United Kingdom 26; West Germany 20; Netherlands 11.
Gravel and crushed rock	do.	4,871	4,497	—	Netherlands 2,129; West Germany 1,002; United Kingdom 801.
Limestone other than dimension	do.	212	299	—	United Kingdom 187; Spain 80; France 28.
Quartz and quartzite	do.	74	70	(2)	West Germany 49; Netherlands 7; France 6.
Sand other than metal-bearing	do.	10,243	10,324	(2)	Netherlands 8,262; West Germany 1,489; France 462.

See footnotes at end of table.

TABLE 3—Continued

BELGIUM-LUXEMBOURG: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
INDUSTRIAL MINERALS—Continued					
Sulfur:					
Elemental:					
Crude including native and byproduct		397,665	414,213	182,062	Netherlands 107,485; West Germany 45,613.
Colloidal, precipitated, sublimed		1,451	2,298	2	Netherlands 995; France 871; West Germany 251.
Dioxide		4,224	3,215	—	West Germany 1,722; France 1,096; Italy 200.
Sulfuric acid		753,947	770,076	439	West Germany 260,063; France 167,549; Netherlands 143,958.
Talc, steatite, soapstone, pyrophyllite		68,616	83,765	17,674	Spain 21,128; Netherlands 15,776.
Vermiculite, perlite, chlorite		57,843	46,648	—	Turkey 22,450; Greece 6,526; West Germany 5,331.
Other:					
Crude	thousand tons	1,665	1,903	9	Spain 288; West Germany 224; Netherlands 210.
Slag, and dross, not metal-bearing	do.	633	490	—	Netherlands 273; France 112; West Germany 103.
MINERAL FUELS AND RELATED MATERIALS					
Asphalt and bitumen, natural		100,974	107,405	105	France 104,639; Netherlands 1,192; Trinidad and Tobago 734.
Carbon:					
Carbon black		25,652	18,812	771	Netherlands 16,463; United Kingdom 903.
Gas carbon		23,419	28,449	57	France 13,978; West Germany 13,371; Italy 660.
Coal:					
Anthracite	thousand tons	1,663	1,215	—	West Germany 695; Netherlands 167; Republic of South Africa 134.
Bituminous	do.	7,092	8,536	4,345	Republic of South Africa 2,149; West Germany 833.
Briquets of anthracite and bituminous coal	do.	93	77	—	West Germany 67; France 10.
Lignite including briquets	do.	366	345	—	West Germany 314; East Germany 30; Netherlands 1.
Coke and semicoke	do.	2,349	1,933	28	West Germany 1,354; Netherlands 364; Poland 139.
Gas, natural: Gaseous	millon cubic feet	362,400	328,644	—	Netherlands 164,435; West Germany 67,567; France 54,198.
Peat including briquets and litter		168,245	184,092	—	Netherlands 128,311; West Germany 38,452; U.S.S.R. 14,207.
Petroleum:					
Crude	thousand 42-gallon barrels	147,329	175,748	12	United Kingdom 26,150; Saudi Arabia 21,655; Libya 19,591.

See footnotes at end of table.

TABLE 3—Continued

BELGIUM-LUXEMBOURG: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
MINERAL FUELS AND RELATED MATERIALS—Continued					
Petroleum—Continued					
Refinery products:					
Liquefied petroleum gas	thousand 42-gallon barrels	6,548	4,669	69	Netherlands 1,611; Norway 1,503; United Kingdom 341.
Gasoline	do.	21,723	21,420	9	Netherlands 13,195; United Kingdom 2,244; Spain 1,846.
Mineral jelly and wax	do.	137	148	1	West Germany 86; Netherlands 28; France 26.
Kerosene and jet fuel	do.	2,263	2,055	19	Netherlands 1,903; Romania 26.
Distillate fuel oil	do.	36,252	32,355	10	Netherlands 27,201; U.S.S.R. 4,946.
Lubricants	do.	3,878	4,155	129	France 1,217; Netherlands 1,111; United Kingdom 679.
Residual fuel oil	do.	61,667	46,489	—	Netherlands 17,815; U.S.S.R. 16,166; United Kingdom 1,736.
Bitumen and other residues	do.	1,270	880	(2)	Netherlands 446; France 194; West Germany 106.
Bituminous mixtures	do.	118	101	2	Netherlands 51; France 31; West Germany 13.
Petroleum coke	do.	2,274	2,062	1,862	Netherlands 91; West Germany 63.

[1] Table prepared by staff, Branch of Geographic Data.
[2] Less than 1/2 unit.
[3] May include other precious metals.

Luxembourg steelmaker Acieries Réunies de Burbach-Eich-Dudelange (Arbed), and 93% of its products were sold through Arbed's sales organization, Trade Arbed, with the remainder being sold through Italian steelmaker Falck, which had a minority share in Sidmar. The Belgian Government held 45% of Sidmar's capital, but only 28% of its voting rights.[9]

Usines Gustave Boël SA at Louviere, the third largest steel producer at about 1.2 million tons, employed more than 3,000 workers. Boël exported almost 95% of its output to EC countries. Belgian steelmakers Boël and Sidmar have each taken a 5% stake in Carlam, a wide hot strip mill, owned 75% by the CS group. Carlam had a rolling capacity of 2.26 million tons per year, and a 5% stake will give Boël and Sidmar 130,000 tons per year each of rolled output.[10]

Tubemeuse SA, the Belgian seamless tube and pipe producer, which had been in receivership since late 1986, was acquired by Soconord SA. The Brussel's oil pipe trading firm purchased Tubemeuse for $11.7 million. Soconord was committed to maintaining production facilities; casting 150,000 tons per year and tubemaking 30,000 to 40,000 tons per year; and to guaranteeing current employment of 750 workers, as well as adopting antipollution measures. Soconord operated trading subsidiaries in Argentina, Singapore, the United States, and Venezuela. The U.S.S.R. had been a big customer of Tubemeuse in the past, but its future import requirements are likely to fall with the startup of its new seamless pipe plant near Volgograd.[11]

Nonferrous Metals.—Générale was one of Europe's largest industrial groups, associated with 12 companies. Générale acquired full control of Union Minière SA (UM) in 1981, and UM in turn controlled all other subsidiaries of Générale. Metallérgie Hoboken-Overpelt SA (MHO), one of Générale's companies, occupied a leading position in the field of nonferrous metallurgy worldwide for base, special, or precious metals. The works at Hoboken, Olen, and Overpelt employed about 6,750 workers. MHO was the largest European supplier of refined copper; the company also produced lead and zinc. MHO imported most of its copper blister, anodes, and leach cathodes from La Générale des Carrières et des Mines dy Zaire, Zaire's state-owned mining complex.

In the special metals field, MHO was the first world producer of cobalt and tellurium-bearing products used in advanced technologies. The company was also a leading world producer of indium, germanium, and selenium, derived from complex metallurgy developed by MHO. In precious metals, the company produced gold, palladium, platinum, rhodium, and silver. Most of its production had increased significantly, while copper, cathodic zinc, and platinum reached record heights.

Belgium's second largest copper and tin refiner, La Metallo-Chemigue SA, had expanded its network of raw materials supply by reaching an agreement with the United Kingdom's Graham Rogers Metals Ltd., the relatively new scrap metal merchant. The merchant would deliver mainly copper and brass scrap for Metallo's refinery in Breese to feed its 14,000-ton-per-month output from its refinery.

Vieille-Montagne SA (VM), also almost wholly owned by Générale, was the largest producer of zinc. VM operated a mine of considerable size in Sweden, and domestically produced, processed, and marketed finished metal. There was a total of 5,095 people employed. VM produced almost 25% of the 1.7 million tons of zinc from the EC. VM's two zinc processing plants were in Balen, Belgium, and Auby, France, each with a capacity of 200,000 tons per year. VM also produced rolled zinc, special alloys, oxides, wire, and zinc powders. At the end of 1981, Générale increased its holding in VM to more than 95%. The profit in 1988 amounted to more than $75 million.

Boliden Cuivre et Zinc (BCZ), the subsidiary of Boliden AB, signed a joint-venture agreement with Bahraini partners Esse Mubarak Al-Kobaisi to start a copper tube plant in Bahrain. BCZ will be the minority owner, at 46%, in the new company, but had been assured of the management responsibility for at least 12 years.

Union Mines Inc. operated the Union Zinc Inc. in the United States, a mining and metallurgical company operated in Clarksville, Tennessee, and produced cadmium and zinc for Générale. It also produced sulfuric acid and germanium residues. The underground development of the gold-silver ore body in Platoro, Colorado, progressed significantly in 1988.

Union Minière Canada Ltd. continued its exploration for precious metals in Canada.

Industrial Minerals.—**Cement.**—SA des Cimenteries CBR, wholly owned by Générale, ranked fifth among the internationally-based European cement groups, and it held a leading position in its European and North American markets. Western Europe accounted for 59% and North America for 41% of its turnover. CBR employed 6,500 people and operated 14 cement works in Europe and North America, with an overall cement production capacity of 11 million tons per year. In 1988, it delivered about 5 million cubic meters of ready-mixed concrete and 18 million tons of aggregates. Since 1983, CBR had committed itself to a capital expenditure amounting to $910 million, which included: in 1986, the startup of a new clinker plant at Antoing, Belgium; the purchase, in 1986, of cement kilns, concrete mixing plants, aggregates and construction materials operations from the Genstar Corp., covering Western Canada and the West Coast in the United States; in 1987, the acquisition of the Columbia Northwest Cement Co. in the State of Washington, United States; in 1988, the purchase of the Monolith Portland Cement Co. in Southern California, United States, which is to be totally modernized and its capacity increased; in 1988, the purchase of several ready-mixed concrete and aggregate operations in Western Canada and Belgium; and plans were made to acquire in 1989 the Cemij Cement Co. in the Netherlands. On the other hand, CBR sold its activities in precast concrete and construction materials.

Diamonds.—Sibeka SA of Générale was an industrial holding company, and among other activities it owned a 20% interest in the Miba diamond mine in Zaire. The mine was the second largest diamond producer in the world. Sibeka was also the majority shareholder of the largest industrial mining operation in Brazil, the Mineracao Tejucana Mine. Sibeko also manufactured synthetic diamonds.

Dolomite.—Belgium had a number of large tonnage producers of dolomite, which are summarized in the text table.

Company	Mine (plant)	Capacity (tons per year)	Uses
Carsambre SA Dolomeuse	Floreffe Marche les Dames (Namur)	D–300,000 D–600,000 D–37,000	Fillers, aglime. Steel, aglime.
SA de Marche les Dames	Vezin, Sclaigneaux Andenne (Vezin)	300,000	Glass, iron, aglime.
SA des Dolomies de Marche-les-Dames	Nameche	D–3,000,000 SDL–500,000 DDL–200,000	Steel, refractories, chemicals, glass, sea water MgO, algime, roads.
SA Dolomies de Villers-le-Gambon	Villers-le-Gambon	D–300,000	Aglime, decoration.

D-dolomite. SDL-soft-burned dolomite. DDL-dead-burned dolomite.

In addition to the text table, Carmeuse, a producer of burned lime, blended its agricultural grades with dolomite to assure variable magnesium carbonate for consumer use.[12]

Mineral Fuels.—**Coal.**—Coal mining was one of Belgium's five so-called national sectors. Until 1983, these national sectors, large employers, enjoyed a privileged status and benefited from the central Government's subsidies. In July 1983, the central Government agreed that the national sectors would be regionalized and financial support for them would have to be provided from the region's own resources. Although there were originally two mining districts, one in Wallonia the French-speaking southern region and one in Dutch-speaking Flanders, only two of the Flanders mines were still in operation. In 1987, when the first mining retrenchment plan was implemented in Limburg, regional authorities affirmed that mining in the two remaining pits would continue at least until 1996. The only leading coal mining company, NV Kempense Steenkolenmijnen, worked its two remaining bituminous mines. The Government heavily subsidized production. It was anticipated that coal mining would decline because of unfavorable geological conditions, although coal reserves were estimated to be 25,000 million tons.

Ending the country's coal production is likely to increase Belgium's coal imports in the coming years and may even increase the import of U.S. coal. Belgium's major coal consumers were as follows: coking works, 7.3 million tons per year; power stations, 3.7 million tons; domestic heating, 1.0 million tons; steel industry, 0.3 million; and other industries, 0.8 million. All of Belgium's 2.5 million tons of 1988 coal production was used in power stations, thus all its coking coal and coal for domestic heating had to be imported. For the past several years, Belgium imported a large share of such imports from the United States. In 1988, U.S. imports represented 45% of total imports.

Natural Gas.—Natural gas consumption continued to rely on imports from Algeria, the Netherlands, and Norway. Only minor domestic gas production came from coal mines. In gas, Belgium had an emerging role as an importer and distributor of liquefied gas from the new terminal at Zeebrugge. The terminal, used for receiving Algerian gas, had been operational since the end of June 1987. Distrigaz, the 50% state-owned gas utility, had an agreement with Algeria to purchase 3 billion cubic meters of natural gas. Under this agreement, Belgium purchased 106 billion cubic feet between April 1986 and March 1987. The same amount was purchased between April 1987 and March 1988. Distrigaz reached an agreement to import gas from Norway's Statfjord, Heimdal, and Gullfaks Fields from the landing point at Emden through the Federal Republic of Germany. Distrigaz was also negotiating prices with its largest supplier, Gasunie of Netherlands, which accounted for nearly 50% of the country's imports.

The undersea pipeline being built by Norway is scheduled for completion in 1993. The pipeline is slated to carry to Belgium 2 billion cubic meters of natural gas from the Troll-Sleipner development.

Nuclear Power.—Belgium derived 66% of its electrical power from six nuclear plants. The seventh plant, BR3 at Mol, was decommissioned in 1987 and its dismantling was under consideration. The plant had begun commercial operation in 1982.

Petroleum.—Belgium was highly dependent on imported energy. Substantial improvements in this area have been made, as demonstrated by the fact that the share of oil was reduced from 60% in 1973 to less than 45% in 1988. Belgium had no indigenous oil production and imported all its requirements. Belgium's refining industry, traditionally a large supplier, had suffered considerably since the fall in European oil demand.

Consumption of coal by power stations has remained fairly steady at 4 to 5 million tons per year since the late-1970's, but oil suffered from the buildup in nuclear power capacity. Heavy fuel oil, which less than 10 years ago was the source of one-third of the country's electricity, now generated a smaller share of power output than gas.

On April 1, 1988, Petrofina S.A. bought out British Petroleum Co.'s share in the SIBP S.A. refinery in Antwerp and 28% in the Rotterdam-Antwerp pipeline. Petrofina thus acquired sole ownership of the largest refinery in Belgium, one of the most important in Europe. Production at the refinery, renamed Fina Roffinaderij Antwerpen, was modernized. American Petrofina has reached an agreement with Tenneco Corp. to acquire Tenneco's exploration and production division, which operated in Louisiana, New Mexico, and Texas. This acquisition doubled Petrofina's subsidiary's oil and gas reserves, and significantly increased its exploration acreage.

LUXEMBOURG[13]

Luxembourg's economy was stable and prosperous, with modest growth, near zero inflation, and the lowest unemployment rate in the EC. Banking, steel, and light industries were the dominant sectors and the largest contributors to Government revenues.

The Grand Duchy of Luxembourg is a small country in terms of population and area, measuring about 82 kilometers in north-south and 57 kilometers in east-west directions; the altitude ranged only from 129 to 559 meters above sea level, with the city of Luxembourg at the 300-meter level. The Duchy was a prosperous country. Its economy practiced an open and free marked economy. Luxembourg shared a common currency and customs facilities with Belgium, and was a partner in the Belgium-Luxembourg economic union (BLEU). The population grew just 22%

in the past 40 years, to 372,100 people in 1988, of which 29% were Portuguese, 20.7% were Italians, 12.6% French and others. Of the total population, 54% were fully employed, mostly in the services and the industry sectors. Unemployment crept up to its highest level at 2.7%. A majority of the unemployed lived in the southern, steel-producing region; most were non-Luxembourgers and nearly one-half were under 25 years of age with few skills. The mining industry contributed only 0.1% to the GDP from sand, gravel, and stone products, the iron and steel products contributed 11%, and metal manufactures, and electrical and mechanical engineering provided 6.6%.

Luxembourg's dependence on exports of goods and services fostered policies favorable to open borders and commercial activity generally. Most trade was with Luxembourg's immediate neighbors. The United States accounted for about 4% of Luxembourg's trade, especially steel exports. Arbed S.A. specialized in the production of large steel beams, used in skyscrapers throughout the United States. Luxembourg exported finished steel goods, chemicals, rubber products, glass, aluminum products, and a wide range of other industrial goods. About 75% of all exports went to other EC member countries. Imports were dominated by mineral products, mechanical and electrical equipment, base metals, and customer-specific quantities of quality consumer goods. About 92% of all imports came from other member countries of the EC.

Arbed, the only iron and steel producer in Luxembourg, employed 11,160 workers, or 7% of the work force, the highest of the 20 most important companies. In 1974, Arbed's work force

TABLE 4

LUXEMBOURG: PRODUCTION OF MINERAL COMMODITIES[1]

(Thousand metric tons unless otherwise specified)

Commodity[2]		1984	1985	1986	1987[p]	1988[e]
Cement, hydraulic	thousand tons	340	295	389	509	550
Gypsum and anhydrite, crude[e]	tons	[3]450	400	420	[3]420	450
Iron and steel: Metal:						
Pig iron (including blast furnace ferroalloys)		2,768	2,754	2,650	2,305	2,400
Steel:						
Crude	thousand tons	3,987	3,945	3,705	3,302	3,700
Semimanufactures		[r]3,551	3,878	3,771	3,481	3,500
Phosphates: Thomas slag, gross weight		728	701	620	542	540
Sand and gravel:						
Foundry sand	tons	2,000	1,500	([4])	([4])	2,000
Other sand except glass sand		[r]661	[r]594	616	760	780
Gravel		[r]135	[r]116	61	197	150
Stone: Construction:						
Crushed	thousand cubic meters	[r]471	[r]523	547	345	400
Dimension:						
Rough cut	do.	8	[r]14	15	16	17
Facing	square meters	560	[r]1,987	4,100	5,599	4,000
Finished	cubic meters	729	[r]1,212	707	[r][e]800	900
Flagstone:						
Polished	square meters	1,260	[r]707	400	([4])	—
Rough	tons	209	[r]131	71	([4])	—
Slate slabs	thousand pieces	646	[5][r]536	335	([4])	—

[e]Estimated. [p]Preliminary. [r]Revised.
[1]Table includes data available through July 1989.
[2]In addition to the commodities listed, dolomite, quartzite, refractory clays and manufactured phosphatic fertilizers other than Thomas slag were produced, but data are not published, and information is inadequate to make reliable estimates of output levels.
[3]Reported figure.
[4]Revised to zero.
[5]In tons.

was at 27,000 people, the peak of Arbed's fortunes. Arbed was the EC's fifth largest steelmaker in 1988. The 11th in rank, Metallurgie et Minière Rodange/Athus S.A., produced steel products and employed 1,120 workers. The restructuring of the steel company began as early as 1974, and as a result of timely modernization, cutbacks in production and employment, and Government assumption of portions of Arbed's debt, Arbed returned to profitability in 1984-86, after a decade of large losses. Arbed's productivity was now among the highest in the world, having improved 20% in the period 1983-85. Government ownership in Arbed amounted to 31% of the voting equity; a 25% stake was held by Belgian's Générale. The Government bailed out Arbed repeatedly, to the extent of levying a special steel tax to help pay for work force reduction. Although the company's debts have decreased about 50% over the past 5 years, financing charges were still heavy compared with other steelmakers, at 4% of turnover. Arbed's plan in 1988 was to use this profitable period to divert cash flow from steel into other related, but less cyclical, business—from laser beam surface measurement to software for industrial robots.[14] In July, Arbed opened a sales and trading office in Tokyo, Japan.

Luxembourg's National Aluminium SA (Luxalum) operated a foil plant at Dudelange Luxalum; Luxalum was a wholly owned subsidiary of National Aluminum Inc. of Pittsburgh, Pennsylvania, United States. Luxalum came on-stream in the summer of 1984. There were plans that Luxalum would be purchased by Granges Aluminum AB, a subsidiary of AB Electrolux, Stockholm, Sweden.

The country was entirely dependent on energy imports, except for some indigenous hydroelectric power. Of the total of 1,036 million kilowatt hours of electric energy produced in 1986, 551 million was generated by hydroelectric power and 485 million by thermal power. More than 82% of the hydroelectric power was generated by the Vianden power station. The plant at Vianden, in the northeast of the country, was the largest of its type in Europe. The plant was not connected to the national grid but was used only as a peak-shaving plant for the West German network. Compagnie Grand Ducal de l'Electricite distributed electricity from the Federal Republic of Germany, while the second distributor, Société de Transport de l'Electricite, imported electricity from Belgium and distributed it to the steel industry. Almost all of its oil products and natural gas were imported from Belgium. Only 1% of total solid fuel requirements was produced domestically, mostly from incineration of waste material. More than 80% of total primary coal requirements went into steel production. The steel industry accounted for more than 80% of total industrial energy demand. New industries, such as ceramics and glass, were being connected to the gas network. The Government extended the domestic gas network across the eastern part of the country to the border of the Federal Republic of Germany.

NETHERLANDS[15]

Favorable world trade and strong EC economic growth resulted in an increase of 3.7% in the GNP for the Netherlands. The loss of competitiveness due to the guilder's appreciation against the U.S. dollar was offset by strong growth in trade and demand for Dutch exports by the Netherlands' other trading partners. An especially encouraging trend was the strong growth in investment for expanding production facilities and plant equipment. Confidence by consumers and businesses continued as a result of the improvement in the economic outlook. Also, the anticipated reforms in the tax structure in response to the Netherlands 1992 harmonization into the EC were expected to benefit the general economy.

In the past 3 years, devaluation of the dollar and deterioration of the price of exported gas limited the economic growth and the decline of Government revenues by 4% of GNP. Anticipated stabilization of oil and gas prices was expected to facilitate forecasting and to improve budgeting expenditures to reduce the Government deficit, currently at 6% of the GNP. Budget reduction has been a top fiscal policy goal of the present Government.

The unemployment rate in the Netherlands remained one of the highest in the EC despite strong economic growth and the creation of numerous new jobs. The Organization for Economic Cooperation and Development (OECD) calculated a 12.5% unemployment rate, but labor costs and productivity increases were compatible and labor unrest minimal.

European Community

The social and economic reforms required by past years of economic hardships were only the prelude to the anticipated challenges of 1992. Reduction in the lavish welfare subsidies were required to integrate the country into the EC economic competitiveness. However, others believe that the transition will be smoother for the trade barrier-free Netherlands community than for other member countries. Major challenges would be to balance the present competitive industrial and trading advantages and to maintain the high standard of living, the work place standards and the cost of a cleaner environment. The budget deficit, down from 9.4% in 1982, remained higher than the European average of 6%. The public sector was 55.6% of the GNP, the biggest in the EC, as were the combination of taxes and social security contributions. The workers' net pay was one of the lowest, despite gross wages paid to workers that are considered among the highest in the EC.

Production

Manufacturing production exceeded the projected growth rate of 3.5%, with the greatest production increases in basic metals, construction materials, and paper products. This increase was almost entirely offset by declining oil and natural gas output and revenues, which resulted in a flat industrial production index for the year. Stability in the exchange rate of the guilder was one factor that permitted the Dutch to consolidate their competitive position with many trading partners, except for the United States and other nations linked to the dollar. Excellent growth in profits and disposable incomes raised consumer and business confidence in the economy, fostering increased domestic consumption and investment. Inflation (.7%) was controlled and kept below that of their trading and EC partners.

Trade

The strength of the Netherlands' trading partners economies created a strong demand for the exports from this country, which resulted in a trade surplus of more than $2.5 billion.[16] Exports increased by 9% and imports by 8%, despite declines of 11% in energy exports and 10% in energy imports. Trade with the United States recorded better import-export figures of 10% and 8.5%, respectively, as the decline in the dollar made U.S. goods more attractive. U.S. trade with the Netherlands is important to both countries with the United States having its highest bilateral trade surplus, of approximately $3 billion, with the Netherlands.

Investment by foreign companies in the Netherlands continued to increase as a result of the attraction of a large open market afforded by the EC 1992 market environment. The Japanese invested in 11 projects valued at $280 million, whereas the United States and Canada invested only $73 million in 17 projects. The advanced transportation infrastructure, ideal proximity to major markets, and extensive experience made the Netherlands an ideal marketplace and entry port to the EC.

Ports

Amsterdam and Rotterdam, situated at the intersection of the Rhine, Europe's major river, and the sea lanes of the North Atlantic, have prospered on trading and distribution of products. These ports compensated for a limited local mineral resource potential upon which to build an industrial economy, and became the Netherlands' most important contribution to the world mineral industry.

Rotterdam, the world's busiest port, imports, bunkers, and redistributes many important raw materials. The strategic location of the Port of Rotterdam was reflected in the trade flow of raw materials from developing countries to the refining plants in developed countries of Europe that were dependent on overseas supplies. For example, approximately 20 million tons of iron ore and pellets was handled at the Ertsoverslagbedrijf Europoort (EECV) terminal and Europees Massagoed-Overslagbedrijf BV (EMO) handled another 13 million tons plus 7 million tons of coal. Of the approximately 42 million tons of imported iron ore required by the West German steel industry, 75% was transshipped through Rotterdam from ocean-going carriers to barges, before being transported 250 kilometers upstream to rail terminals in the Federal Republic of Germany. In the past, iron ore sources at EECV were as follows: 40% of the ore was from Brazil, 20.7% from the Republic of South Africa, 14.6% from Western Australia, and 14.5% from Canada. The composition of the imported ore was 50% fines, 24% pellets, 16% concentrates, and 10% coarse ore. Although the terminal stockpile capacity totaled 3.7 million tons, approximately 2 million tons was estimated to have been stockpiled in more than 30 different grades of ore. In 1988, the EECV port recorded a 20% increase in iron ore and pellets handled at the port during 1987, with most of the 24 million metric tons transshipped into 10,525 barges.

The deepening of the Eurochannel to 74 feet allowed ships like the 365,000-ton deadweight *Berge Stahl*, the world's largest ore carrier, to deliver an estimated 4 million tons per year of iron ore to EECV. Unloading at more than 4,400 tons per hour, the 343-meter by 63.5-meter by 30.2-meter ship required only a 4-day unloading period before returning to Brazilian mines for additional ores. In the Botlek district, an old terminal built in 1956 and operated by Frans Swarttouw, BV had only a 44-foot draft needed to serve production from Iron Ore Co. of Canada. This facility had limited potential to meet the possible needs of future growth. Swarttouw, Europe's largest handler of ores and coal, invested approximately $50 million in a new terminal in the Maasvlakte district, adjacent to the deepwater terminal facility of EMO. The new terminal was planned to be capable of custom mixing coals for specific steel mill furnaces and attaining high efficiency and flexibility, while safeguarding the environment. Another major investment in the port was by European Containers Terminal (EAT), a joint effort between three companies and the Netherlands railway. The $656.6 million effort was to convince Sea-Land Service to remain in Rotterdam and not to relocate to the Belgium Port of Antwerp. The resultant loss of numerous jobs, businesses and revenues at the port would have affected the national economy. Investments by companies and the Government in the port facility had totaled $656.6 million in the past 5 years as the need to modernize and update the port was recognized as essential to maintain the port's leadership in the European market and to maintain the port's market share.

The importation of basic metal ores of aluminum, iron, and zinc increased until 1975 as indicated on figures 1 and 2. These graphs demonstrate a trend of growth and stabilization in importation of ores for the national aluminum and steel industries and not total transshipments through the port. Future increases in importations were to be minor unless new facilities are planned and built. Iron ore imports were ex-

TABLE 5

NETHERLANDS: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1984	1985	1986	1987	1988[p]
METALS						
Aluminum metal:						
Primary		249,170	250,603	265,768	275,939	278,198
Secondary		59,894	62,315	96,794	101,403	115,866
Cadmium metal		636	598	565	517	[e]528
Iron and steel:						
Ore sintered (from imported ore)	thousand tons	3,516	3,737	3,706	3,682	3,935
Metal:						
Pig iron	do.	4,926	4,819	4,628	4,575	4,994
Steel, crude	do.	5,739	5,517	5,283	5,082	5,518
Semimanufactures	do.	4,928	4,868	4,799	4,709	5,043
Lead metal, refined, secondary[e]		25,000	25,000	33,000	[r]35,700	38,000
Tin metal, refined:						
Primary		6,517	6,033	5,104	3,834	3,478
Secondary[e]		180	204	200	180	180
Zinc (slab), primary		209,657	201,712	196,156	207,111	211,019
INDUSTRIAL MINERALS						
Cement, hydraulic	thousand tons	3,176	2,911	3,100	2,929	3,100
Nitrogen: N content of ammonia	do.	2,312	2,386	2,185	2,287	2,700
Salt, all types	do.	3,674	4,154	3,763	3,979	3,693
Sand, industrial	do.	[e]19,000	19,988	22,841	22,274	25,999
Sodium compounds, n.e.s.:[e]						
Carbonate	do.	400	380	380	380	400
Sulfate, synthetic	do.	45	45	45	45	50
Sulfur:						
Elemental byproduct:[e]						
Of metallurgy	do.	—	—	—	—	125
Of petroleum and other forms	do.	245	250	250	[r]211	210
Total	**do.**	**245**	**250**	**250**	**[r]211**	**335**
Sulfuric acid, 100% H_2SO_4	do.	1,609	1,508	1,209	1,043	1,144
MINERAL FUELS AND RELATED MATERIALS						
Carbon black		102,300	103,000	104,700	105,500	107,500
Coke	thousand tons	2,726	2,971	2,867	2,736	2,908
Gas:						
Manufactured[3]	million cubic feet	298,631	266,056	271,918	325,489	333,538
Natural, gross	do.	2,728,041	2,850,581	2,614,543	2,621,959	2,316,689
Natural gas liquids	thousand 42-gallon barrels	3,818	4,221	4,221	4,278	3,707
Peat[e]	thousand tons	450	450	400	400	300
Petroleum:						
Crude	thousand 42-gallon barrels	21,143	27,734	34,046	29,243	29,111

See footnotes at end of table.

TABLE 5—Continued

NETHERLANDS: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1984	1985	1986	1987	1988[p]
MINERAL FUELS AND RELATED MATERIALS—Continued						
Petroleum—Continued						
Refinery products:						
Gasoline, motor	thousand 42-gallon barrels	56,568	53,049	60,189	62,254	68,757
Jet fuel	do.	28,968	27,800	30,808	31,120	38,408
Kerosene	do.	4,487	3,550	4,658	3,891	4,720
Distillate fuel oil	do.	120,039	111,303	147,305	133,549	137,488
Residual fuel oil	do.	102,744	85,901	85,901	92,154	95,464
Lubricants	do.	[e]3,500	5,544	5,117	[e]5,000	5,712
Liquefied petroleum gas	do.	[e]22,000	22,562	25,230	27,457	26,576
Naphtha	do.	63,784	50,133	65,986	75,944	93,866
Bitumen	do.	[e]4,500	4,242	5,048	4,545	4,721
Total[4]	**do.**	**406,590**	**364,084**	**430,242**	**435,914**	**475,712**

[e]Estimated. [p]Preliminary. [r]Revised.
[1]Table includes data available through Sept. 1989.
[2]In addition to the commodities listed, a variety of crude construction materials (clays, stone, and gravel) are also produced, but output is not reported and available information is inadequate to make reliable estimates of output levels.
[3]Coke oven and blast furnace gas only.
[4]Total of listed products only; refinery fuel and losses included in listed products.

pected to decline slightly by 1992 as the steel industry restructured.

Commodity Review

***Metals.*—Aluminum.**—Output from the plants in the Netherlands remained almost unchanged at 278,198 tons. The primary smeltering plants, Delfzijl and Vlissingen produced near their capacities of 96,000 tons per year and 170,000 tons per year, respectively. Secondary production increased 14% to 115,866 tons per year while aluminum demand remained strong. An increase of 3% in world consumption, strong worldwide metal prices, and previous years' purchases of aluminum plants resulted in a good year for Hoogovens aluminium divisions, Alumined Beheer BV and Hoogovens Aluminium Div. GmbH. Hoogovens Aluminium GmbH was established to operate Kaiser Aluminum Europe, which Hoogovens purchased in 1987. This division remained a separate unit, returning $1,010 million gross to Hoogovens, and served an international market, selling 85% outside of Benelux. The company reported production capacity of 300,000 tons per year of rolled aluminum, 50,000 tons per year of extrusion products, and 10,000 tons per year of cable and ropes. Of the primary metal requirements for Hoogovens, 50% to 60% was from their two smelters with 175,000-ton-per-year output in the Netherlands and the Federal Republic of Germany.

Hoogovens' expansion activities resulted in the company becoming a leader in the integrated aluminum and steel industries, with planned participation in projects like the "Alquette" Project to be completed in 1992 in Quebec, Canada. The new smelter would increase the primary production capacity of the company by 32,500 tons. This plan indicated an effort by the company to continue expansion in nonsteel activities.

Iron and Steel.—Hoogovens Groep BV reported a recovery from the $37 million loss in 1987 by posting a profit of $142.7 million for 1988, in response to favorable steel and aluminum sales, up 35% to $3.7 billion. Hoogovens Ijmuiden steelworks increased crude steel output 9% to 5.3 million tons and operated at 87% of the 7.7-million-ton-per-year capacity. However, as a contribution to the restructuring of EC steel industries, the hot-rolled capacity was reduced by 12% to 9 million tons. To broaden the product line Hoogovens invested $211 million in coated products and packaging by purchasing 50% of the German company Hille and Muller. In addition, Hoogovens acquired Sab Profiel BV, a major supplier of galvanized and painted products in the Dutch construction industry and acquired a 30% interest in Namasior BV, which specialized in cutting heavy plate from hot-rolled core.

In February 1988, production started

on Hoogovens' first electrolytic chromium-coated sheet line. This venture was to produce more end products and diversify into value-added products. The $28.5 million investment was projected to produce 20,000 to 40,000 tons in 1988. The tin-free steel (TVS) production in EC was reported as approximately 600,000 tons, however, Hoogovens was the first to use high current density (HAD) developed by U.S. Steel.

Most of the deliveries from Hoogovens were to EC countries and increased 11.7% against a decline in exports to non-EC countries. In 1988, semifinished products gained the most over 1987, posting a 16.5% increase. The Dutch steel industry was not subject to any voluntary restraint agreement (VRA), but requires import permits only as a means to monitor the industry, not restrict markets.

Lead.—The Highlands Metallurgische Industrie Billiton BV (HMIB) plant in Arnhem produced approximately 25,000 tons of lead and 3.8 tons of tin from imported ores. This was partially the result of the efficiency of the plant's secondary refinery and its operating near capacity. The HMIB lead production from the Netherlands accounted for 17.5% of Bilton's worldwide production.

Magnesium.—Magnesia production of approximately 100,000 tons was from salts mined by the deep solution method at Veendam in the northern Netherlands. Noodelijke Zoutuinning NV and Magnesia International NV, both owned by Billiton Refractories Inc., produced refractory grade magnesium oxide at the plant and accounted for a large portion of the 152,000 tons of magnesium produced worldwide by Bilton BV.

Molybdenum.—Climax Molybdenum BV, a division of AMAX Inc., operated a 9,100-ton-per-year plant at Zozenburg. This plant produced mo-

FIGURE 1

SELECTED ORE IMPORTS INTO THE NETHERLANDS

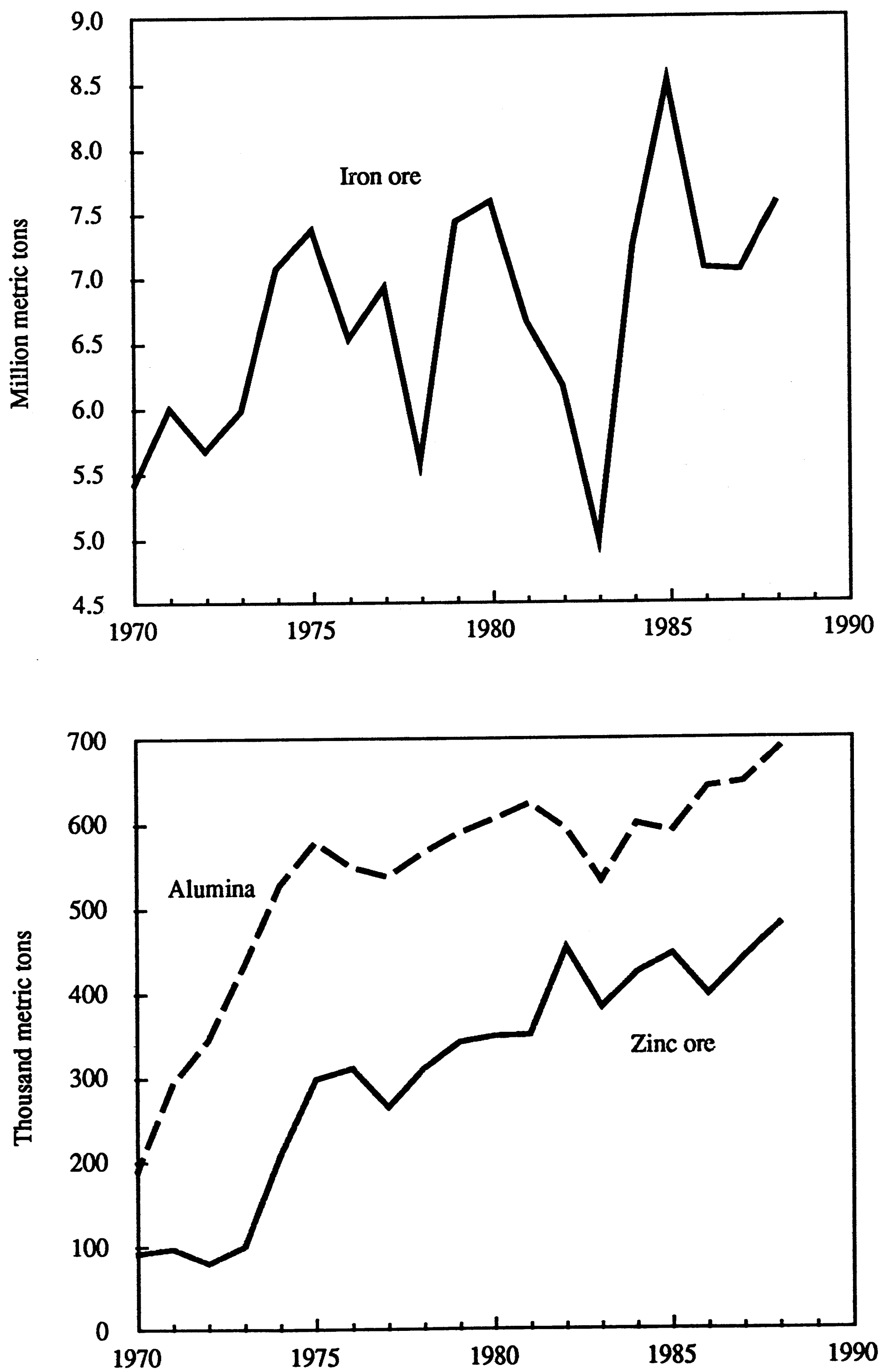
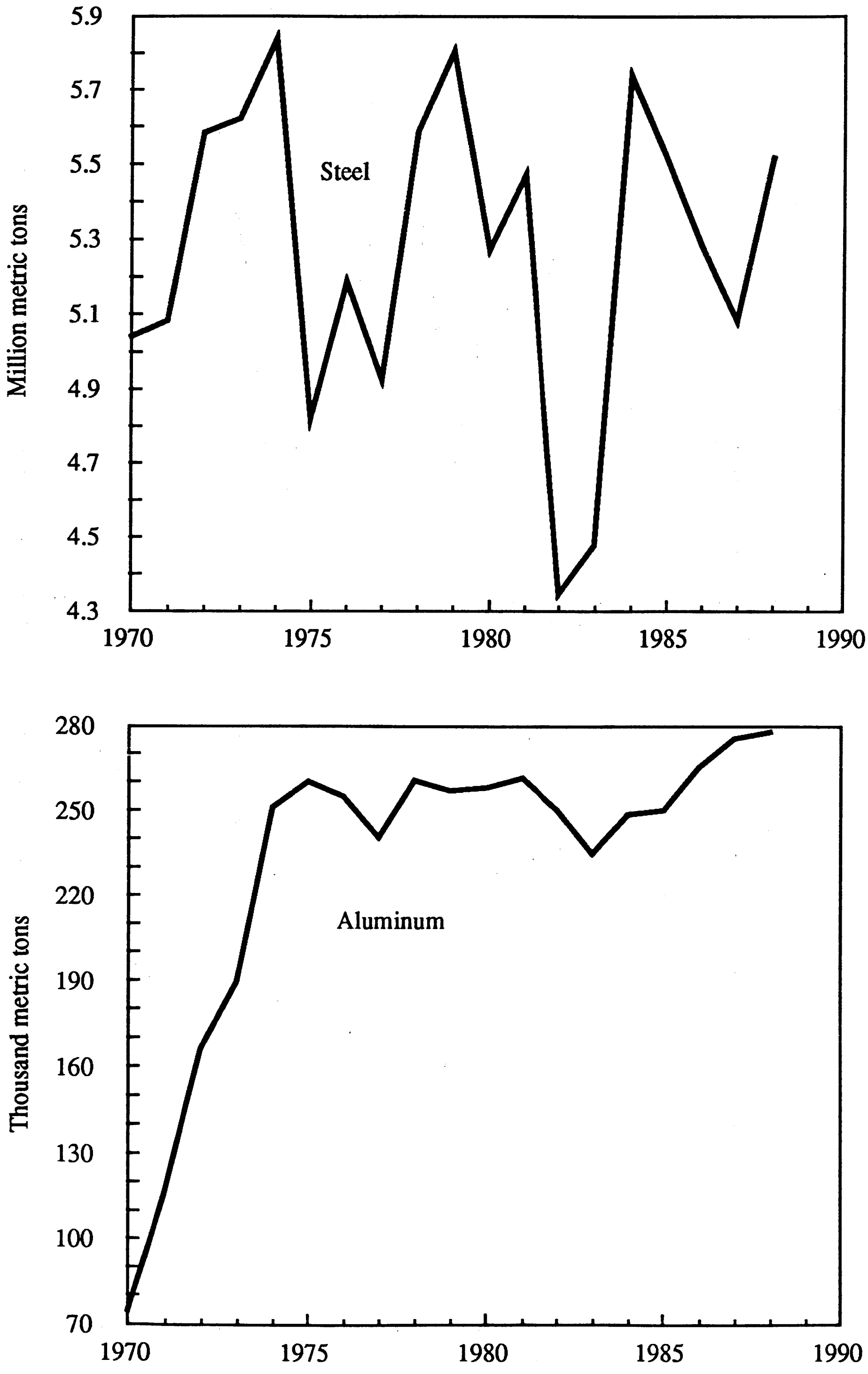


FIGURE 2

NETHERLANDS ALUMINUM AND STEEL PRODUCTION



lybdic oxides and other materials for the steel industry, by processing concentrates imported from mines in the United States.

Zinc.—Budelco BV, a subsidiary of Billiton International Metals BV and Australian Mining and Smelting Ltd. operated the near capacity 200,000 tons per year electrolytic zinc smelter at Budel. Environmental awareness in the country was becoming more of a concern for companies with large stockpiles of hazardous material. This company has accumulated large quantities of toxic waste, including cadmium byproducts from smelting operations.

***Industrial Minerals.*—Fertilizer Materials.**—The Dutch state-owned DSM Mestoffen BV (DSM) posted a $314 million profit, a 40% increase over that of 1987 as the economic conditions improved. A 6% decrease in domestic fertilizer demand forced the company to reduce operating costs to remain competitive. However, the cadmium pollution problem was a great concern for the company as well as for the Netherlands. Agreements or licenses to dispose of cadmium and other heavy minerals had been denied by local authorities who refused to accept waste from the phosphorus plants. The solution was to allow the company to dump cadmium-carrying phosphogypsum into the sea until 1994 or until clean production technology for phosphatic acid becomes available. This compromise to the regulations was in response to the company's successful effort in the reduction of cadmium to 2.2 tons generated in the phosphogypsum waste of 1.2 million tons. Another company with 10 to 12 tons of cadmium waste was thought to have to continue to use land disposal for the toxic gypsum byproduct. The lack of a license to dispose of the waste jeopardized an agreement between DSM and Kemira Oy, a Finnish chemical company, to exchange assets and cash between the two companies. From DSM, Kemira received the Pernis phosphoric acid plant and the

460,000 tons per year compound plant in Rotterdam, and the Inca ammonia and a 730,000 tons per year NPK plant in the United Kingdom. DSM was reported to have received from Kemira Oy cash and a one-third interest in the Uncam ammonia plant in the Netherlands. The finalized agreement reduced DSM's 4 million tons per year fertilizer production by one-third. A beneficial result was that phosphoric acid production in the Netherlands would switch to a low cadmium phosphate rock from Finland as opposed to the higher cadmium source rock from Morocco. This change was expected to meet the Government's waste discharge requirements.

The privatization of the second largest chemical company was to have begun by yearend; however, delays in obtaining Parliament approval postponed the sale of the first shares until 1989. One-third of the 11.7 million shares were to be sold, raising an amount estimated to be between $500-$750 million.

Lime.—B.V. Nekami Kalk, the Netherlands producer of burnt lime products, produced 80,000 tons of product from the Gouda plant in western Netherlands. Growth in the pollution control market has led to emphasis on development of new products to replace decreased sales to the steel industry. Generally, these sales have been flat for the past several years.

Mineral Fuels.—**Natural Gas and Petroleum.**—The umbrella organization for Dutch electric producers concluded a contract for Norwegian natural gas to begin in 1995. The linkage of the price of gas to the price of coal and not oil was unusual in this contract and was postulated to reflect the country's long-term energy policy. A goal of the Government was to have coal provide 40% of the future power generation needs of the Netherlands by the year 2000.

The Government offered 132 partial and whole blocks in a licensing sale to attract work in previously less attractive areas of the Dutch North Sea or under military restrictions. One hundred fifteen applications from 23 groups representing 59 companies were received. The Nederlandse Aardolie Maatschappij (NAM), jointly owned by Royal Dutch/Shell NV and Exxon Corp., group sought 18 licenses followed by Mobil with 11 licenses, and BP and Wintershall with 8 licenses each. Production of 83,700 barrels per day from onshore and offshore reflected the 20% decrease from Amoco Netherlands Petroleum Co.'s Rijin Field and the increase to 32,000 barrels per day from Continental Oil Co.'s Kotter-Logger offshore fields.

Royal/Dutch Shell's planned $750 million modernization of the refinery complex at Pernis was completed. More than $350 million was invested in a converter to alter heavy crude residues into lighter products, such as gas oil, naphtha, etc. By yearend, the refinery had again returned a profit after substantial losses in prior years. The country's seven refining plants had a total refining capacity of 1.4 million barrels per day.

NV Nederlandse Gasunie, the Dutch state-owned gas company, reported an 11% decline in gas sales to 2,362 billion cubic feet and in exports, down 13% to 946.3 billion cubic feet generating 19% less revenues at $5.9 billion. Primary production fell 7.7%, covering only 61.9% of domestic energy requirements down from 64.6% in 1987. Total energy imports declined 2.2%.

Reserves increased in 1988 with the addition of 1,306.5 billion cubic feet of new reserves discovered from offshore fields. At the beginning of the year, reserves increased from 10,663.6 to 11,299.2 billion cubic feet, despite the production of 600.27 billion cubic feet of gas. During the year, three new offshore fields and five onshore fields were brought into production. The largest offshore field was Elf Petroland's Zuidwal in the Waddenzee. NAM's abandonment of the Wassenaar Field, discovered in 1950 near The Hague, resulted in the ultimate recovery of 47 million barrels from that field.

An offshore pipeline project, Northern Offshore Gas Pipeline (Nogat), once suspended due to low natural gas prices, was again planned for construction. One of the largest development projects in recent years, the 36-inch gas transmission line to the F-3 field, was designed to pipe gas from the northern part of the Netherlands Continental Shelf to a landfall north of Den Helder. The $2.1 billion project was to have a startup capacity of 1.7 billion cubic feet per day in 1991. The 140-mile first phase of the total 161-mile pipeline was expected to collect reserves from L-2 and L-15 development projects and to expand the next year to the F-3 and F-15 fields to the north. The total reserves from the four fields were estimated to be 1,765 billion cubic feet of gas to be sold to NV Nederlandse Gasunie. Liquid transportation from the fields has not been established as the two-phase system was abandoned with the oil price collapse. The line initially was proposed to access 429 billion cubic feet of gas and 37.7 million barrels of oil from several offshore fields.

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[1] Prepared by George A. Rabchevsky, physical scientist, Division of International Minerals.

[2] FFO Belgium, III-Domestic Financing Business International Corp. (London). July 1988.

[3] International Bulk Journal (Dorking Survey). V. 8, No. 8, Aug. 1988, p. 10.

[4] Financial Times (London). June 16, 1988, p. IV.

[5] Page 25 of work cited in footnote 4.

[6] Page 33 of work cited in footnote 4.

[7] Where necessary, values have been converted from Belgian francs (BF) to U.S. dollars at the rate of BF38.46=US$1.00.

[8] American Metal Market (New York City). Aug. 1, 1988, p. 6.

[9] Metal Bulletin (London). June 6, 1988, p. 18.

[10] ———. Aug. 11, 1988, p. 20.

[11] ———. Aug. 1, 1988, p. 25.

[12] Industrial Minerals (London). Sept. 1988, p. 63.

[13] Prepared by George A. Rabchevsky, physical scientist, Division of International Minerals.

[14] Financial Times (London). Nov. 3, 1988, p. 6.

[15] Prepared by Donald E. Buck, Jr., physical scientist, Division of International Minerals.

[16] Where necessary, values have been converted from Netherlands guilder (f.) to U.S. dollars at the rate of f.1.98=US$1.00, the average for 1988.

THE MINERAL INDUSTRIES OF

EASTERN EUROPE

By John G. Panulas, George A. Rabchevsky, and Walter G. Steblez

CZECHOSLOVAKIA[1]

Total profits of Czechoslovak enterprises rose 5.4%, as opposed to the state plan of 8.1%. Industrial production grew 2.6%, compared with a planned growth of 2.1%. Much of that growth was generated by the ceramics sector of the economy.

Major developments in the mining industry included the exploitation of numerous uranium deposits in North Bohemia, as a means of developing Czechoslovakia's nuclear power capability as a major source of energy. Automation of the country's iron and steel industry continued, with the aim of improving product quality and increasing productivity. This progress took place within an economic environment of technologic shortfalls and managerial deficiencies.

Government Policies and Programs

The Czechoslovak Federal Assembly enacted legislation to address the problems of outdated technology and equipment and, consequently, work that did not meet specifications or was of low quality. The new law regulates conditions for enterprises that are partially owned by a foreign partner.

Basically, the law stipulated that if a jointly owned enterprise engaged in producing technology of higher quality and productivity level, and the foreign producer sought an ownership share larger than that of the Czechoslovak partner, the foreign partner was to be allowed the larger share. The foreign partner also could transfer profits abroad without restriction. This action was expected to enable the Czechoslovak economy to acquire the technologies necessary to improve economic performance.

In solving the problem of managerial inefficiency, the Czechoslovak Government continued to implement its economic restructuring program, "prestavba." The program called for improved productivity and profitability through the introduction of a new management approach that placed increased responsibility and decisionmaking authority with individual managers and enterprises.

Production

Production of gallium and graphite each accounted for about 9% of the world total. Output of magnesite amounted to roughly 5% of the whole; kaolin, approximately 3%; and pig iron and steel, each about 2%. Most of the kaolin was produced around Karlovy Vary, West Bohemia. The bulk of Czechoslovakia's steel production took place at Vitkovice in North Moravia. The Ostrava-Karvina Basin provided most of the country's bituminous coal, and the North Bohemian Basin continued as the major source of brown coal.

Trade

Czechoslovakia's foreign trade position continued to deteriorate, in large part because of the effect of Czechoslovakia's less competitively priced goods on hard-currency markets. In 1987, 75.4% of Czechoslovakia's total trade was with member countries of the Council for Mutual Economic Assistance (CMEA),[2] and 43.4% was with the Soviet Union alone. The Soviet Union provided most of Czechoslovakia's chromium, ferroalloys, iron ore, manganese, natural gas, nitrogen fertilizer, petroleum, pig iron, and nonferrous metals.

From 1986 to 1987, imports from nonsocialist countries increased 5.1%. Exports to the same countries fell 4% indicating a worsening trade balance with those trading partners. In an effort to offset this condition, the country increased exports of mineral commodities to its largest nonsocialist trading partners, Austria and the Federal Republic of Germany, and sought improved trade relations with Belgium, Denmark, Finland, France, Italy, the Netherlands, and Norway.

Commodity Review

Metals.—**Aluminum.**—The Metal Research Institute in Panenske Brezany, the Aviation Research and Experimental Institute in Prague-Letnany, and the Nuclear and Physical Engineering Department of the Czech College of Technology in Prague jointly developed an aluminum-based alloy for the aviation industry. Airworthiness tests, consistent with Czech aviation regulations, proved that the alloy resulted in a 20% to 30% higher fatigue life span for aircraft fuselages. The tests also proved that intervals between stress checks could be lengthened 50% to 100%. Typically, aluminum alloyed to zinc, titanium, chromium, or most recently, to lithium is most effective in producing airplane fuselages that have relatively low fatigue factors.

Gallium.—About 3,500 kilograms of 99.9% to 99.99% pure gallium metal was produced at the Slovak National Uprising (SNP) plant at Ziar and Hronom, East Slovakia. SNP planned to increase output to 4,000 kilograms by the end of the decade to accommodate anticipated demand by manufacturers of high-speed gallium arsenide integrated circuits. About one-third of the country's output was exported to Japan. Future demand is expected to be contingent on a method of reducing arsenic diffusion, when temperatures are lowered to form the crystals found in gallium arsenide wafers. Demand also depends on a cost-efficient approach being developed to routinely eliminate impurities in the gallium arsenide such as calcium, carbon, copper, iron, magnesium, manganese, nickel, selenium, silicon, sulfur, tellurium, and tin. Gallium arsenide has been used to a limited extent in high-temperature thermometers and switches, phased-array antenna systems in aviation, fiber optics, and photoelectric solar cells.

Gold.—Open pit mining of low-grade ore began at the Kreminca gold mine in central Slovakia. Exploration at Celina Morkrsko revealed new gold reserves in excess of 150 tons. The open pit mine at that location is scheduled to restart in

TABLE 1

CZECHOSLOVAKIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

COMMODITY		1984	1985	1986	1987[p]	1988[e]
METALS						
Aluminum:						
Alumina[e]		[2]85,000	85,000	80,000	85,000	82,000
Aluminum ingot, primary only		31,635	31,000	33,078	[e]33,000	[2]31,435
Antimony, mine output, Sb content[e]		[2]1,000	1,000	1,000	1,000	[2]2,921
Copper:						
Mine output, Cu content[e]		[2]10,000	10,300	10,000	10,000	10,000
Metal:						
Smelter, primary only[e]		[2]10,000	10,200	[r]5,000	10,000	10,000
Refined including secondary		26,068	26,414	26,182	27,202	[2]34,792
Iron and steel:						
Iron ore:						
Gross weight	thousand tons	1,869	1,859	1,784	1,798	[2]1,773
Fe content	do.	481	[e]490	470	[e]470	480
Metal:						
Pig iron	do.	9,561	9,562	9,573	9,788	[2]9,706
Ferroalloys, electric furnace	do.	151	161	160	2,039	[2]9,338
Crude steel	do.	14,831	15,036	15,112	15,415	[2]15,379
Semimanufactures[e]	do.	[2]12,431	12,700	12,000	12,000	[2]11,419
Lead:						
Mine output, Pb content		3,078	[r]2,718	2,944	2,801	2,800
Metal including secondary		21,134	21,437	23,602	26,008	[2]26,045
Manganese ore, gross weight[e 3]		900	950	900	900	—
Mercury	76-pound flasks	4,409	4,583	4,873	4,757	[2]4,872
Nickel metal, primary[e]		4,500	4,500	4,500	4,500	—
Silver[e]	thousand troy ounces	[2]1,029	1,000	1,000	1,000	1,000
Tin:						
Mine output, Sn content		200	250	[e]200	550	[2]515
Metal including secondary		425	507	240	240	250
Tungsten, mine output, W content[e]		50	50	50	45	14
Zinc:						
Mine output, Zn content		7,185	[e]7,300	6,700	[r e]7,000	7,000
Metal including secondary[e]		9,100	9,250	9,250	[e]9,300	9,000
INDUSTRIAL MINERALS						
Barite[e]		60,000	60,000	60,000	60,000	[2]60,794
Cement, hydraulic	thousand tons	10,530	10,265	10,298	10,369	[2]10,975
Clays: Kaolin		540,000	548,000	546,101	697,000	[2]685,958
Fluorspar[e]		96,000	95,000	95,000	95,000	96,000
Graphite		26,666	[r e]35,000	25,254	[r e]25,000	25,000
Gypsum and anhydrite, crude		842,000	771,600	743,100	770,998	[2]774,133
Lime, hydrated and quicklime	thousand tons	3,117	3,227	3,329	3,237	[2]3,311
Magnesite, crude		660,000	654,000	666,000	671,000	[2]630,786

See footnotes at end of table.

TABLE 1—Continued

CZECHOSLOVAKIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

COMMODITY		1984	1985	1986	1987[p]	1988[e]
INDUSTRIAL MINERALS—Continued						
Nitrogen: N content of ammonia		576,000	526,000	614,000	[e]600,000	[2]596,420
Perlite		[e]44,000	[e]44,000	41,443	41,997	[2]43,390
Pyrite, gross weight[e]		140,000	145,000	140,000	140,000	140,000
Salt		[r]343,760	349,174	338,240	[r e]110,000	[2]88,255
Sodium compounds, n.e.s.:						
Caustic soda		327,000	331,000	335,000	332,441	[2]337,062
Carbonate, manufactured		101,000	112,000	113,000	102,659	[2]112,217
Stone:						
Limestone and other calcareous stone	thousand tons	23,684	23,252	23,566	22,927	[2]23,244
Quarry stone, not further described	thousand cubic meters	32,274	32,269	32,826	[e]32,000	32,000
Sulfur:						
Native[e]		5,000	6,000	[r]6,000	[r]6,000	6,000
From pyrites[e]		60,000	62,000	60,000	[2]38,000	60,000
Byproducts, all sources		[e]10,000	41,866	42,193	[r e]40,000	40,000
Total[e]		**75,000**	**[r]109,866**	**[r]108,193**	**[r]84,000**	**106,000**
Sulfuric acid	thousand tons	1,246	1,297	1,292	[e]1,300	1,300
MINERAL FUELS AND RELATED MATERIALS						
Coal:						
Bituminous	do.	26,421	26,223	25,658	25,740	26,000
Brown and lignite	do.	102,857	102,315	102,738	100,668	102,000
Coke:						
Metallurgical	do.	8,211	8,112	8,005	8,189	8,100
Unspecified	do.	2,091	2,125	2,068	2,145	2,200
Fuel briquets from brown coal	do.	1,069	1,118	1,093	[e]1,000	1,100
Gas:						
Manufactured, all types	million cubic feet	271,710	264,859	255,854	[e]260,000	260,000
Natural, marketed[e 4]	do.	24,500	24,500	24,700	[2]24,564	24,000
Petroleum:						
Crude:						
As reported	thousand tons	95	123	142	144	140
Converted	thousand 42-gallon barrels	644	834	963	976	950
Refinery products[e]	do.	125,000	127,000	125,000	126,000	126,000

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

[1] Table includes data available through July 1989. In addition to the commodities listed, arsenic, feldspar, gold, graphite, uranium, and a variety of other petroleum products are produced, but information is inadequate to make reliable estimates of output levels.

[2] Reported figure.

[3] 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 material ordinarily reported as manganese ore, which generally contains 25% or more manganese.

[4] 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.

1990. Significant reserves of gold were also discovered at Karpenske Hory in Bohemia. It was expected that exploration of the Soviansko scheelite-gold deposit would be terminated by yearend because of ore dressing problems.

Iron and Steel.—The Czechoslovak Government set output goals for 1995 of 8.9 million metric tons of pig iron, 14.1 million metric tons of crude steel, 10.8 million metric tons of rolled steel, and 1.6 million metric tons of tube products, shifting focus from the production of pig iron and crude steel to the production of semimanufactures and finished products. The packaging and power engineering segments of the Czechoslovakian economy were the target markets for the steel products. Particularly important in this plan was an increase in the continuous casting of steel so that output would represent 50% of the country's steelmaking activities by 1995 and 90% by 2000.

For this purpose, at the Trinec Iron and Steel Works, near Ostrava, work was being completed on a continuous caster. The machine, designed by Clecim, the French concern, would have an annual capacity of 810,000 tons per year. Installation of a second identical unit was planned for the early 1990's.

At the Eastern Slovakia Iron and Steel Works at Kosice, the continuous slab caster was being rebuilt to increase capacity from 850,000 tons per year to 1.1 million tons per year. Modification of a second caster and installation of a third, capable of an annual output of 1.7 million metric tons, was expected to bring the plant to a 100% continuous casting capacity of 4.2 million tons by 1992.

The Czechoslovak Government aimed to reduce energy consumption and associated costs of steel production. To meet this goal, the Klement Gottwald New Metallurgical Works pursued the tandem process, a steelmaking technology that accounted for 25% of total output.

The tandem process involves a furnace that blends open-hearth technology with oxygen-blowing and preheating. The furnace is a twin-hearth tilting unit, wherein 75% scrap is charged into one hearth. In the other hearth, an oxygen blowing process occurs whereby carbon dioxide exhaust gases combust over the scrap charge, raising its temperature to about 850° C. When steelmaking in the second hearth is completed, 25% hot metal is added to make up the total change in the first hearth, and oxygen is blown onto the surface of the liquid. Meltdown of the scrap and carbon reduction of the 220-ton charge takes 1 hour and 15 minutes.

Mercury.—Mercury ore was extracted at the Slovinky and Maria Bana deposits near Roznava and at Rudnany. Mercury deposits also were being mined at Tajov near Banska Bystrica. At nearby Malachov and at Presov, exploitation of deposits yielding 90,000 tons of ore annually was to proceed.

Polymetallics.—Plans called for the construction of a centralized processing plant for the treatment of nonferrous metal ores. Specifically, ore complexes of copper, lead, and zinc concentrates were to be treated in a hydrometallurgical process utilizing a collective concentration system. In doing so, the Government intended to centralize treatment facilities, obtain a higher percentage of recovery of the contained metals, increase the recovery of trace elements, and possibly double the concentrate output.

Tin.—The Czechoslovak Government overhauled its tin mining operations at Stannum. The modified operation included six long-hole drills with respective capacities of 1.5 and 1.7 cubic meters, drill rigs, and rock shovels built in the Soviet Union. Blastholes were made by fan-drilling, and were filled with Danubit nitroglycerin-based explosives.

New ventilation shafts, underground shop facilities, and access ramps were installed. The main shaft was furnished with a twin-rope friction hoist for coiling its 7.5-ton-capacity bucket at 12 meters per second. A Czechoslovak-built primary crusher began service, crushing mined ores to 160 millimeters for transfer to the buckets. Annual ore production capacity from the modernized operation was expected to range from 250,000 to 300,000 tons.

***Industrial Minerals.*—Magnesite.**—With a view toward significant cost savings and increased productivity, a long-hole stoping approach, accounting for 50% of the mill feed at the Mikova-Dubrava Mine near Jelsava, was implemented. The stopes measured 100 meters long, 20 meters wide, and 70 meters high. Along the length of the stopes, sub-level drilling passages were created, utilizing bar-mounted rock drills for long-hole ring drilling. Rings were separated from each other at a distance of 2.5 meters, with each blasting round releasing 5,000 to 6,000 tons of ore. Broken ore was collected by front-end loaders operating in the haulage level below. Loader capacity was 15 tons, identical to that of the trucks utilized to move the material.

***Mineral Fuels.*—Coal.**—New methods and equipment were being developed to enable exploitation of the 4.5 million tons of bituminous coal 1,000 meters below the surface of the Ostrava Basin. The coal was expected to meet a significant portion of Czechoslovakia's fuel requirements.

Mining of a black coal deposit near the town of Slany, in Bohemia, was expected to begin by yearend. Production was scheduled to replace output from the Kladno Basin, where reserves were being depleted rapidly.

Natural Gas and Petroleum.—The Chemopetrol Chemical Works at Litvinov, Czechoslovakia, began operating the world's first commercial unicracking-feed preparation unit. The pretreatment unit, developed by the West German manufacturer, Voest Alpine-Salzgitter

Lummus GmbH, produces hydrocracked vacuum gas oil, gasoline fraction, and catalytic reformer feeds. This development occured at a time when Czechoslovakia had reduced sharply the amount of crude oil imported from the Middle East via the Adriatic pipeline. The Government plans are consistent with its aim to replace oil and coal with natural gas as a source of electrical power. This program, directed toward saving energy and reducing emissions initially called for the expanded use of gas at the Melnik power station to heat the city of Prague.

Czechoslovakia's annual consumption of Soviet natural gas was expected to increase by 450 billion cubic feet by 1989. Much of that amount would be taken by Czechoslovakia as compensation for its work in building a natural gas pipeline. The pipeline would transport Soviet natural gas through Czechoslovakia to customers in Austria, Italy, the Federal Republic of Germany, and Yugoslavia.

The Morava Crude Oilfields Enterprise in Michalovce, East Slovakia discovered natural gas deposits at Senna, estimated to contain at least 3 billion cubic meters of gas. Deposits found at Visnov and Rakovec were estimated to contain another 1 billion cubic meters of natural gas.

Nuclear Power.—Czechoslovakia was instrumental in setting up the Council of Nuclear Power Station Directors. The Council was to develop, on an ongoing basis, uniform safety standards concomitant with developments in nuclear power engineering. Other Council participants were Finland and members of the CMEA, including Bulgaria, Cuba, the German Democratic Republic, Hungary, Poland, and the U.S.S.R. Czechoslovakia's emphasis on safety standards was part of a broad program to make the country's nuclear powerplants more resistant to natural disasters such as earthquakes.

Technicians at the Plzen Skoda Works conducted several pressure tests on the pressure vessel and lid of a Czechoslovak-built nuclear reactor. Test results indicated that the reactor can withstand very high temperatures over protracted periods of time.

The Vltana River, near Tyn and Vltavon, was rerouted in order to supply water to the Temelin nuclear power station that was under construction during 1988. Some of the water would be used to cool the 1,000-megawatt reactor. The diversion of the river coincided with the completion, in October, of the reactor's cooling tower. Concrete reinforcement of the tower was done by the Armabeton reinforced concrete enterprise of Prague. The 153.8-meter tower was the tallest of its kind in Czechoslovakia.

GERMAN DEMOCRATIC REPUBLIC[3]

Of all the member countries of the CMEA, the German Democratic Republic (GDR) had the highest per capita income and the highest standard of living. The GDR was also the most industrially advanced of the CMEA countries, and the economic expansion was above average for those countries. The GDR generally was ranked among the top 10 industrial nations of the world. Manufacturing was the GDR's most important sector of national income.

About the size of Ohio, with a population of 16.6 million, the country employed 3.2 million in industry of the total work force of 7.3 million in 1987. The metallurgical industry employed 138,000 persons in 1987, and the energy and fuel sector employed 227,000 persons. The GDR's population declined from 1950 to 1962, then stabilized for 6 years before beginning another 20-year decline. The extreme scarcity of labor was strongly felt throughout the economy. Women accounted for 49% of the entire work force.

The GDR produced a variety of mineral commodities, but output of most commodities was the result of processing imported raw materials. Metals, minerals, and the mining industry were significant components of the produced national income. The processing of metals and the recycling of scrap materials also contributed somewhat to the general economy. The GDR was the world's leading producer of lignite and the third largest producer of potash, accounting for approximately 25% of the world's lignite output and 11% of the world's output of potash. Other commodities mined in quantities less important by world standards included copper, nickel, silver, tin, and uranium ores, as well as cement, chalk, fluorspar, gypsum, salt, sand and gravel, natural gas, and crude oil. The GDR was relatively poor in other mineral raw materials, and thus it was heavily dependent on imports including most notably bauxite, iron, phosphates, and crude oil. The metallurgical industry has been expanded far beyond the domestic raw materials base, and this has resulted in heavy import demands. The GDR territory has already been well explored for mineral resources. Presently, prospecting was centered mainly on further delineation of lignite deposits for new mines and on development of existing oil and gas resources. The centrally controlled economy of the GDR was based on mutually coordinated production schedules, and plan targets were predetermined by the 1986-90 5-year national plan for economic development. The GDR tacitly admitted that the 5-year plan economic goals were no longer achievable.

In 1988, the planned national income increase of 4.1% rose only 2.7% to about $133 billion.[4] As in the previous 2 years, the increase in national income was attributed completely to the higher labor productivity. Since 1971, the GDR had an average annual growth rate of more than 4.6% in its national income. The economy continued to slow, trade with the West also stagnated, and the convertible currency trade surplus fell sharply. The 1987 result was the GDR's poorest economic performance since 1982. Payments to Western countries were made in freely convertible currencies or through countertrade arrangements. Slower economic growth was partly a reflection of the sluggish investment performance earlier this decade. Although investment in real terms rose by 5% in 1988, growth in private consumption was markedly lower. Reportedly, there were plans for a number of combined industrial works to operate on the principle of self-financing. In 1988, about 4.5% of production was in private companies. As much as 80% of GDR's research and development funds, about $5.9 billion in 1987, went to the applied research.

Production

The planned gross industrial product increase of 4.1% rose only 3.7%, the same as in 1987. The GDR supplied advanced technology to other CMEA countries, despite the slow domestic modernization. Because of the geological conditions, most minerals were extracted by surface mining methods, about 58% of which was lignite and 35% was industrial minerals. Research continued on the improved extraction, production, and utilization of the already available resources such as lignite, nickel, geothermal, ground water, natural gas, and tin.

According to the 1988 report on plan fulfillment, the metal-processing industry achieved its production increase of 6%.[5] Secondary raw materials continued to play a vital role in the production of ferrous and nonferrous metals, and the Government continued to promote the use of domestic scrap in order to cut down imports. Because of the lack of significant indigenous raw materials, the utilization of secondary raw materials expanded. About 5.6 million tons of metal scrap and approximately 1.3 billion bottles and glasses were collected. The share of secondary raw materials for the production of raw steel and copper was 67% each and 100% for the production of lead. Byproducts metals were also obtained from copper-bearing schists and tin ores, and bromine was extracted during the processing of potash salt. In minerals production, the output rose slightly in 1988. The production of brown coal continued to decrease for the fourth year, while the output of crude petroleum and refinery products increased the third year. The GDR led the world in the manufacture of surface coal mine machinery and had one of the largest firms in the world that produced this equipment.

Trade

The main exports from the GDR included chalk, kaolin, lignite briquets, potash, and salt, although the GDR imported anthracite coal, bauxite, chrome ore, coke, crude steel, iron ore, manganese ore, natural gas, and petroleum.

At $1.5 billion, the 1988 trade surplus remained the same as in the previous year. The Soviet Union remained the GDR's major trading partner, at almost 40% of total turnover, but the trade deficit fell significantly. Exports to the Soviet Union remained at approximately the same as the 1987 level, although imports of largely energy, raw materials, and metals fell by about 5%. About one-half of the GDR's exports to the Soviet Union were specialized products in the field of metal-processing industry. This proportion amounted to 70%. In 1988, the Soviet Union delivered to the GDR 17.1 million tons of crude oil, 7.1 billion cubic meters of natural gas, and 3 million tons of rolled steel. The direct relations between the GDR's combines and those with Bulgaria, China, Czechoslovakia, Hungary, and Romania were conducted primarily by the branches of the metal-processing industry. Trade with the CMEA countries and other centrally planned economy countries accounted for 69% of the GDR's foreign trade.

Trade with the industrialized countries increased only slightly. The Federal Republic of Germany (FRG) was the GDR's main Western trading partner. In 1988, imports under the Berlin Agreement fell by 7% in value terms. Exports, however, rose by 3% to the FRG. In accordance with a supplementary protocol to the European Community (EC) treaty, intra-German trade provided the GDR with customs and duty-free access to the FRG market, with which it also entered into diplomatic relations in 1988. The GDR had also conducted more triangular trade since 1987 by importing goods from the FRG through developing countries for convertible currency.[6] The press commented that after the State Council Chairman visited Bonn in 1987 the inner-German economic relations improved substantially.

Of the Eastern European nations, the GDR had by far the largest volume of imports from the West. However, among U.S. trading partners in Eastern Europe, the GDR ranked last. U.S. exports to the GDR more than doubled to $109 million in 1988.

Commodity Review

Metals.—**Copper.**—Most of the metal production in smelters continued to increase slightly and was based on imported materials and the recovery of scrap. Reportedly, 48,000 tons of refined and electrolytic copper was used domestically. The copper ore was being depleted, gradually leading to the end of mining. A photograph was published in the GDR Review magazine showing the slag being dumped into heaps from train bins.[7] The photograph was taken at Helbra in Mansfeld region, the location of the VEB Mansfeld Kombinat "Wilhelm Pieck." A new technology was reportedly being developed at Helbra for the production of ore briquets from copper concentrates.

Iron and Steel.—The steel industry remained the mainstay of the GDR's heavy industry, still ranking 20th in world production, just below the Re-

TABLE 2

GERMAN DEMOCRATIC REPUBLIC: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]	1984	1985	1986	1987[p]	1988[e]
METALS					
Aluminum:					
Alumina:					
For metallurgical use	43,239	46,695	46,350	50,880	51,000
For other use[e]	20,000	20,000	20,000	20,000	20,000
Metal:[e]					
Primary	58,000	60,000	[r]61,000	[r]62,000	65,000
Secondary	52,000	52,000	52,000	52,000	55,000
Total	**110,000**	**112,000**	**[r]113,000**	**[r]114,000**	**120,000**
Cadmium metal, primary[e]	15	15	18	18	18
Copper:					
Mine output, Cu content[e]	12,000	12,000	[r]11,000	[r]11,000	9,000
Metal:					
Smelter, primary	14,000	14,000	15,000	16,000	17,000
Refined, primary and secondary, including alloys	69,000	75,000	73,000	72,000	72,000
Iron and steel:					
Iron ore and concentrate thousand tons	36	30	—	—	—
Fe content do.	20	15	—	—	—
Metal:					
Pig iron do.	2,357	2,578	2,738	2,799	2,900
Ferroalloys, electric furnace do.	124	124	135	135	135
Steel, crude do.	7,573	7,853	7,967	8,243	8,400
Semimanufactures (hot-rolled only) do.	5,386	5,637	5,656	5,887	5,900
Lead:[e]					
Smelter, primary	22,000	20,000	20,000	18,000	20,000
Refined, all sources	35,000	55,000	[r]36,000	[r]38,000	39,000
Nickel:					
Mine output, Ni content, recoverable	2,000	2,000	2,000	2,000	2,000
Metal, refined[e]	3,000	3,000	3,200	[r]3,500	3,500
Silver, mine output, Ag content, recoverable thousand troy ounces	1,290	1,320	1,320	1,320	1,320
Tin:[e]					
Mine output, Sn content, recoverable	2,500	2,800	2,800	[r]3,000	3,000
Metal, refinery output including secondary	3,000	3,300	[r]3,300	[r]3,400	3,400
Zinc metal including secondary	17,000	17,000	17,000	18,000	21,000
INDUSTRIAL MINERALS					
Barite[e]	35,000	34,000	34,000	32,000	32,000
Boron materials: Processed borax, $Na_2B_4O_7$ $10H_2O$ content[e]	4,000	4,000	4,000	4,000	4,000
Cement, hydraulic thousand tons	11,555	11,608	11,988	12,430	12,200
Chalk[e] do.	40	40	40	40	40
Clay, kaolin:[e]					
Crude do.	350	350	330	[r]320	350
Marketable do.	175	175	165	150	165

See footnotes at end of table.

TABLE 2—Continued

GERMAN DEMOCRATIC REPUBLIC: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1984	1985	1986	1987[p]	1988[e]
INDUSTRIAL MINERALS—Continued						
Fluorspar[e]	thousand tons	100	100	100	90	90
Gypsum and anhydrite:						
Crude[e]	do.	360	360	340	[r]320	320
Calcined	do.	302	312	305	299	300
Lime and dead-burned dolomite	do.	3,597	3,567	3,545	3,378	3,500
Nitrogen: N content of ammonia	do.	1,203	1,206	1,193	1,315	1,320
Phosphate, P_2O_5 content	do.	308	299	309	291	285
Potash, marketable, K_2O equivalent	do.	3,465	3,465	3,485	3,510	3,509
Salt:						
Marine	do.	58	58	59	59	59
Rock[e]	do.	3,075	3,080	3,075	3,075	3,000
Total	**do.**	**3,133**	**3,138**	**3,134**	**3,134**	**3,059**
Sodium compounds, n.e.s.:						
Caustic soda	do.	694	667	638	577	600
Sodium carbonate	do.	890	884	885	893	890
Sodium sulfate	do.	164	172	181	179	185
Stone, sand and gravel:						
Crushed stone[e]	do.	14,500	15,000	15,000	14,500	14,500
Sand and gravel	do.	8,599	8,437	8,163	7,576	7,980
Sulfur:						
Byproduct:[e]						
Elemental	do.	80	80	75	75	75
Other forms	do.	270	250	240	240	240
Sulfuric acid	do.	885	883	883	867	865
MINERAL FUELS AND RELATED MATERIALS						
Coal, brown coal (lignite)	do.	296,341	[r]312,156	311,260	308,976	305,000
Coke:						
From anthracite and bituminous coal[e]	do.	1,150	—	—	—	—
From brown coal:						
High-temperature	do.	2,463	2,497	2,509	2,487	2,500
Low-temperature	do.	3,327	3,185	3,092	2,743	2,900
Total	**do.**	**6,940**	**5,682**	**5,601**	**5,230**	**5,400**
Fuel briquets (from lignite)	do.	50,270	50,666	50,434	49,514	49,800
Gas:						
Manufactured	million cubic feet	272,695	274,743	281,029	286,185	295,000
Natural, marketed production[e]	do.	459,000	459,000	459,000	459,100	425,000
Petroleum:						
Crude[e]	thousand 42-gallon barrels	[3]430	430	360	360	360
Refinery products:						
Gasoline	do.	35,190	36,567	36,792	39,783	40,000
Kerosene, jet fuel, distillate fuel oil	do.	47,525	49,216	49,013	49,458	49,800
Residual fuel oil[e]	do.	[3]59,940	60,000	60,000	65,000	65,000
Lubricants	do.	3,231	3,346	3,317	3,365	3,400
Total[4]	**do.**	**145,886**	**149,129**	**149,122**	**157,606**	**158,200**

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

[1] Table includes data available through Aug. 1989.

[2] In addition to the commodities listed, magnesium, peat, and a variety of construction materials were produced, but output was not reported, and available information was inadequate to make estimates of output levels.

[3] Reported figure.

[4] Total of listed products only.

public of South Africa. The production continued to rise virtually uninterrupted from 3,207 tons in 1959 to its record-high level in 1988. The production of pig iron also continued to grow to a record high in 1988. The share of oxygen-blown steel continued to rise to about 27% and the share of continuously cast steel to 38%. The mining of iron ore virtually ceased in 1983, and the Soviet Union continued to supply most of its iron ore requirements.

Production capacity continued to be brought on-stream and built up, such as a converter shop with a continuous-casting unit and a 1,700 series cold-rolling mill at the Eisenhuttenstadt iron and steel combine; a 3,200 series four-high plate mill at the Elsenburg rolling plant; a continuous wire mill and electric-arc furnaces with continuous-casting and vacuum-refining units at the Brandenburg iron and steel works; and a sections mill for rolling I-beams with parallel flanges started at the Maxhutte iron and steel works at Unterwellenborn.[8]

The Central Institute for the use of metals was established in Dresden, specifically promoting the use of existing rolled steel.

The exports of steel to the EC continued to grow, amounting to 495,000 tons. It ranked third after Czechoslovakia (724,000 tons) and the Soviet Union (657,000 tons).[9] In 1987, the GDR imported (4.8 million tons) slightly more steel than it exported (4 million tons).

Silver.—A new precipitation process for the recovery of silver from photographic materials was developed by the GDR's Academy in Freiberg, in the Karl-Marx-Stadt area. Grains of graphite from 2 to 5 millimeters in diameter attract silver to a diameter of up to 10 millimeters and are separated out automatically. The process improved the precipitation by about a hundredfold, according to the director of the project.[10]

***Industrial Minerals.*—Cement.**—The production of cement has almost trebled in the last 20 years, with exports increasing gradually while imports increased substantially. VEB Zement Kombinat was the only state-run concern, which operated about 32 cement plants. Cement was exported to other CMEA countries, especially Hungary, but also to Egypt, FRG, and Sweden. Most of the limestone was mined in open pit quarries.

Clays (Ceramics).—On the basis of domestic raw materials and other materials, the glass and ceramics industry supplied increasing amounts of highly refined glass and ceramics materials. In 1988, lead crystal and porcelain were produced as new products bearing the "a" quality mark.

The most important sources of white-firing clays in GDR occurred in Bennstedt, Lothian, and Schlettau. Clays were extracted from beds that ranged in thickness from 1 to 20 meters and were associated with seams containing sand and silt with associated lignite. Other clay deposits worked in the country included Brandeis bei Leipzig, Frohnsdorf, and Hasebach in Thuringen, Gutenberg, and Prusitz.

Chalk.—The abundant chalk deposits on Rugen Island were the largest in Europe. The chalk was mined in surface pits by the only state-held company, the VEG Kreidewerke Rugen, on the island near Sassnitz. Reportedly, about 24,000 cubic meters were mined per month in the Wittenfelde chalk pit, near Sassnitz. The high-quality chalk was exported to many countries. The island was preparing to celebrate its 40th year of joining the Republic.

Potash.—Potash continued its steady expansion until 1987, but in 1988 it decreased only slightly, and the 1989 plan anticipated another downward slide. Potash remained an important mining activity. It supplied domestic requirements for fertilizer and exported significant amounts. Carnallite was experimentally produced from solutions at the Blecherode potash plant. The GDR remained the third largest producer of potash in the world after the Soviet Union and Canada. Most, or about 80% of the output, was exported.

In the GDR, VEB Kombinat Kali also administered all the salt mining operations and the country's four potash producing plants, which were Kalibetrieb Werra, Kalibetrieb Sud Harz, Kali und Steinsalzbetrieb Saak, and Kalibetrieb Zielitz. Kali Bergbau handled foreign trade for VEB Kombinat Kali.[11]

***Mineral Fuels.*—Coal.**—Brown coal provided about 70% of GDR's primary energy consumption and 82.5% of its total electrical energy. There were 33 lignite mines, mostly as open pit operations.

Open pit brown coal mines became operational at Groitsche, Grobern, Klettwitz-Nord, Kolckern, Reichwalde, and Seese-Ost. A 4-kilometer long conveyor belt, built in Poland, operated in the Witznitz pit, even during the cold winter weather. Ground water in mined lands was initiated to be treated, as in Vetschau. The removal of sulfur from smoke was introduced, as was started at the Vetschau power station. About 80% of sulfur dioxide was reportedly removed from the smoke. An open pit mine, at Pirkau in the Halle region, was reclaimed as a park.

High-temperature coke was produced from brown coal at the "Fritz Selbmann" Schwarze Pumpe Gas Combine VEB.

Reportedly, more than 70% of solid fuels and building materials were transported by railroads that ran from the producer to the consumer without stops for switching. In addition to the severe winter weather in 1987, which detrimentally affected the delivery of coal to the powerplants, the electrical powerplant at Boxberg near Cottbus exploded and burned badly, decreasing its capacity by one-half for the longer term.

Natural Gas.—The production of natural gas continued its slow decrease because of small gas deposits. About 10% of the domestic and industrial energy requirements was met by manufactured gas and natural gas; the manufactured gas reportedly accounted for 27% of the total gas consumption. Large quantities of gas were imported from the Soviet Union. Natural gas reserves were estimated at 187 billion cubic meters, which may supply gas for the next 15 years.

Nuclear Power.—By some accounts, the GDR had five operating nuclear power reactors. The share of nuclear energy in electricity production was just below 10%.[12]

Uranium was mined by Wismut AG in an area east of the city of Gera. Wismut was established by the Soviet occupation forces after the Second World War and still delivers its output to the Soviet Union. Miners who suffered from periodic impotency and loss of hair were never told what they were mining. Many local residents complained about tiredness. Oberrothenbach, near a uranium ore processing plant, was locally referred to as the "tired village." The alarmed population in a uranium mining district demanded official action following an independent report of widespread cancer from radioactivity in the air, earth, and water. The authorities, however, continued to treat the relevant hospital statistics as top secret, while the subject of uranium mining and its consequences remained undisclosed.

Petroleum.—The GDR was virtually 100% dependent on imported oil, mainly from the Soviet Union. Almost 80% of this oil was transported through the "Friendship Pipeline." Another pipeline brought oil from the Siberian oilfields and the third one brought oil via Rostok to VEB Petrochemisches Kombinat, a major refinery and petrochemical complex at Schwedt. The VEB Leunawerke "Walter Ulbricht" was the largest industrial complex. Leuna produced 13% of the GDR's chemical industry products. Walter Ulbricht covered an area of 7 square kilometers, with 135 kilometers of roads, 220 kilometers in rail, and almost 2,300 kilometers in pipelines. The plant produced about 500 products, mostly motor fuels and fertilizers, raw materials for fibers and plastics, and others. On January 1, 1954, the Soviet Union handed over Walter Ulbricht to the GDR, and by 1955, Soviet oil was already refined at this plant. In 1987, Leuna, one of GDR's 14 chemical combines, accounted for 4.5 million tons of oil.[13] Of the territory's work force of about 100,000, every second person was employed in the chemical industry—30,000 in Leuna.

HUNGARY[14]

Hungary remained a significant European producer of bauxite, but was only a modest producer of fuels and industrial minerals. Hungary's aluminum industry was the only branch of the metals industry sector that was fully integrated from bauxite mining to finished aluminum products. In 1988, the country's economy showed little growth compared with that of 1987. This was due largely to transitions in the economy from centrally planned to more decentralized forms. Total industrial production remained at about the same level as that of 1987; production of metals grew by 3.4% and the toolmaking and chemical industries by 1.2% and 0.6%, respectively. Major events in the fuels and energy sectors during the year included the construction startup of a new 1,000-megawatt reactor block at the Paks nuclear powerplant, as well as the discovery of a new petroleum field. In the metals sector, major proposals for rationalizing the steel industry were announced, and new capacities were planned for the aluminum industry.

Hungary's Government continued to promote rationalization in the mining sector and decentralization of the economy as a whole. Emphasis was placed on the changeover from central economic planning to a supply and demand market orientation of the economy. State subsidies were reduced for most branches of industry, including mining, metallurgy, and fabricating. Also, state subsidies for Hungary's foreign mineral commercial activities within the CMEA were under review for possible reduction and/or abolition. The Government's main planned targets for 1989 called for national income to be at essentially the same level as that of 1988; the maximum growth of industrial production would be about 1%. The planned low growth levels of these key indicators would reflect a continuing transition from central planning to a decentralized market-based economy. To control inflation, the Government proposed strict budgetary and monetary controls; imports would be largely restricted to technically advanced machinery and equipment. The Government planned to meet expected increases in unemployment by raising the state unemployment funds to about twice its level in 1988. The anticipated increase in unemployment in 1989 would result largely from continuing restructuring in the steel and coal mining sectors.

Production

Production of most mineral and mineral fuel commodities in 1988 declined slightly compared with that of 1987, owing to the country's industrial restructuring program. Operations at several coal mines ceased because of low efficiency. To meet market demands, Hungary's state owned and operated mineral industries continued to rationalize production in favor of higher value goods. Bauxite and manganese remained the country's only domestically mined metallic ores. Byproduct gallium and vanadium were produced at the Almasfuzito alumina refining operations.

Trade

Hungary's 1988 trade returns generally were more favorable than those in 1987. The country's hard currency balance in 1988 improved by $900 million;

TABLE 3

HUNGARY: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1984	1985	1986	1987[p]	1988[e]
METALS						
Aluminum:						
Bauxite, gross weight	thousand tons	2,994	2,815	3,022	3,101	[3]2,906
Alumina, gross weight	do.	811	798	856	858	[3]873
Metal:						
Primary		74,202	73,859	73,877	75,500	[3]74,692
Secondary		31,900	23,300	23,000	[e]24,000	24,000
Total		**106,102**	**97,159**	**96,877**	**[e]99,500**	**98,692**
Copper, metal:[e]						
Smelter, secondary		100	100	100	100	100
Refined including secondary		12,800	12,800	12,800	12,500	12,500
Gallium, metal		[e]2,400	2,800	4,062	4,103	4,100
Gold, mine output, Au content[e]	thousand troy ounces	20	20	20	18	18
Iron and steel:						
Iron ore:						
Gross weight	thousand tons	383	311	—	—	—
Fe content	do.	92	75	—	—	—
Metal:						
Pig iron:						
For steel industry	do.	2,029	2,007	1,987	2,053	[3]2,038
For foundry use	do.	68	88	67	[e]54	55
Total	**do.**	**2,097**	**2,095**	**2,054**	**2,107**	**[3]2,093**
Ferroalloys:[e]						
Ferrosilicon		9,000	9,000	9,000	10,000	10,000
Silicon metal		2,000	2,000	2,000	2,000	2,000
Other		2,000	2,000	2,000	2,000	1,000
Total		**13,000**	**13,000**	**13,000**	**14,000**	**13,000**
Steel, crude	thousand tons	3,750	3,647	3,715	3,621	[3]3,583
Semimanufactures, rolled only	do.	2,953	2,863	2,898	2,831	2,790
Lead:[e]						
Mine output, Pb content		700	700	—	—	—
Metal, refined, secondary		100	100	100	100	100
Manganese ore:						
Run of mine:						
Gross weight		115,885	115,334	106,009	125,634	[3]110,908
Mn content		22,000	22,000	20,000	24,000	24,000
Concentrate:						
Gross weight		67,000	[r]63,000	63,000	78,000	75,000
Mn content		20,100	[r]18,900	18,900	25,000	24,000
Vanadium, metal[e]		275	300	300	300	300

See footnotes at end of table.

TABLE 3—Continued

HUNGARY: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1984	1985	1986	1987[p]	1988[e]
METALS—Continued						
Zinc:[e]						
Mine output, Zn content		2,300	2,200	—	—	—
Metal, smelter, secondary		600	600	600	[3]1,565	1,500
INDUSTRIAL MINERALS						
Cement, hydraulic	thousand tons	4,145	3,678	3,846	4,153	[3]3,873
Clays:						
Bentonite:						
Raw		64,158	59,853	79,888	98,331	[3]66,014
Processed		45,759	44,431	47,504	52,828	[3]53,250
Kaolin:						
Raw		38,869	29,038	29,837	33,289	[3]29,572
Processed		8,303	6,485	6,032	5,179	[3]5,329
Gypsum		—	—	—	84,438	85,000
Lime, calcined	thousand tons	823	801	831	831	[3]851
Nitrogen: N content of ammonia	do.	814	791	811	786	800
Perlite		94,360	94,460	109,360	112,410	[3]120,562
Pyrites, gross weight[e]		7,000	7,000	([4])	([4])	—
Refractory materials, n.e.s.:						
Chamotte products	thousand tons	164	153	132	135	135
Chrome magnesite products	do.	38	39	42	45	45
Sand and gravel:						
Gravel	thousand cubic meters	10,317	8,529	8,179	8,269	8,300
Sand:						
Common[e]	do.	400	400	400	400	400
Foundry	thousand tons	591	560	519	631	[3]648
Sodium compounds:						
Hydroxide (caustic soda)		193,693	193,719	201,684	197,376	200,000
Sulfate[e]		10,000	10,000	10,000	9,000	9,000
Stone:						
Dimension, all types	thousand tons	5,874	5,718	5,966	5,537	5,500
Dolomite	do.	1,205	1,158	1,146	1,086	1,100
Limestone	do.	7,695	7,418	7,469	7,282	7,300
Quartzite	do.	22	37	33	35	35
Sulfur:						
From pyrite[e]		2,000	2,000	1,000	1,000	1,000
Byproduct, elemental, all sources[e]		9,000	9,000	10,000	10,000	10,000
Total[e]		**11,000**	**11,000**	**11,000**	**11,000**	**11,000**
Sulfuric acid		549,159	520,338	539,775	573,323	[3]512,374
Talc[e]		17,500	17,000	16,000	15,000	13,000

See footnotes at end of table.

TABLE 3—Continued

HUNGARY: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1984	1985	1986	1987[p]	1988[e]
MINERAL FUELS AND RELATED MATERIALS						
Asphalt, natural[e]		500,000	500,000	550,000	[3]572,117	550,000
Carbon black[e]		5,000	5,000	5,000	5,000	5,500
Coal:						
Bituminous	thousand tons	2,573	2,639	2,325	2,360	[3]2,255
Brown	do.	14,448	14,016	13,821	13,261	[3]12,986
Lignite	do.	8,026	7,387	6,983	7,223	[3]5,636
Total	**do.**	**25,047**	**24,042**	**23,129**	**22,844**	**[3]20,877**
Coke:						
Coke oven:						
Metallurgical	do.	546	492	547	669	670
Other[e]	do.	160	160	150	150	150
Total	**do.**	**706**	**652**	**697**	**819**	**820**
Gashouse[e]	do.	160	160	160	160	160
Total coke	**do.**	**866**	**812**	**857**	**979**	**980**
Fuel briquets	do.	1,549	1,722	2,006	2,134	[3]2,302
Gas:						
Manufactured	million cubic feet	14,232	11,830	8,122	5,338	6,000
Natural, marketed	do.	244,060	263,306	250,663	247,980	250,000
Natural gas liquids:[e]						
Natural gasoline	thousand 42-gallon barrels	3,900	3,800	3,700	[3]5,540	5,500
Liquefied petroleum gas	do.	3,500	3,500	3,400	[3]2,444	2,400
Peat, agricultural use[e]	thousand tons	70	70	75	70	70
Petroleum:						
Crude:						
As reported	do.	2,007	2,012	2,005	1,876	[3]1,947
Converted	thousand 42-gallon barrels	13,607	13,641	13,594	12,977	[3]13,025
Refinery products:[5]						
Gasoline including naphtha	do.	21,479	22,644	24,310	25,321	25,000
Kerosene and other light distillates[e] [6]	do.	7,000	7,000	7,000	7,000	7,000
Distillate fuel oil	do.	25,909	24,506	26,088	26,147	26,000
Residual fuel oil	do.	16,960	16,970	15,664	17,296	18,000
Lubricants[e]	do.	1,000	1,000	1,000	[3]1,519	1,500
Liquefied petroleum gas[e]	do.	1,000	1,000	1,000	1,000	1,000
Asphalt and bitumen[e]	do.	3,800	3,800	3,600	[3]3,466	3,500
Paraffin and petrolatum[e]	do.	250	250	250	[3]346	350
Total	**do.**	**77,398**	**77,170**	**78,912**	**82,095**	**82,350**

[e] Estimated. [p] Preliminary. [r] Revised.
[1] Table includes data available through June 6, 1989.
[2] In addition to the commodities listed, diatomite and a variety of other crude construction materials such as common clays are produced, but available information is inadequate to make reliable estimates of output levels.
[3] Reported figure.
[4] Revised to zero.
[5] Excludes refinery fuel and losses.
[6] Data derived by subtracting reported motor gasoline and white spirit data from reported light refinery products total.

a trade surplus of $515 million was achieved compared with a $378 million deficit in 1987.[15] Hard currency exports increased by 16.4% compared with those of 1987, while imports declined slightly. Hungary's hard currency trade improvement was as much due to favorable market conditions for commodities such as aluminum, plastics, steel products, and grain as to the country's general export growth. The total hard currency export value of Hungary's metals rose by 1.4% compared with that of 1987. Individually, the export value of rolled steel increased by 1.3%, that of unalloyed plate and band steel by 1.5%, primary aluminum shapes and sections by 1.5%, and aluminum products by 1.4%. The export values of machine tools and chemicals grew by 1.15% and 1.2%, respectively. Despite the country's trade upturn in 1988, Hungary remained a substantial hard currency debtor nation. At yearend, the current account deficit amounted to about $600 million. The net real debt amounted to over $16 billion, and the net debt-to-export ratio in units of debt per 100 units of export was $274 in 1988, which was the second highest among CMEA countries. Hungary's debt service ratio at 62 was also among the highest in CMEA countries.[16] The country's nonconvertible currency trade with the U.S.S.R. and other CMEA block countries improved by 2.4% compared with that of 1987. Hungary's terms of trade within the CMEA improved largely on the basis of a price decline of imported energy, although, quantitatively, imports of such energy carriers as electricity, coal, and natural gas rose by 19%, 15%, and 3.9%, respectively. During the year, to promote industrial efficiency and a greater reliance on market forces, the Government of Hungary undertook a subsidy reduction program along a broad economic front. State subsidies, a constant feature of Hungary's centrally planned economy in past years, were sharply cut in the area of mining and foreign trade with CMEA and other centrally planned economy countries. The subsidy cuts largely involved the country's trade with the U.S.S.R.; however, the important energy-related portion of Hungarian-Soviet trade was often very profitable for the Hungarian side, especially when the 5-year sliding price scale for petroleum and natural gas was below market prices. In August, a meeting was held by Hungary's Chamber of Commerce. A study group responsible for the iron and steel industry, which was composed of industry managers, indicated that subsidy reductions for exports to centrally planned economy countries had made 70% to 80% of the metallurgical sales to CMEA countries unprofitable, and that a sharp reduction of exports would cut the profit margin to the extent that metallurgical supplies for domestic needs could be endangered. The management of the country's main iron and steel enterprises indicated that the export subsidy system was a complex chain of taxes and subsidies to bridge accounting differences in the CMEA centrally planned economies. They advised a cautious approach to subsidy reduction that would involve the study of discrete subsidy factors, and that would allow the removal of import taxes on goods from centrally planned economy countries in the event that subsidies were to be entirely eliminated.

Among a number of foreign commercial agreements reached in 1988, Hungary signed a trade agreement with China that included Hungarian exports of aluminum cables, machine tools, steel pipes, and consumer and producer durables in exchange for chemicals, industrial raw materials, and consumer goods. Talks were held with Iran on industrial cooperation in the fields of ferrous and nonferrous ore mining and processing, and an agreement was reached on cooperation in the area of exploration and utilization of industrial minerals for Iran's construction industry.

Commodity Review

Metals.—**Aluminum and Bauxite.**—The Hungarian Aluminum Trust (Hungalu) benefited from relatively good aluminum prices in 1988, earning $264.2 million, while importing $45.5 million. The company remained Hungary's only vertically integrated corporation involved in all areas of bauxite mining and processing and alumina and aluminum refining and smelting. In 1988, Hungalu began its first imports of high-grade Guinean bauxite, owing to the declining efficiency of domestic mining, complex karstic geological conditions, and declining grades of domestic bauxite. About 50,000 tons of the 86,000-ton Guinean bauxite consignment was shipped to the Almasfuzito alumina refinery to be experimentally blended with domestic bauxite to reduce the use of electricity and caustic soda. The electrical engineering and fabricating industries consumed the largest share of the country's end-use aluminum, about 32% of total consumption. At yearend, Hungalu announced that a new wire mill would be installed at the Tatabanya aluminum fabricating enterprise. The new mill would be operational in 1989 and would produce heat-treated alloyed wire at higher efficiencies in terms of energy use and product quality. The machinery would cost $2 million and would be supplied by the Continuous Co., a U.S. firm operating in Italy. The addition of the mill was expected to increase Tatabanya's output by 40% to about 30,000 tons of aluminum products per year.

Owing to a shortage of domestically produced electric power, Hungary and the Soviet Union had maintained an agreement since 1962 that called for deliveries of Hungarian alumina and aluminum semimanufactures to the Soviet Union in exchange for primary aluminum. The agreement was renegotiated in 1985, calling for annual deliveries of 530,000 tons of Hungarian alumina and 5,000 tons of semimanufactures to the Soviet Union for the 1986-90 period in exchange for 205,000 tons of primary aluminum. In September, Austria's Erich Barth Co. OHG and Hungalu signed an agreement for a joint venture to supply salts used in light metal processing at the Tatabanya smelter to improve production designated for hard currency export. The joint venture, named EBA-TALKO, would be 49% owned by OHG and 51% by Hungalu.

Copper.—In 1988, debate continued in Hungary concerning the development of the Recsk copper deposit, near the old Recsk copper-gold mine. The deposit, first surveyed in 1967, revealed the presence of about 175 million tons of copper contained in the ore. Two 1,200-meter shafts were sunk to provide access to the deep-lying deposit as well as about 7 kilometers of prospecting galleries. Development and construction costs for the project were estimated to be in excess of $0.5 billion. Owing to a lack of development funds, the Government had allocated about $130 million over a period of about 20 years for maintenance of the site. Exponents of the site's closure argued that unless the necessary capital were raised soon, the site should be closed down because of high maintenance costs. Negotiations with the Soviet Union over the possibility of joint development of the site appeared at an impasse at yearend, and the Hungarian Planning Office indicated that if no agreement is reached in 1989, part or all of the $4 million for maintenance for 1989 would be used to close the facility.

Gallium.—Most of the country's gallium, produced as a byproduct of alumina refining at Ajka, was sold to market economy countries, primarily Japan, the Federal Republic of Germany, and the United States. The material was a key ingredient in the manufacture of semiconductor chips. Hungarian gallium oxide and gallium arsenide had a purity of 99.999% and 99.99%, respectively. During the year, Hungalu negotiated with a number of firms from the Federal Republic of Germany and Japan to create a joint venture for expanding facilities at the Almasfuzito alumina refinery to produce up to 3 additional tons of gallium per year.

Iron and Steel.—The restructuring of Hungary's steel industry was the chief event during the year. The Ministry of Industry accepted a World Bank sponsored restructuring program developed by the Swedish consulting firm, Scandiaconsult. The proposed streamlining of the industry would involve 20% production cuts from 3.6 million tons of steel to 2.9 million tons, and a workforce reduction of 50% over a 3- to 5-year period, which would result in layoffs of about 30,000 steel industry workers and employees. The plan also involved the reorganization of the industry into several joint stock companies under a holding company for the state. Steel would be manufactured from only high-grade imported ore and scrap. The $100 million restructuring plan included the addition of new electric steel furnaces, waste-treatment facilities, and beneficiation plants to make the industry fully competitive on the world market.

Manganese.—The Urkut manganese mine in the Bakony Mountains continued to supply both oxidized and carbonated ores. In 1988, the mine produced about five times more carbonated ore than in 1987. Most of the manganese ore was designated for export since Hungary lacked the necessary facilities and electric power to domestically produce electric furnace ferromanganese.

Scandium.—In midyear, Hungary announced that an experimental pilot plant at the Mecsek Mine began to produce scandium with a 99.9% purity. In 1989, the operation planned to produce scandium with a purity of 99.99% and eventually produce from 100 to 200 kilograms per year for export to the world electronics market.

Tungsten.—The Hungarian-owned Caganova tungsten mine and beneficiation complex at the Tsogaan-Davaa deposit in Mongolia became fully operational in September with the completion of the site's beneficiation plant. Hungary would keep 87% of the complex's production, about 450 tons per year of which about 250 tons would be consumed domestically; the balance would be exported.

Industrial Minerals.—Hungary continued to produce a number of commercially useful industrial minerals such as bentonite, kaolin, and perlite in the Matra and Tokaj Mountains. Also, the development of newly discovered deposits of gypsum and anhydrite were under development. At yearend, a 150-million-ton deposit of alginate was discovered in the western part of the country. Alginate was found to be useful in agriculture, and a nine-member partnership headed by the Hungarian Geological Institute planned to market the material in the Burgenland Province of Austria.

Mineral Fuels.—**Coal.**—Although a number of coal mining operations had to be modified or even terminated because of increasing inflows of underground water, the Tatabanya coal mining complex would remain in operation, but would have to undergo extensive rationalization. The Government told the enterprise that financial support for the enterprise would be provided through 1989. Afterwards, the Tatabanya coal mining complex would have to be financially independent. Reportedly, streamlining Tatabanya's operations would affect 1,800 employees.

Nuclear Power.—Start of construction on the first 1,000-megawatt reactor block at the Paks Nuclear power station would be delayed until 1989, and completion was expected in 1995. A number of security inspections were scheduled in the Soviet Union, where the units were built. The Paks reactor was already fully operational with four

440-megawatt Soviet reactor blocks.

Petroleum.—Hungary produced about 25% of its domestic needs of petroleum; the balance was imported from the U.S.S.R. In 1988, consumption reached 8.7 million tons of crude petroleum of which 7.0 million was imported. During a drilling program funded by the World Bank, petroleum was discovered in Bekes County in the southern part of the country. The new field could produce between 250 and 315 barrels per day.

POLAND[17]

In 1988, Poland's centrally planned economy continued to improve, despite strikes in the mineral industry. The country's industrial production grew by 5.4% in 1988 compared with that of 1987, and national income increased by 4.5%. Although mineral production was at the level of output of 1987, in many cases slight increases occurred. The chief mineral industry projects during the year included continuing construction work at six coal mines. Poland remained a major European and world producer of coal, copper, salt, and sulfur.

Government policy continued to implement economic reforms that were initiated in 1982, but the reform program had met with a series of difficulties. The second stage of economic reforms, initiated in 1987, aimed to decentralize the state's control over the economy to stimulate initiative within the public and private sectors and to increase the role of the market within the economy. Despite the increased autonomy of many state-owned enterprises, Government authorities retained a large number of direct controls and continued to subsidize some priority industries that operated inefficiently. The Government directly allocated about 35% of all basic raw materials to manufacturers as well as more than 50% of the foreign exchange that was needed by the economy. Little progress was made toward a more efficient use of labor, capital investment, and energy resources. The Government's efforts to raise prices on food and energy products resulted in a series of strikes by steel workers and miners in April and August. Inflation also reduced the value of miners' wages. Coal and steel were the main industries affected by strikes. Apart from demands to improve living conditions, Poland's miners and other industrial workers demanded the restoration of the banned trade union "Solidarity." The August strikes ended only after the Government agreed to hold roundtable talks with the leadership of the "Solidarity" union. A new Government, formed in September, set as main goals control over inflation, the restoration of market equilibrium, and increased agricultural production.

Production

Poland's mineral industry remained state-owned and operated. Despite work stoppages during the year, the output of industrial minerals and nonferrous metals increased slightly compared with that of 1987. The production of coal remained at about the 1987 level, but production of crude steel declined by about 2%.

Trade

Poland's total exports rose by 9.3%, while imports rose 9.2%. Exports to the EC accounted for 26.5% of total exports and those to the U.S.S.R. for 24.8%. Imports from the U.S.S.R. accounted for 27.5% of total imports, while those from the EC accounted for 25.1%. Coal exports to European market economy countries were Poland's chief source of convertible currency earnings. Coal exports to EC countries declined by about 5%, owing partly to mild winter weather. The U.S.S.R. remained Poland's most important trading partner providing most of the country's needs for alloying metals, iron ore, petroleum, and natural gas. In October, Poland and Mongolia signed a cooperative agreement to prospect for minerals in the Gobi Desert. The agreement came under an accord on geological cooperation signed by both countries in 1981.

Commodity Review

***Metals.*—Copper.**—Poland was the sixth largest producer of copper in the world with estimated reserves of about 50 million tons of recoverable metal. Copper was mined and processed in the southwestern part of the country under the management of the Kombinat Gorniczno-Hutniczy Miedi (KGHM). Lubin, Polkowice, Rudna, and Sieroszowice were the chief mines, with an annual combined production capacity of about 31.9 million tons of ore. The ore averaged 1.65% copper and contained associated cobalt, gold, lead, nickel, platinum, rhenium, and selenium. In 1988, Poland exported about 160,000 tons of copper semimanufactures to market economy countries out of a total export of 184,000 tons. Exports of concentrate amounted to 116,000 tons compared with 43,000 tons in 1987.

Ferroalloys.—At yearend, the Polish Government decided to close down Huta-Siechnice in Wroclaw, the country's sole ferrochromium producer, by 1991 because of serious environmental problems associated with the plant's operation. Production at the 21,000-ton-per-year plant would be gradually reduced until final closure. Poland's needs for ferrochromium would be met by imports until the construction of a modern ferrochromium plant is completed.

Iron and Steel.—Strikes in the country's steel industry resulted in shortages of hot- and cold-rolled steel for domestic as well as export markets. The loss was estimated at between 120,000 and 140,000 tons. Long-term plans for the steel industry included the replacement

TABLE 4

POLAND: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1984	1985	1986	1987[p]	1988[e]
METALS						
Aluminum metal, primary		45,900	47,000	47,500	47,500	47,700
Cadmium metal, primary[e]		570	600	620	620	600
Copper:						
Mine output, Cu content, recoverable		431,000	[e]431,000	434,000	[e]437,000	437,000
Metal:						
Smelter, including secondary[e]		375,000	390,000	400,000	410,000	410,000
Refined, including secondary		372,300	387,000	[e]388,000	390,000	[3]401,000
Gold:[e]						
Mine output, Au content, recoverable	thousand troy ounces	1,110	1,110	1,110	1,110	1,000
Metal, smelter[4]	troy ounces	5,800	5,800	5,800	5,800	5,700
Iron and steel:						
Iron ore and concentrate, gross weight	thousand tons	11	11	9	6	6
Metal:						
Pig iron	do.	9,981	9,807	10,574	10,476	[3]10,264
Ferroalloys:[e]						
Blast furnace	do.	[3]94	83	83	85	80
Electric furnace	do.	[3]174	177	176	180	175
Steel:						
Crude	do.	16,533	16,126	17,144	17,145	[3]16,873
Semimanufactures:						
Rolled excluding pipe	do.	12,195	11,845	12,340	12,412	[3]12,420
Pipe	do.	1,010	992	1,027	1,038	[3]1,054
Lead:						
Mine output, Pb content, recoverable		52,800	[e]53,000	[e]53,500	48,800	50,000
Metal, smelter		83,400	87,300	88,300	89,500	90,700
Nickel:[e]						
Mine output, Ni content, recoverable		2,100	2,000	2,000	2,000	1,800
Metal, smelter		2,100	2,000	1,900	1,900	1,600
Silver, mine output, Ag content, recoverable	thousand troy ounces	23,920	26,717	26,653	26,717	[3]34,176
Zinc:						
Mine output, Zn content		190,700	187,000	185,000	[e]184,000	184,000
Metal, refined, including secondary		176,000	180,000	179,000	177,000	177,000
INDUSTRIAL MINERALS						
Barite		91,000	91,000	77,100	73,100	75,000
Cement, hydraulic	thousand tons	16,700	15,000	15,831	16,100	17,000

See footnotes at end of table.

TABLE 4—Continued

POLAND: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1984	1985	1986	1987[p]	1988[e]
INDUSTRIAL MINERALS—Continued						
Clays and clay products:						
Crude:						
Bentonite[e]	thousand tons	70	75	75	75	80
Fire clay	do.	1,037	980	1,076	1,104	1,100
Kaolin	do.	[e]50	48	49	[e]49	59
Products[e]	do.	600	550	600	600	600
Feldspar[e]		46,300	60,100	57,200	[r e]55,000	50,000
Gypsum and anhydrite, crude[5]	do.	1,167	973	1,107	[e]1,110	1,100
Lime, hydrated and quicklime	do.	4,251	4,124	4,151	4,261	4,100
Magnesite, crude		20,600	19,200	20,900	22,300	[3]23,000
Nitrogen: N content of ammonia	thousand tons	1,822	1,812	2,124	2,177	2,200
Salt:						
Rock	thousand tons	1,185	1,198	1,222	1,234	1,200
Other	do.	3,526	3,660	4,197	4,934	4,500
Sodium compounds, n.e.s.:						
Carbonate (soda ash)	do.	918	939	963	[e]970	910
Caustic soda (96% NaOH)	do.	434	431	445	440	450
Stone: Dolomite	do.	3,227	3,025	3,333	3,390	[3]3,422
Sulfur:						
Native:						
Frasch	do.	4,485	4,326	4,437	4,410	4,400
Other than Frasch	do.	505	550	457	556	500
Total	**do.**	**4,990**	**4,876**	**4,894**	**4,966**	**4,900**
Byproduct:[e]						
From metallurgy	do.	170	170	170	170	150
From petroleum	do.	30	30	30	25	20
Total	**do.**	**200**	**200**	**200**	**195**	**170**
From gypsum[e]	do.	20	20	20	22	20
Total sulfur	**do.**	**5,210**	**5,096**	**5,114**	**5,183**	**5,090**
MINERAL FUELS AND RELATED MATERIALS						
Coal:						
Bituminous	do.	191,592	191,642	192,080	193,010	[3]193,015
Lignite and brown	do.	50,400	57,800	67,257	73,200	[3]73,500
Total	**do.**	**241,992**	**249,442**	**259,337**	**266,210**	**[3]266,515**
Coke:						
Coke oven	do.	16,200	16,000	16,400	17,100	[3]17,100
Gashouse[e]	do.	600	620	610	610	610
Total[e]	**do.**	**16,800**	**16,620**	**[r]17,010**	**17,710**	**17,710**
Fuel briquets, all grades	do.	719	1,010	1,309	[e]1,380	[3]1,451

See footnotes at end of table.

TABLE 4—Continued

POLAND: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1984	1985	1986	1987[p]	1988[e]
MINERAL FUELS AND RELATED MATERIALS—Continued						
Gas:						
Manufactured:[e]						
Town gas	million cubic feet	9,041	7,875	6,427	6,215	6,300
Coke oven gas	do.	217,114	208,780	216,832	228,417	220,000
Natural, marketed	do.	214,430	225,024	205,708	208,882	[3]201,790
Natural gas liquids:[e]						
Natural gasoline	thousand 42-gallon barrels	80	75	80	80	80
Propane and butane	do.	53	50	60	60	60
Peat: Fuel and agricultural[e]		200,000	200,000	200,000	250,000	200,000
Petroleum:						
Crude:						
As reported	thousand tons	189	194	167	149	[3]163
Converted	thousand 42-gallon barrels	1,401	1,439	1,239	1,105	[3]1,209
Refinery products[6]	do.	95,529	98,469	100,086	115,020	[3]120,648

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

[1]Table includes data available through August 26, 1989.

[2]In addition to the commodities listed, antimony, cobalt, germanium, a variety of crude nonmetallic construction materials, and carbon black are also produced, but available information is inadequate to make reliable estimates of output levels. Poland may also produce alumina in small quantities, but details of such an operation, if it exists, are not available.

[3]Reported figure.

[4]Based on official Polish estimates.

[5]Includes building gypsum, as well as an estimate for gypsum used in production of cement.

[6]Includes virtually all major products; excludes some minor products as well as refinery fuel and losses.

of open-hearth furnaces with oxygen converters. A third 350-ton oxygen converter was planned to go on-stream at the Katowice steelworks by 1991. New 3.6-million-ton-per-year continuous bloom and slab casting facilities were planned to be put into operation by 1990.

Lead and Zinc.—Poland's lead and zinc reserves were estimated at 400 million tons of low-grade ore. Mining beneficiation and smelting were managed by the Gorniczo-Hutniczy Kombinat Metali Niezelaznych (KHGMN). About 60% of the refined lead was produced from scrap. Exports of refined lead and zinc to market economy countries amounted to 39,000 tons and 11,600 tons, respectively. Exports of lead and zinc concentrates amounted to 4,000 tons and 12,500 tons, respectively.

***Industrial Minerals.*—Sulfur.**—The development of a new Frasch sulfur mine at Osiek was delayed because of problems connected with wastewater disposal and a lack of funds for machinery purchases and mandatory land purchase compensation. The mine originally was to come on-stream in 1990 with an initial capacity of 200,000 tons per year and a final capacity of 1.5 million tons by 1993. The Osiek Mine will not begin operating until the early 1990's. The Siarkopol sulfur plant installed a new facility during the year to produce sulfur that would be insoluble in carbon disulfide. The sulfur would be used in the manufacture of automobile tires. The installation would initially produce 1,000 tons per year and would be expanded to 2,250 tons per year to allow for export.

***Mineral Fuels.*—Coal.**—As part of its package of economic reforms, the Polish Government announced plans to reorganize the coal mining industry effective January 1, 1989. The eight mining guilds would be replaced by five enterprises that would be only responsible for production and technical issues. Labor policy, personnel training, and organizational matters would be managed by individual mines. The reorganization would eliminate the management of five central coal mining enterprises and nine auxiliary plants. The coal mining industry would be subdivided into five districts and headed by directorates at Katowice, Jastrzebie, Sosnowiec, Zabrze, and Walbrzych. Foreign trade organizations involved in coal marketing (Weglokoks) and coal mine construction (Kopex) would also be reorganized. Coal mining was heavily subsidized; only one-third of the country's 69 coal mines operated profitably. The strike in August resulted in a production shortfall of 777,000 tons and a decline in export deliveries of 258,400 tons.

Petroleum and Natural Gas.—Poland produced half of its natural gas needs from domestic gasfields. The balance was imported from the Soviet Union. In addition, the country produced small amounts of petroleum; however it imported 98% of its needs from the Soviet Union through the Friedship pipeline.

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[1] Prepared by John G. Panulas, physical scientist, Division of International Minerals.

[2] An organization of 10 centrally planned economy countries involved in economic cooperation and coordination, comprising the following countries: Bulgaria, Cuba, Czechoslovakia, the German Democratic Republic, Hungary, Mongolia, Poland, Romania, the U.S.S.R., and Vietnam. Yugoslavia has permanent observer status.

[3] Prepared by George A. Rabchevsky, physical scientist, Division of International Minerals.

[4] The GDR mark (M) is not convertible, and the official exchange rate cannot be used as a measure of relative value. Foreign trade figures, however, are denoted in valuta marks (VM), which are convertible. The rate of valuta marks converted to U.S. dollars in 1988 was taken as VM1.96 = US$1.00.

[5] Neues Deutschland (East Berlin). Jan. 19, 1989, pp. 3–6.

[6] ABECOR Country Report. Barclays (London). July 1989.

[7] GDR Review (East Berlin). Oct. 1988.

[8] United Nations. The Steel Market in 1987. Economic Commission for Europe (Geneva). 1988, p. 71.

[9] Metal Bulletin (London). Aug. 8, 1988, p. 13.

[10] ADN (East Berlin). Nov. 15, 1988.

[11] Industrial Minerals (London). Jan. 1988, p. 32.

[12] Petroleum Economist (London). Nov. 1988, p. 360.

[13] GDR Review (East Berlin). Nov. 1988.

[14] Prepared by Walter G. Steblez, foreign mineral specialist, Division of International Minerals.

[15] The Hungarian forint (ft) is a nonconvertible currency. Conversions with the U.S. dollar, or other convertible currencies should not be done owing to different criteria used in determining value in centrally planned economies as opposed to those used in market economies. Values in this report expressed in U.S. dollars were derived by Hungarian authorities.

[16] Financial Market Trends (Paris: OECD, Feb. 1989) in RAD Background Report 151, pp. 2–5.

[17] Prepared by Walter G. Steblez, foreign mineral specialist, Division of International Minerals.

THE MINERAL INDUSTRY OF

FRANCE

By Donald E. Buck, Jr.[1]

The strong economic conditions in the world and in Europe contributed to the recovery of the French steel and nonferrous metals industries. Facilitated by the recent restructuring, the steel industry reported profitable operations in 1988 after 13 years of losses. During those years, substantial Government assistance was required to keep the industries in operation. Additional rationalization and restructuring were deemed possible to meet future market conditions. Also, some companies in the mining sector had not benefited by the buoyed economic conditions and faced greater competition from alternate sources of supply and the depletion of domestic recoverable reserves. To meet these challenges, mergers of significant companies continued as the country and industries formulated strategies for the present and for the economic conditions postulated to be present with the realization of the 1992 market in the European Community (EC).

The traditional trading patterns between France and her former colonies, in the less dynamic growth areas of Africa and the Middle East, resulted in France's economic growth being below average in the EC. For a number of reasons, these markets were depressed, and French exports to them were limited.

GOVERNMENT POLICIES AND THE EC

With the unity of the present 12 national economies into a single common market, driven by market forces, the EC was projected to have around 4.5% gross national product growth, increased employment by 1.8 million, and prices decreased by around 6%. Given the elimination of custom barriers, excise taxes, and value added taxes, some countries were thought to be more adversely effected by the elimination of these conditions. France was one of the countries for which the harmonization would have an adverse effect, costing the country too much in tax revenues. The estimated amounts of lost revenues were the loss of $2.5 to $3.3 billion[2] from withholding tax on savings and $16.6 to $20 billion for harmonization on value added taxes. The French Government believed the loss of revenue would be bearable if economic growth remained at 2.5% to 3%, and public spending was rigorously managed. Progress toward a more open market was being encouraged by the French; however, the nation had a history of protectionism and its economy could be severely affected by the open market. Particularly affected would be the trade deficit and unemployment, which were problems for the present Government.

Government policy has been to reduce unemployment and to improve the competitiveness of the French industries. A modest attempt by the Government was introduced to promote private sector investment and thereby accelerate creation of jobs. The present Government ended the privatization program, which had led to the privatization of 31 state-owned firms between 1986 and 1988. However, the present weak financial condition of French companies places them in precarious positions in the more competitive market evolving in Europe and, therefore, more likely candidates for takeovers. Several companies had taken individual steps to increase profitability and productivity, joining other EC companies in combining operations or facilities to create profitable operations.

PRODUCTION

The French Government held the preponderant financial interests in most of the mining, metallurgical, and energy companies in France. These included Bureau de Recherches Géologiques et Minières (BRGM) and its subsidiary, Compagnie Française des Mines S.A.; Charbonnages de France (CdF); Compagnie Générale des Matières Nucléaires; Imetal S.A.; Pechiney, Société Nationale Elf Aquitaine (Elf Aquitaine); and Société des Acieries et Laminoir de Larraine (Sacilor) and Union Siderurgique du Nord et de l'Est de la France S.A. (Usinor), which merged into Usinor-Sacilor. Since 1979, the French industries have been losing export markets, due to a lack of competitiveness. Other considerations were that the industries were not specialized, or were specialized in the wrong markets, or that the company was not the optimum size to be effective on the worldwide market. Another problem was that France's strong industry sectors were limited to two, namely, metalworking and transportation, a smaller number than the neighboring country's strong industry sectors, which number four to six.

TRADE

Trade relations between the United States and France were excellent; bilateral trade totaled over $22 billion. U.S. exports to France were up 28% over 1987 totals, resulting from strong French demand, despite the strengthening of the dollar. In general, the domestic demand for imported goods grew at 8%, slightly higher than the exports at 7.4%. This trend further weakened the trade deficit and balance of payments. The trade deficit at $4.1 billion was down from the surplus of $3.5 billion in 1986.

COMMODITY REVIEW

Metals

Alumina and Bauxite.—Pechiney purchased American National Can Co., a major producer of aluminum

TABLE 1

FRANCE: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1984	1985	1986	1987[p]	1988[p]
METALS						
Aluminum:						
Bauxite, gross weight	thousand tons	1,607	1,530	1,379	1,272	878
Alumina:						
Crude	do.	898	734	884	866	720
Calcined	do.	750	624	740	712	551
Metal:						
Primary	do.	342	293	322	323	327
Secondary	do.	169	170	173	196	211
Antimony: Metal, including regulus		7,036	7,333	6,822	7,100	[e]7,000
Arsenic, white[e]		[3]3,828	8,000	10,000	10,000	10,000
Cadmium metal		568	337	431	400	[e]400
Cobalt metal including powder		116	123	[e]100	110	—
Copper:						
Mine output, Cu content		79	253	294	300	246
Metal:						
Blister, secondary		6,796	7,000	6,100	6,492	6,400
Refined:						
Primary[e]		20,931	23,500	18,294	[r]20,323	23,239
Secondary		20,000	20,200	27,400	[e]19,000	[e]20,000
Total		**40,931**	**[r]43,700**	**45,694**	**39,323**	**43,239**
Gold, mine output, Au content	troy ounces	70,279	[r]68,385	76,582	71,535	[e]70,000
Iron and steel:						
Iron ore and concentrates:						
Gross weight	thousand tons	14,839	14,681	12,436	10,852	[e]9,700
Fe content	do.	4,680	4,700	3,861	3,255	[e]3,000
Metal:						
Pig iron	do.	15,039	15,426	13,708	13,267	13,500
Ferroalloys:						
Blast furnace: Spiegeleisen and ferromanganese	do.	329	331	274	[r e]296	300
Electric furnace:						
Ferrochrome	do.	19	[e]20	[e]1	1	18
Ferromanganese	do.	35	[e]35	22	15	15
Ferrosilicon	do.	205	[e]205	196	190	195
Silicon metal	do.	71	[e]70	[e]75	70	75
Other	do.	119	[e]120	77	70	59
Total	**do.**	**778**	**781**	**[e]645**	**[r e]642**	**[e]662**
Steel ingots and castings	do.	19,008	[r]18,832	17,624	17,726	19,003
Semimanufactures	do.	16,543	17,234	15,343	[e]15,000	16,000
Lead:						
Mine output, Pb content		2,263	1,600	2,478	2,213	1,966

See footnotes at end of table.

TABLE 1—Continued

FRANCE: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1984	1985	1986	1987[p]	1988[p]
METALS—Continued						
Lead—Continued						
Smelter:						
Primary		117,900	133,600	132,000	138,795	146,500
Secondary		13,500	12,200	[e]12,500	[e]12,000	[e]15,000
Total		**131,400**	**145,800**	**144,500**	**150,795**	**[e]161,500**
Refined:						
Primary: Soft lead		117,900	133,600	132,000	138,795	146,511
Secondary:						
Soft lead		24,900	25,525	27,300	32,700	37,400
Lead content of antimonial lead		62,900	[r]64,512	71,100	74,370	71,791
Total		**205,700**	**223,637**	**230,400**	**245,865**	**255,702**
Magnesium metal including secondary		12,972	13,800	13,376	13,600	13,700
Nickel, metal		5,217	7,020	8,241	6,680	9,200
Silver:						
Mine output, Ag content:						
Lead and zinc concentrates	thousand troy ounces	634	691	677	680	774
Mixed copper, gold, silver concentrates	do.	156	158	155	150	[e]200
Total	**do.**	**790**	**849**	**832**	**830**	**[e]974**
Metal, Ag content of final smelter products	do.	25,540	25,856	[e]26,000	24,200	24,882
Tin, smelter output of solder and other alloys, secondary		6,700	3,074	2,912	2,532	2,635
Tungsten concentrate, W content		796	735	982	—	—
Uranium:						
Mine output, U content		3,116	3,752	3,737	3,321	3,385
Chemical concentrate, U_3O_8 equivalent		3,676	3,940	4,106	3,740	3,669
Zinc:						
Mine output, Zn content		36,231	40,572	39,534	31,339	30,900
Metal including secondary:						
Slab		258,514	285,600	289,500	249,340	274,000
Dust		7,400	8,200	[e]8,000	[e]9,000	[e]9,000
INDUSTRIAL MINERALS						
Barite		148,200	120,800	116,400	104,050	[e]100,000
Bromine, elemental[e]		17,500	20,000	19,000	20,000	[e]20,000
Cement, hydraulic	thousand tons	22,724	22,219	22,596	23,560	25,300
Clays:						
Bentonite[4]		3,475	14,900	[e]10,000	[e]10,000	10,000
Kaolin and kaolinitic clay (marketable)	thousand tons	307	1,510	1,350	[e]1,400	[e]1,400
Refractory clay, unspecified	do.	458	486	[e]500	[e]500	[e]500
Diamonds, synthetic industrial	thousand carats	—	—	—	—	4,000
Diatomite	do.	247	270	269	[e]270	[e]270

See footnotes at end of table.

TABLE 1—Continued

FRANCE: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1984	1985	1986	1987[p]	1988[p]
INDUSTRIAL MINERALS—Continued						
Feldspar, crude	thousand carats	209	172	216	274	322
Fluorspar:						
Crude	do.	504	562	497	374	313
Marketable:						
Acid and ceramic-grade	do.	159	160	148	134	133
Metallurgical-grade	do.	73	64	50	[e]50	50
Total	**do.**	**232**	**224**	**198**	**184**	**183**
Gypsum and anhydrite, crude	do.	5,401	5,286	5,259	5,409	5,628
Kyanite, andalusite, related materials	do.	52	57	51	50	[e]50
Lime: Quicklime, hydrated lime, dead-burned dolomite	do.	3,130	3,100	2,900	[e]3,000	[e]3,000
Mica		10,854	10,084	10,834	[e]11,000	[e]11,000
Nitrogen: N content of ammonia	thousand tons	2,350	2,010	[e]2,000	[e]2,100	[e]2,100
Pigments, mineral, natural: Iron oxides[e]		15,000	14,500	15,000	15,000	15,000
Phosphates: Thomas slag	thousand tons	1,194	1,165	855	768	[e]750
Potash:						
Gross weight (run-of-mine)	do.	12,480	12,021	11,600	10,716	10,392
K_2O equivalent (run-of-mine)	do.	1,873	1,882	1,748	1,500	[e]1,400
K_2O equivalent (marketable)	do.	1,739	1,750	1,620	1,485	[e]1,350
Pozzolan and lapilli	do.	500	496	410	420	[e]400
Salt:						
Rock salt	do.	226	369	386	1,476	1,145
Brine salt (refined)	do.	1,125	1,154	1,125	1,070	[e]1,100
Marine salt	do.	1,381	1,423	1,610	1,627	1,435
Salt in solution	do.	4,417	4,167	3,963	3,663	3,973
Total	**do.**	**7,149**	**7,113**	**7,084**	**7,836**	**7,653**
Sodium compounds:[e]						
Sodium sulfate	do.	120	125	110	120	120
Sodium carbonate	do.	900	900	750	780	780
Stone, sand and gravel:						
Limestone, agricultural and industrial[e]	do.	6,700	[3]7,002	6,000	6,000	7,000
Slate, roof	do.	64	60	57	60	[e]60
Sand and gravel:						
Industrial sands, total	do.	5,395	5,512	5,332	7,472	[e]7,500
Other sand and gravel, alluvial	do.	181,000	17,300	186,800	193,000	208,000
Sulfur, byproduct:						
Of natural gas	do.	1,589	1,400	957	1,092	1,007
Of petroleum	do.	163	161	193	188	225
Of unspecified sources[e]	do.	110	162	156	150	150
Total	**do.**	**1,862**	**1,723**	**1,306**	**1,430**	**1,382**

See footnotes at end of table.

TABLE 1—Continued

FRANCE: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1984	1985	1986	1987[p]	1988[p]
INDUSTRIAL MINERALS—Continued						
Talc:						
Crude		320,300	316,595	324,660	269,000	280,000
Powder		292,406	310,897	314,965	[r] [e]260,000	[e]270,000
MINERAL FUELS AND RELATED MATERIALS						
Asphaltic material		44,500	40,942	37,817	[e]40,000	40,000
Carbon black[e]		[3]165,900	200,000	175,000	180,000	180,000
Coal, including briquets:						
Anthracite and bituminous coal	thousand tons	16,594	15,124	14,394	13,694	12,139
Lignite	do.	2,426	1,839	2,142	2,061	2,344
Total	**do.**	**19,020**	**16,963**	**16,536**	**15,755**	**14,483**
Briquets	do.	1,450	1,408	1,176	1,071	804
Coke, metallurgical	do.	8,999	8,691	8,258	7,470	7,305
Gas, natural:						
Gross	million cubic feet	224,601	275,753	210,619	208,000	164,001
Marketed	do.	213,124	191,359	148,932	145,000	113,254
Natural gas liquids	thousand 42-gallon barrels	7,424	6,840	[e]7,000	[e]7,000	6,500
Peat[e]	thousand tons	228	191	220	[e]200	200
Petroleum:						
Crude	thousand 42-gallon barrels	15,040	19,252	21,482	23,610	24,776
Refinery products:						
Liquified petroleum gas	do.	27,863	30,334	27,326	28,835	24,000
Gasoline, all kinds	do.	138,782	141,950	140,637	141,620	127,140
Jet fuel	do.	35,488	34,176	33,886	32,850	30,600
Kerosene	do.	388	481	376	365	400
Distillate fuel oil	do.	218,302	217,989	214,165	193,450	200,150
Heavy fuel oil	do.	103,889	89,636	85,227	86,140	77,000
Other products	do.	5,119	53,164	51,189	46,355	45,000
Refinery fuel and losses	do.	39,744	35,261	30,935	27,740	28,000
Total	**do.**	**569,575**	**602,991**	**583,741**	**557,355**	**532,290**

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

[1] Table includes data available through Sept. 23, 1989.

[2] In addition to the commodities listed, France also produces germanium from domestic ores, and has been described as the world's leading producer of this commodity in French sources. Output was reported as being all from the Saint-Salvy Mine. Unfortunately, actual output is not regularly reported, and the ore from this mine is not sufficiently uniform in grade to permit estimates of output based on reported concentrate production. In addition, France produces large quantities of stone, but statistics on output are not available.

[3] Reported figure.

[4] Includes smectic clay.

beverage cans in the United States, thus transforming Pechiney into one of the leading packaging companies in the world. The $1.3 billion purchase would provide a downstream market for their products and blend with Cebal, the group's packaging subsidiary, moving the company closer to the consumer. This follows the strategy of the chairman of Pechiney to restructure and focus around a core business, and through acquisitions and internal growth, to enable the company to achieve a size necessary to compete in the emerging world market. This policy had already paid dividends, turning a $90 million loss in 1986 to a profit of over $250 million in 1988.

Pechiney announced plans to build a new aluminum smelter at Dunkirk. The 200,000-ton-per-year (tpy) plant near the harbor would be a joint venture with Electricté De France, (EdF). Pechiney would own 51%, but only invest initially $100 million plus the equivalent amount for the next 3 years on the $850 million project. One important factor was that EdF was to own 49% and supply power for one-third the normal cost or approximately 1 cent per kilowatt-hour until 1997. It was proposed at one time that another aluminum company participate in the project; however, it was apparent by yearend that Pechiney planned to raise capital on the French Stock Exchange, by forming another company under the name of Pechiney International. The new company would include the assets of companies in the United States, Canada, and Australia, with sales totaling $5 billion dollars. The company was postulated to raise approximately $650 million for Pechiney. Pechiney would close two older, obsolete smelting plants with the capacities of 66,500 tpy at Noguere and of 13,000 tpy at Riouperoux, to offset the addition of new production capacity.

Last year, Pechiney initiated a research program to develop a new generation of electrolytic smelters, more advanced than the 280,000 ampere series built at the St. Jean de Marian facility in 1986. It was unclear if the new works planned at Dunkirk might use a more advanced energy-efficient technology. When this plant opens, Pechiney would have one million typ capacity, of which 400,000 would be in France.

The large decrease in bauxite production resulted in the output of only .9 million tons, as compared to 1.3 million tons in 1987. The depletion of ores and competition from foreign sources had forced closure of production output, which was once 1.921 million tons in 1980.

Antimony.—BRGM and Gagneraud announced the opening of a new mine in the Vendee region at Brouziles, 25 miles from Nantes. Although close to the old Roches Tregeoux mine, which produced 17,000 tpy at its production height, the smaller 2,000 tpy, 60% Sb concentrate operation was expected to begin in September of 1988.

Bismuth.—Société des Mines et Produits Chimiques de Salsigne S.A., the French mining and chemical company, planned to produce 150 tpy bismuth metal. Although the company has produced this metal since the 1960's, there were 4,000 tons of dust and residue stockpiled from operations at the Aude mine, which were thought profitable at the $2 to $6 per pound price. The small plant would supply 3% to 4% of the world's current supply.

Copper.—Pechiney and the Italian metal group, Società Metallurgica Italiana (SMI), merged their copper-processing activities into a joint company named Europeene de Metallurgie. The accord provided that, while daily operations would be controlled by SMI, strategic decisions would be made jointly. The added capital strength of the new company was expected to allow the enterprise to focus on production and sales aimed at growth areas, such as electronics and telecommunications. Moreover, its output could amount to 20% of the European market, making it Europe's leading copper processor.

Gallium.—Rhône-Poulenc S.A., the large French chemicals, producer, continued to operate the world's largest gallium extraction plant at Salindres. With a capacity of 20,000 kilograms per year of primary gallium, the extraction plant accepted Bayer liquor from Pechiney's La Barrasse alumina refinery, which was threatened with closure before the recent price increases in the aluminum market. Also, the company signed an agreement with the Spanish Government to purchase the entire gallium residue from the Inespal alumina refinery at San Ciprian. Rhône-Poulenc S.A. was building a 40- to 50-tpy plant in Pinjarra in Western Australia, potentially doubling the world output of gallium. The construction would offset some of the production that would be lost if the La Barrasse refinery closed in the future.

Gold.—Two small gold mines operated in France during the year, namely, Salsigne Mine near Carcassonne and Société des Mines du Bourneix Mine south of Limoges. The latter mine produced 24,000 ounces of gold from 60,000 tons ore and was in an expansion program to increase production to 50,000 ounces per year. The Brourneix mine is known to have operated in Roman times and since than was estimated to have produced a cumulative of 7 metric tons of gold. BRGM resumed exploration in the area in the 1950's. In 1981, Société Minière et Métallurgique de Peñarroya began underground operations at Cros-Gallet. In 1988, these operations were taken over by Cie. Generale de Matieres Nucleaires (Cpgema), which drilled 49,000 feet of drill holes between Cros-Gallet and Laurieras, approximately 15.5 miles away. Proven reserves are around 700,000 metric tons at 12 grams per metric tons gold. The mineralized quartz veins in schistose rocks dip at 45° and are 10 to 30 feet thick. Mined ores were trucked to a 12-metric-ton-per-hour concentrator at Cros-Gallet, which treats the different ores in batches. Underground ores average 12 grams per metric ton of gold, but 80–100 grams per metric ton were not uncommon, while three surface pits produced 6 grams per metric ton average ores. A new 35 metric tons per hour concentrator was under construction, and there were plans, pending environmental approval, for leaching and smelter facilities. All of the above projects are in the Massif Central, as are 47 additional exploration areas. In the Pyrenees there were two areas, and in the Armorican Massif there were eight areas for which permits or applications had been filled.

Secondary treatment of gold tailings were proposed by Salsigne at its Aude mine, which would add 1.4 tpy to its 2.2 tpy current output. The new company, SNC Lastours, would begin to treat the tailings in 1989 with assay of 1.8 grams per ton. Another project involves the Chatelet property, in the northwestern area of the Massif Central, which produced 10.8 tons of gold from 1906 through 1955, and was one of the most important gold producers in France in the past. A feasibility study indicated that the 506,000 tons of tailings could yield another 56,000 ounces of gold. Thus BRGM's exploration program had identified a resource of 3.6 tons of gold, which would provide revenues equivalent to 1.5% royalty.

Iron and Steel.—The restructuring of Usinor-Sacilor continued in 1988 after their 1987 merger into Europe's largest flat rolled steel producer. The efforts of 10 years of painful modernization and rationalization, mandated by the requirements of the economic conditions of the EC, finally began to show positive results. Usinor-Sacilor's production capacity had been cut in the last 10 years, 37% for long products and 15% for flat products. Employment adjustments resulted in downward employment, from 160,000 workers in the mid-1970's to 58,000 in 1987; another 13,000 employees expected to be idled before 1990. The resultant restructuring had at last made France's steel industry productivity competitive with the neighboring countries at 4.6 hours per metric ton. However, French overcapacity and the capacity of the EC, in general, will cause additional changes in the future. The decrease in Government aid for restructuring shrank to $45 million in 1988, down from almost $100 million in 1987. This reorganization of Usinor-Sacilor resulted in the formation of profitable product divisions, Sollac (carbon steel flat products) and Ugine Aciers (stainless steel); however, the Unimétal (wire rod) and Ascométal (long products) divisions required additional restructuring to become profitable. While Sollac had returned a profit since 1986, the doubling of returns in the first half of the year as compared to 1987, and the profitability of the steel tube maker, Vallourec, posting a 25% increase in turnover, were good news to the parent company.

Steel production costs at Vallourec had been cut 40% since 1981. Output increased to 560,000 tpy, with only 59% of the 10,000 employees working in 1981. The St. Saulve works produced 300,000 tpy of the 420,000 tpy domestic production of the division; 40% of the tubular production went to one of the three other Vallourec operations for further handling. The subgroups were as follows: Valtubes (steel tubes), Sopretac (other metallurgical activities), and Valinco (buildings and public works). Reorganizations in the past had led to the closing of the rolling mill at Anzin and the pipe threading operations at Deville-les-Rouen. Worldwide output was 4.5% higher in 1988, but French production, at 22 to 23 million tons, was below the 27 million tons high recorded in 1981.

The flat products operations consolidated under Sollac into a single branch were the activities of Usinor Aciers, Solmer, and Sollac, and their associated plants. These operations were reported to have been profitable since 1986 and to be operating at near capacity. Extensive capital investment had been made in the Dunkirk, Florange, and Fos-sur-Mer plants, with modernization and improvements, especially in the blast furnaces and coking ovens. Downline improvements were made to several plants; electro-galvanizing and continuous annealing lines were commissioned.

Usinor-Sacilor Chairman, Francis Mer, declined to reduce the 2.3-million-tpy-capacity of the Unimétal Div. The plants in Gandrange, Longwy, and Neuves-Maisons, the subsidiaries Ste. Metallurgique de Normandie (SMN) and Ste. des Acieries de Montereau (SAM) were not restructured, despite the $299 million loss on $1,554 million sales. Unimétal delivered 1.7 million tons product to the EC and was operating at 85% capacity during the year. The Chairman argued that any additional cuts in employment, which declined 22% in 1987 to 12,372 workers, or in capacity would hurt any upturn in product demand.

Asométal closed the steelmaking plant at its Mardis a St. Etienne works, hoping to return the division to economic viability after large losses in 1986 and 1987. Operating only at 60% capacity and at 180 tons output per employee, the plant was not competitive. In general, plants in Europe produce between 220- to- 260-tpy mill employee; the world leader, Japan's Daido Steel, produced 500 tpy per employee. Asométal scheduled $166.67 million for restructuring financing between 1988–92 (5% of sales). Asométal plans reductions of 25% or 1,600 jobs by 1991, and stresses improvements in the finishing mills. The move will keep the steel production plants of Les Dome, Hagondange, and Fos sur Mer in operation.

Usinor-Sacilor entered into several joint operating agreements with other European companies. One was the merging of Usinor-Sacilor (Metalescaut), and Belgium's Cockerill-Sambre

(Laminoirs eu Ruau) merchant bar output into the newly formed Lamines Marchands Europeans owned 60% and 40%, respectively. The Metaolescaut-Ruau combined capacity was 500,000 tpy. Cockrill-Sambre closed its grain oriented electric sheet production and transferred the order-book to Usinor-Sacilor's Ugine Acier division in 1989. A rolling mill integration was under consideration involving the Ketin mills of Cockrill-Sambre and Thionville mills of Usinor-Sacilor.

Another joint venture involved Usinor-Sacilor and Italy's Acciaierrie e Ferriere Riva, in the formation of Italpa, a reinforcing bar venture. The Usinor-Sacilor plants of Bonnieres sur Seine and Porcheville were to be incorporated into the new company, which was 34% owned by Usinor-Sacilor. Also, the Vallourec subsidiary purchased 100% of the Anpab company, previously jointly owned with the Swedish company, Avesta. The stainless powder and high alloy plant at Nyby produced 5,000 tpy powder for seamless tube production; the semifinished products were sent to the pipe works at Persan and Montbard in France.

Sweden's Ovako Steel purchased Ste. Nouvelle des Forges & Ateliers de la Foulerie, France's special steel ring producer providing the Swedish company access to the Common Market. Both companies serve the ball bearing industries in Europe and the United States; however, the purchase meant the smaller ring products were to be concentrated at the works in Carignan, France.

Ferroalloys.—Pechiney Electrométallurgie completed the switch at the Dunkirk plant from ferrosilicon to silconmanganese in May 1988. The production of ferrosilicon continued at the Laudun plant. Targeted production was 35,000 tpy, and the planned objective was increasing production of high purity grades. Most of the high-purity grades of ferrosilicon were produced at the Bel Garde plant near the Swiss frontier. All of Pechiney's plants in France only operate 9 months of the year because the cost of electric power for the 3 winter months has been prohibitive. Pechiney intends to keep its two-thirds share of Spanish ferroalloy producer Hidro Nitro Española S.A. despite the rationalization in that ferroalloy sector. However, the Spanish subsidiary of Ferroaleaciones Españolas SA started production at the Chromeurope SA plant in Dunkirk. This 18,000 tpy plant utilizes a 12-megavolt-ampere (MVA) furnace producing 65% to 67% chromium in the ferrochrome. A second furnace under construction, to be completed in 1989, was rated at 25,000 tpy with a 16-MVA furnace. These plants represent the total ferrochrome production in France, since the 1985 closing of St. Beron plant in Savoie region. Chromite ore for the new production was to be supplied by Albania and the Republic of South Africa for at least 85% of the requirements, and the nearby nuclear plants were to supply long-term power contracts.

Société Métallurgique Le Nickel (SLN) tried to encourage talks on floor and ceiling prices for nickel; however, the mills were reluctant to change the pricing formula. SLN was interested in selling its New Caledonian ferronickel operations, despite the rising prices for nickel and the increasing demand for stainless steel.

Polymetallics.—Mining feasibility studies were completed by the state-owned BRGM on its Chessy copper-zinc-barite deposit, 30 kilometers from Lyon. Proven ore reserves of 3.7 million tons were identified, averaging 2.23% copper, 9.6% zinc. A flotation plant was designed for processing the ores. This pilot treating plant at a rated capacity of 500 tons per hour was proven to be successful. In light of this, BRGM and its mining subsidiary entered into talks aimed at establishing a financial partnership to include joint ventures with third parties. Capital outlays for a 300,000-tpy-capacity underground mine at Chessy were estimated to be $50 million.

Zinc.—The merger of the West German firm, Preussag, and the French, Peñarroya, at yearend resulted in the formation of the world's largest lead and the second largest zinc producer. The new company, Metaleurop SA, was to take over Preussag's smelters and mines, except the two scheduled to close in West Germany. Metaleurop's capacity would approach 450,000 tpy lead and 330,000 tpy zinc, some 60,000 tons less as a result of the closure of Harlingerode smelter in June 1988. The merger of the two companies resulted in the combination of Preussag's manufacturing and high purity expertise with Peñarroya's raw material supply, raw materials handling experience, and basic metal-grade production. Other minor metal production affected by the merger were cadmium, indium, and germanium. Metaleurop's 20-tpy-germanium capacity production of the world's output of 150 to 160 tpy, and 20 to 35 tpy indium metal were significant portions of the world's market.

The new company, Ste. des Mines et Fonderies de Zinc de la Vieille-Montagne (VM) increased the capacity of the zinc refinery at Auby-les-Douai by an additional 100,000 tpy to a total of 210,000 tpy. The plant, built at a cost of $70 million in 1987, recovers zinc by scrapping aluminum cathodes and produces 7-million-meters-thick zinc plate, pure zinc ingots, alloys, and semifinished products. This new electrolytic facility, reportedly, the most modern and efficient in the world, uses super-jumbo sized cathodes, scrapped at the rate of 360 units per hour. The plant generates 280 tons per day of zinc with 108 cathodes per cell and 68 cells. Some 600 tpy of silver and 1,300 tpy cadmium were produced as byproducts, making VM one of the largest cadmium producers with 15,000 tpy. The integrated plant includes continuous rolling operations with a capacity of 70,000 tpy. Since the closing of the older Penarroya SA plant at Viviez and the Preussag Harlingerode works, VM dominated the domestic market, and the supply and demand of zinc in Europe was in balance.

Industrial Minerals

Barite.—The Bertholene Mine, also owned by Ste. des Produits Chimiques de Vivez SPCV, had reserves redelineated, extending the life another 5 years, to approximately 1993. SPCV opened a second barite mine, an underground facility at Privezac, in the Vivez area, only 19 miles from the processing plant. This new mine has an ore grade of 65% to 70% $BaSO_4$, similar to the existing mine and that of another mine, scheduled to open in 1990.

The country's major producer, Kali-Chemie AG's subsidiary, Barytine de Chaillac SA, produced 80,000 tpy from the Argenton Mine and processed the ore at the Chaillac flotation plant. Because the barite production from France was not generally used in petroleum well drilling production, sales were not affected by the recent slump in that industry.

Cement.—Forty-four operating grinding mills and operating plants were managed by only 10 companies in 1986. Since the production level of 29 million tons in 1980, output dropped to 22.6 million tons in 1986. The recent restructuring of the industry led to the use of more energy efficient dry and semidry processes. Sales by Ciments Lafarge France and Société des Ciments Francais constituted 73% of the market. Ciments Lafarge produced in excess of 24 million tons in 1988 and made a number of improvements to plants. For example, a bag facility was added at the Contes plant and grinding operation in Brest was revamped. Numerous planned modernization objectives were defined for the next few years.

Fertilizer Materials.—Norsk Hydro A/S planned restructuring of its French subsidiary, renamed Norsk Hydro Azote, and its 10 major manufacturing operations. Norsk Hydro Azote intended to retain complex fertilizer production, but close old, outdated facilities. The 250,000-tpy ammonia plant at Pierrefitte and three plants at Ambares producing nitric, phosphoric, and sulfuric acids were to be closed. Other important facilities were at Le Havre, Rouen, and Montoir where the company's primary products were urea, complex fertilizers, and ammonium nitrate.

CdF Chimie, the state-owned chemicals group, was renamed Orkem and given a "last-chance" injection of capital to turn around the group's uneconomic performance. At yearend, company profits were $477 million; all four divisions returned a profit. Thermoplastics demand, for example, had increased 8% to 10% for the third consecutive year, and production could not keep up with demand. The fertilizer division was profitable despite the downturn in use and competition from imports. However, Orem planned to continue development of its specialties products. A new acrylic acid reactor at the Carling plant was expanded to 160,000 tpy, with further expansion to 220,000 tpy in 1990.

French agriculture was the largest consumer of fertilizer in Europe; 97% was in the form of nitrogen and nitrogen compounds. The importation from Eastern Europe and developing countries prompted antidumping measures by the EC in 1987. France imposed national quotas on nitrogen imports, banned fertilizers from the U.S.S.R. and Czechoslovakia, and limited other Eastern bloc imports on a country-by-country basis. Spanish nitrogen compound imports were cut almost in half to 33,000 tpy, resulting in court action from Spanish producers against the restrictions.

Fluorspar.—Société Industrielle du Centre, based in Chaillac, planned to increase plant capacity by the addition of a flotation unit processing ores from the Le Burg Mine. Of the 40,000 tpy crude ore produced, approximately 25,000 tons of metallurgical spar was produced with 80% to 90% grade for use in the steel industry. By the end of 1988, the new flotation plant was to produce a 12,000- to 15,000-tpy acid-grade fluorspar. The larger Pechiney Group's Ste. Generale de Recherches et d'Exploitions Minières (Sogerem) controlled 90% of French production. A 45,000-tpy acidspar plant was closed in mid-1987. To compensate for this loss in acid, the Montroc Mine was to increase production to 175,000 tpy, with an additional 75,000 tons of acidspar production. The end use of the production was to be a 50–50 split between the chemical and aluminum industries.

Gypsum.—France was one of the largest producers of gypsum in Europe. Two-thirds of the production was from the Paris Basin. Four companies produced approximately 95% of the output and in recent years had reported increased sales to other European countries. The largest producer was SA de Materiel de Construction with 2.2 million tons of the 5 million tons total for the country. The largest mine operated was the 1.3-million-tpy underground mine at Taverny.

Magnesia.—Pechiney Electrometallurgie increased production to 30,000 tpy electrofused magnesia used in the manufacture of high-quality magnesia-graphite refractory bricks for lining electric furnaces and steelworks. Eighty percent of the product was exported to European and Asian markets.

Potash.—At 400,000 tpy production, France was Europe's second largest producer and largest importer of potash. The two mines of Marie-Louise and Amelie were the only remaining operations after the closure of the Theodore Mine in 1986. However, the Morie-Louise Mine was expected to be closed in 5 years, owing to the rationalization of capacity in Europe. Furthermore, there was a 16% decrease in product use in the 1986–87 crop year compared to the previous year.

Rare Earth.—Rhône-Poulenc, one of the leading processors of rare earths, purchased the Research Chemicals Div. of Nucor Corp., which produced rare-earth alloys including custom made products. Research Chemicals was particularly active in neodymium-based and samarium-cobalt alloys for permanent magnet manufacture. This purchase of the U.S. company compliments Rhône-Poulenc's Freeport, Texas, separation facility, which in recent years had expanded its capacity. The growth in the yttrium, neodymium, samarium, and cerium markets, was due to developments especially in the new permanent magnets, electronics, and superconductivity products.

Talc.—The talc operation of Talc de Luzenac dominated the French and European market. Since 1905, at the open pit Trimouns Mine in the Pyrenees, the excavation has been a mixture of talc and 5% to 60% chlorite ores. The cosmetic grade talc has been hand sorted and accounts for only 3% of the 10,000 tpy production. Owing to adverse alpine weather conditions, the mine only operates for 6 months. Some 180,000 tons are stored at the plant in 30 grades for winter processing into the grades needed for ceramics, paint, filler in sealants, and the paper industry. The recent use of the product in the paper industry accounts for approximately 45% of production.

In midyear, Talcs de Luzenac increased the company's leading role in worldwide talc production by the acquisition of the Italian firm, Mineraria Valle Spluga. Talc de Luzenac also purchased additional shares in Canadian Luzcan Inc., which subsequently merged with American French Talc to form Luzenac American Inc., with subsidiaries in Austria and Spain. In December 1988, reportedly, Borax Francais SA purchased 49% of Talcs de Luzenac, giving the parent company, RTZ Corp., a total of 67% interest in Talc de Luzenac. Borax Francais SA outbid the French company, Copagnie Internationale de Developpement Minier, for the shares and controlling interest in Talc de Luzenac.

Mineral Fuels

Coal.—CdF, the national company responsible for the production of coal, reported another year of production decreases, similar to that of other EC coal operations. The decreasing use of coal to generate electricity contributed to the decline. Coal contributed less than 8.8% of the country's energy needs and only 6.6% of the electric generating capacity. CdF initiated a restructuring program in the previous years to cut operating costs and to modernize operations. The company reported a lost of $283 million, in spite of these efforts, and the Government's subsidy of $560 million. Coal production, down 12.2%, at 12.6 million tons, reflected production levels in the Lorraine region of 9 million tons, in the Centre-Midi region of 2.0 million tons, and in the Nord-Pas de Calais region of 1.2 million tons. The centre-Midi and Nord-Pas de Calais regions recorded less production, as higher cost mines were closed. The Ledoux shaft in the North and the Carmaux Mine in Tarn were closed. Other mines in the Lorraine region, namely, Provence at Blanzy, and the opencast mines, produced approximately the same amount as in previous years and accounted for 88% of CdF production; 66% of this was from Lorraine.

The increasing use of mechanized equipment, especially in new operations like La Houve and Remaux, made the operations viable and raised the tons per worker-shift for many of the basins to a national average of 4.8 tons per worker-shift. However, the costly unit production from Nord-Pas de Calais, which accounted for approximately one-third of the total production in 1970, was being phased out. This trend was in adherence with the Government's policy to extract CdF from the coal mining business, as French coal was the most expensive in the world. With this decreased emphasis on domestic production, industry employment decreased from 200,000 in the postwar era to under 20,000.

The loss of jobs was one factor that contributed to a 2-day strike by the coal miners in the Lorraine Basin; the other issues were better pay and benefits. This strike followed an earlier strike in the Center-Midi region, which shut mines down from April to July; a strike in the latter part of 1987 took place in the Nord-Palais de Calais region over inadequate benefits for workers who had lost their jobs.

The state-owned EDF, in the early 1970's, purchased 9.5 million tons of coal, before the addition of nuclear plants into the power grid. Presently, coal consumption is approximately 2 million tons; a 4-year commitment was signed in 1987 to end coal use. The coal strikes and lower mine production resulted in the necessity of increasing foreign coal purchases. The trend had been for declining purchases of coal. In 1980, 32.4 million tons were imported; importation dropped to approximately 13 million tons in 1988. This decline resulted in the French steel industry's decreased use, from 10 million tons in 1980 down to 1.8 million tons in 1988. However, the United States exported additional coal to France, which was purchased on the spot market. Seven additional ships of 85,000 to 99,000 tons capacity were scheduled to transport coal to France. The United States was the leading export supplier of coal to France with 4 million tons. Australia was second at 3.3 million tons, and the Federal Republic of Germany was third at 2.2 millions tons. Some of the coal imports were from the Republic of South Africa, for which new coal contracts were banned in 1985. Some 60,000 tons of coal unloaded at

Dunkirk was illegal South African coal, mislabeled as Australian coal transshipped from Belgium. The legal imports of 780,000 tons of coal from the Republic of South Africa represented only 7% of the total imports for France.

Nuclear Power.—EdF also administrates the nuclear industry and was affected by strikes at some plants. The deficit budget of CdF, however, was the result more of the warmer than normal weather and the inability of the company to raise prices. A $283 million loss resulted, despite a 23% increase in electricity exports, which amounts to approximately 36.7 billion kilowatt hours in 1988. The United Kingdom remained the biggest customer with 12.8 billion kilowatt hours, followed by Switzerland and Italy, each with between 9 and 10 billion kilowatt hours. The French utility company had recently made long-term contracts with neighboring utilities and countries supplying excess French power.

The excess supply of nuclear generated electric power was the result of the Government's strategic objective to not be dependent on imported oil. Another objective, namely, to make France the premier vendor of nuclear reactors, dissolved with the excess supply of oil and the market collapse for reactors. However, between 1974 and 1982, France contracted for an average of 6,000 megawatts per year in nuclear power generating plants. Another 13,200 megawatts will be commissioned by 1993 with those plants planned or under construction. EdF was already planning to prematurely shut down older units as larger newer units come on-line.

While French electrical power is significantly cheaper than in neighboring countries, the debt amassed by EdF was approximately $40 billion. This has been a problem for France, but the building program could become beneficial if the availability of electrical power attracts additional industrial facilities, such as an arrangement with Péchiney involving a 200,000 tpy aluminum plant at Dunkirk.

Petroleum and Natural Gas.—Elf Aquitaine, the French Government controlled oil company (Elf), purchased a 25.5% stake in Enterprise Oil Co. for 368 million British pounds. The acquisition netted reserves of 600 million barrels oil equivalent and oil production of 60,000 barrels oil per day, and a majority interest in the Nelson Field, which is due to begin production in the early 1990's. This entry in the British North Sea conformed to the company's policy of renewing reserves in politically and geographically safe areas. Previous investments of approximately $1 billion in the British and Dutch North Sea had been for acquisitions of new oil and gas interests. The purchase of RTZ assets in the North Sea was successful but the attempt to merge RTZ's Elf Aquitaine Norge with Saga Petroleum AS failed.

Elf Aquitaine planned to reduce its total work force by approximately 30% in the next 3 years, resulting in the reduction in force of 1,400 workers. Also, the rationalization move would reduce the refining capacity by 22 million barrels. This planned reduction was to affect the Feyzin refinery in the Lyon area. Downstream operations that lost money in the first portion of the year were to be receive additional funding to improve productivity in domestic operations.

The French oil and service industry, including Elf Aquitaine, Total CFP, and Institut Francais du Petrole, jointly formulated plans for research and development expenditures of $850 to $1,020 million over the next 5 years. The intent was to keep French companies in the forefront of developing technologies especially involving arctic petroleum and to reduce exploration and production costs.

Domestic oil production increased again in 1988 by 6% to 25 million barrels, breaking previous records. The Aquitaine Basin's contribution to total output diminished to 8.7 million barrels of oil, less than 32% of the total. By contrast, Paris Basin production increased 9% to 15 million barrels. Elf Aquitaine encountered an oil zone in a Paris suburb well and Triton France SA tested oil in a Paris Basin wildcat. Premier Consolidated Oilfields PLC received a permit for a concession in the Dordogne region of southwest France and plans to spend $175,000 for geophysical work alone in the first 2 years; total expenditure is estimated at $1.5 million. Conoco Inc.'s French unit was attempting to farmout acreage to the Japanese company, Nippon Mining Co. Ltd. The area, Conoco's Permis d'Auch acreage in southwest France, would be the first Japanese entry into France.

The production breakdown for the top producers were as follows: Esso, 10.6 million barrels; Elf, 7.7 million barrels; and Total, 5.5 million barrels.

The refinery investment and renovation totaled more than $600 million during the year. Elf Aquitaine planned to spend $340 million on refinery enhancements and to upgrade its marketing system. Solvay Group of Brussels was to expand the Sarrable high density plant to 120,000 million tons and Ste. Francaise Exxon Chemicals increased olefins capacity at its Notre Dame de Gravenchon plant slightly, from 300,000 to 320,000 tpy; however, the company may increase capacity to 400,000 tpy in the future. Mobil was building a plant at Notre Dame de Gravenchon to make the base for synthetic lubricants, increasing the company's capacity by 60%. ARCO Chemical Europe started up a $340 million plant at Fos-Mur-Mer to make propylene oxide-tertiary butly alcohol; the total plant was nearing completion.

Although France was dependent on oil imports for its refineries, Iranian imports, which had constituted 6.6% of the French imports, were banned in July 1987. This ban was lifted when the barter agreement involving French agriculture for Iranian oil was negotiated;

however, the barter trade failed to work efficiently.

Output of natural gas in 1988 declined 8% from the 1987 production levels and accounted for less than 12% of the requirements for the country. The settlement of the 2-year-old dispute with the Algerian Sonatrach gas supplier was completed. Gas de France and Sonatrach compromised between the \$1.97 paid for the gas and the \$2.79 price billed by Sonatrach. The initial contracts dated and signed in 1965 had been amended several times; temporary formulas solved disagreements as they arose. These disagreements were the result of large fluctuations in market conditions, especially the price of oil. The new indexed terms were linked to actual market conditions of indexed crudes every 3 months; the formulas were to change every 4 years instead of 8 years. The benefit to France was an established price formula and for Algeria's Sonatrach the maintenance of market share for their gas products in relationship to the emergence of other sources. Imported Algerian gas has great competition from vast reserves of gas from the U.S.S.R. and Norway, but to France importation of Algerian gas was important in maintaining good relations with its former colonial state.

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[1] Donald E. Buck, Jr., physical scientist, Division of International Minerals.

[2] Where necessary, values have been converted from French francs (f) to U.S. dollars at the rate of f6.00 = US\$1.00, the average rate in 1988.

THE MINERAL INDUSTRY OF

THE FEDERAL REPUBLIC OF GERMANY

By George A. Rabchevsky[1]

INTRODUCTION

The Federal Republic of Germany (FRG) was one of the world's major processors, refiners, and consumers of minerals and metals. The area of the FRG was about the same as that of Oregon, with a population of 61.1 million, down from 61.7 million in 1984. The FRG remained a significant producer of steel and the processor of selected nonferrous metals, potash, and coal. Except for lignite, potash, and salt, and some lead and zinc, the mining industry was declining. The FRG has a long history of mining and metals production and was relatively well endowed with certain mineral resources. In 1988, 8 of the FRG's 11 underground noncoal mines were potash and salt mines. The others were producing lead, pyrite, silver, and zinc. However, changing world trade patterns and technologies altered traditional smokestack industries, resulting in declining production and mine closures. Mining, minerals, and metals production industries have been largely replaced by the FRG's heavy dependence on the production of technology-intensive industrial products. Much of the metal raw-materials base was imported to maintain the processing industry. The FRG remained the largest producer of aluminum and zinc in Western Europe, was the second largest producer of cadmium, copper, and lead, and the largest producer of copper smelter. The FRG's steel industry was the largest in the European Community (EC), and the third largest in the Western World. The FRG was also the second largest producer of cement and potash, and ranked fourth in the world in potash output. The FRG had ample coal reserves and had the most efficient coal industry in Europe.

In 1988, the FRG registered gross national product (GNP) growth of 3.4%, the highest rate since 1979, to $1.21 billion.[2] The growth was attributed to a 5.1% rise in exports and a 5.4% increase in business investment. The Federal budget deficit ended up at about $20.1 billion.

Despite a favorable trend in the FRG's labor market in 1988, there was no relief in the country's relatively high unemployment rate of 8.9%. Total employment rose to 26.1 million, or back essentially to the 1980 level. In 1988, 143,000 new jobs were created. The structural change from an industrial to a service economy continued, and most of the new jobs were created in the service sector. However, despite rising employment, average unemployment also increased to a level of about 2.24 million workers. In 1988, the FRG had the shortest work year among the 19 Western industrialized nations. The public service workers' union negotiated a 3-year agreement for the 2.7 million Federal, State, and municipal employees providing for a 38.5 hour work week in 1990.

The Rhine-Ruhr region was dominated by the coal, metalworking, and steel and iron industries. The Ruhr region had Europe's most concentrated area of universities and research institutes. Five technically oriented universities have been built since 1965. In 1988, the gross domestic product of the Ruhr was 3.3%, and thus remained only slightly below the national average of 3.4%. In order to upgrade the economically depressed Rhine-Ruhr industrial region, Chancellor Kohl pledged $284 million in aid, provided that the State Government of North Rhine-Westphalia would provide a similar commitment. A meeting was called to discuss ways of overcoming the structure problems of the traditional iron, steel, and coal centers of the Rhine and Ruhr valleys.

The Ruhr district lies slightly northwest of the heartland of the FRG. Over 5.2 million people live in a 4,432-square-kilometer area. The Ruhr district has no district borders, but spreads over three regional districts, four counties with 42 communities, and 11 independent communities. The businesses are made up of steel mills and foundries, powerplants, and clusters of houses bordering on fields and slag heaps. Not one Ruhr city had a population of 650,000 inhabitants. The three largest cities were Dortmund in the east, Duisburg in the west, and Essen in the center. Düsseldorf was considered as the financial and administrative capital of the Ruhr. The Ruhr has been a melting pot since the mid-1800's, when the application of English steam technology to the rich coal deposits transformed the area into the center of German heavy industry. Since 1980, the Ruhr lost more than one-third of its jobs in iron and steel (36,000), 21% (27,600) of the coal mining jobs, and 16% (14,300) in the machine tool industry. New jobs, however, were created in the electronics, chemicals, printing, and energy sectors. Despite the benefit of the steel boom, the region had the highest unemployment rate in the FRG. There were about 1.5 million employed workers in the Ruhr district. About 90,000 worked in iron and steel, 106,000 in coal, 73,500 in machine tool, and 31,000 in metalworking industries. The North Rhine-Westphalia State Government published its latest program, the "Future-directed initiative for coal and steel regions-Zukunftsinitiative montan regionen" (ZIM), in June 1987. ZIM was given credit for its decentralized approach and morale effect, but had limited success in creating jobs.

C. Deilmann AG celebrated its 100-year anniversary, servicing mineral extractive industries worldwide. The headquarters were in Bad Bentheim. Founded in Dortmund in 1888 by Carl Deilmann under the company name of C. Deilmann Bergbau-Unternehmung, the company activities included mining, exploration, and the exploitation of energy resources, as well as civil and mechanical engineering. The company employed 10,000 workers. Preussag AG has held a 50.1% share since 1985.[3]

PRODUCTION

The companies were seeking ways to either restructure or diversify, to ensure continued employment of their workers. The mining production in all metallic ores had declined considerably, including the continued decrease in the production of industrial minerals. The output of lignite was at a record low. Copper, lead, and zinc mining had almost stopped, and the production of graphite, gypsum, potash, pyrite, and salt continued to decline for the fourth year.

The EC planned to aid the industrial Ruhr area with grants. The financial assistance was for measures to restructure the region's steel industry, and it was expected to create or preserve at least 7,000 jobs in the Dortmund-Muna, Duisburg-Oberhausen, and Bochum areas.

A new procedure for the production of extremely fine films of high-temperature superconductors was developed by the nuclear research installation at Julich, Kernforschungsanlage Julich GmbH. A high-energy laser beam vaporized superconducting yttrium-barium-copper oxide from the surface of a probe. The superconducting fine films were designed to be used for the wiring of semiconductor elements, thus reducing the heat developed in computers.

The FRG started a $250 million continuously cored research well to a depth of 13,996 meters. The drillsite was near Windischeschenbach, in Bavaria, near the border with Czechoslovakia and about 193 kilometers north northeast of Munich. To date, no hole has been drilled to this planned depth. Drilling was expected to take at least 10 years and would give scientists more clues about the composition of the Earth's crust and the processes that formed the planet. The FRG research funding led to the development of a nonorganic drilling mud additive, allowing good penetration rates without contaminating cuttings and complicating geochemical analysis.[4]

Siemens AG announced a first in-mine hoisting technology. The winder, with a diameter of 7.2 meters, was installed in the No. 7 shaft, at the Haus Aden coal mine, near Romberg, Siemens, in 1981. Siemens was also the first to install three frequency-controlled cycloconverter drives with induction motors in a winder at the Monopol coal mine, also in Westphalia.

TRADE

The FRG's exports were at a record high, remaining the highest in the world. In 1988, the FRG's trade surplus was about $72.7 billion, or 6.1% of GNP, up $5.9 billion from the previous year's record of $66.9 billion. Exports of goods rose by 5.3%, and imports rose by a stronger 6.6%. Between 1985 and 1988, the FRG's trade surplus with the EC member countries jumped from about $18 to $46 billion, accounting for 63% of the FRG's overall trade surplus.

As the world's leading exporter, the FRG shipped out about 70% of its 1988 exports to West European countries, 8.9% to North America, and 4.4% to the combined European and Asian centrally planned economy countries. Trade between the FRG and the German Democratic Republic (GDR) stagnated in 1988, falling 2%. Because it did not have manufactured goods, the Soviet Union continued to export mainly raw materials, oil, gas, and gold to the FRG. The FRG exported heavy machinery to the Soviet Union.

Imports from the United States and Canada rose 13% to $16.6 billion, which represented 7.4% of total FRG imports. FRG exports to North America dropped 7.5% to $28.7 billion, which accounted for 8.9% of the country's 1988 exports volume. U.S. exports to the FRG rose to $14.3 billion, a 22% increase over the previous year, and the United States imported $26.5 billion worth of goods and services from the FRG.

Exports to the EC climbed 11% to $175.1 billion, representing 54% of all FRG's exports. EC imports went up only 5.5%, amounting to a 52% share of total imports.

Total FRG's direct investments abroad amounted to $8.7 billion in 1988, some 16.7% more than in 1987. Although direct investments in the EC jumped 110% to $3.4 billion, those in developing nations dropped significantly. The United States led in attracting FRG's investments with $3.8 billion, followed by the United Kingdom. About 45% of all foreign investments in the FRG, or more than $1.14 billion, were made in the most populous Federal State of Nordrhein-Westfalen.

W. C. Heraeus GmbH, headquartered in Hanau, joined two Swedish companies to establish a $14 million facility for production of automotive catalytic converters in Carlskoga, Sweden. Each partner owned a one-third interest in the facility.

Krupp Industrietechnik GmbH, in Duisburg, was contracted to build a modern copper rod mill with a capacity of 25 tons per hour for Hitachi Cable Ltd. in Japan.

FRG's KSW Stahl- und Walzwerks-Engineering GmbH reached a contract of collaboration with Songer Corp. of Washington, Pennsylvania, United States. Songer became entitled to use KSW's know-how in the field of steel and rolling mills. KSW and Songer were already cooperating in continuous slab casting projects. KSW was also redesigning a 6-strand billet caster for Krupp-Stahl Sudwestfalen GmbH, and was working on a direct reduction based steelworks for New Delhi, India. The FRG had become the largest exporter of goods to India, overtaking the United States, Japan, and the United Kingdom. FRG's investments have risen from less than $400,000 in 1980 to nearly $16 million in the first 6 months of 1988.

Mannesmann AG and Hoesch AG

TABLE 1

FEDERAL REPUBLIC OF GERMANY: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987[p]	1988[e]
METALS						
Aluminum:						
Bauxite, gross weight		343	275	410	—	—
Alumina	thousand tons	1,701	1,657	1,560	1,313	1,145
Metal:						
Primary	do.	777	745	765	738	740
Secondary:						
Alloyed	do.	402	415	441	470	490
Unalloyed	do.	44	44	39	36	40
Cadmium metal, smelter		1,111	1,095	1,218	1,125	[2]1,159
Copper:						
Mine output, Cu content		1,046	857	834	1,482	[2]693
Metal:						
Smelter:						
Primary		148,800	152,400	161,900	165,000	165,000
Secondary		76,700	94,600	76,700	42,700	42,800
Total		**225,500**	**247,000**	**238,600**	**207,700**	**207,800**
Refined including secondary:						
Electrolytic		297,854	330,034	339,053	308,069	[2]336,450
Fired-refined		81,144	84,131	82,958	91,753	[2]89,999
Total		**378,998**	**414,165**	**422,011**	**399,822**	**[2]426,449**
Gold: Mine output, Au content[e]	troy ounces	1,500	1,200	1,200	850	500
Iron and steel:						
Iron ore and concentrate:						
Gross weight	thousand tons	977	1,034	717	247	[2]70
Fe content	do.	293	309	212	68	[2]10
Metal:						
Pig iron	do.	30,203	31,531	29,018	28,517	[2]32,453
Blast furnace ferromanganese, spiegeleisen, ferrosilicon	do.	309	205	256	260	280
Electric furnace ferroalloys	do.	156	171	206	185	220
Steel, crude	do.	39,389	40,497	37,134	36,248	[2]41,023
Semimanufactures	do.	27,957	28,919	27,540	27,437	[2]30,385
Lead:						
Mine output, Pb content		20,998	20,496	16,736	18,844	[2]14,264
Metal:						
Smelter:						
Primary		102,289	109,674	111,092	113,600	[2]126,358
Secondary		254,944	246,586	255,529	226,778	218,290
Total		**357,233**	**356,260**	**366,621**	**340,378**	**[2]344,648**
Refined:						
Primary		191,900	181,000	182,100	167,600	125,900
Secondary		165,300	175,300	184,500	172,800	[2]129,600
Total		**357,200**	**356,300**	**366,600**	**340,400**	**[2]255,500**

See footnotes at end of table.

TABLE 1—Continued

FEDERAL REPUBLIC OF GERMANY: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987[p]	1988[e]
METALS—Continued						
Nickel metal including secondary[e 3]		1,000	700	—	—	—
Platinum[e]	troy ounces	2,000	2,200	1,800	2,000	2,200
Silver:						
Mine output, Ag content	thousand troy ounces	1,225	1,090	884	1,736	1,740
Metal including secondary[e]	do.	21,500	20,500	20,000	22,000	22,000
Tin metal including secondary[e]		417	[r]1,000	[2]346	[r]250	300
Zinc:						
Mine output:						
Zn content		[r]113,059	117,600	103,700	98,900	75,400
Zn content, recoverable		92,467	95,505	84,786	80,542	[2]61,619
Metal, unwrought, unalloyed:						
Primary		325,567	339,876	344,319	348,240	309,554
Secondary		30,825	27,887	26,622	29,313	[2]42,442
Total		**356,392**	**367,763**	**370,941**	**377,553**	**[2]351,996**
INDUSTRIAL MINERALS						
Abrasives: Artifical corundum		88,962	91,506	88,447	84,576	83,400
Barite		166,568	171,269	201,565	173,356	167,000
Bromine		3,306	3,077	[e]2,500	[e]2,500	2,500
Cement and clinker:						
Cement (excluding clinker)	thousand tons	28,909	25,758	26,580	25,268	31,010
Clinker	do.	742	599	599	872	990
Clays:						
Fire clay, excluding klebsand	do.	[e]5,800	5,384	5,534	5,810	5,800
Kaolin, marketable	do.	360	410	512	588	600
Bleaching	do.	628	1,595	1,319	269	300
Other (schieferton)	do.	69	75	80	93	95
Diatomite and similar earth, marketable		49,009	48,427	49,432	47,206	47,500
Feldspar, marketable		297,850	322,000	247,498	310,447	300,000
Fluorspar, marketable:						
Acid-grade		72,098	74,824	79,951	76,681	77,100
Metallurgical-grade[e]		11,170	8,314	8,883	[r]8,520	8,900
Total		**83,268**	**83,138**	**88,834**	**85,201**	**86,000**
Graphite:						
Crude		18,756	20,958	23,226	17,255	15,000
Marketable[4]		12,356	12,798	13,233	9,891	7,000
Gypsum and anhydrite, marketable	thousand tons	[r]2,262	[r]2,367	1,896	1,707	1,700
Lime (hydrated), quicklime, dead-burned dolomite	do.	6,941	6,845	6,476	6,111	7,200
Nitrogen, N content of ammonia	do.	1,963	1,908	1,570	1,931	1,750
Phosphates: Thomas slag-based fertilizer, P_2O_5 content	do.	62	67	54	[e]50	45

See footnotes at end of table.

TABLE 1—Continued

FEDERAL REPUBLIC OF GERMANY: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987[p]	1988[e]
INDUSTRIAL MINERALS—Continued						
Pigments, mineral, natural		16,178	15,764	11,365	10,003	10,000
Potash, K_2O equivalent:						
Crude, marketable	thousand tons	92	88	85	84	100
Chemically processed	do.	2,553	2,495	2,076	2,115	2,200
Total	**do.**	**2,645**	**2,583**	**2,161**	**2,199**	**2,300**
Pumice:						
Crude and washed	do.	1,013	690	612	580	530
Marketable[e]	do.	355	207	215	205	185
Pyrites, marketable concentrate, gross weight	do.	514	512	471	412	350
Quartz, quartzite, glass sand:						
Quartzite	do.	362	346	339	290	250
Quartz sand, ground	do.	316	304	317	316	315
Quartz sand, unground and glass sand	do.	7,195	7,021	6,557	6,128	5,600
Salt, marketable:						
Rock and other[5]	do.	7,110	9,654	12,498	12,862	13,600
Marine[6]	do.	5,102	3,426	604	604	605
Sodium compounds:						
Carbonate	do.	1,364	1,412	1,442	1,448	1,400
Sulfate, synthetic	do.	128	139	163	164	168
Stone, sand and gravel:						
Dimension stone[7]	thousand cubic meters	291	254	257	264	265
Limestone, industrial	thousand tons	43,505	40,403	40,267	41,059	42,000
Crushed and broken stone	do.	97,439	94,072	101,189	99,755	100,000
Slate	do.	23	28	[e]25	22	25
Basalt lava and lava sand	do.	7,482	7,544	7,657	8,023	8,050
Calcite	do.	3	2	—	—	—
Grinding stone[e]	cubic meters	42	40	40	45	45
Sand and gravel	thousand tons	143,278	131,014	142,555	137,050	120,000
Sulfur, byproduct:						
Of metallurgy[e]	do.	350	320	300	300	310
Of natural gas	do.	851	964	998	1,030	1,000
Of petroleum[e]	do.	190	200	190	210	205
Unspecified[e]	do.	90	85	85	85	80
Total	**do.**	**1,481**	**1,569**	**1,573**	**1,625**	**1,595**
Talc including talc schist	do.	17	21	22	20	20
MINERAL FUELS AND RELATED MATERIALS						
Carbon black		382,420	387,134	383,666	361,982	380,500
Coal:						
Anthracite and bituminous	thousand tons	79,426	82,396	80,801	76,300	73,000
Lignite	do.	126,739	[r]20,667	114,310	108,799	108,650
Total	**do.**	**206,165**	**203,063**	**195,111**	**185,099**	**181,650**

See footnotes at end of table.

TABLE 1—Continued

FEDERAL REPUBLIC OF GERMANY: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987[p]	1988[e]
MINERAL FUELS AND RELATED MATERIALS—Continued						
Coke, metallurgical	do.	20,586	22,331	22,254	19,674	18,700
Fuel briquets:						
Of anthracite and bituminous coal	do.	1,437	1,511	1,199	1,001	890
Of lignite	do.	3,818	4,068	3,630	3,188	2,650
Gas:						
Manufactured (excluding that from petroleum refineries):[8]						
Blast furnace	million cubic feet	174,345	176,641	159,795	154,145	176,900
Coke oven	do.	174,345	187,588	190,025	166,788	96,100
Natural, gross	do.	563,258	510,605	489,629	560,468	412,000
Peat:						
Agricultural use	thousand tons	1,429	1,516	2,017	2,002	2,000
Fuel use	do.	277	284	246	240	200
Petroleum:						
Crude	thousand 42-gallon barrels	29,289	29,650	29,015	27,447	27,000
Refinery products:						
Gasoline, motor	do.	170,629	173,293	166,054	160,072	170,300
Jet fuel (including aviation gasoline)	do.	13,318	13,797	14,140	14,774	15,000
Kerosene	do.	295	364	543	550	600
Distillate fuel oil	do.	260,018	256,691	259,668	242,517	[2]273,305
Residual fuel oil	do.	92,701	69,117	65,468	58,355	[2]57,582
Lubricants	do.	11,205	10,656	9,988	9,961	10,265
Liquified petroleum gas	do.	24,511	25,462	23,270	24,963	[2]26,483
Bitumen	do.	18,514	17,076	16,915	16,259	11,100
Unspecified	do.	42,665	52,299	46,576	48,904	60,468
Refinery fuel and losses	do.	48,769	46,557	46,403	45,682	46,000
Total	**do.**	**682,625**	**665,312**	**649,025**	**622,037**	**[2]671,103**

[e] Estimated. [p] Preliminary. [r] Revised.
[1] Table includes data available through Aug. 1989.
[2] Reported figure.
[3] Primary nickel and nickel contained in ferronickel, Monel Metal, and nickel oxide directly used by the steel industry.
[4] Includes imported stock.
[5] Rock only for 1984 and 1985.
[6] Marine and other for 1984 and 1985.
[7] Incomplete data.
[8] Other types of manufactured gas may be produced but production data are not reported and available information is inadequate to make reliable estimates.

received a $33 million contract from Egypt to supply steel pipes to build a 240-kilometer pipeline, to link the Badreddin No. 3 gasfield in the Western Desert with the Ameriya petrochemical complex near Alexandria.

The Frankfurt-based Metallgesellschaft AG (MG) was to buy a 47.5% stake in Austria's Wolfram Bergbau-und Hüttengesellschaft mbH (WBH) from the State-owned Voest-Alpine AG group. As part of the arrangement, MG was to sell its packaging concerns to the Voest subsidiary, Austria Metall AG. MG, which already owned 47.5% of WBH, was to purchase the remaining 5% from Teledyne Inc. of the United States. In a separate move, MG was purchasing the 12.5% minority stake in the Queensland nickel joint venture.

COMMODITY REVIEW

Metals

Aluminum.—FRG remained the largest European producer of secondary aluminum, foundry aluminum, and aluminum semimanufactures; FRG was the second largest producer of primary aluminum metal. Vereinigte Aluminum Werke AG (VAW) was the largest aluminum producer in the FRG. The aluminum production section employed 9,370 workers and the company as a whole had 16,163 employees, both numbers being a record low.

Almost 35% of the total annual aluminum production in the FRG was recycled, thus becoming the most effective aluminum recycling nation in the world. In 1988, primary aluminum production plants worked at almost full capacity. Almost 100% of scrap originating from the aluminum production process was recycled. The FRG's car industry used about 295,000 tons of aluminum cast alloys, of which about 235,000 tons were secondary materials. Secondary aluminum consumption in the FRG rose to 544,000 tons; 127,000 tons were imported, and 117,000 tons were exported.[5]

W. C. Heraeus GmbH developed a process called "Jetomisation" for the production of very fine metal powders. The company was primarily involved in the production and processing of precious metal products, and it now offered the production of rapidly solidified aluminum alloy powders for aerospace.

Hoogovens Aluminum GmbH (HA), owned 100% by the Netherlands, and located in Düsseldorf, was expanding its capabilities and research. The company had about 2,850 employees. HA increased its aluminum operations with the acquisition of Kaiser Aluminum and Chemicals Corp. in 1987. HA was the only producer of aluminum plate products in FRG for the aerospace industry.[6]

A Norwegian-owned company, Hydro Aluminum A/S, planned to build a 6,500-ton-per-year aluminum extrusions plant near Ulm. When built, the capacity will rise to about 11,000 tons per year. The Ulm plant was designed to fit in with the needs of Wicona GmbH, a manufacturer of aluminum products, in which Hydro had a 25% stake. Hydro operated 16 European plants and 1 U.S. plant.

Copper.—FRG was the largest producer of smelter copper and second largest, after Belgium, in refined copper output in Western Europe. Most of the copper concentrates and blister copper were imported. Mine production of copper was a byproduct of the three lead-zinc mines, two of which were closed by the end of 1988. Preussag owned the Bad Grund and Rammelsberg mines in lower Saxony, now closed, and Sachtleben Bergbau GmbH, a subsidiary of MG, operated the third mine, Meggen, in Westphalia.

FRG's largest copper smelter and refinery at Hamburg was operated by Norddeutsche Affinerie AG (NA). Hüttenwerke Kayzer AG operated a smaller smelter and a refinery at Lunen. The FRG also operated a large and diverse copper and copper alloy semimanufacturing industry. NA signed an agreement with MIM Holdings Ltd., an Australian company that held a 35% interest in NA, licensing the NA to use MIM's SIS process in a new 140,000-ton-per-year copper refinery to be built in Hamburg. The process replaced the traditional copper starting sheets used in electrolytic refining with reusable stainless steel blanks. Stainless steel cathode plates were planned to be shipped to Hamburg in 1989 by the Copper Refineries Pty. Ltd., in Townsville, Queensland.

Ferroalloys.—Düsseldorf-based Gesellschaft für Electrometallurgie GmbH (GfE), part of the Metallurg group, supplied over 50% of its ferroalloys to the steel industry. GfE was the only FRG producer of ferrochrome and ferrovanadium, at its 98% holding of Electrowerk Weisweiler plant. It also produced ferrocolumbium (ferroniobium) and ferrovanadium at its Nürnberg works. GfE spent about one-third of its capital in pollution-control projects.

The best year for the ferroalloys FRG traders was 1988. FRG's ferroalloys trading business was composed of more than 50 dealers, mostly centered around Düsseldorf, the Ruhr area. Trading was dominated by about 15 companies, which dealt in a wide range of ferroalloys. One company sold 55,000 tons of ferroalloys, mostly to the domestic steel industry, but it also exported a few hundred tons to Belgium and France.[7]

Gallium.—Ingal International Gallium GmbH operated the only gallium recovery plant at Schwandorf; the plant at Lunen was planned to close in 1988. Ingal announced plans to construct a 20,000-kilogram-per-year primary gallium extraction plant at Stade to replace the closed plant in Lunen by mid-1989. The capacity of the Schwandorf plant was at 15 tons per year of refined gallium. VAW's two alumina plants supplied Bayer liquor to Ingal's gallium extraction circuit. In addition to recovering virgin gallium, Ingal also purified its gallium to 6N to 7N purity at Schwandorf and recovered gallium from gallium-arsenic scrap. Most of the high-purity gallium was exported to the United States and Japan.

Ingal was owned jointly by Billiton and VAW and was one of the world's leading producers of gallium.

Iron and Steel.—Essentially all mining of iron ore ceased in 1987 after the closure of the Leonie Mine in Sulzbach-Rosenberg near Auerbach in eastern Bavaria. One other small iron ore mine remained open, the Wahlverfahrt-Nammen, operated by Barbara Rohstoffbetriebe GmbH. In 1988, about 330 people were employed in iron mining, including the Konrad radioactive waste storage pit and the closed Leonie mine.

The iron and steel industry continued to be an important industry in the FRG. After years of crises, the FRG steel industry was on an upswing since the end of 1981. With many plants working at almost full capacity in 1988 and prices rising, all companies were more or less in the black. The year 1988 marked the FRG's highest output of raw steel, an increase of 13% over the 1987 output. Rolled steel was also estimated to be up about 13%, amounting to about 13 million tons. The FRG was in fifth place in the world in steel production, following the Soviet Union, Japan, the United States, and China. The total number of employees did not decrease in 1988 and remained unchanged at 180,000 workers. In 1980, the FRG steel industry employed 293,000 workers, and the target is to have employment reduced to 160,000 workers by the end of 1990.

Twenty years ago, 400,000 workers produced 36 million metric tons of steel at a labor cost of 400,000 deutsche marks. Two decades later, about one-half this number of workers produced the same tonnage, but at a total cost of 900,000 marks. In the FRG's steel mills, all of the workers are behind glass walls pushing buttons. In contrast, in years past, workers used to swarm around furnaces and rolling mills.

A number of plants and facilities have been closed and three were in the process of being shut down as the industry continued its rationalization. Thyssen Stahl AG was to close its Oberhausen and Hattingen plants. By 1990, the 1-million-ton-per-year capacity Rheinhausen plant of Krupp Stahl AG and Mannesmannrohren Werke AG will be merged. Due to the shutdowns and shift to heavy emphasis on flat-rolled and coated flat-rolled products, the FRG steel industry was one of the major sheet producers in Europe in 1988. It accounted for 67% of the FRG's total steel products. The continuous casting rate was almost 90%.[8]

A new West German steel company, Neue Maxhütte Stahlwerke GmbH, was formed in Sulzbach-Rosenberg of southern Germany. The company was formed both to rescue the bankrupt Eisenwerk-Gesellschaft Maximilianshütte mbH, 50.1% owned by Klöckner-werke AG, and because of the world slump in steel and the company's rambling structure. Neue Maxhütte was started on January 26, 1988, and is now owned 40% by the Bavarian state, 10% by the City of Düsseldorf, and 50% (10% each) by five German steelworks: Klöckner Stahl, Krupp Stahl, Lech-Stahlwerke, Mannesmann Röhrenwerke, and Thyssen Stahl and Thyssen Edelstahlwerke. About 5% was reserved for Peine-Salzgitter AG. The EC Commission approved the structure of the new Maxhutte Stahlwerke company. The new company was to be fully integrated in 1989 and was expected to be reorganized again in 1990 under new management. The formation of Neue Maxhütte would involve cutting the work force to 950 in steelworks and 550 in the tube works, from the total of about 3,300. Maxhütte's location in Sulzbach-Rosenberg was near the GDR's border and was far from both ore supplies and customers. Maxhütte produced about 840,000 tons per year of raw steel, in addition to bars and sections. The steelworks capacity was to be limited to 360,000 tons per year.

Krupp Stahl AG, an FRG steel giant, with about 26,500 employees, was facing near economic bankruptcy, because it was unable to close losing steel plants fast enough. Since the 1972 plant-closing law was passed, FRG had lost 1 million jobs. Krupp has been trying for 3 years to close its vast money-losing Rheinhausen steelworks in Bochum, Ruhr. So far, the FRG's steel industry has spent more than $4.5 billion since 1980 just closing down plants. The steel production in the Ruhr district declined by one-third between 1974 and 1985. The steel producers, such as Thyssen, Krupp, and Hoesch, have established expertise in the high-quality specialty and coated steel markets, but another 30,000 jobs were scheduled to be cut by the early 1990's. The hardest hit Ruhr steel towns were Bochum, Dortmund, Duisburg, Oberhausen, and Witten. Krupp was to close its Rheinhausen plant and transfer pig iron, raw steel, and semis production to Huckingen, a Mannesmann Röhrenwerke's AG plant. Krupp, Mannesmann, and Thyssen Stahl AG completed a feasibility study for restructuring of the Düisburg steel industry involving the closure of the Rheinhausen plant. Strikes followed at the plant, semis production was scheduled to phase out by March 1989, and its rail production will be transferred to Thyssen. About 5,300 jobs in Krupp were involved in this merger, but the union guaranteed that 1,500 jobs will be found in the new company. Krupp delayed the planned closure of its second blast furnace at Rheinhausen after July 1989 for an extra 6 months, because of a delay in preparations at Mannesmann's Huckingen plant. This plant would form the basis of the new joint company, Hüttenwerke Krupp-Mannesmann AG, from July 1989. Fried. Krupp GmbH, in Essen, owned 70.4% of Krupp Stahl AG.

Thyssen Stahl AG, the largest steel producer in FRG, operated profitably in 1988. The work force fell by more than 2,000 in the middle of 1988 from

40,000 in 1987. Thyssen's most important products were strip mill products, which accounted for 70% of its total steel output. Thyssen Stahl benefited from lower raw material and energy costs and the effects of restructuring. The company invested over $1.7 billion in the past 5 years in the Ruhr area. The most recent investment of $95.5 million was in the electrolytic galvanizing line at its Duisburg-Beeckerwerth works. Thyssen Stahl began production of electrolytically galvanized sheet in 1962.

Klöckner & Co., an FRG trading group, had its base in steel-related activities. More than one-half of the company's earnings came from steel and scrap trading. It ran steel service centers in several EC countries, North America, and East Asia. Eight fully owned German-based companies involved in trading and processing of steel and scrap were part of the Klöckner enterprise. Some examples were the recently modernized service center in Nürnberg, the newly built flat products center in Schwerte, and the new warehouses in Hamburg.[9]

Lead and Zinc.—In 1988, about 770 people worked in the metallic ore mining industry. Preussag AG, a leading producer of nonferrous metals, energy, and other activities, has moved into a five-story office building to consolidate all its operations under one roof in Hanover. Preussag's nonferrous metals activities were completely reorganized. After the decisions were made in 1987, two lead and zinc ore mines in the Harz Mountains, Grund and Rammelsberg mines, and the 50-year-old Harlingerode zinc smelter were closed at the end of 1988. The third lead and zinc mine, Meggen, operated by Sachtleben Bergbau GmbH, in Lennestadt, was the only one left. Metallic ores have been mined in the Harz Mountains south of Hanover since the early Middle Ages. The ores at Rammelsberg were unusual, because they occurred as massive complex sulfides. Mining started in 968, producing metallic ore from open pit workings, which was smelted at that time for copper, lead, and silver. But in 1988, the ore at Rammelsberg was exhausted and production ended.[10]

Preussag's smelting and processing operations were combined with Panarroya SA, within the newly established Metaleurop SA, in Paris. Metaleurop had locations in France, the FRG, Italy, and Spain. Preussag cut back its exploration work. The income from metals accounted for 0.6% of its total $6.5 billion sales.

Preussag was also producing some coal, at the Ibbenburen mine, and crude oil. Except for the petroleum and natural gas, all other products contributed less in 1988 to the company's gross profit.

FRG's Metallgesellschaft AG (MG) became a 19.9% stake-holder in an industrial waste recycling company owned by Horsehead Industries, Inc., Palmerton, Pennsylvania, United States. Horsehead Resource Development Co. Inc. recycled inorganic hazardous wastes, primarily zinc-containing waste from the steel industry, extracting nonferrous metals for resale. MG bought its interest in Horsehead Resource through its subsidiary Berzelius Umwelt-Service GmbH. Berzelius processed about 300,000 short tons of industrial residues containing nonferrous metals, and was expecting to process 1 million tons of waste in the near future.

MG, headquartered in Frankfurt, was a large firm, whose principal interests centered around the production and processing of metals and minerals. The company also produced chemical products, designed and developed industrial processing technologies, and planned and constructed industrial plants. MG had numerous wholly and partially owned subsidiaries throughout the world, including the United States. In 1988, the company employed almost 22,000 workers worldwide, and total annual sales amounted to about $8.5 billion. The Kuwait investment authority held 20% interest in MG, and 25% was held by the Allgemeine Verwaltungsgesellschaft fur Industriebeteiligungen mbH.

Other Metals.—Degussa AG's metal activities centered around the supply of high-purity materials and semifinished parts for the computer industry. In 1987, Degussa acquired Leybold AG, a leading producer of high-technology manufacturing equipment for the electronics industry. Leybold manufactured high-quality materials, such as superconductors, high-purity superalloys, amorphous alloys, aluminum-lithium composites, magnetic alloys, high-purity copper, and copper alloys for electronic applications.[11] Its subsidiary, Degussa Präzisionstechnik GmbH, specialized in the supply of lead frames or system carriers, producing them at its precision stamping facility at Pforzheim, then plating them with gold and silver. In California, Degussa Electronics Inc. operated a large hot isostatic press for the manufacture of equipment for thin-film technology. An electron beam melting furnace at Vallejo near San Francisco enabled Degussa to produce the high-purity, gas-free alloys, such as cobalt-chromium-nickel and cobalt-chromium-tantalum, used for targets for magnetic storage data discs. In 1986, Degussa expanded its electronics subsidiaries by the acquisition of Metz Metallurgical Corp. of New Jersey, United States, a leading manufacturer of precious metals powders for the electronics industry.

Metal Mining Corp. (MM) began operation in Toronto, Canada, on April 1, 1987, and reported the first good year in 1988. MM was a 62.7%-owned subsidiary of MG. MM had a 49% interest in Temagami Mining Co., held a 10% stake in Cominco Ltd., and a 7.5% holding in copper and gold mines of Oktedi Mining Ltd.

Krupp Pulvermetall GmbH, headquartered in Essen, was owned 51% by Krupp Stahl AG. It was founded in July 1987 to commercialize Krupp's research and development activities in powder metallurgy, which began at the end of the 1970's. In titanium powder metallurgy, the so-called "rotating" electrode process was developed.

Industrial Minerals

Carbon Black.—Degussa and Ashland Oil Inc. of Ashland, Kentucky, United States, have concluded an agreement for the sale of Ashland Oil's carbon black activities to Degussa. The plants (in Ivanhoe, Louisiana; Aransas Pass, Texas; and Belpre, Ohio) had a total annual capacity of 200,000 metric tons. Carbon black operations will be run by the newly founded Degussa Carbon Black Corporation, based in Columbus, Ohio. Degussa, the oldest carbon black producer in Europe, further strengthened its position by buying five European carbon black plants from the Phillips Petroleum Company in 1986. Degussa was the world's second largest producer of carbon black.

Ceramics.—FRG was regarded as the third leading country in developing and producing advanced ceramics, behind Japan and the United States. A large part of the market potential for advanced ceramics was in applications involving gas turbines and hot components of automobile advanced heat engines. Substantial research has not yet resulted in a breakthrough in wide commercial application of ceramic engine parts.[12]

Friction welding, a new welding technique, was developed by the Fraunhofer-Institut fur Systemtechnik und Innovationsforschung at Karlsruhe, in cooperation with a private company. The technique produced ceramic-metal compound materials for use in machine and motor construction.

Dolomite.—In the FRG, dolomite production was dominated by Dolomitwerke GmbH Wulfrath, owned jointly by Thyssen AG (50%) and Hoesch AG (50%). Dolomitwerke had a mine with a 2.5-million-ton-per-year capacity at Hagen-Hagen, and also produced various dolomite grades, about 70,000 tons per year of soft burned dolomite, and 220,000 tons per year of dead burned dolomite.

Graphite.—The only producing graphite mine in the FRG was in Bavaria, east of Passau, close to the Austrian and Czechoslovakian borders. Graphitwerk Kropfmuhl AG, headquartered in Hauzenberg, operated the oldest graphite mine in the world. Graphite used to be mined by the Celtic people around 800 B.C. In the Middle Ages, the graphite mining was restarted when Passau was the center of the crucible industry. Grafitwerk was established in 1916 and now sells a full range of flaky graphites from powders of 60% carbon to high-purity grades of 99.9% carbon and also micronized grades. About one-half of the company's production went into the refractory industry, mostly to Europe. In addition to the mines and a processing plant at Kropfmuhl, the company also operated a processing plant at Werk Wedel in Holstein. Richard Anton KG, in Graefelfing, Munich, 50%-owned by Kropfmuhl, operated three production plants in Hagen, Mannheim, and Obernzell.[13]

Gypsum.—There were about 17 companies in the FRG that were engaged in the mining and/or processing of gypsum. The largest producer was Gebr. Knauf Westdeutsche Gipswerke GmbH (GKWG), contributing more than two-thirds of the gypsum production. The company was based at Iphofen and operated 11 mines and quarries in northern Bavaria. It also operated mines at Laufen, near Rottweil, Winterhausen in Baden-Württemberg, Adorf in Hessen, Wallerfangen in Saarland, and Stadtoldendorf and Luthorst in Lower Saxony. In addition, the GKWG had 15 plants nationwide, 3 of which were plasterboard producers. GKWG also operated gypsum plaster plants in Belgium and Italy, and a plasterboard facility in Austria. The second largest producer was Rigips GmbH, which became a wholly owned subsidiary of BPB Industries in April 1987. Rigips was based in Bodenwerder and had quarries in Baden-Württemberg, and two near Osterale in Lower Saxony.[14]

An estimated 90% of FRG's flue gas desulfurization (FGD) gypsum plants were using the gypsum-limestone process. In Europe, FRG was the leading producer of FGD gypsum, at about 650,000 tons per year, and the material was used in gypsum building products, including plasterboard and plaster. FRG's production of FGD gypsum was based mainly on the burning of lignite and coal for power generation. About 67% of FGD gypsum was produced from power generation in North Rhine-Westphalia. Because the lignite is produced close to the power station, much of the gypsum was also utilized as landfill. Rigips was already using FGD materials in plasterboard fabrication.[15]

Potash.—Almost one-half of the world's potash was produced in Eastern Europe, in the Soviet Union, and the GDR, over 25% in Canada and the United States, and about 18% in Western Europe, 43% of which was produced in the FRG. The rest was produced in Israel and Jordan, and some in Brazil. The production of potash in the FRG was stagnant for the last 4 years. In 1986, production breaks lasting from 8 to 16 weeks, were introduced; shorter work hours were initiated; and some plants were shut down. In eight potash plants, there were 7,890 employees in 1986, and as many as 900 were laid off the following year at the Bergmannssegen-Hugo, Salzdetfurth, and Siegfried-Giesen plants. Production of crude potash was halted at the Siegfried-Giesen plant, but the shafts were kept open. The depth at the Riedel section of the Nidersachsen-Riedel plant was 1,505 meters. This was the deepest potash and rock salt mine in the world. Rock salt was also mined at the Bergmannssegen-Huga and the

Salzdetfurth mines.[16] Kali und Salz AG, in Kassel, was the only operator of potash mines and plants in the FRG. The company had a 20% interest in the Denison-Potacan Potash Company, in Sussex, in the eastern Canadian Province of New Brunswick.

Sodium Cyanide.—The worldwide Degussa AG group announced plans to build a new sodium cyanide plant in Mobile, Alabama, United States, and to expand its Wesseling, FRG's cyanide facility, by 50%. The combined expansion will bring Degussa's world capacity to about 180 million pounds per year. The U.S. plant, to be completed in early 1991, will have a rated capacity of 60 million pounds per year. Degussa has supplied sodium cyanide from Europe to the North American market throughout most of the 1980's.[17]

Mineral Fuels

The FRG energy policy was a reflection of the country's experiences during the 1970's oil crises. In 1973, 55% of the FRG's energy was derived from oil, compared to 42% in 1987. In 1973, 96% of the oil was provided by the Organization of Petroleum Exporting Countries (OPEC); in 1987, 40% of FRG's oil came from North Sea sources alone. Long-term contracts with the Soviet Union, the Netherlands, and Norway insured that the FRG would have increasing reliance on natural gas in the future.

Political opposition on environmental and safety grounds in the FRG has not diminished over time. Even though there may not be an increase in the number of nuclear power stations, the FRG may become more reliant on nuclear power from neighboring France. The spent-fuel processing facility planned for Wackersdorf in northern Bavaria was terminated. The construction of the high-temperature reactor project at Hammdentrop in North Rhine-Westphalia was canceled in 1988, and the Kalkar fast breeder reactor had been idle since its completion more than 4 years ago. The 11.5% increase in consumption of nuclear energy was mainly attributed to the activation of the Isar 2 and Emsland powerplants.

Another controversial component of the FRG's energy strategy was the reliance on domestic hard coal. The coal continued to be the only significant domestic energy source. As the price of oil had dropped, the Government and consumers had to increase their subsidization of the German hard coal industry. In 1988, an 8.5% surcharge was paid on the electricity bills, which totaled about $5.7 billion. Lower Saxony in the north, used relatively little domestic coal for power generation.

Primary energy consumption in the FRG by energy source, in metric tons hard coal equivalents (MTCE) and percentages are shown in the text table.

Energy source	1987		1988		Percent change
	MTCE	Share	MTCE	Share	
Petroleum	163.3	42.1	164.0	42.1	0.4
Hard coal	75.5	19.5	75.0	19.2	-.7
Natural gas	64.4	16.6	62.5	16.0	-3.0
Nuclear power	42.1	10.0	46.9	12.0	11.5
Brown coal	31.2	8.0	31.4	8.1	.2
Hydro/net imports	7.2	1.9	5.9	1.5	-18.0
Other	4.3	1.1	4.3	1.1	0.0
Total	**388.0**	**100**	**390.0**	**100**	**0.5**

The FRG continued to be the second largest producer of agricultural peat after the Soviet Union. It was in fourth place after the Soviet Union, Ireland, and Finland in the use of peat for fuel.

The Rheinisch-Westfalisches Elektrizitatswerk AG (RWE) acquired Texaco's German subsidiary, Deutsche Texaco AG (DT). The newly formed subsidiary of RWE, RWE Mineral- und Chemie-Beteiligungsgesellschaft mbH, became one of Europe's largest and most diversified energy concerns. The DT company had about 4,200 employees, and its sales totaled $4.3 billion in 1987. RWE's principal motivation for purchasing DT was to diversify its operations in the FRG's slow-growth energy market.

On December 9, 1988, the Institute for Solar Energy Technology was opened, staffed with 15 scientists. The Institute was affiliated with Kassel College, and was focusing on the use of solar and wind energy.

Coal.—The production of coal continued to drop. All of the anthracite and bituminous coal was mined from underground, and all of the lignite was extracted from surface pits. About 148,000 people were employed in the coal industry, and another 18,400 worked in lignite mining.

The largest coal deposits were in the Ruhr district, and in the Saar, in the western half of the country. The coal deposits in the central Ruhr district were becoming exhausted, and new areas were being developed to the north of the Lippe River. Long roadways connected the new workings to the existing hoisting shafts in the central Ruhr. Lignite occurred west of the Rhine River, between Aachen and Köln. Early coal mining was from outcrops and shallow pits. In 1839, Franz Haniel first used steam pumps for shaft sinking, and thus inaugurated the industrial revolution in the FRG, and the upsurge of the iron, steel, and heavy manufacturing industries.

The coal industry of the Ruhr district faced its first major crisis in the mid-1950's, as inexpensive supplies of domestic gas, U.S. and Australian coal, and oil from the Persian Gulf, flooded the FRG's market. By the beginning of the 1960's, the postwar reconstruction boom slowed down, and the Ruhr's coal was affected by cyclical and structural crises. More mines were being closed than were being opened, and miners were let out at early retirement. Almost three out of four coal jobs have been lost since the mid-1950's. In 1988, the Ruhr had about 110,000 mining jobs. There were practically no 48- or 49-year-old miners.

Between 1983 and 1988, the cost of coal subsidies totaled about $19 billion. The recently renewed steelworks contract obligated steel companies to buy domestic coal, which was two to three times the world average production cost. The price difference was made up by the Federal or State Government. The 1980 contract required the electricity producers to take 40 to 45 million metric tons of coal per year, and consumers paid for the premium with a surcharge. The so-called "coal penny" (Kohlpfennig) amounted to about $2.7 billion in 1988. Electricity companies were advocating a reduction in the use of coal. The cost of electricity in the FRG was one of the highest in the world.

The largest FRG coal mining company, Ruhrkohle AG (RAG), based in Essen, celebrated its 20th anniversary at the end of November 1988. RAG lost about $95.5 million in 1988, mostly because of costs incurred by continuing use of uneconomic production units, reconstruction, and closures. Twenty-one mines were operating in 1988, compared with 52 in 1970. RAG had three operating companies and was owned by a number of shareholders. Bergbau AG Niederrhein operated seven mines in the west. Bergbau AG Lippe had nine mines in the central area, and Bergbau AG Westfalen in the east operated five mines. RAG closed its Heinrich Robert and Minister Stein coke plants, including the Osterfeld plant. Seven coke plants were operating, and more closures were possible. RAG also partly owned four generating stations, and chemical, aluminum, and plastics subsidiaries.

The second largest coal mining company was Saarbergwerke AG, based in Saarbrücken, and owned 74% by the Federal Government and 26% by the Saarland State Government. Saarbergwerke operated six mines: Camphausen, Ensdorf, Gottelborn, Luisenthal, Reden, and Warndt. It also operated a coke plant at Furstenhausen, and four generating stations.

There were five other smaller companies, operating one mine each, with an output of about 2 million tons per year. The Eschweiler Bergwerkverein, mostly owned by Arbed SA of Luxembourg, was taken over by RAG in March 1988.

Lignite was mined by surface, west of the Rhin River, between Köln and Aachen. Rheinische Braunkohlenwerke AG (Rheinbraun), based in Köln, used about 84% of its production for power generation, and the rest was converted to briquets, powder, and lignite coke. Lignite was extracted from four surface pits: Fortuna/Bergheim, Garzweiler, Hambach, and Inden. The Fortuna/Bergheim pit was being filled and reclaimed. A smaller lignite mining company, Braunselweigische Kohlen-Bergwerke AG (BKB) was operating close to the GDR's border, near Helmstedt. BKB was working two power stations and three pits: Alversdorf, Helmstedt, and Schöningen. About 18,355 employees worked in the lignite mining industry.

The worst underground coal mine disaster in the past 25 years in the FRG occurred at the Stolzenberg mine in the Hesse region, near Borken, on June 8, 1988. The mine was operated by PreussenElektra AG of Hanover. The mine employed 110 to 170 people, who worked more than 100 meters below the surface. The mine was one of the few remaining underground brown coal operations in the FRG, and had about 25 kilometers of galleries. The mine was 60 years old, and was scheduled to close within the next few years. Two days following the methane gas or coal dust explosion, rescue workers had recovered 51 bodies of the 57 trapped miners.

Natural Gas and Petroleum.—Natural gas comprised over 18% of the FRG's primary energy, compared to only 5.5% in 1970. About 27% of gas consumption came from domestic sources. The FRG was the second largest importer of natural gas in the world, mostly from Denmark, the Netherlands, Norway, and the U.S.S.R. The U.S.S.R. provided about 30% and the Netherlands 28% of the FRG's natural gas.

Production of crude petroleum declined for the fourth year, and domestic output contributed only marginally to the FRG's energy balance. While the volume of oil imports continued to fall, the prices had steadily increased, but not uniformly, mainly because of the transportation costs. Libya and the U.S.S.R. were the leading sources of FRG's crude oil imports.

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[1] Physical scientist, Division of International Minerals.

[2] Where necessary, values have been converted from the deutsche mark (DM) to U.S. dollars at the rate of DM1.76=US$1.00, for yearend 1988.

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THE MINERAL INDUSTRIES OF

PORTUGAL AND SPAIN

By John G. Panulas[1]

PORTUGAL

In 1988, Portugal's mineral industry underwent an important change with the discovery and development of rich copper and tin deposits at the Neves-Corvo ore body. Demand for Portugal's metallic and nonmetallic minerals increased, as a result of growth in the construction industry. The increasingly robust condition of Portugal's minerals industry occurred within a milieu of overall economic growth of 5% and a changing tax environment.

Government Policies and Programs

The Portuguese Government sought to produce legislation that would further revise the country's tax system. Several aspects of taxation were germane to the country's minerals industry.

First, with respect to the depreciation of assets, expenditure for scientific research could be depreciated in full within 1 year. This would exempt the research and development components of mining companies from having to utilize straight-line depreciation of their business assets.

Second, the authority to tax capital gains was shifted from the state to localities. The taxable base for capital gains would be computed as the difference between the sales price of fixed assets and their book value. Coefficients adjusting book value might vary from locality to locality, and, hence, the liability incurred by a mining company may vary, depending on its operational location.

Third, reinvested profits or reinvested capital gains could be deducted from taxable profits, provided the profits or gains were reinvested within 3 years in assets that would further development of a business enterprise.

Finally, the Portuguese Government would grant tax incentives to those companies that would help to strengthen the country's economy. On one level, companies investing in new plants and productive capital equipment could offset their tax on business income for 1988 by 8% on investments made in 1987; for 1989, by 6% on investments made in 1988; for 1990, by 4% on investments made in 1989. On another level, however, if a company invested in projects that fell within the purview of the Government's program of "structural correction of the country's external deficit and unemployment (PCEDED)," the percentage of tax relief would be doubled to 16%, 12%, and 8% for 1988, 1989, and 1990, respectively.

Production

The mineral industry was composed of privately owned and Government-run enterprises. Cimentos de Portugal was an important producer of cement. Sociedade Mineira de Neves-Corvo S.A.R.L. (Somincor) produced copper and tin at the Neves-Corvo mine. Piritas Alentejanas S.A.R.L. was the largest producer of pyrite; Siderurgia Nacional S.A.R.L. produced iron and steel; and Beralt Tin and Wolfram Ltd. remained a significant tungsten producer. Except for ferroalloys, dimension stone, tungsten, and copper, production of minerals and related materials was significant only domestically.

Trade

The following table shows the impact of selected classes of minerals commodities on Portugal's balance of payments position in relation to that of other number nations of the European Community (EC) and the world. The figures, in thousand dollars, are for 1987, the latest year for which data were available.

Commodity Review

Metals.—**Copper.**—The Neves-Corvo copper mine, which is run by Somincor, began producing well ahead of its schedule. Somincor indicated that, for its initial quarter of operations, output of copper concentrate amounted to 225,000 tons, about 30,000 tons higher than scheduled for the period. It was expected

Mineral Commodity[1]	Exports to EC	Imports from EC	Net gain or (loss)	Exports to the World	Imports from the World	Net gain or (loss)
Crude industrial minerals	$25,714	$26,853	($1,139)	$41,497	$56,428	($14,931)
Metalliferous ores:						
Copper	—	1	(1)	1,072	45	1,027
Tungsten	2,653	—	2,653	7,667	—	7,667
Other	15,585	39,155	(23,570)	16,136	90,611	(74,475)
Total	**18,238**	**39,156**	**(20,918)**	**24,875**	**90,656**	**(65,781)**
Nonmetallic mineral manufactures	235,059	157,463	77,596	583,892	202,973	180,919
Metals:						
Ferroalloys	1,909	3,243	(1,334)	2,214	3,735	(1,521)
Other	86,794	573,680	(486,886)	126,715	731,570	(604,855)
Total	**88,703**	**576,923**	**(488,220)**	**128,929**	**735,305**	**(606,376)**

[1] Raw minerals and mineral products accounted for 6.3% of all Portuguese exports and 8.1% of all Portuguese imports.

TABLE 1

PORTUGAL: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987[p]	1988[e]
METALS						
Arsenic, white[e]		180	170	150	150	160
Beryl concentrate, gross weight		10	2	—	4	4
Columbite and tantalite concentrates, gross weight		3	[r]2	6	—	—
Copper:						
Ore and concentrate:						
Gross weight		1,654	1,183	865	800	1,000
Cu content		366	261	184	100	200
Metal:						
Smelter:[e]						
Primary		2,500	2,600	3,000	2,000	2,500
Secondary		1,000	2,000	3,000	2,000	2,000
Total		**3,500**	**4,600**	**6,000**	**4,000**	**4,500**
Refined, primary		[r]5,320	[e]4,500	[e]5,300	5,300	6,000
Gold, mine output, Au content	troy ounces	6,205	9,259	6,173	10,236	8,000
Iron and steel:						
Iron ore and concentrate:						
Gross weight:						
Hematite and magnetite		—	46,910	22,412	9,142	10,000
Manganiferous		36,000	26,300	28,200	18,316	20,000
Total		**36,000**	**73,210**	**50,612**	**27,458**	**30,000**
Fe content:						
Hematite and magnetite		—	2,017	9,413	[e]4,000	4,000
Manganiferous		11,772	8,502	9,447	[e]5,000	5,000
Total		**11,772**	**10,519**	**18,860**	**9,000**	**9,000**
Metal:						
Pig iron	thousand tons	[r]382	[r]423	429	435	430
Ferroalloys:						
Ferromanganese[e]		46,500	48,000	20,000	([2])	1,000
Silicomanganese[e]		24,000	25,000	10,000	([2])	—
Ferrosilicon[e]		9,000	9,000	5,000	([2])	—
Silicon metal[e]		10,500	11,000	7,000	([2])	—
Ferrotungsten		183	151	17	([2])	—
Total[e]		**90,183**	**93,151**	**42,017**	**([2])**	**1,000**
Crude steel	thousand tons	690	665	708	530	600
Lead: Refined, secondary		6,000	7,000	6,000	6,500	6,500
Manganese: Mn content of iron ore		2,448	1,768	2,087	2,059	2,000
Silver, mine output, Ag content	troy ounces	22,280	33,244	16,847	24,352	25,000
Tin:						
Mine output, Sn content		320	[r]263	197	64	100
Metal, primary and secondary		432	408	194	22	25

See footnotes at end of table.

TABLE 1—Continued

PORTUGAL: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987[p]	1988[e]
METALS—Continued						
Titanium, concentrates:						
Gross weight		164	227	232	141	200
Content of TiO_2		82	[r]114	116	70	100
Tungsten, mine output, W content		1,509	1,755	1,637	1,205	1,400
Uranium concentrate: U content		[r]103	[r]105	109	142	120
Zinc: Smelter, primary		6,400	5,900	5,700	5,800	6,000
INDUSTRIAL MINERALS						
Barite		318	1,094	120	660	700
Cement, hydraulic	thousand tons	5,539	5,364	5,444	[e]5,800	6,000
Clays:						
Kaolin		104,388	80,097	54,841	66,736	70,000
Refractory		291,592	[e]240,000	[e]250,000	[e]240,000	240,000
Diatomite		1,600	1,600	2,120	2,880	3,000
Feldspar		29,003	29,011	33,740	40,729	40,000
Gypsum and anhydrite		227,708	[e]250,000	[e]230,000	(2)	—
Lime, hydrated and quicklime[e]		210,000	200,000	200,000	200,000	200,000
Lithium minerals: Lepidolite		985	130	—	—	—
Nitrogen: N content of ammonia		160,000	154,000	[e]150,000	[e]155,000	160,000
Pyrite and pyrrhotite (including cuprous), gross weight		334,371	[e]356,000	327,966	279,061	280,000
Salt:						
Rock		455,272	463,001	450,908	513,203	500,000
Marine[e]		[r]163,000	[r]214,000	110,000	[3]123,000	100,000
Total[e]		**[r]618,272**	**[r]677,001**	**560,908**	**636,203**	**600,000**
Sand[e]		5,000	5,000	5,000	5,000	5,000
Sodium compounds, n.e.s.:[e]						
Carbonate		150,000	150,000	155,000	160,000	155,000
Sulfate		50,000	50,000	52,000	55,000	52,000
Stone:[e]						
Basalt	thousand tons	[3]63	65	65	65	65
Calcareous:						
Dolomite	do.	[3]157	160	100	100	100
Limestone, marl, calcite	do.	[3]10,985	11,000	10,000	10,000	10,000
Marble	do.	[3]440	500	500	500	500
Diorite	do.	[3]1,596	1,600	1,600	1,600	1,600
Gabbro	do.	[3]45	50	50	50	50
Granite	do.	[3]4,208	4,200	4,200	4,200	4,200
Graywacke	do.	[3]1	1	1	1	1
Ophite	do.	[3]48	50	50	50	50
Quartz	do.	[3]125	130	130	130	130
Quartzite	do.	[3]588	600	600	600	600
Schist	do.	50	50	50	50	50

See footnotes at end of table.

TABLE 1—Continued

PORTUGAL: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987[p]	1988[e]
INDUSTRIAL MINERALS—Continued						
Stone—Continued						
Slate	do.	100	100	100	100	100
Syenite	do.	75	75	75	75	75
Sulfur:						
Content of pyrites		140,000	155,000	144,000	120,000	130,000
Byproduct, all sources[e]		4,000	4,000	5,000	5,000	5,000
Total[e]		**144,000**	**160,000**	**149,000**	**[r]125,000**	**135,000**
Talc		6,822	4,998	4,141	7,292	7,000
MINERAL FUELS AND RELATED MATERIALS						
Coal, anthracite	thousand tons	195	234	209	[e]240	230
Coke, metallurgical	do.	237	275	280	160	160
Gas, manufactured	million cubic feet	5,159	5,111	[e]4,700	[e]4,800	4,800
Petroleum refinery products:						
Gasoline	thousand 42-gallon barrels	6,794	7,174	10,632	[e]8,500	8,900
Jet fuel	do.	4,416	4,150	5,111	[e]4,900	4,700
Kerosene	do.	240	225	227	[e]220	230
Distillate fuel oil	do.	13,875	14,509	16,550	[e]16,800	17,500
Residual fuel oil	do.	20,579	17,796	17,289	[e]15,600	16,200
Liquified petroleum gas	do.	2,496	2,819	3,577	[e]3,500	3,600
All other products	do.	6,447	6,520	10,389	[e]8,800	9,300
Refinery fuel and losses	do.	3,983	1,748	3,995	[e]3,900	4,100
Total	**do.**	**58,830**	**54,941**	**67,770**	**[e]62,220**	**64,530**

[e] Estimated. [p] Preliminary. [r] Revised.
[1] Table includes data available through May 1989.
[2] Revised to zero.
[3] Reported figure.

that, in 1989, the Neves-Corvo Mine would produce significant profits for the company's two shareholders, Empresa de Desenvol Vimento Mineiro (EDM), which holds 51%, and RTZ Corp., which owns the remainder. There were two reasons for this.

First, the cash cost for copper metal produced from concentrates at Neves-Corvo, at full capacity, was computed to be 40 cents per pound, or in the lowest 25% of costs sustained by world producers.

Second, having reached a monthly output of copper-bearing ore of 100,000 tons, Somincor concluded long term contracts to supply 140,000 tons per year, over 10 years, of 25% copper concentrate to Norddeutsche Affinerie (Federal Republic of Germany); 100,000 tons per year for 15 years to Rio Tinto Mineira (Spain); 60,000 tons per year for 15 years to Noranda Inc. (Canada); and 60,000 tons per year to a consortium led by Mitsubishi (Japan), some of which will feed a U.S. smelter planned by the Japanese company. An additional 20,000 tons was to be delivered over the next year to Outokumpu Oy (Finland).

Early results indicated that significant revenues would be generated because the first deliveries to those customers were made without delay. The contract with Rio Tinto Mineira S.A. (RTM) was expected to be the most profitable because of the low cost of transporting the copper concentrates 70 kilometers to RTM's Huelva, Spain, smelter. In addition, the discovery of a major body of tin ore at Neves-Corvo was estimated to result in an additional 100,000 tons per year of copper concentrate production, of which a significant percentage might be contracted to Outokumpu.

Ferroalloys.—Novos Fornos de Beira Alta Lda (Forbel), a subsidiary of the Brazilian ferroalloys producer Italmagnesio Group, acquired operational con-

TABLE 2

PORTUGAL: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
METALS				
Alkali and alkaline-earth metals:				
Alkali metals	20	—	—	
Aluminum:				
Oxides and hydroxides	3	6	—	All to West Germany.
Ash and residue containing aluminum	243	282	—	All to Spain.
Metal including alloys:				
Scrap	3,879	5,659	13	Spain 3,678; Netherlands 1,025; West Germany 406.
Unwrought	—	2,065	—	Spain 1,952; Norway 95; France 18.
Semimanufactures	5,008	5,192	1	Spain 3,940; France 754; Italy 115.
Arsenic: Oxides and acids	139	76	18	Italy 58.
Chromium: Metal including alloys, all forms	—	(2)	—	All to Spain.
Cobalt:				
Metal including alloys, all forms	4	(2)	—	All to France.
Columbium and tantalum:				
Ore and concentrate	120	6	—	All to Netherlands.
Metal including alloys, all forms:				
Tantalum	2	1	—	Mainly to Switzerland.
Copper:				
Ore and concentrate	1	8,211	—	All to Canada.
Matte and speiss including cement copper	348	—		
Sulfate	305	1,005	—	Spain 984; Sao Tome and Principe 21.
Ash and residue containing copper	21	—	—	
Metal including alloys:				
Scrap	518	1,354	—	Netherlands 781; West Germany 247; United Kingdom 135.
Unwrought	1,565	3	—	Spain 2.
Semimanufactures	3,459	10,165	830	Spain 7,231; France 857.
Gold: Metal including alloys, unwrought and partly wrought troy ounces	15,657	9,541	50	Switzerland 9,484; Malaysia 6.
Iron and steel:				
Iron ore and concentrate excluding roasted pyrite	—	1,534	—	All to Italy.
Metal:				
Scrap	10,821	6,594	—	Spain 3,095; Netherlands 1,732; United Kingdom 1,598.
Pig iron, cast iron, related materials	45	80	—	Martinique 47; France 27; Denmark 5.
Ferroalloys:				
Ferromanganese	21,404	9,562	—	Italy 6,356; Japan 1,652; United Kingdom 1,000.
Ferrosilicomanganese	43,957	—	—	

See footnotes at end of table.

TABLE 2—Continued

PORTUGAL: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987 United States	Destinations, 1987 Other (principal)
METALS—Continued				
Iron and steel—Continued				
Metal—Continued				
Ferroalloys—Continued				
Ferrosilicon	5,402	12	—	All to France.
Silicon metal	7,047	995	—	West Germany 584; Italy 230; United Kingdom 180.
Unspecified	r28	2,655	—	France 2,650; Netherlands 5.
Steel, primary forms	9,063	33	6	France 19; Angola 8.
Semimanufactures:				
Bars, rods, angles, shapes, sections	197,314	75,588	—	United Kingdom 18,362; China 10,141; Japan 9,777.
Universals, plates, sheets	68,892	74,838	32,796	Spain 27,800; United Kingdom 4,077.
Hoop and strip	50	5,040	—	Spain 4,881; Italy 66; Mozambique 41.
Rails and accessories	207	186	—	Switzerland 107; Algeria 58; Turkey 10.
Wire	6,244	4,489	—	Algeria 3,744; Spain 223; Cameroon 112.
Tubes, pipes, fittings	4,284	2,768	—	France 740; West Germany 671; Italy 292.
Castings and forgings, rough	11,516	8,716	698	United Kingdom 4,035; Switzerland 1,082; Sweden 703.
Lead:				
Ore and concentrate	1,029	1,065	—	All to Belgium-Luxembourg.
Ash and residue containing lead	2	2	—	All to United Kingdom.
Metal including alloys:				
Scrap	24	598	—	West Germany 430; Belgium-Luxembourg 81; Spain 46.
Unwrought	60	4	—	Angola 2; Cape Verde 2.
Semimanufactures	29	104	—	Spain 49; Liberia 19; Morocco 19.
Manganese: Ore and concentrate, metallurgical-grade	—	19,459	—	Italy 17,459; West Germany 2,000.
Mercury 76-pound flasks	([2])	—	—	
Nickel: Metal including alloys:				
Scrap	3	—	—	
Semimanufactures	3	5	—	Mozambique 4; Angola 1.
Platinum-group metals:				
Waste and sweepings value, thousands	$297	$1,459	—	United Kingdom $1,351; France $108.
Metals including alloys, unwrought and partly wrought troy ounces	27,306	12,783	—	United Kingdom 8,387; France 2,741; West Germany 1,655.
Silver:				
Waste and sweepings value, thousands	$16	$8	—	All to West Germany.
Metal including alloys, unwrought and partly wrought troy ounces	322	3,215	—	All to Spain.

See footnotes at end of table.

TABLE 2—Continued

PORTUGAL: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
METALS—Continued				
Tin:				
Ash and residue containing tin	326	51	—	Netherlands 32; Belgium-Luxembourg 10; United Kingdom 9.
Metal including alloys:				
Scrap	76	26	—	Belgium-Luxembourg 21; Netherlands 5.
Unwrought	2	—	—	
Semimanufactures	24	62	—	Spain 55; West Germany 3; Angola 1.
Titanium:				
Ore and concentrate	925	101	—	All to Belgium-Luxembourg.
Oxides	5	5	—	All to Spain.
Metal including alloys, semimanufactures	(2)	4	—	Italy 3; Netherlands 1.
Tungsten:				
Ore and concentrate	1,455	2,008	680	Japan 610; Netherlands 500.
Ash and residue containing tungsten	12	—	—	
Metal including alloys:				
Scrap	3	—	—	
Unwrought	12	13	—	All to Spain.
Semimanufactures	5	(2)	—	All to Belgium-Luxembourg.
Zinc:				
Ore and concentrate	23	—	—	
Oxides	2,681	2,483	—	Spain 815; Italy 456; France 440.
Ash and residue containing zinc	—	827	—	All to Sweden.
Metal including alloys:				
Scrap	1	62	—	Netherlands 42; West Germany 20.
Unwrought	66	—		
Semimanufactures	27	9	—	Guinea-Bissau 4; France 2; Spain 1.
Other:				
Ores and concentrates	r20	1,934	24	Italy 1,890; Spain 20.
Oxides and hydroxides	5	1	—	NA.
Ashes and residues	—	2	—	All to Spain.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	1	1	(2)	Mainly to Angola.
Dust and powder of precious and semiprecious stones including diamond value, thousands	—	$110	—	All to Switzerland.
Grinding and polishing wheels and stones	78	42	(2)	Spain 24; Angola 5; Greece 4.
Asbestos, crude	—	8	—	All to Angola.
Barite and witherite	20	(2)	—	Do.
Cement	55,950	102,219	—	Spain 31,865; Ivory Coast 28,725; Cameroon 13,783.

See footnotes at end of table.

TABLE 2—Continued

PORTUGAL: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Destinations, 1987 United States	Destinations, 1987 Other (principal)
INDUSTRIAL MINERALS—Continued					
Chalk		72	90	—	Spain 48; Cape Verde 24; Ivory Coast 18.
Clays, crude:					
Bentonite		367	—	—	
Chamotte earth		4	—	—	
Kaolin		1,140	2,595	—	Turkey 2,000; Spain 592.
Unspecified		404	4	—	Italy 2.
Diamond:					
Gem, not set or strung	carats	86,529	86,766	465	Switzerland 51,870; Belgium-Luxembourg 34,431.
Industrial stones	do.	6,733	389	—	All to Belgium-Luxembourg.
Diatomite and other infusorial earth		8	10	—	All to Venezuela.
Feldspar, fluorspar, related materials		7,267	22,706	—	East Germany 11,428; Spain 6,545; United Kingdom 1,660.
Fertilizer materials:					
Crude, n.e.s.		—	1,766	—	Spain 1,756; France 10.
Manufactured:					
Ammonia		24,942	6,452	—	Spain 6,450; Angola 1.
Nitrogenous		117,909	124,663	20	West Germany 47,947; France 32,901; Spain 16,551.
Phosphatic		12,212	46,657	—	France 21,530; Spain 18,160; Italy 3,000.
Potassic		109	12	—	All to Sao Tome and Principe.
Unspecified and mixed		24,433	17,990	—	West Germany 13,850; Spain 4,135;
Graphite, natural		—	78	—	All to Spain.
Gypsum and plaster		34	63	—	Spain 25; Cape Verde 15; Sao Tome and Principe 9.
Iodine		(2)	(2)	—	All to Cape Verde.
Lime		430	598	—	Sao Tome and Principe 322; Guinea-Bissau 80; Benin 60.
Magnesium compounds: Oxides and hydroxides		2	—	—	
Mica:					
Crude including splittings and waste		484	160	—	All to United Kingdom.
Worked including agglomerated splittings		1	(2)	—	All to Angola.
Pigments, mineral:					
Natural, crude		9	2	—	NA.
Iron oxides and hydroxides, processed		21	27	—	Cape Verde 26.
Precious and semiprecious stones other than diamond, natural	value, thousands	$12	—	—	
Pyrite, unroasted		—	2	—	NA.
Salt and brine		5,555	31,660	93	Nigeria 29,723; France 707; Netherlands 547.

See footnotes at end of table.

TABLE 2—Continued

PORTUGAL: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Destinations, 1987	
				United States	Other (principal)
INDUSTRIAL MINERALS—Continued					
Sodium compounds, n.e.s.: Carbonate, manufactured		100	26	—	Mozambique 25.
Stone, sand and gravel:					
Dimension stone:					
Crude and partly worked		147,491	188,668	13,251	Spain 66,130; Japan 41,616; Italy 32,694.
Worked		447,278	451,185	27,835	West Germany 231,381; Denmark 24,381.
Gravel and crushed rock		2,368	4,382	3	Spain 2,992; Italy 1,098; France 223.
Limestone other than dimension		46	40	—	All to Cape Verde.
Quartz and quartzite		6,716	3,108	—	Italy 2,380; United Kingdom 500; Ireland 160.
Sand other than metal-bearing		23,312	14,819	—	Greece 11,100; Morocco 3,460; Spain 229.
Sulfur:					
Elemental:					
Crude including native and byproduct		23	30	—	Spain 25; Ecuador 4.
Colloidal, precipitated, sublimed		68	120	—	All to Spain.
Sulfuric acid		11,260	216	—	Angola 106; Cape Verde 21; France 19.
Talc, steatite, soapstone, pyrophyllite		80	5	—	Cape Verde 1.
Other:					
Crude		r219	1,154	—	France 717; Spain 436; Netherlands 1.
Slag and dross, not metal-bearing		44	12,835	—	Spain 12,822; France 12.
MINERAL FUELS AND RELATED MATERIALS					
Asphalt and bitumen, natural		71	69	—	Sao Tome and Principe 55; Cape Verde 14.
Carbon:					
Carbon black		24	39	—	Spain 38; Mozambique 1.
Gas carbon		1,709	7,700	—	Turkey 1,446; United Kingdom 1,246; Morocco 1,175.
Coal: Bituminous		8	—		
Coke and semicoke		43	2,289	5	Spain 1,600; Italy 615; Mozambique 51.
Gas, natural: Gaseous	million cubic feet	1,147	607	—	West Germany 532; Netherlands 75.
Petroleum refinery products:					
Liquefied petroleum gas	thousand 42-gallon barrels	r16	13	—	France 12.
Gasoline	do.	2,272	1,360	—	Netherlands 469; France 369; United Kingdom 333.
Mineral jelly and wax	do.	16	13	—	Spain 12.
Kerosene and jet fuel	do.	3,016	2,585	—	Cape Verde 348; Spain 209; bunkers 1,693.
Distillate fuel oil	do.	1,453	523	—	Cape Verde 142; Senegal 49; bunkers 244.
Lubricants	do.	337	569	17	United Kingdom 191; France 80; Nigeria 60.
Residual fuel oil	do.	2,601	1,086	—	Netherlands 283; France 277; bunkers 280.
Bitumen and other residues	do.	15	116	—	Spain 115.
Bituminous mixtures	do.	1	(2)	—	Mainly to Spain.
Petroleum coke	do.	(2)	—	—	

r Revised. NA Not available.

[1] Table prepared by Staff, Branch of Geographic Data.

[2] Less than 1/2 unit.

TABLE 3

PORTUGAL: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS				
Alkali and alkaline-earth metals:				
Alkali metals	(2)	(2)	—	NA.
Alkaline-earth metals	—	(2)	—	All from West Germany.
Aluminum:				
Ore and concentrate	—	1,793	—	Spain 1,752; Italy 41.
Oxides and hydroxides	8,197	7,968	22	United Kingdom 3,778; West Germany 1,922; Finland 1,774.
Ash and residue containing aluminum	3	11,830	—	Switzerland 11,828; United Kingdom 2.
Metal including alloys:				
Scrap	72	85	4	Spain 54; West Germany 14; Sweden 6.
Unwrought	38,984	43,459	—	Norway 12,080; Canada 6,509; Argentina 5,659.
Semimanufactures	14,084	16,568	8	Spain 3,759; France 3,045; West Germany 2,943.
Antimony:				
Ore and concentrate	1	1	—	All from Spain.
Oxides	61	84	—	France 31; United Kingdom 26; Belgium-Luxembourg 12.
Metal including alloys, all forms	28	79	—	China 68; Belgium-Luxembourg 9; France 2.
Arsenic: Oxides and acids	(2)	54	—	France 50; Belgium-Luxembourg 2; West Germany 2.
Beryllium: Metal including alloys, all forms	(2)	(2)	(2)	
Bismuth: Metal including alloys, all forms	5	4	—	United Kingdom 2; Belgium-Luxembourg 1; West Germany 1.
Cadmium: Metal including alloys, all forms	3	2	—	France 1; Netherlands 1.
Chromium:				
Ore and concentrate	1,098	779	—	Netherlands 357; Belgium-Luxembourg 341; Republic of South Africa 41.
Oxides and hydroxides	96	201	—	West Germany 111; United Kingdom 23; Poland 21.
Metal including alloys, all forms	5	29	(2)	Hong Kong 21; Austria 3; West Germany 1.
Cobalt:				
Oxides and hydroxides	15	19	—	Finland 7; Spain 4; Netherlands 3.
Metal including alloys, all forms	11	14	(2)	Belgium-Luxembourg 6; West Germany 4; France 2.
Columbium and tantalum: Metal including alloys, all forms: Tantalum	2	—	—	
Copper:				
Ore and concentrate	—	(2)	—	All from Italy.
Matte and speiss including cement copper	147	103	103	
Oxides and hydroxides	317	281	—	Norway 152; Italy 45; United Kingdom 36.

See footnotes at end of table.

TABLE 3—Continued

PORTUGAL: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS—Continued				
Copper—Continued				
Sulfate	214	498	—	France 155; Italy 110; Bulgaria 100.
Metal including alloys:				
Scrap	309	1,545	56	Netherlands 467; United Kingdom 305; Spain 154.
Unwrought	12,246	29,768	(2)	Belgium-Luxembourg 6,617; Chile 6,154; Peru 4,077.
Semimanufactures	11,536	15,463	4	Italy 4,243; Spain 3,662; West Germany 2,691.
Gold:				
Waste and sweepings value, thousands	—	$2	—	All from Sao Tome and Principe.
Metal including alloys, unwrought and partly wrought troy ounces	20,852	11,178	6	Switzerland 6,553; West Germany 4,300. Singapore 158.
Iron and steel:				
Iron ore and concentrate:				
Excluding roasted pyrite	542,935	764,084	—	Canada 350,016; Mauritania 228,020; Venezuela 95,692.
Pyrite, roasted	20	18	—	All from United Kingdom.
Metal:				
Scrap	102,953	119,384	889	United Kingdom 59,491; Netherlands 29,126; Canada 8,267.
Pig iron, cast iron, related materials	33,566	19,010	(2)	West Germany 5,037; Brazil 4,628; France 1,789.
Ferroalloys:				
Ferrochromium	271	254	—	Spain 120; United Kingdom 24; West Germany 12.
Ferromanganese	180	463	—	West Germany 113; France 27; United Kingdom 8.
Ferromolybdenum	10	17	—	United Kingdom 7; Spain 5; West Germany 2.
Ferronickel	2	1	—	All from West Germany.
Ferrosilicochromium	1	12	—	United Kingdom 11; Sweden 1.
Ferrosilicomanganese	30	14	—	France 11; Spain 3.
Ferrosilicon	990	3,088	—	Spain 1,805; France 676; Netherlands 191.
Silicon metal	—	84	—	All from Sweden.
Unspecified	r394	495	—	Brazil 198; France 187; Spain 90.
Steel, primary forms	214,466	322,045	—	West Germany 123,589; Belgium-Luxembourg 100,636; France 44,792.
Semimanufactures:				
Bars, rods, angles, shapes, sections	170,002	141,727	3	Spain 51,075; France 26,534; United Kingdom 12,143.
Universals, plates, sheets	239,173	259,869	5	West Germany 76,299; Belgium-Luxembourg 46,304; Spain 27,989.

See footnotes at end of table.

TABLE 3—Continued

PORTUGAL: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS—Continued				
Metal—Continued				
Semimanufactures—Continued				
Hoop and strip	35,649	48,269	—	West Germany 22,130; Belgium-Luxembourg 6,805; France 5,965.
Rails and accessories	8,557	3,159	—	Sweden 1,100; Spain 687; United Kingdom 494.
Wire	22,928	30,648	2	Spain 11,211; United Kingdom 5,818; Belgium-Luxembourg 3,914.
Tubes, pipes, fittings	30,688	53,852	60	Spain 21,907; West Germany 11,669; France 8,719.
Castings and forgings, rough	266	570	—	Spain 382; West Germany 52; France 40.
Lead:				
Oxides	862	1,301	—	West Germany 603; Spain 459; United Kingdom 200.
Ash and residue containing lead	5,700	—	—	
Metal including alloys:				
Scrap	6,235	53	—	Spain 25; Denmark 22.
Unwrought	346,092	23,671	250	Morocco 6,122; Peru 5,543; West Germany 2,443.
Semimanufactures	35	89	([2])	United Kingdom 75; Spain 11; West Germany 2.
Lithium:				
Oxides and hydroxides	6	5	—	All from United Kingdom.
Metal including alloys, all forms	([2])	([2])	([2])	
Magnesium: Metal including alloys:				
Unwrought	16	14	—	United Kingdom 8; France 4; Netherlands 1.
Semimanufactures	3	6	—	West Germany 2; Switzerland 2; France 1.
Manganese:				
Ore and concentrate, metallurical-grade	126,703	78,052	—	Brazil 4,071; France 302; unspecified 73,586.
Oxides	1,226	1,317	—	Netherlands 700; Republic of South Africa 229; Belgium-Luxembourg 176.
Metal including alloys, all forms	5	2	2	
Mercury 76-pound flasks	435	203	—	Finland 174; Spain 29.
Molybdenum:				
Ore and concentrate	—	3	—	All from United Kingdom.
Oxides and hydroxides	4	—	—	
Metal including alloys:				
Unwrought	2	—	—	
Semimanufactures	1	1	([2])	Mainly from France.

See footnotes at end of table.

TABLE 3—Continued

PORTUGAL: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS—Continued				
Nickel:				
Matte and speiss	3	1	—	All from France.
Oxides and hydroxides	7	14	—	France 10; United Kingdom 2; Spain 1.
Metal including alloys:				
Scrap	5	4	—	All from Spain.
Unwrought	347	328	—	Canada 80; Republic of South Africa 65; Netherlands 48.
Semimanufactures	200	182	(2)	West Germany 74; Finland 36; France 21.
Platinum-group metals:				
Metals including alloys, unwrought and partly wrought troy ounces	7,977	22,174	3	United Kingdom 13,482; France 4,568. Switzerland 1,127.
Rare-earth metals including alloys, all forms	(2)	(2)	—	All from Austria.
Selenium, elemental	3	9	—	United Kingdom 8; West Germany 1.
Silver: Metal including alloys, unwrought and partly wrought thousand troy ounces	2,251	2,449	—	West Germany 1,929; Spain 386; Switzerland 32.
Tin:				
Ore and concentrate	11	—	—	
Oxides	20	17	—	United Kingdom 10; Belgium-Luxembourg 2; Italy 2.
Metal including alloys:				
Scrap	—	20	—	All from Spain.
Unwrought	655	786	(2)	United Kingdom 426; Netherlands 328; Belgium-Luxembourg 12.
Semimanufactures	96	66	(2)	United Kingdom 41; West Germany 20; Switzerland 2.
Titanium:				
Ore and concentrate	587	532	—	Republic of South Africa 432; Italy 64; Spain 15.
Oxides	10,183	10,773	383	Spain 3,320; Finland 2,349; United Kingdom 2,200.
Metal including alloys:				
Unwrought	(2)	1	—	Mainly from United Kingdom.
Semimanufactures	79	78	(2)	France 33; Japan 33; Italy 4.
Tungsten: Metal including alloys:				
Unwrought	13	5	(2)	West Germany 4.
Semimanufactures	2	(2)	(2)	Mainly from West Germany.
Vanadium:				
Oxides and hydroxides	17	14	—	Belgium-Luxembourg 12; West Germany 1.
Metal including alloys, unwrought	(2)	(2)	—	All from Switzerland.

See footnotes at end of table.

TABLE 3—Continued

PORTUGAL: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS—Continued				
Zinc:				
Oxides	337	317	—	Spain 85; Netherlands 80; France 44.
Blue powder	9	61	—	Belgium-Luxembourg 36; France 23; United Kingdom 2.
Metal including alloys:				
Scrap	2,199	1,813	70	United Kingdom 562; Belgium-Luxembourg 314; Saudi Arabia 275.
Unwrought	11,143	13,311	—	Belgium-Luxembourg 5,110; France 2,854; Canada 2,117.
Semimanufactures	r1,543	1,817	—	Republic of South Africa 409; Belgium-Luxembourg 388; Italy 272.
Zirconium:				
Ore and concentrate	1,891	2,188	—	Spain 1,183; United Kingdom 819; Netherlands 140.
Metal including alloys, semimanufactures	(2)	—	—	
Other:				
Ores and concentrates	r15	56	—	Belgium-Luxembourg 55; Netherlands 1.
Oxides and hydroxides	5	10	—	Belgium-Luxembourg 4; West Germany 4; France 2.
Ashes and residues	r50	—	—	
Base metals including alloys, all forms	—	(2)	—	Mainly from West Germany.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	588	2,179	5	Turkey 572; Italy 403; Spain 351.
Artificial:				
Corundum	1,246	1,691	(2)	West Germany 986; France 215; Brazil 171.
Silicon carbide	650	716	—	West Germany 415; Norway 195; Spain 77.
Dust and powder of precious and semiprecious stones including diamond value thousands	$1,789	$3,057	—	Switzerland $1,517; West Germany $552; Belgium-Luxembourg $460.
Grinding and polishing wheels and stones	767	1,122	4	Italy 514; Spain 296; France 84.
Asbestos, crude	9,208	14,243	7	Canada 5,704; Zimbabwe 5,416; Greece 1,560.
Barite and witherite	1,466	1,428	—	Morocco 997; West Germany 178; France 157.
Boron materials:				
Crude natural borates	5,371	11,094	—	Turkey 9,490; Spain 1,266; Netherlands 290.
Elemental	—	(2)	—	NA.
Oxides and acids	201	344	—	France 182; Italy 120; Belgium-Luxembourg 38.
Cement	164,738	106,139	—	Spain 55,727; Greece 48,765; United Kingdom 1,198.

See footnotes at end of table.

TABLE 3—Continued

PORTUGAL: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
INDUSTRIAL MINERALS—Continued					
Chalk		8,881	8,292	—	France 5,875; United Kingdom 1,252; Belgium-Luxembourg 620.
Clays, crude:					
Bentonite		22,115	22,943	340	Spain 17,236; France 3,761; West Germany 598.
Chamotte earth		1,821	1,955	—	Spain 1,587; France 368.
Fuller's earth		883	416	—	Spain 410; West Germany 5; France 1.
Kaolin		15,719	17,261	34	Spain 11,086; United Kingdom 5,356; France 426.
Unspecified		2,097	5,406	4	United Kingdom 2,431; France 1,641; Spain 1,251.
Cryolite and chiolite		24	23	—	Denmark 21; Spain 1.
Diamond:					
Gem, not set or strung	carats	25,678	136,455	218	Switzerland 61,621; Belgium-Luxembourg 59,463; United Kingdom 13,542.
Industrial stones	do.	150,009	8,550	—	Belgium-Luxembourg 6,543; Zaire 1,876; Netherlands 131.
Diatomite and other infusorial earth		3,789	4,252	1,039	Spain 1,799; France 546.
Feldspar, fluorspar, related materials:					
Feldspar		319	423	—	France 287; West Germany 135; Finland 1.
Fluorspar		435	2,617	—	France 1,199; Netherlands 993; United Kingdom 330.
Unspecified		—	3	—	All from France.
Fertilizer materials:					
Crude, n.e.s.		23	154	—	Israel 74; France 57; Spain 23.
Manufactured:					
Ammonia		125,178	64,625	3,973	Netherlands 31,090; West Germany 16,036; United Kingdom 5,428.
Nitrogenous		94,131	106,105	2,718	East Germany 30,211; Italy 22,241; Libya 11,041.
Phosphatic		73	171	—	All from Spain.
Potassic		63,806	80,613	—	Spain 45,582; Israel 17,156; East Germany 16,025.
Unspecified and mixed		16,909	52,344	21,462	Canada 8,391; Morocco 7,503.
Graphite, natural		148	541	—	Zimbabwe 388; United Kingdom 104; West Germany 37.
Gypsum and plaster		49,163	53,542	—	Spain 47,985; Morocco 3,361; West Germany 1,970.
Iodine		16	14	—	All from Japan.
Kyanite and related materials		89	289	—	Republic of South Africa 254; Spain 24; France 6.
Lime		90	75	—	West Germany 44; France 31.

See footnotes at end of table.

TABLE 3—Continued

PORTUGAL: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
INDUSTRIAL MINERALS—Continued				
Magnesium compounds:				
Magnesite, crude	245	165	(2)	West Germany 99; Spain 47; France 13.
Oxides and hydroxides	2,907	2,849	—	United Kingdom 1,878; Spain 276; Netherlands 274.
Mica:				
Crude including splittings and waste	168	145	—	France 62; United Kingdom 62; Norway 20.
Worked including agglomerated splittings	19	23	1	France 7; Belgium-Luxembourg 4; Spain 4.
Nitrates, crude	518	1,000	—	All from Belgium-Luxembourg.
Phosphates, crude	307,611	324,888	—	Morocco 264,810; Spain 37,606; Togo 16,500.
Phosphorous, elemental	23	18	—	West Germany 11; United Kingdom 7.
Pigments, mineral:				
Natural, crude	89	105	—	France 96; West Germany 5; Italy 4.
Iron oxides and hydroxides, processed	1,616	1,862	—	West Germany 1,070; Spain 621; United Kingdom 69.
Precious and semiprecious stones other than diamond:				
Natural value, thousands	$422	$1,117	$53	Belgium-Luxembourg $309; West Germany $215; France $111.
Synthetic do.	$107	$214	—	Switzerland $110; West Germany $29; Thailand $29.
Pyrite, unroasted	22	60	—	West Germany 46; Spain 14.
Salt and brine	31,235	33,486	—	Spain 32,955; West Germany 360; Netherlands 140.
Sodium compounds, n.e.s.: Carbonate, manufactured	7	341	—	Spain 308; United Kingdom 4.
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked	3,249	10,331	—	Brazil 4,214; Republic of South Africa 2,158; Finland 936.
Worked	341	525	—	Spain 255; Saudi Arabia 71; France 54.
Dolomite, chiefly refractory-grade	4,182	4,249	—	Norway 1,275; France 576; Italy 259.
Gravel and crushed rock	143	194	—	France 78; Spain 50; West Germany 48.
Limestone other than dimension	3,000	2,900	—	All from France.
Quartz and quartzite	286	430	(2)	Finland 181; West Germany 132; Sweden 47.
Sand other than metal-bearing	12,863	23,316	9	Spain 21,627; Belgium-Luxembourg 1,281; France 322.
Sulfur:				
Elemental:				
Crude including native and byproduct	23,088	22,842	—	France 18,095; Spain 2,112; China 1,506.
Colloidal, precipitated, sublimed	67	3	—	Mainly from West Germany.

See footnotes at end of table.

TABLE 3—Continued

PORTUGAL: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
INDUSTRIAL MINERALS—Continued					
Sulfur—Continued					
Dioxide		410	2,572	—	Spain 2,322; West Germany 227; Netherlands 22.
Sulfuric acid		7,937	65,988	—	Spain 42,714; West Germany 8,706; Sweden 4,197.
Talc, steatite, soapstone, pyrophyllite		6,670	7,666	219	France 2,591; Belgium-Luxembourg 1,841; Norway 945.
Vermiculite		209	239	—	France 123; China 54; Republic of South Africa 36.
Other:					
Crude		r2,314	10,434	23	Spain 9,755; United Kingdom 443; Italy 142.
Slag and dross, not metal-bearing		20,017	14,425	—	Spain 14,424; United Kingdom 1.
MINERAL FUELS AND RELATED MATERIALS					
Asphalt and bitumen, natural		814	595	55	Spain 500; France 22.
Carbon:					
Carbon black		594	1,195	91	France 683; West Germany 219; Spain 149.
Gas carbon		428	491	—	France 251; West Germany 84; Republic of South Africa 72.
Coal:					
Anthracite	thousand tons	384	531	47	Republic of South Africa 479; Belgium-Luxembourg 5.
Bituminous	do.	1,509	2,015	1,135	Republic of South Africa 300; United Kingdom 225.
Coke and semicoke	do.	46	32	—	Spain 7; United Kingdom 6; West Germany 5.
Gas, natural: Gaseous	million cubic feet	(2)	—		
Peat including briquets and litter		3,596	5,004	—	West Germany 3,441; Belgium-Luxembourg 827; Netherlands 314.
Petroleum:					
Crude	thousand 42-gallon barrels	60,493	58,067	—	Egypt 12,770; Saudi Arabia 11,216; Nigeria 7,329.
Refinery products:					
Liquefied petroleum gas	do.	3,620	3,912	—	United Kingdom 2,297; Netherlands 644; France 370.
Gasoline	do.	4,913	5,481	(2)	Italy 1,273; Greece 1,031; Spain 918.
Mineral jelly and wax	do.	19	19	(2)	Spain 9; West Germany 4; Netherlands 2.
Kerosene and jet fuel	do.	24	22	1	Spain 16; Netherlands 4.
Distillate fuel oil	do.	698	1,742	—	Libya 697; United Kingdom 334; Netherlands 317.
Lubricants	do.	289	353	1	Netherlands 140; Italy 93; France 40.
Residual fuel oil	do.	9,473	4,897	33	France 1,866; United Kingdom 1,146; Spain 1,105.
Bitumen and other residues	do.	362	691	—	Spain 680; Netherlands 7; West Germany 2.
Bituminous mixtures	do.	35	26	—	Spain 19; United Kingdom 4; France 1.
Petroleum coke	do.	79	2	—	Mainly from West Germany.

r Revised. NA Not available.

[1] Table prepared by Staff, Branch of Geographic Data.

[2] Less than 1/2 unit.

trol of six 3-megawatt monophasic furnaces, one 19-megawatt triphasic unit, and one 10-megawatt triphasic unit from Fornos Eletricos Companhia Portuguesa de Lisboa (CPFE). Terms of the agreement between the two companies called for Forbel to rent CPFE furnaces at Canas de Senorhim, near Coimbra for 10 years. In addition, Forbel would make a minimum annual investment of $100,000 earmarked for plant improvements. Part of that capital would come from the equity held in the company by 30 ex-CPFE employees.

In a separate agreement, Forbel signed a contract with Elèctricidade de Portugal (EDP), the Portuguese energy company, calling for EDP to supply energy within an undisclosed price range that would be acceptable to both parties. It should be noted that CPFE ceased ferroalloy production in 1987, because it could no longer afford the electricity costs stipulated by EDP.

The two agreements by Forbel were significant in that they would enable the company to increase its market share within Europe before the planned integration of the EC in 1992, when it is expected that Norway will dominate the EC ferroalloys market.

Forbel planned to restart the 19-megawatt triphasic furnace in March 1989 to produce 75% ferrosilicon at a rate of 180,000 tons per year. This would be followed in late summer 1989 by the restart of three of the monophasic furnaces, scheduled to produce 20,000 tons per year of ferromanganese. By the end of 1989, the remaining three monophasic furnaces would be allocated to produce 2,000 tons per month of calcium carbide.

Iron and Steel.—Sidèrurgia Nacional (SN) proceeded with its three-part program to restructure its steelworks. First, SN planned to cut its work force significantly from 1988 to 1990 with a view toward improving product quality, increasing productivity, and cutting costs. It also planned to reduce long steel product capacity from 750,000 tons per year to 650,000 tons per year. In exchange for this, SN would receive compensation in varying amounts from the EC. In addition, SN secured an EC exemption that would permit the Portuguese Government to offer the company subsidies that otherwise would have been prohibited.

Second, SN negotiated a financing package with the European Coal and Steel Commission worth $1 million.[2] The financing would be applied toward plant upgrading, where necessary.

Third, the restructuring program called for increased decentralized and autonomous decisionmaking in the budgetary and investment process at each of the two SN plants at Seixal and Maia, near Lisbon. Reflective of this policy was Seixal's decision to phase out electric arc steelmaking and to modernize its continuous casting facilities.

Tin.—The tin in Neves-Corvo occurs in a massive sulfide ore complex with an average grade of 2.37%. Plans called for tin production to add 300,000 tons to the annual mine output. Moreover, construction began on a tin concentrator scheduled to produce an average 5,000 tons per year of tin concentrate. It was determined by Somincor that the economies of scale derived from the additional output would reduce costs further.

Financing for the tin development was strong. Perceived by financial institutions as having a potentially very successful project, Somincor was able to secure 50% of the necessary funding from the European Investment Bank (EIB). EIB offered a 15-year loan with a 7-year grace period followed by an 8-year repayment cycle. Portuguese commercial banks provided an additional 20% of the capital, and equity investors supplied the remaining 30%.

The Portuguese Government gave the mine a 5-year tax holiday because of its ability to create jobs for Portuguese nationals and its anticipated significant contribution to the country's national income. The work at Neves-Corvo was to create at least 700 new jobs and generate $10 million in revenues for the locality near the mine. More broadly, it was expected that Neves-Corvo would be the catalyst that would improve European mining, in terms of both productivity and profitability.

Zinc.—Pirites Alentajanas announced that it would triple its output of zinc over a 3-year period, beginning in mid-1988. Annual output would rise from about 9,000 tons to 27,500 tons. Ore grade assay was 3.06% zinc. The company planned to capitalize the expansion through a $14.6 million increase in equity shares and a number of long-term loans.

Industrial Minerals.—Demand for Portuguese cement increased as the building industry in Portugal continued the growth that began in 1987. Simultaneously, at the Marmoz Ltd. quarry facility, near Fatima, new diamond wire saws from Italy were installed for cutting granite and marble. The new saws would ensure smoother, more precise stone-cutting. During 1988, there were reportedly 1,000 operators involved with quarrying activities. The preponderance of those operators were small family businesses.

Mineral Fuels.—Volume quotas were lifted on the amount of oil private companies could buy or sell. Simultaneously, Petrogal, Portugal's state-owned oil company, was expected to relinquish one share of its quota to the free oil market each year over the next 6 years. In response to this liberalization, Quimatex, a Portuguese petroleum storage and warehousing company, constructed an additional 16,000 cubic meters of refined products capacity at its Barreiro installation near Lisbon.

As part of a program to increase coal usage for energy purposes, work was nearly completed on the third of a four-unit, coal-fired powerplant at Sines. The fourth was to be completed at the end of 1989. Despite construction of the powerplant, domestic production of coal remained relatively low, as did that of hydropower, and uranium. In general, Portugal continued to depend heavily on imported energy sources.

SPAIN

Spain remained the world's largest producer of slate in 1988. In addition, the country was a leading world producer of feldspar, fluorspar, kyanite, magnesite, natural sodium sulfate, and potash. Among the EC members, Spain was the organization's largest producer of mined zinc, second largest producer of mined tin, third largest producer of mined lead, and eighth largest producer of mined copper and cadmium. Spain continued as the EC's sole producer of mercury, natural sodium sulfate, and tantalite.

Production

The mineral industry in Spain operated in numerous regions throughout the country. The Government retained a majority position in many of the mining enterprises. Among the prominent companies were Empresa Nacional del Aluminio S.A., which produced aluminum; Empresa Nacional Hulleras del Norte S.A., which produced bituminous coal; RTM, which produced copper ore and refined copper; Sociedad Minera y Metallúrgica de Penarroya de Espana (Peñarroya), which produced lead ore and primary lead; Minas de Almadén y Arrayanes S.A. (MAYASA), which produced mercury; Empresa Nacional Siderúrgica S.A. (ENSIDESA) and Altos Hornos de Vizcaya S.A. (AHV), which produced steel; and Astuiana de Zinc S.A., which produced zinc ore and primary zinc.

On balance, Spain's 1988 production of metallic minerals increased slightly over that of 1987, except for copper, the output of which was depressed owing to mine closures. Output of industrial minerals posted negligible growth or remained steady relative to the previous year, while production of minerals fuels and related materials grew modestly, reflecting relatively stable demand.

Trade

Spain's major minerals trading partners were France, Italy, and Portugal. The following table outlines the impact of selected classes of minerals commodities on Spain's minerals balance-of-payments position in relation to other EC member nations and the world. The figures, in thousand dollars, are for 1987, the latest year for which data were available.

Spain's balance-of-payments deficit with EC trading partners amounted to $5 billion. Of that total, trade in fuel

MINERAL COMMODITY	Exports to EC	Imports from EC	Net gain or (loss)	Exports to the world	Imports from the world	Net gain or (loss)
Crude industrial minerals:						
Feldspar	$5,918	$2,273	$3,645	$10,494	$3,208	$7,286
Magnesite	11,843	16,681	(4,838)	13,846	21,292	(7,446)
Slate	23	11	12	47	11	36
Other	116,046	98,174	17,872	171,537	306,105	(134,568)
Total	**133,830**	**117,139**	**16,691**	**195,924**	**330,616**	**(134,692)**
Metalliferous ores:						
Copper	7,606	90	7,516	17,557	117,555	(99,998)
Lead	8,134	408	7,726	12,333	10,892	1,441
Tin[1]	943	330	613	943	7,149	(6,206)
Zinc	7,655	6,315	1,340	11,260	7,211	4,049
Other	60,540	340,583	(280,043)	110,516	795,472	(684,956)
Total	**84,878**	**347,726**	**(262,848)**	**152,609**	**938,279**	**(785,670)**
Nonmetallic mineral manufactures	491,634	441,620	50,014	1,023,185	554,805	468,380
Metals:						
Iron and steel	868,089	1,113,126	(245,037)	1,921,621	1,442,962	478,659
Mercury	2,722	66	2,656	4,962	667	4,295
Other nonferrous metals	324,280	432,218	(107,938)	515,747	573,176	(57,429)
Total	**1,195,091**	**1,545,410**	**(350,319)**	**2,442,330**	**2,016,805**	**425,525**
Mineral fuels	900,144	820,506	79,638	2,000,895	7,992,563	(5,991,668)

[1] Reflects scrap.

TABLE 4

SPAIN: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons, unless otherwise specified)

Commodity		1984	1985	1986	1987[p]	1988[e]
METALS						
Aluminum:						
Bauxite		7,273	2,427	[e]7,000	1,050	2,000
Alumina[2]		741,569	724,700	748,006	800,654	800,000
Metal:						
Primary		380,830	370,118	354,687	340,972	293,900
Secondary[e]		[3]40,600	38,000	54,000	70,000	80,000
Antimony, mine output, Sb content		[r]554	248	45	([4])	—
Cadmium metal		290	268	247	297	[3]306
Copper:						
Mine output, Cu content		63,105	55,486	51,084	16,300	18,100
Metal:						
Blister:						
Primary		97,000	88,000	103,000	95,000	[3]95,600
Secondary		30,000	40,000	33,000	47,560	[3]50,000
Total		**127,000**	**128,000**	**136,000**	**142,560**	**[3]145,600**
Refined:						
Primary		117,400	101,700	130,500	100,400	[3]100,000
Secondary		39,000	50,000	24,600	51,000	[3]58,800
Total		**156,400**	**151,700**	**155,100**	**151,400**	**[3]158,800**
Gold, mine output, Au content	troy ounces	123,330	185,524	167,184	248,064	250,000
Iron and steel:						
Iron ore and concentrates (including byproduct concentrate):						
Gross weight	thousand tons	7,961	6,463	6,054	4,499	5,000
Fe content	do.	3,558	2,926	2,761	2,200	2,500
Metal:						
Pig iron	do.	5,338	5,477	4,803	4,901	5,000
Ferroalloys, electric furnace	do.	291	[e]300	[e]300	146	200
Steel:						
Crude	do.	13,484	14,235	11,977	[e]11,900	12,800
Castings and forgings	do.	156	138	[e]150	[e]140	150
Total	**do.**	**13,640**	**14,373**	**12,127**	**13,040**	**12,950**
Semimanufactures	do.	10,703	11,050	[e]11,000	[e]11,000	11,000
Lead:						
Mine output, Pb content		96,638	85,636	82,057	81,629	[3]74,900
Metal:						
Primary		110,088	112,800	88,000	71,400	[3]68,800
Secondary		49,912	43,300	42,000	51,300	[3]52,000
Mercury:						
Mine output, Hg content	76-pound flasks	22,680	25,333	79,987	40,470	40,000
Metal	do.	44,090	45,042	42,653	21,704	30,000

See footnotes at end of table.

TABLE 4—Continued

SPAIN: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons, unless otherwise specified)

Commodity		1984	1985	1986	1987[p]	1988[e]
METALS—Continued						
Silver, mine output, Ag content	thousand troy ounces	4,999	9,482	9,298	5,664	[3]5,664
Tantalum minerals (tin byproduct):						
Gross weight	kilograms	31,950	18,300	12,500	[e]10,000	10,000
Ta content	do.	9,739	4,496	3,071	[e]2,500	2,700
Tin:						
Mine output, Sn content		438	637	296	100	100
Metal, primary		4,400	[r]3,500	2,000	1,700	800
Titanium dioxide[e]		34,000	38,000	35,000	36,000	37,000
Tungsten, mine output, W content		565	458	495	101	250
Uranium, mine output, U_3O_8 content		366	308	376	372	370
Zinc:						
Mine output, Zn content		230,378	234,695	233,307	267,788	[3]277,000
Metal, primary and secondary		207,400	213,300	199,300	213,600	[3]245,400
INDUSTRIAL MINERALS						
Barite		68,919	67,512	49,678	7,776	8,000
Bromine[e]		300	350	280	300	300
Cement, hydraulic, other than natural	thousand tons	25,435	24,197	24,201	[e]25,000	25,000
Clays:						
Attapulgite		43,907	59,697	67,820	40,818	45,000
Bentonite		72,582	90,239	114,972	103,420	100,000
Kaolin, marketable:						
Crude		56,640	96,533	259,572	17,891	20,000
Washed		262,633	317,186	314,094	433,077	430,000
Refractory, not further described		516,166	449,226	549,457	484,608	500,000
Other	thousand tons	9,006	9,598	9,244	9,949	10,000
Diatomite and tripoli		73,013	96,251	128,050	66,217	80,000
Feldspar		136,943	136,190	135,526	161,631	150,000
Fluorspar:						
Gross weight:						
Acid-grade		253,221	266,774	257,108	147,757	150,000
Metallurgical-grade		42,445	38,835	25,352	23,859	30,000
Total		**295,666**	**305,609**	**282,460**	**171,616**	**180,000**
CaF_2 content:						
Acid-grade		246,121	258,561	250,374	[e]250,000	250,000
Metallurgical-grade		33,710	31,140	22,404	[e]25,000	25,000
Total		**279,831**	**289,701**	**272,778**	**[e]275,000**	**275,000**
Gypsum and anhydrite, crude	thousand tons	5,365	5,525	5,062	6,684	6,700
Kyanite, andalusite, related materials		3,000	2,800	3,304	3,916	4,000
Lime, hydrated and quicklime[e]	thousand tons	[3]1,088	1,100	1,200	1,200	1,200

See footnotes at end of table.

TABLE 4—Continued

SPAIN: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons, unless otherwise specified)

Commodity		1984	1985	1986	1987[p]	1988[e]
INDUSTRIAL MINERALS—Continued						
Magnesite:						
Calcined		169,191	173,927	177,681	127,375	150,000
Crude		691,542	692,196	[e]700,000	[e]710,000	700,000
Mica		990	727	325	370	370
Nitrogen: N content of ammonia	thousand tons	670	600	[e]600	[e]650	650
Pigments, mineral:						
Ocher		10,316	10,293	7,697	7,765	7,800
Red iron oxide[e]		20,000	21,000	20,000	20,000	20,000
Potash, K_2O equivalent		677,201	658,863	794,586	741,240	750,000
Pumice		829,827	849,440	968,116	1,053,914	1,000,000
Pyrite, including cuprous, gross weight	thousand tons	2,329	2,676	2,614	2,177	2,200
Salt:						
Rock, including byproduct from potash works	do.	2,156	2,160	2,101	2,250	2,300
Marine and other	do.	1,233	1,079	1,006	944	1,000
Sand and gravel: Silica sand[5]	do.	2,267	2,467	2,403	2,434	2,500
Sepiolite		237,570	341,193	455,194	[e]400,000	400,000
Sodium compounds; n.e.s.:						
Carbonate, manufactured[e]	thousand tons	550	550	525	550	550
Sulfate:						
Natural:						
Glauberite, Na_2SO_4 content		214,198	243,745	288,714	266,885	290,000
Thenardite, Na_2SO_4 content		152,829	237,502	162,197	208,370	160,000
Manufactured[e]		170,000	150,000	150,000	160,000	160,000
Stone:						
Calcareous:						
Chalk	thousand tons	362	412	427	345	400
Dolomite	do.	2,112	2,196	2,192	2,240	2,200
Limestone	do.	77,468	74,173	77,050	85,522	80,000
Marble	do.	623	798	955	948	950
Marl	do.	5,772	5,043	5,326	5,474	5,400
Basalt	do.	1,992	3,956	3,476	1,352	2,000
Granite	do.	7,853	9,127	10,843	11,433	11,000
Ofite	do.	1,212	1,225	1,050	1,552	1,300
Phonolite	do.	472	559	593	[e]600	600
Porphyry	do.	475	795	715	721	720
Quartz	do.	372	252	568	532	500
Quartzite	do.	831	993	744	910	800
Sandstone	do.	1,599	2,274	2,620	1,549	2,000
Serpentine	do.	376	375	417	544	500
Other	do.	23,055	25,243	26,660	[e]26,000	26,000

See footnotes at end of table.

TABLE 4—Continued

SPAIN: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons, unless otherwise specified)

Commodity		1984	1985	1986	1987[p]	1988[e]
INDUSTRIAL MINERALS—Continued						
Strontium minerals:						
Gross weight		27,000	42,500	34,500	28,867	30,000
Sr_2O_4 content		24,840	39,100	31,740	26,496	27,000
Sulfur:						
S content of pyrites	thousand tons	1,094	1,231	1,192	[e]1,200	1,200
Byproduct:[e]						
Of metallurgy	do.	125	115	105	110	110
Of petroleum	do.	9	9	8	8	8
Of coal (lignite) gasification	do.	3	2	2	2	2
Total	**do.**	**1,231**	**1,357**	**1,310**	**1,320**	**1,320**
Talc and steatite		72,237	88,776	73,914	75,307	75,000
MINERAL FUELS AND RELATED MATERIALS						
Coal (marketable):						
Anthracite	thousand tons	5,476	5,810	5,610	5,361	5,500
Bituminous	do.	9,814	10,281	10,286	13,607	11,000
Lignite	do.	24,303	23,572	22,425	15,627	20,000
Total	**do.**	**39,593**	**39,663**	**38,321**	**34,595**	**36,500**
Coke, metallurgical[e]	do.	[3]2,842	3,000	3,000	3,000	3,000
Gas, natural (marketed)	million cubic feet	6,245	9,626	13,554	25,073	25,000
Peat		55,561	54,049	63,869	67,401	70,000
Petroleum:						
Crude	thousand 42-gallon barrels	16,361	15,217	13,154	14,207	[3]15,949
Refinery products:						
Liquified petroleum gas	do.	14,964	13,642	19,116	18,850	[3]20,497
Naphtha	do.	23,709	24,973	25,160	21,224	[3]20,336
Gasoline, motor	do.	52,350	57,019	66,164	68,629	[3]68,655
Jet fuel	do.	18,160	19,312	25,192	24,344	[3]27,600
Kerosene	do.	[r]19,545	[r]22,002	26,862	24,986	[3]29,613
Distillate fuel oil	do.	78,067	85,887	91,825	89,385	[3]95,757
Residual fuel oil	do.	108,238	94,719	107,572	98,801	[3]93,220
Other	do.	28,420	46,267	39,592	38,836	[3]37,709
Refinery fuel and losses	do.	1,112	5,582	14,637	12,957	[3]12,026
Total	**do.**	**[r]344,565**	**[r]369,403**	**416,120**	**398,012**	**[3]405,413**

[e]Estimated. [p]Preliminary. [r]Revised.
[1]Table includes data available through Sept. 1989.
[2]Reflects aluminum hydrate.
[3]Reported figure.
[4]Revised to zero.
[5]Includes sand obtained as a byproduct of feldspar and kaolin production.

and nonfuel minerals with the EC accounted for 9.3%. Combined trade in fuel, and to a much lesser extent, nonfuel minerals, with all trading partners contributed 40.3% of Spain's $14.9 billion balance-of-payments deficit with the world.

Tables 5 and 6 give the volume of minerals exported and imported by Spain.

Commodity Review

Metals.—**Aluminum.**—In 1988, Industria Española del Aluminio S.A. (Inespal) produced revenues of $111 million,[3] $97 million more than in 1987. This increase resulted in 1988 pretax profits of $11 million, compared with $14 million in 1987, and a loss of $19 million in 1986. The profits in 1988 were attributed to favorable aluminum prices, reduced production costs, increased productivity, and reduced capital costs. The gains were especially significant in light of the wildcat strike that shut down 512 potlines at the company's San Ciprian smelting facility until June, consequently reducing output to about 290,000 tons, down from 294,972 tons in 1987.

Given its solid financial position, Inespal secured $42 million in credit from a Spanish bank consortium and invested $134 million in the installation of a 125,000-ton-per-year, hot-rolling facility at its Amorbieta site. The company also planned to increase its annual alumina capacity from 800,000 tons to 1 million tons. The increase was expected to produce an annual surplus of 300,000 tons.

Within this milieu, however, Aluminum Co. of Canada Ltd. (Alcan), decided to divest itself of its 23.9% financial share of Inespal. Reportedly in disagreement with the strategic direction set forth by Spain's Instituto Nacional de Industria (INI), Inespal's major shareholder, Alcan cited Inespal's sustained high cost of capital and heavy expenditure to supply energy to the San Ciprian smelter as reasons for divestiture. Alcan's withdrawal was significant because of the technical expertise and supply of raw material the company had provided.

Copper.—Spain's copper concentrate output was 18,100 tons in 1988. This amount was slightly above 1987 production levels, and was about one-third of the output produced in 1986, reflecting the continued closure of RTM's copper mines at Huelva and Cebreiros. The company, in financial difficulty, suspended its debt payments in July while it explored ways to refinance the $178 million it owed to merchants. Under consideration were two proposals to restructure the company's debt. The first proposal called for creditor banks to voluntarily renounce their right to collect up to 15% of RTM's debt, and the second guaranteed $68 million of international credit to the company. It was not clear, however, if the proposals would be accepted or when RTM debt refinancing would be completed.

Ferroalloys.—Carburos Metalicos (Carburos), Spain's leading ferroalloys producer, planned to purchase 30% of the ferromanganese enterprise Ferroaleaciones y Electrometales (Fyesa) for approximately $8 million. Motivating Carburos' plans was the fact that ferroalloy prices increased sharply during 1988; Fyesa's sustained annual ferromanganese production of 60,000 tons also proved attractive to Carburos. The purchase was contingent on an arrangement whereby Carburos would sell electricity to Union Fenosa, and, in return, Electra de Viesgo, the Spanish electricity enterprise, would deliver energy to Fyesa.

Ferronor, another Spanish ferroalloys producer, signed an agreement with Carburos, Electra de Viesgo, and workers at Ferronor's Mataporquera plant in northwest Spain to close that facility and place the company in liquidation. The reason for the closure was that Ferronor was unable to pay the $3 million it owed Electra de Viesgo. Consequently, the electricity concern cut off power to the Mataporqueras plant, resulting in the cessation of Ferronor's ferrosilicon operations. As part of the liquidation arrangement, 36 of Ferronor's 80 employees would be transferred by Carburos Metalicos to Carburos' ferroalloys plant in Galicia, in northwest Spain.

Ferroaleaciones Especials Asturianas (Ferroastur), a family-owned ferroalloys concern, suspended payments to its creditors and curtailed production of its ferroalloy products. Producing 2,000 tons annually of ferromolybdenum for export, as well as ferrovanadium, ferroaluminum, and ferrotitanium for domestic consumption, Ferroastur encountered severe financial difficulties for two reasons. First, one of its major customers suspended payments because of the decline in the value of the U.S. dollar. Second, the company's credit lines of $3 million were withdrawn. Ferroastur began talks with its bank creditors to structure a debt-repayment plan.

Gallium.—Rhône-Poulenc signed an agreement with the Spanish Government to purchase the entire output of gallium-containing residues from the Alumina Española S.A. (Inespal) alumina refinery at San Ciprian. Although no date was given for the start of construction, Rhône-Poulenc planned to build a gallium extraction facility near San Ciprian, at a cost of $51 million. The residues purchased from Inespal were estimated to contain up to 30,000 kilograms per year of gallium, but Rhône-Poulenc did not indicate what plant capacity that would be.

Gold.—Filon Sur and Thorco Resources began processing gold ore at Europe's first heap-leach gold project in Spain. The project, located near the southwestern Spanish port of Huelva, focused on processing gossan ore to recover gold. The ore was produced from Tharsis Mining's operations, which recovered copper, zinc, and sulphur from pyrite deposits. Using heap-

TABLE 5

SPAIN: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987 United States	Destinations, 1987 Other (principal)
METALS				
Alkali and alkaline-earth metals:				
Alkali metals	—	(2)	—	Mainly to West Germany.
Aluminum:				
Ore and concentrate	1,120	1,849	—	Portugal 1,751; Tunisia 52.
Oxides and hydroxides	42,744	159,787	10	France 64,321; Italy 18,837; Finland 18,157.
Ash and residue containing aluminum	137	526	—	All to France.
Metal including alloys:				
Scrap	557	810	—	Belgium-Luxembourg 273; West Germany 98; Netherlands 88.
Unwrought	146,388	106,479	1,915	Netherlands 33,125; Italy 20,428; Japan 17,246.
Semimanufactures	32,124	40,954	1,084	France 11,719; Portugal 3,757; United Kingdom 3,641.
Antimony:				
Ore and concentrate	1	1	—	All to Portugal.
Oxides	8	25	—	Italy 15; West Germany 10.
Metal including alloys, all forms	43	5	—	All to Italy.
Arsenic: Oxides and acids	—	1	—	Venezuela (2); France (2).
Bismuth: Oxides and hydroxides	—	2	—	Switzerland 1; Italy 1.
Cadmium: Metal including alloys, all forms	230	230	—	Netherlands 210; United Kingdom 20.
Chromium:				
Ore and concentrate	24	(2)	—	Austria (2); Netherlands (2).
Oxides and hydroxides	109	33	—	Colombia 11; Sweden 5; United Kingdom 5.
Metal including alloys, all forms	2	(2)	—	Italy (2); France (2).
Cobalt:				
Oxides and hydroxides	1	2	—	Mainly to Portugal.
Metal including alloys, all forms	63	29	—	Italy 15; Belgium-Luxembourg 12.
Columbium and tantalum:				
Ash and residue containing columbium and tantalum	—	76	—	All to Netherlands.
Metal including alloys, all forms:				
Tantalum	3	4	2	France 1.
Copper:				
Ore and concentrate	59,397	47,402	—	Japan 23,408; Finland 16,402; Canada 4,779.
Matte and speiss including cement copper	3,134	3,778	—	West Germany 3,516; Belgium-Luxembourg 262.
Oxides and hydroxides	18	2	—	Mainly to Belgium-Luxembourg.
Sulfate	1,503	2,045	20	France 611; Equatorial Guinea 575; West Germany 523.

See footnotes at end of table.

TABLE 5—Continued

SPAIN: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987 United States	Destinations, 1987 Other (principal)
METALS—Continued				
Ash and residue containing copper	1,465	2,116	—	Gibraltar 1,898; Belgium-Luxembourg 182.
Metal including alloys:				
Scrap	607	967	—	Belgium-Luxembourg 380; West Germany 274; France 178.
Unwrought	66,464	44,126	—	Italy 13,783; United Kingdom 9,061; Netherlands 7,187.
Semimanufactures	12,288	36,679	167	Italy 12,109; France 9,646; Portugal 3,930.
Germanium: Metal including alloys, all forms	—	1	—	All to France.
Gold:				
Waste and sweepings value, thousands	$2	$4	—	France $4; Andorra $1.
Metal including alloys, unwrought and partly wrought do.	$9,068	$20,198	$102	United Kingdom $13,307; Switzerland $6,299; Andorra $128.
Iron and steel:				
Iron ore and concentrate:				
Excluding roasted pyrite thousand tons	1,791	1,991	([2])	Netherlands 780; France 543; United Kingdom 417.
Pyrite, roasted do.	5	24	—	France 9; Sweden 5; Lebanon 4.
Metal:				
Scrap	1,350	15,790	7	France 12,407; Belgium-Luxembourg 2,172; West Germany 646.
Pig iron, cast iron, related materials	47,115	18,870	14	Italy 6,126; West Germany 3,120; Portugal 1,652.
Ferroalloys:				
Ferroaluminum	—	503	—	Italy 422; France 81.
Ferrochromium	9,909	13,949	—	United Kingdom 5,242; Japan 2,468; France 2,356.
Ferromanganese	22,084	13,103	—	Italy 4,702; United Kingdom 2,147; Canada 1,725.
Ferromolybdenum	2,389	2,027	76	Netherlands 792; Austria 642; Sweden 267.
Ferrosilicochromium	—	152	—	Japan 150.
Ferrosilicomanganese	7,077	7,132	1,508	West Germany 1,393; Italy 1,393.
Ferrosilicon	3,620	4,579	47	Portugal 2,090; West Germany 1,935; United Kingdom 296.
Silicon metal	3,273	2,361	—	Japan 1,884; West Germany 372; Italy 70.
Unspecified	3,951	1,144	1,121	France 12.
Steel, primary forms	608,659	679,970	37,105	France 195,848; Morocco 123,142; Italy 73,656.
Semimanufactures:				
Bars, rods, angles, shapes, sections thousand tons	2,762	2,606	272	West Germany 309; France 239.
Universals, plates, sheets do.	1,288	1,149	168	France 122; U.S.S.R. 99.
Hoop and strip do.	65	64	11	France 13; U.S.S.R. 10.

See footnotes at end of table.

TABLE 5—Continued

SPAIN: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
METALS—Continued					
Iron and steel—Continued					
Metal—Continued					
Semimanufactures—Continued					
Rails and accessories	do.	2	14	—	Colombia 9; Israel 3; Morocco 1.
Wire	do.	70	78	1	Libya 20; France 12; Portugal 11.
Tubes, pipes, fittings	do.	423	351	33	France 44; U.S.S.R. 44.
Castings and forgings, rough	do.	17	17	1	Italy 4; West Germany 3; France 2.
Lead:					
Ore and concentrate		42,215	65,913	—	Italy 18,386; Morocco 9,370; Belgium-Luxembourg 9,295.
Oxides		499	2,158	—	U.S.S.R. 1,116; Portugal 483; Morocco 214.
Ash and residue containing lead		29,606	2,031	—	All to United Kingdom.
Metal including alloys:					
Scrap		122	3,976	—	France 2,124; Taiwan 1,062; United Kingdom 347.
Unwrought		22,502	18,250	7,200	Turkey 5,380; Portugal 2,150.
Semimanufactures		207	395	—	Portugal 197; West Germany 85; United Kingdom 42.
Lithium:					
Ore and concentrate		—	96	—	France 72; Italy 21; Portugal 2.
Oxides and hydroxides		1	1	—	Algeria ([2]); Portugal ([2]).
Metal including alloys, all forms		—	([2])	—	All to France.
Magnesium: Metal including alloys:					
Scrap		14	—	—	
Unwrought		648	1,175	—	France 1,151; West Germany 22.
Semimanufactures		34	57	—	France 53; United Kingdom 3.
Manganese:					
Oxides		2,231	1,375	—	France 587; Czechoslovakia 420; Nigeria 160.
Metal including alloys, all forms		2	19	—	United Kingdom 16; Cuba 1; Venezuela 1.
Mercury	76-pound flasks	31,610	20,364	5,918	West Germany 3,249; United Kingdom 3,075.
Molybdenum:					
Ore and concentrate		—	30	—	All to Netherlands.
Metal including alloys, semimanufactures		([2])	1	—	Mainly to Belgium-Luxembourg.
Nickel:					
Matte and speiss		—	3	—	Portugal 2; Italy 1.
Oxides and hydroxides		2	1	—	All to Portugal.
Ash and residue containing nickel		86	226	—	United Kingdom 91; West Germany 62; Japan 45.

See footnotes at end of table.

TABLE 5—Continued

SPAIN: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Destinations, 1987	
				United States	Other (principal)
METALS—Continued					
Nickel—Continued					
Metal including alloys:					
Scrap		97	64	—	France 26; West Germany 24; Netherlands 9.
Unwrought		13	11	—	France 4; Belgium-Luxembourg 4; United Kingdom 1.
Semimanufactures		104	46	—	West Germany 17; France 13; Italy 8.
Platinum-group metals:					
Waste and sweepings	value, thousands	$419	$922	—	France $921.
Metals including alloys, unwrought and partly wrought	do.	$1,621	$778	—	France $289; West Germany $240; Argentina $141.
Rare-earth metals including alloys, all forms		3	—	—	
Selenium, elemental		—	3	—	All to Netherlands.
Silicon, high-purity		1	18	—	Cuba 1; Venezuela 1; unspecified 16.
Silver:					
Ore and concentrate[3]	value, thousands	$38	—	—	
Waste and sweepings	do.	$1,896	[3]$1,444	—	Sweden $1,028; France $414.
Metal including alloys, unwrought and partly wrought	do.	$9,825	$41,333	—	West Germany $11,376; United Kingdom $11,350; Switzerland $9,560.
Tin:					
Oxides		—	([2])	—	Portugal ([2]); Morocco ([2]).
Ash and residue containing tin		—	72	—	United Kingdom 52; Portugal 20.
Metal including alloys:					
Scrap		—	275	—	All to United Kingdom.
Unwrought		226	6	—	Mainly to United Kingdom.
Semimanufactures		278	51	—	Netherlands 25; Saudi Arabia 14; Italy 8.
Titanium:					
Ore and concentrate		125	20	—	All to Portugal.
Oxides		1,904	1,475	870	Canada 216; Cuba 106.
Metal including alloys:					
Scrap		31	21	—	West Germany 11; United Kingdom 9.
Unwrought		17	([2])	([2])	
Semimanufactures		23	28	([2])	Italy 20; West Germany 6; Belgium-Luxembourg 2.
Tungsten:					
Ore and concentrate		744	140	—	West Germany 120; Republic of South Africa 20.
Metal including alloys:					
Scrap		1	([2])	—	All to West Germany.
Unwrought		—	([2])	—	All to Belgium-Luxembourg.
Semimanufactures		([2])	2	—	Belgium-Luxembourg 1.

See footnotes at end of table.

TABLE 5—Continued

SPAIN: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987	
			United States	Other (principal)
METALS—Continued				
Uranium and thorium: Ore and concentrate	108	744	—	U.S.S.R. 557; France 187.
Vanadium:				
Oxides and hydroxides	15	1	—	Belgium-Luxembourg (2); United Kingdom (2).
Ash and residue containing vanadium	46	190	190	
Zinc:				
Ore and concentrate	126,443	79,481	—	Italy 35,645; Finland 17,974; Belgium-Luxembourg 15,074.
Oxides	2,197	2,817	—	West Germany 680; Italy 486; France 442.
Blue powder	598	10	—	Mainly to West Germany.
Matte	196	429	—	All to United Kingdom.
Ash and residue containing zinc	2,387	3,023	—	Italy 1,530; West Germany 1,204; France 146.
Metal including alloys:				
Scrap	1	—	—	
Unwrought	94,199	105,532	46,352	Netherlands 18,143; U.S.S.R. 17,297.
Semimanufactures	276	1,219	—	Iran 514; France 477; United Kingdom 118.
Zirconium:				
Ore and concentrate	110	135	—	Portugal 49; Mexico 36; West Germany 25.
Metal including alloys:				
Scrap	—	22	—	All to France.
Semimanufactures	—	(2)	—	All to Egypt.
Other:				
Ores and concentrates	24	279	—	Iran 250; Norway 23; Portugal 2.
Oxides and hydroxides	262	328	62	United Kingdom 128; Hong Kong 38.
Ashes and residues	731	[4]1,579	—	Japan 549; Belgium-Luxembourg 467; United Kingdom 349.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	2,085	2,301	1	West Germany 1,031; Portugal 499; France 231.
Artificial:				
Corundum	2,251	2,626	—	United Kingdom 1,332; West Germany 913; Portugal 162.
Silicon carbide	3,618	4,811	72	United Kingdom 2,382; France 773; West Germany 522.
Dust and powder of precious and semiprecious stones including diamond value, thousands	$30	$63	$14	Argentina $20; Mexico $9.
Grinding and polishing wheels and stones	3,117	3,790	334	West Germany 610; France 538.
Asbestos, crude	194	23	—	Morocco 22; Gibraltar 1.
Barite and witherite	41,892	22,346	—	Italy 13,619; Angola 4,471; Egypt 3,756.

See footnotes at end of table.

TABLE 5—Continued

SPAIN: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
INDUSTRIAL MINERALS—Continued					
Boron materials:					
Crude natural borates		637	1,510	—	Portugal 1,312; Tunisia 165.
Elemental		—	(2)	—	NA.
Oxides and acids		2	1	—	Cuba (2); Cyprus (2).
Bromine		—	43	—	All to Belgium-Luxembourg.
Cement	thousand tons	5,578	4,697	2,737	Ivory Coast 317; Algeria 307.
Chalk		2,969	2,248	—	Portugal 568; Morocco 406; France 119.
Clays, crude:					
Bentonite		33,258	36,914	—	Portugal 11,149; Netherlands 11,086; West Germany 9,161.
Chamotte earth		1,493	452	—	Morocco 200; Italy 92; Belgium-Luxembourg 69.
Fullers' earth		3,337	2,702	—	Italy 1,203; Netherlands 1.025; United Kingdom 190.
Kaolin		127,842	160,924	(2)	Italy 54,625; West Germany 17,545; Tunisia 17,373.
Unspecified		72,702	41,238	—	Netherlands 26,437; France 3,596; Portugal 3,476.
Cryolite and chiolite		1	—	—	
Diamond:					
Gem, not set or strung	value, thousands	$236	$507	—	Belgium-Luxembourg $230; Panama $104; Israel $86.
Industrial stones	do.	$57	$45	$14	Argentina $18; Ireland $9.
Diatomite and other infusorial earth		4,087	7,780	—	Belgium-Luxembourg 4,616; France 1,887; Italy 301.
Feldspar, fluorspar, related materials:					
Feldspar		2,578	3,382	—	France 2,954; Morocco 347; Cuba 56.
Fluorspar		171,600	90,970	11,590	Italy 30,369; Canada 22,368.
Unspecified		5	328	—	Syria 150; Cuba 113; Tunisia 60.
Fertilizer materials:					
Crude, n.e.s.		838	732	(2)	Andorra 599; France 41; Israel 40.
Manufactured:					
Ammonia		(2)	76	—	Belgium-Luxembourg 64; Trinidad and Tobago 6.
Nitrogenous		162,833	237,180	—	West Germany 182,812; France 48,561; Netherlands 2,796.
Phosphatic		1,017	1,466	—	France 1,280; Portugal 170.
Potassic		488,900	686,298	—	France 149,406; Brazil 139,285; Italy 91,755.
Unspecified and mixed		133,212	268,803	—	China 72,000; Venezuela 57,250; West Germany 23,070.
Graphite, natural		126	72	—	Italy 44; France 22; Portugal 5.

See footnotes at end of table.

TABLE 5—Continued

SPAIN: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Destinations, 1987	
				United States	Other (principal)
INDUSTRIAL MINERALS—Continued					
Gypsum and plaster	thousand tons	2,486	2,596	1,165	Sweden 246; Denmark 207.
Iodine		6	5	—	Mainly to West Germany.
Kyanite and related materials		49	11	—	West Germany 8; Algeria 3.
Lime		6,329	16,077	—	France 10,146; Cameroon 1,897; Equatorial Guinea 1,750.
Magnesium compounds:					
Magnesite, crude		8	216	—	All to Italy.
Oxides and hydroxides		109,289	87,058	355	France 5,731; Netherlands 2,066; West Germany 1,144.
Meerschaum, amber, jet		—	459,905	674	France 151,468; West Germany 76,252; Netherlands 57,812.
Mica:					
Crude including splittings and waste		23	21	—	Austria 13; West Germany 8.
Worked including agglomerated splittings		100	110	—	United Kingdom 27; Turkey 19; West Germany 17.
Phosphates, crude		404	200	—	All to Portugal.
Phosphorous, elemental		9	67	—	Do.
Pigments, mineral:					
Natural, crude		34	522	6	Austria 288; France 139; United Kingdom 54.
Iron oxides and hydroxides, processed		9,881	10,846	786	United Kingdom 1,850; Belgium-Luxembourg 943.
Potassium salts, crude		5,650	—	—	
Precious and semiprecious stones other than diamond:					
Natural	value, thousands	$151	$336	$21	West Germany $112; Portugal $34; Belgium-Luxembourg $28.
Synthetic	do.	$460	[5]$481	$85	Switzerland $246; Greece $57.
Pyrite, unroasted		347,216	248,457	2	Belgium-Luxembourg 179,217; Turkey 37,044; Italy 10,847
Salt and brine		511,152	435,424	26,327	Iceland 79,589; Norway 58,714; Portugal 30,966.
Sodium compounds, n.e.s.:					
Carbonate, manufactured		137,821	169,246	—	Belgium-Luxembourg 113,582; Uruguay 15,597; Argentina 12,861.
Sulfate, manufactured		NA	146,886	20	United Kingdom 25,328; Netherlands 20,683; Portugal 19,856.
Stone, sand and gravel:					
Dimension stone:					
Crude and partly worked		376,204	428,447	492	Italy 278,756; Belgium-Luxembourg 80,391; Taiwan 25,503.
Worked		316,966	383,207	41,531	France 201,513; West Germany 55,294.

See footnotes at end of table.

TABLE 5—Continued

SPAIN: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987	
			United States	Other (principal)
INDUSTRIAL MINERALS—Continued				
Stone, sand and gravel—Continued				
Dolomite, chiefly refractory-grade	184,497	131,015	—	United Kingdom 123,248; Finland 5,094; Morocco 711.
Gravel and crushed rock	47,087	42,451	—	Gibraltar 22,000; Morocco 17,931; Andorra 1,246.
Limestone other than dimension	—	(2)	—	All to West Germany.
Quartz and quartzite	374,982	434,804	—	Norway 276,117; Sweden 53,674; Iceland 46,749.
Sand other than metal-bearing	269,363	393,496	—	Andorra 340,995; Gibraltar 30,716; Portugal 20,857.
Sulfur:				
Elemental:				
Crude including native and byproduct	425	10,774	—	France 3,187; Italy 2,866; Lebanon 2,514.
Colloidal, precipitated, sublimed	76	47	—	Mainly to France.
Dioxide	55	2,217	—	All to Portugal.
Sulfuric acid	482,245	290,836	5,111	Portugal 46,495; Italy 44,302; Brazil 33,499.
Talc, steatite, soapstone, pyrophyllite	32,911	31,875	—	Belgium-Luxembourg 21,128; United Kingdom 3,932; Italy 2,221.
Vermiculite, perlite, chlorite	608	209	—	Italy 134; Andorra 50; France 23.
Other:				
Crude	748,605	411,740	(2)	Belgium-Luxembourg 264,107; West Germany 49,484; France 33,220.
Slag and dross, not metal-bearing	115,878	125,098	3,200	Portugal 66,397; France 29,495; Israel 18,348.
MINERAL FUELS AND RELATED MATERIALS				
Asphalt and bitumen, natural	1,553	9,564	—	Portugal 6,662; Italy 2,752.
Carbon:				
Carbon black	16,420	16,828	—	France 8,985; West Germany 4,899; Italy 862.
Gas carbon	6,965	5,451	(2)	Morocco 2,684; Iraq 600; Yugoslavia 506.
Coal:				
Anthracite	28	21	—	France 10; Belgium-Luxembourg 10; Andorra 1.
Bituminous	37	74	—	Andorra 56; ship's stores 15.
Briquets of anthracite and bituminous coal	1	—		
Lignite including briquets	—	35	—	France 24; Portugal 10.
Coke and semicoke	26,733	50,300	(2)	Sweden 10,954; West Germany 9,356; Portugal 6,844.
Gas, natural: Gaseous cubic feet	—	740	—	All to Equatorial Guinea.
Peat including briquets and litter	56	37	—	Italy 24; Portugal 7; Andorra 4.

See footnotes at end of table.

TABLE 5—Continued

SPAIN: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Destinations, 1987	
				United States	Other (principal)
MINERAL FUELS AND RELATED MATERIALS—Continued					
Petroleum refinery products:					
Liquefied petroleum gas	thousand 42-gallon barrels	2,075	2,149	—	Morocco 1,131; Italy 355; Netherlands 207.
Gasoline, motor	do.	26,092	26,446	8,058	Nigeria 6,448; Netherlands 5,024.
Mineral jelly and wax	do.	96	152	1	West Germany 46; Netherlands 26; Algeria 26.
Kerosene and jet fuel	do.	12,030	12,360	1,623	Netherlands 3,430; Nigeria 1,592.
Distillate fuel oil	do.	8,218	7,495	198	Netherlands 1,127; Mauritania 699; France 600.
Lubricants	do.	3,284	3,466	61	France 1,473; Italy 515; Bermuda 140.
Residual fuel oil	do.	53,683	49,876	5,722	Netherlands 14,611; Algeria 3,146.
Bitumen and other residues	do.	2,471	4,114	984	Portugal 504; Netherlands 436.
Bituminous mixtures	do.	753	240	—	Portugal 78; Libya 75; Senegal 23.
Petroleum coke	do.	35	229	—	U.S.S.R. 195; Netherlands 33; Sierra Leone 1.

NA Not available.
[1] Table prepared by P.J. Roetzel.
[2] Less than 1/2 unit.
[3] Includes other precious metals.
[4] Contains precious metals.
[5] Includes diamonds.

leaching and carbon extraction processes, Filon Sur processed 5,600 tons of ore containing 1.87 grams of gold per ton. It was expected that around 12,000 ounces of gold were to be produced annually from the 300,000 tons of ore. Anticipated project life was estimated at 15 years.

In early 1988, Glamis Gold and Biomet Technology Inc. entered into an agreement with Charter Exploraciones (CE) to create a joint-venture partnership whereby CE would develop and exploit the Salave gold property in Oviedo Province, 800 kilometers northwest of Madrid. Mineralization at Salave was composed of gold-bearing sulfide ore with a high arseno-pyrite content contained within a large body of intrusive rock. Reserves were estimated to be 9,000 tons. Average grades were measured at 3 grams per ton.

The Salave project was to proceed in three parts. Initially, a 9,000-ton bioheap leach test would be conducted. This test would be followed by expansion toward a 450,000-ton, bio-leach facility by the end of the test program. The test facility would then be integrated into a full-scale production design plan that would result in a plant with a processing capacity of 900,000 tons per year.

Orminex S.A. was issued a license to prospect 120 square kilometers for gold at Suspiron in the Provinces of Castille and Leon, northern Spain. Bedrock panel sampling at Suspiron identified gold grades of 4.4 grams per ton. Orminex planned to start an exploration program there by the end of 1988.

The company also planned to explore a 170-square-kilometer area of the Leon Oeste concession in northern Spain. Having entered into a joint venture agreement with Rio Tinto Miniera, Orminex would operate the joint venture at Leon Oeste. Bedrock chip sampling at the Black Rock deposit there returned gold grades of up to 16.5 grams per ton.

Fifty percent of Orminex is owned by Andaman Resources, and 50% by Ashchurch Investments.

Iron and Steel.—Consolidation of Spain's steel industry continued during 1988. Compania Española de Laminacion (Celsa) minimill group purchased Nervaceso, a bar producer, for the token sum of 1 peseta (less than U.S. 1 cent). In doing so, Celsa agreed to cut the labor force at Nervaceso's facilities

TABLE 6

SPAIN: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987 United States	Sources, 1987 Other (principal)
METALS				
Alkali and alkaline-earth metals:				
Alkali metals	90	94	([2])	West Germany 48; France 41; United Kingdom 2.
Alkaline-earth metals	48	86	—	France 61; West Germany 10; Canada 9.
Aluminum:				
Ore and concentrate thousand tons	1,431	1,663	—	Guinea 1,565; Guyana 38; China 25.
Oxides and hydroxides	22,302	27,305	105	France 14,286; West Germany 6,990; United Kingdom 4,058.
Ash and residue containing aluminum	17,028	19,680	3	Netherlands 3,736; Austria 3,486; West Germany 3,295.
Metal including alloys:				
Scrap	19,133	16,103	401	France 8,374; Portugal 3,607; West Germany 930.
Unwrought	21,814	13,691	4	West Germany 2,255; Brazil 2,070; France 1,963.
Semimanufactures	42,287	50,495	1,602	West Germany 12,692; Italy 7,930; France 7,055.
Antimony:				
Ore and concentrate	630	684	—	Thailand 448; China 84; Morocco 79.
Oxides	273	411	4	China 130; France 110; United Kingdom 62.
Ash and residue containing antimony	—	265	—	All from Morocco.
Metal including alloys, all forms	178	235	—	China 128; United Kingdom 22; U.S.S.R. 19.
Arsenic:				
Oxides and acids	182	280	—	France 206; China 72.
Metal including alloys, all forms	NA	20	—	Netherlands 15; China 2; Sweden 2.
Bismuth:				
Oxides and hydroxides	—	71	([2])	Belgium-Luxembourg 66; Bulgaria 5.
Metal including alloys, all forms	83	82	—	Belgium-Luxembourg 23; United Kingdom 20; Peru 18.
Cadmium: Metal including alloys, all forms	92	87	—	West Germany 86; Belgium-Luxembourg 1.
Chromium:				
Ore and concentrate	92,194	76,902	—	Turkey 34,029; Albania 23,349; Republic of South Africa 17,292.
Oxides and hydroxides	349	449	58	West Germany 278; Poland 58.
Metal including alloys, all forms	40	143	74	United Kingdom 45; West Germany 22.
Cobalt:				
Ore and concentrate	([2])	—		
Oxides and hydroxides	113	140	7	Belgium-Luxembourg 60; Canada 27; Finland 21.
Metal including alloys, all forms	197	208	1	Zaire 61; West Germany 55; Belgium-Luxembourg 36.

See footnotes at end of table.

TABLE 6—Continued

SPAIN: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS—Continued				
Columbium and tantalum: Metal including alloys, all forms:				
Columbium (niobium)	(2)	18	(2)	United Kingdom 17.
Tantalum	18	10	9	France (2)
Copper:				
Ore and concentrate	249,641	346,867	—	Chile 109,414; Mexico 82,843; Canada 55,207.
Matte and speiss including cement copper	2,217	226	—	Netherlands 116; West Germany 58; Belgium-Luxembourg 51.
Oxides and hydroxides	527	344	(2)	Norway 114; Italy 103; Australia 61.
Sulfate	1,081	1,808	—	Portugal 961; France 639; U.S.S.R. 60.
Ash and residue containing copper	44,342	22,640	11,707	Norway 2,204; Belgium-Luxembourg 1,773.
Metal including alloys:				
Scrap	29,984	33,002	4,921	France 11,362; United Kingdom 3,842.
Unwrought	51,759	19,595	16	Chile 7,087; Belgium-Luxembourg 6,858; Italy 1,897.
Semimanufactures	63,239	72,555	406	France 22,814; Italy 14,806; West Germany 11,341.
Germanium: Metal including alloys, all forms	(2)	(2)	—	Belgium-Luxembourg (2); Switzerland (2).
Gold:				
Waste and sweeping value, thousands	$26,912	$334	—	All from Switzerland.
Metal including alloys, unwrought and partly wrought do.	$35,090	$65,967	$250	Switzerland $39,389; Sweden $6,417; Panama $5,695.
Iron and steel:				
Iron ore and concentrate:				
Excluding roasted pyrite thousand tons	4,287	5,767	—	Brazil 2,538; Liberia 1,100; Venezuela 729.
Pyrite, roasted do.	120	179	—	Mainly from Belgium-Luxembourg.
Metal:				
Scrap do.	4,342	4,285	469	United Kingdom 1,678; France 959; U.S.S.R. 601.
Pig iron, cast iron, related materials	206,523	166,178	17	Canada 33,977; Brazil 26,318; Nigeria 20,437.
Ferroalloys:				
Ferroaluminum	—	1	—	All from United Kingdom.
Ferrochromium	71,373	80,627	—	Republic of South Africa 60,521; Finland 7,492; Greece 3,453.
Ferromanganese	6,636	14,129	(2)	Republic of South Africa 7,319; Yugoslavia 2,343; Brazil 2,000.
Ferromolybdenum	109	197	—	United Kingdom 114; Belgium-Luxembourg 53; France 20.
Ferronickel	24,851	24,632	20	New Caledonia 10,699; Dominican Republic 6,579; Colombia 2,921.

See footnotes at end of table.

TABLE 6—Continued

SPAIN: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS—Continued				
Iron and steel—Continued				
Metal—Continued				
Ferroalloys—Continued				
Ferrosilicochromium	1,620	2,080	—	Zimbabwe 1,640; Finland 325; Republic of South Africa 50.
Ferrosilicomanganese	11,393	14,535	—	Republic of South Africa 11,552; Portugal 2,650; Bulgaria 300.
Ferrosilicon	11,998	11,089	(2)	Yugoslavia 2,912; France 2,279; Republic of South Africa 2,256.
Silicon metal	17	298	33	Hong Kong 110; Norway 70; Republic of South Africa 34.
Unspecified	10,841	2,881	—	France 1,209; West Germany 1,046; United Kingdom 201.
Steel, primary forms thousand tons	1,287	1,093	8	West Germany 319; France 287; Italy 112.
Semimanufactures:				
Bars, rods, angles, shapes, sections	226,772	232,712	378	West Germany 67,069; France 52,781; United Kingdom 25,291.
Universals, plates, sheets	864,578	813,580	4,436	West Germany 272,445; France 153,892; United Kingdom 72,754.
Hoop and strip	128,182	147,366	103	West Germany 72,884; France 19,980; Belgium-Luxembourg 14,090.
Rails and accessories	3,439	5,212	23	Austria 1,819; Belgium-Luxembourg 1,039; France 983.
Wire	23,345	31,219	184	Belgium-Luxembourg 13,415; France 6,151; United Kingdom 3,904.
Tubes, pipes, fittings	90,841	109,217	2,557	Italy 28,590; France 24,162; West Germany 23,466.
Castings and forgings, rough	2,487	2,249	10	Italy 994; France 514; West Germany 290.
Lead:				
Ore and concentrate	50,320	40,866	—	Republic of South Africa 12,699; Canada 10,965; Mexico 6,908.
Oxides	33	23	—	United Kingdom 20; West Germany 2.
Ash and residue containing lead	7,493	2,004	63	Canada 1,613; Greece 281.
Metal including alloys:				
Scrap	44	698	636	France 29; United Kingdom 27.
Unwrought	8,902	13,370	(2)	Morocco 8,835; France 3,285; West Germany 579.
Semimanufactures	149	333	144	France 92; Italy 36.
Lithium:				
Ore and concentrate	—	803	—	Netherlands 433; Australia 269; Republic of South Africa 98.
Oxides and hydroxides	95	206	—	West Germany 57; China 46; U.S.S.R. 40.
Metal including alloys, all forms	(2)	(2)	—	West Germany (2); United Kingdom (2).

See footnotes at end of table.

TABLE 6—Continued

SPAIN: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS—Continued				
Magnesium: Metal including alloys:				
Scrap	4	25	—	Lebanon 17; France 16.
Unwrought	2,390	2,773	2,046	Norway 362; France 214.
Semimanufactures	31	26	(2)	West Germany 13; Belgium-Luxembourg 8.
Manganese:				
Ore and concentrate, metallurgical grade	244,300	202,286	—	Republic of South Africa 77,446; Mexico 30,120; Australia 28,344.
Oxides	1,471	3,009	4	Republic of South Africa 1,842; Japan 983.
Metal including alloys, all forms	676	614	77	China 159; United Kingdom 89.
Mercury 76-pound flasks	551	2,843	—	China 1,450; Algeria 464; U.S.S.R. 435.
Molybdenum:				
Ore and concentrate	5,236	4,991	234	Chile 3,180; China 349; West Germany 348.
Oxides and hydroxides	2	(2)	—	All from West Germany.
Metal including alloys:				
Scrap	2	—		
Unwrought	3	3	1	West Germany 1; United Kingdom 1.
Semimanufactures	27	41	13	Netherlands 12; Austria 7; West Germany 3.
Nickel:				
Matte and speiss	1,591	1,503	22	Canada 761; U.S.S.R. 260; Australia 161.
Oxides and hydroxides	16	28	—	Canada 27.
Ash and residue containing nickel	209	191	94	France 96; Portugal 1.
Metal including alloys:				
Scrap	15	45	—	France 23; United Kingdom 10; Republic of South Africa 5.
Unwrought	4,864	4,270	6	U.S.S.R. 955; Canada 802; United Kingdom 740.
Semimanufactures	865	784	33	West Germany 293; Italy 130; United Kingdom 119.
Platinum-group metals:				
Waste and sweepings value, thousands	$5,054	$3,577	—	Mexico $1,839; Colombia $586; France $395.
Metals including alloys, unwrought and partly wrought do.	$9,718	$11,201	$34	United Kingdom $5,115; Republic of South Africa $2,893; Switzerland $1,114.
Rare-earth metals including alloys, all forms	43	14	9	Austria 4; Brazil 1.
Rhenium: Metal including alloys, all forms	(2)	(2)	—	Mainly from United Kingdom.
Selenium, elemental	83	69	1	United Kingdom 31; Canada 14; Yugoslavia 11.
Silicon, high-purity	1	10	(2)	Mainly from Norway.
Silver:				
Ore and concentrate[3] value, thousands	$31,864	$40,410	$270	Papua New Guinea $17,918; Mexico $11,893; Canada $2,790.

See footnotes at end of table.

TABLE 6—Continued

SPAIN: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS—Continued				
Silver—Continued				
Waste and sweepings do.	$2,439	[3]$4,008	—	Peru $3,127; Panama $729; West Germany $113.
Metal including alloys, unwrought and partly wrought do.	$43,680	$44,558	$61	United Kingdom $8,521; Chile $7,722; Mexico $7,071.
Tellurium, elemental	[4]16	7	([2])	United Kingdom 3; Peru 2; Japan 1.
Thallium, gallium and indium: Metals including alloys, all forms kilograms	—	42	13	Switzerland 21.
Tin:				
Ore and concentrate	3,071	1,848	—	Zaire 934; China 658; Nigeria 84.
Oxides	249	310	—	United Kingdom 183; Italy 80; West Germany 46.
Ash and residue containing tin	—	56	—	All from Switzerland.
Metal including alloys:				
Scrap	—	2	—	United Kingdom 1; Switzerland 1.
Unwrought	1,576	1,838	—	United Kingdom 1,080; Netherlands 502; West Germany 68.
Semimanufactures	167	205	([2])	United Kingdom 60; West Germany 58; Portugal 36.
Titanium:				
Ore and concentrate	106,920	135,941	99	Australia 82,119; Malaysia 36,145; Canada 15,848.
Oxides	1,336	2,354	1	France 483; United Kingdom 438; West Germany 364.
Ash and residue bearing titanium	—	2	—	All from West Germany.
Metal including alloys:				
Scrap	322	196	18	France 174; Austria 3.
Unwrought	368	23	12	France 10.
Semimanufactures	1,018	230	76	Italy 51; United Kingdom 38.
Tungsten:				
Oxides and hydroxides	1	1	—	Mainly from West Germany.
Metal including alloys:				
Scrap	9	20	—	Sweden 19.
Unwrought	5	3	([2])	France 2; West Germany 1.
Semimanufactures	75	14	1	Austria 5; United Kingdom 3; West Germany 2.
Uranium and thorium:				
Ore and concentrate	47	([2])	—	All from Niger.
Metal including alloys, all forms:				
Uranium	([2])	([2])	([2])	United Kingdom ([2]).
Thorium	([2])	—	—	

See footnotes at end of table.

TABLE 6—Continued

SPAIN: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS—Continued				
Vanadium:				
Oxides and hydroxides	117	216	([2])	China 104; Austria 63; Netherlands 25.
Metal including alloys, unwrought	([2])	—	—	
Zinc:				
Ore and concentrate	34,615	33,743	—	Ireland 25,390; Peru 4,399; Greece 3,954.
Oxides	706	2,244	([2])	Portugal 865; France 743; China 306.
Blue powder	176	145	—	West Germany 121; Belgium-Luxembourg 16.
Matte	3,127	3,244	—	France 1,813; West Germany 710; Algeria 155.
Ash and residue containing zinc	6,131	7,206	1,345	Belgium-Luxembourg 2,265; France 2,234.
Metal including alloys:				
Scrap	1,326	1,292	—	France 923; United Kingdom 174; Belgium-Luxembourg 123.
Unwrought	7,174	6,919	1	Belgium-Luxembourg 3,899; France 1,772; United Kingdom 579.
Semimanufactures	730	769	([2])	West Germany 350; Belgium-Luxembourg 228; United Kingdom 95.
Zirconium:				
Ore and concentrate	25,813	35,300	36	Australia 17,041; Republic of South Africa 16,240; West Germany 571.
Metal including alloys:				
Unwrought	([2])	1	—	Mainly from Netherlands.
Semimanufactures	1	1	([2])	Mainly from West Germany.
Other:				
Ores and concentrates	4	1	—	Mainly from Peru.
Oxides and hydroxides	207	224	([2])	France 127; United Kingdom 65; West Germany 13.
Ashes and residues	6,312	[5]614	13	West Germany 449; Italy 100; Norway 26.
Base metals including alloys, all forms	—	2	—	Italy 1.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	2,890	24,539	23	Turkey 10,023; Greece 8,054; Italy 4,691.
Artificial:				
Corundum	5,742	7,996	60	France 1,896; West Germany 1,616; Austria 1,535.
Silicon carbide	2,620	3,393	([2])	West Germany 1,169; Norway 738; Italy 576.
Dust and powder of precious and semiprecious stones including diamond value, thousands	$4,904	$4,920	$1,146	Ireland $3,281; West Germany $150.
Grinding and polishing wheels and stones	3,831	2,427	11	Italy 1,080; West Germany 394; France 337.

See footnotes at end of table.

TABLE 6—Continued

SPAIN: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
INDUSTRIAL MINERALS—Continued				
Asbestos, crude	43,874	45,666	75	Canada 24,216; Zimbabwe 15,217; Italy 3,787.
Barite and witherite	1,238	7,243	([2])	Morocco 5,302; Canada 1,155; Sweden 368.
Boron materials:				
Crude natural borates	99,510	64,839	10,502	Turkey 53,794.
Elemental	([2])	([2])	([2])	United Kingdom ([2]).
Oxides and acids	443	440	—	United Kingdom 400; France 24.
Bromine	45	59	—	Israel 44; France 11.
Cement	76,115	503,832	([2])	Tunisia 318,000; Poland 74,484; Romania 29,528.
Chalk	12,788	13,153	9	France 12,959; United Kingdom 111.
Clays, crude:				
Bentonite	27,361	28,692	234	Morocco 21,201; Greece 3,520; United Kingdom 1,748.
Chamotte earth	5,951	6,777	558	France 4,443; West Germany 1,651.
Fullers' earth	2,978	4	([2])	France 2; Morocco 2.
Kaolin	177,730	196,495	14,605	United Kingdom 148,466; France 22,102.
Unspecified	21,481	27,483	35	United Kingdom 17,118; France 7,948; West Germany 1,778.
Cryolite and chiolite	690	92	—	Denmark 81; France 11.
Diamond:				
Gem, not set or strung value, thousands	$6,283	$8,828	$191	Belgium-Luxembourg $6,970; India $829; Netherlands $420.
Industrial stones do.	$1,382	$1,555	$2	Iceland $621; Belgium-Luxembourg $438; Zaire $227.
Diatomite and other infusorial earth	3,355	3,221	1,016	France 1,625; Iceland 302.
Feldspar, fluorspar, related materials:				
Feldspar	19,830	32,607	—	France 23,927; Portugal 6,667; Republic of South Africa 1,074.
Fluorspar	44	1,387	—	West Germany 1,328; France 58.
Unspecified	2,416	6,050	—	Norway 3,793; Canada 2,065.
Fertilizer materials:				
Crude, n.e.s.	1,568	3,610	1	Portugal 1,780; Netherlands 908; France 790.
Manufactured:				
Ammonia	782,114	750,953	104,884	U.S.S.R. 214,636; Trinidad and Tobago 70,625.
Nitrogenous	599,926	677,881	15,808	Italy 183,537; West Germany 169,203; France 94,434.
Phosphatic	55,624	89,087	3,946	Israel 32,905; Portugal 18,160; Morocco 10,823.
Potassic	12,643	30,767	5,000	Israel 18,127; Canada 6,689.
Unspecified and mixed	291,056	568,847	160,561	West Germany 84,935; France 75,136.

See footnotes at end of table.

TABLE 6—Continued

SPAIN: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987 United States	Sources, 1987 Other (principal)
INDUSTRIAL MINERALS—Continued					
Graphite, natural		3,993	4,692	18	China 1,752; West Germany 1,138; Mexico 752.
Gypsum and plaster		30,985	61,903	74	Morocco 60,590; United Kingdom 653.
Iodine		228	335	—	Japan 264; Chile 45; United Kingdom 11.
Kyanite and related materials		5,284	5,502	284	Republic of South Africa 3,206; West Germany 1,127; France 730.
Lime		404	875	—	France 438; West Germany 388.
Magnesium compounds:					
Magnesite, crude		5	14	—	West Germany 10; Austria 2; Switzerland 1.
Oxides and hydroxides		62,480	58,940	323	Italy 13,704; Greece 9,753; United Kingdom 6,974.
Sulfate		264	452	—	France 384; West Germany 54.
Meerschaum, amber, jet		—	47	46	West Germany 1.
Mica:					
Crude including splittings and waste		2,602	1,515	6	France 489; India 339; Austria 318.
Worked including agglomerated splittings		528	192	66	France 54; Belgium-Luxembourg 31.
Nitrates, crude		25,050	24,922	—	Chile 24,850.
Phosphates, crude	thousand tons	3,701	2,833	137	Morocco 2,054; Togo 283; Senegal 142.
Phosphorous, elemental		302	76	33	West Germany 18; Republic of South Africa 15.
Pigments, mineral:					
Natural, crude		231	429	36	United Kingdom 194; West Germany 93; Austria 62.
Iron oxides and hydroxides, processed		6,237	6,614	34	West Germany 5,008; France 833.
Precious and semiprecious stones other than diamond:					
Natural	value, thousands	$3,740	$7,173	$70	Thailand $3,465; India $1,075; West Germany $635.
Synthetic	do.	$5,958	[6]$6,528	$536	Ireland $2,097; Switzerland $1,013; Republic of Korea $931.
Pyrite, unroasted		253	278	—	Italy 134; France 120; West Germany 22.
Quartz crystal, piezoelectric	kilograms	—	43	—	United Kingdom 41; Japan 2.
Salt and brine	thousand tons	5,155	13	([2])	France 11; United Kingdom 1.
Sodium compounds, n.e.s.:					
Carbonate, manufactured		403	13,471	—	Belgium-Luxembourg 6,823; Italy 4,192; Bulgaria 2,000.
Sulfate, manufactured		1,176	1,134	([2])	Belgium-Luxembourg 360; United Kingdom 308; Portugal 288.

See footnotes at end of table.

TABLE 6—Continued

SPAIN: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
INDUSTRIAL MINERALS—Continued					
Stone, sand and gravel:					
Dimension stone:					
Crude and partly worked		164,181	202,988	(2)	Portugal 70,197; Italy 44,105; Finland 35,921.
Worked		14,570	26,433	(2)	Portugal 14,124; Italy 9,891; France 1,897.
Dolomite, chiefly refractory-grade		12,263	19,472	—	France 9,542; Belgium-Luxembourg 4,653; United Kingdom 4,495.
Gravel and crushed rock		60,484	63,615	1	Morocco 45,316; France 17,038; United Kingdom 585.
Limestone other than dimension		—	(2)	—	All from Egypt.
Quartz and quartzite		2,501	4,199	24	Yugoslavia 2,144; Sweden 990; West Germany 343.
Sand other than metal-bearing		40,472	74,033	41	France 30,154; Portugal 1,256; West Germany 1,224.
Sulfur:					
Elemental:					
Crude including native and byproduct		43,079	42,825	—	France 41,229; West Germany 1,404.
Colloidal, precipitated, sublimed		37	87	37	West Germany 25; France 24.
Dioxide		3	271	—	Mainly from Italy.
Sulfuric acid		35,744	69,070	(2)	Italy 39,923; France 11,318; West Germany 8,758.
Talc, steatite, soapstone, pyrophyllite		13,662	19,998	356	France 11,281; Norway 3,293; Italy 2,504.
Vermiculite, perlite, chlorite		16,909	16,452	—	Turkey 6,200; U.S.S.R. 6,000; Republic of South Africa 2,998.
Other:					
Crude		21,823	35,062	1,114	Norway 7,441; Morocco 6,955; Italy 3,349.
Slag and dross, not metal-bearing		5,073	51,047	1,500	Denmark 19,108; West Germany 13,217; United Kingdom 2,226.
MINERAL FUELS AND RELATED MATERIALS					
Asphalt and bitumen, natural		702	744	491	United Kingdom 214; Netherlands 38.
Carbon:					
Carbon black		5,155	5,136	181	France 2,938; Netherlands 1,590; United Kingdom 209.
Gas carbon		17,597	28,914	490	France 20,603; Mexico 1,919; West Germany 1,665.
Coal:					
Anthracite	thousand tons	28	35	—	Republic of South Africa 23; Belgium-Luxembourg 6; Netherlands 6.
Bituminous	do.	8,687	8,844	2,165	Republic of South Africa 4,468; Australia 1,309.
Briquets of anthracite and bituminous coal	do.	(2)	8	—	Colombia 6; France 1.
Lignite including briquets	do.	146	64	—	East Germany 62; France 2.

See footnotes at end of table.

TABLE 6—Continued

SPAIN: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
MINERAL FUELS AND RELATED MATERIALS—Continued					
Coke and semicoke		198,232	170,526	2,852	Poland 36,213; France 30,645; East Germany 13,035.
Gas, natural:					
Gaseous	million cubic feet	(2)	2	—	Mainly from France.
Liquefied	thousand tons	1,987	1,969	—	Algeria 1,232; Libya 710.
Peat including briquets and litter		49,090	54,938	29	West Germany 45,488; Netherlands 5,444; United Kingdom 1,145.
Petroleum:					
Crude	thousand 42-gallon barrels	325,745	359,107	—	Mexico 90,185; Nigeria 43,660; Iraq 38,238.
Refinery products:					
Liquefied petroleum gas	do.	8,547	10,919	(2)	France 3,045; Saudi Arabia 2,489; Algeria 1,367.
Gasoline, motor	do.	17,271	23,870	(2)	U.S.S.R. 4,950; Kuwait 3,925; Libya 3,023.
Mineral jelly and wax	do.	43	69	8	Portugal 12; Netherlands 10.
Kerosene and jet fuel	do.	573	1,125	4	Venezuela 236; Netherlands 232; United Kingdom 192.
Distillate fuel oil	do.	11,472	13,480	3,025	U.S.S.R. 2,367; Italy 1,904.
Lubricants	do.	531	537	31	France 233; Italy 73; West Germany 34.
Residual fuel oil	do.	12,536	11,833	1,153	U.S.S.R. 4,436; Netherlands 1,698.
Bitumen and other residues	do.	59	708	(2)	France 359; Netherlands Antilles 211; Portugal 114.
Bituminous mixtures	do.	12	12	(2)	West Germany 4; France 2; United Kingdom 2.
Petroleum coke	do.	9,571	6,779	6,328	Italy 62; West Germany 52.

NA Not available.
[1] Table prepared by P.J. Roetzel.
[2] Less than 1/2 unit.
[3] Includes other precious metals.
[4] Includes arsenic.
[5] Includes precious metals.
[6] Includes diamonds.

by a number yet to be determined. For this, Celsa would receive $17 million from the Spanish Government.

Strip producers Aristrain and Arregui reached an accord to close inefficient plants and to cut their labor forces. Specifically, the agreement called for Aristrain to close its 150,000-ton-per-year hot strip mill, simultaneously taking feed for its tube mills from Arrequi. In turn, Arrequi would close its melting shop, consisting of one 65-ton electric furnace and a four-strand caster, with a capacity of 295,000 tons per year. Instead, the company would take semimanufactures from Aristrain.

Laminados Siderurgicos Arbizu, part of the Laminados Velasco group, curtailed production at its Arbizu works and dismantled its 12,000-ton-per-year sheet mill there. The mill was producing about 7,200 tons per year at the time of closure.

One of the more significant developments associated with the rationalization brought about by the integration of Spain's steel industry into the European Coal and Steel Community was Ensidesa's restructuring plan. The plan involved several elements.

First, the plan provided for the construction of a third Linz-Donawitz (LD) steel plant at Aviles. This plant would replace the operations of two existing LD plants with capacities of 1.5 million tons per year and 1 million tons per year. Those plants were expected to close in mid-1989. The replacement plant was expected to increase the efficiency of the company's operations.

The two LD converters in the new plant have a working volume of 270 cubic meters and a capacity of 250 tons each. The converters were equipped for combined blowing, a process entailing the injection of inert gas, either argon or nitrogen, by tuyeres installed at the bottom of the furnace. The benefits of this process include rapid homogenization of the bath, quick scrap melting, higher yield from iron and ferroalloys, and reduced lime and oxygen consumption.

Two new continuous-slab casters were also installed. Each was two-strand, with curved molds 33 meters long. Each had a working radius of 10.5 meters, which produced slabs of 230 millimeters by 600 to 1,600 millimeters by 5,500 to 9,000 millimeters at a speed of 1.6 meters per minute. Mold width was automatically variable, and there was mixed air and water secondary recooling. There were 4 burners and 18 segments per line. The tundish had a 60-ton capacity.

The second element of Ensidesa's restructuring plan entailed modernization of the Aviles hot strip mill. The mill's furnace was rebuilt, thereby reducing energy consumption and increasing productivity. The mill was expected to produce hot-rolled strip in coil weights up to 25 tons, with a production capacity of 2.3 million tons per year.

With a view toward improving product quality, the company introduced a flux-flow cooling process that would enable deep stamping with a high degree of homogeneity and consistency. It was expected that the improvements would help stem strip imports into Spain.

Additionally, Ensidesa installed a computer system that automated the mill and related the computer program of the mill to that of the continuous caster.

The third element of Ensidesa's restructuring involved rebuilding the sections line at Gijon-Verina. In doing so, the company intended to concentrate its production of sections and rails there, while closing down the Aviles line. It was expected that energy costs would be significantly reduced. Investment in the Gijon-Verina overhaul amounted to $55 million.

Mercury.—Minas de Almadén y Arrayanes S.A. (MAYASA) invested $13 million, primarily on the company's new Entredicho mine, the expansion of the red mercury oxide plant, and on a mercury residues recovery unit. The investments were made in a market climate of uncertain prices.

After a sustained period of market prices hovering at the $280-per-flask level in Europe, Almadén set its price at $340 per flask. Moreover, in agreement with Algerian producer Enof, it stipulated that production might be cut by as much as 30% to support the higher price. It was estimated that a price of $400 per flask would cover the producer's cost and yield a reasonable profit.

Simultaneously, work continued on MAYASA's new mine at Almadén, in southern Spain. The new facility, expected to begin production in 1990, contains ore with a relatively high mercury content of 20.5%, an amount sufficient to reduce extraction costs by more than one-half. Compared with expenditures of $190 per flask at the company's opencast Entredicho Mine and $300 per flask at its old Almadén operation, costs at the new mine should average $87 per flask. It was expected that reduced production costs would result in a commensurate price drop for MAYASA's mercury.

Tungsten.—Minas de Almadén undertook technical and economic feasibility studies related to the restart of mining operations for wolfram, scheelite and tin at the Mari Carmen-La Parilla mine in Extremadura. The company was interested in managing part of the mine operations, and in taking shares in a joint venture structured by the Banco de Credito.

Capitalization of the new company was expected to amount to $7 million. The banks indicated that the new company would be eligible for financial assistance from the regional government, Junta de Extremadura.

Zinc.—Peñarroya España sold its opencast zinc mining operations at Minas de Silicatos in the Sierra de Cartagena, to Portman, a newly incorporated company. Included in the sale were ore-crushing equipment, the Roberto ore-dressing plant, and the conveyor haulage system from Peñarroya's Sultana and Tomaso operations. The Cartagena mines had been losing $1 million per month due to low zinc content in the ore.

Española de Zinc completed construction of a tailings treatment plant at its Cartagena electrolytic refinery site in January 1988. Building expenses amounted to $9 million, which was paid from company revenues. Utilizing an organic-solvent extraction process that is followed by electrolytic refining to derive the finished product, the plant was expected to yield 6,000 tons of zinc metal annually. This would raise Española's total annual output to 46,000 tons. In addition, Española projected recovery of approximately 70 kilograms of zinc per ton of tailings from a supply source adequate to feed the plant for 7 years.

***Industrial Minerals.*—Fertilizer Materials.**—A rationalization plan was instituted that entailed the closure of Spain's less competitive ammonia-producing units. Primarily, plants with annual outputs of 100,000 tons or less were closed. In turn, the closures concentrated ammonia production into three large plants:

Fesa's plant at Huelva, with an annual capacity of 246,000 tons, and Enfersa's two plants at Cartagena and Puertollano, with a combined annual capacity of 380,000 tons.

Apart from the closures, rationalization involved improving the competitiveness of the three remaining plants. On the one hand, this improvement was accomplished by increasing the annual capacity of the Puertollano plant from 217,000 tons per year to 228,000 tons per year and that of the Huelva plant to 307,000 tons. On the other hand, energy consumption was made more efficient by converting plant feedstocks from naphtha to natural gas.

With the completion of the rationalization plan, ammonia capacity in Spain would be around 700,000 tons per year, well below the 900,000 tons per year produced over the preceding decade.

A significant effort was made to focus on ammonium nitrate, which accounts for most of Spain's nitrogen fertilizer capacity. To this end, many ammonium sulfate plants were closed, and investment in ammonium nitrate plants increased. Specifically, Enfersa invested $102 million in a new ammonium nitrate plant at Sagunto, which began operations in mid-1988. Annual capacity at that plant was 122,000 tons.

Dimension Stone.—Steetly PLC, a British dimension stone concern, acquired Canteras La Pola S.A. for $18 million. The La Pola quarrying and ready-mixed concrete operation is near the town of Colemar Viejo, 20 miles north of Madrid. At the site are two hard rock deposits, with a combined annual capacity of 1.3 tons. One is a granite quarry; the other is a porphyry stone quarry. The granite quarry produces 1 million tons annually, the bulk of which is supplied to local markets. The other quarry, opened in early 1988, was expected to produce 400,000 tons by yearend. Most of this production was supposed to be sold to the Spanish railway, RENFE.

***Mineral Fuels.*—Petroleum.**—Repsol Petrolèo S.A. started two methyl tertiary butyl ether (MTBE) plants, with a combined capacity of 78,000 tons per year, thereby increasing Spain's MTBE capacity to 168,000 tons per year. The plants were located at Repsol's 160,000-barrel-per-day Tarragona and 130,000-barrel-per-day Corunna refineries. The company also proceeded with plans to build a 55,000-ton-per-year MTBE plant at its 120,000-barrel-per-day refinery at Puertollano. Utilizing technology from the Federal Republic of Germany's Chemische Werke Huls AS, the new plants increased Repsol's capacity to produce unleaded gasoline, the bulk of which was to be exported to other member nations of the EC.

Uranium.—Empresa Nacional del Uranio S.A. (ENUSA) continued its exploration work over a 46,000-square-kilometer region of Salamanca Province in western Spain. Extensive examinations of the Retortillo, Esperanza, and Villares de Yeltes deposits were made, with a view toward defining more reserves. The host rock at these locations was sericitic-chloritic slate of Precambrian or Cambrian age, with significant amounts of carbon compounds. Mineralization was of the stockwork type and was very close to the surface. The preponderant mineral was pitchblend.

Additional deposits in Precambrian schists were identified in the Provinces of Badajoz, near Don Benito, in southwestern Spain, and in nearby Caceres.

Plans called for maintaining production capacity of 30 tons of uranium per year at Don Benito. The uranium is obtained by acid leaching and heap leaching pitchblend at a rate of 200 tons per day. The pitchblend is obtained through open pit mining methods. In addition, production capacity of 800 tons of uranium per year was to be added to the existing 200 tons per year at Salamanca. This increase was to be accomplished by heap leaching and in situ leaching methods.

Fosforico Espagñol S.A. (FESA) and ENUSA planned the construction of a plant to extract uranium from phosphoric acid at Huelva. The plant was to process 300,000 tons of P_2O_5 per year, thereby yielding 75 tons of uranium annually. The process, designed by JEN, was one of decantation and precipitation. Uranium solution was to be decanted from the phosphoric acid, and then precipitated with ammonium carbonate and ammonia to obtain ammonium diuranate with 80% uranium content.

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[1] Physical scientist, Division of International Minerals.

[2] Where necessary, values have been converted from Portuguese escudos (Esc) to U.S. dollars at the rate Esc143.95 = US$1.00, the average exchange rate in 1988.

[3] Where necessary, values have been converted from Spanish pesetas (Ptas) to U.S. dollars at the rate of Ptas 117 = US$1.00, the average exchange rate in 1988.

THE MINERAL INDUSTRIES OF

SCANDINAVIA

By Donald E. Buck, Jr., and Harold R. Newman

DENMARK[1]

The value of Denmark's oil and gas industry from North Sea production was approximately $2.9 billion[2] in taxes and supplied 40% of the energy needs of the country. The only significant metals industry was the Danish Steel Works Ltd., a steel plant based on scrap. Significant industrial minerals were cement, diatomaceous materials, and crushed and dimension stone.

Denmark's production of North Sea oil and gas continued to increase significantly and provided more than 70% of the country's petroleum requirements. The major objective of the Government's energy policy continued to be the reduction of net oil imports and encouragement of the development of the country's indigenous sources of oil. Development of the North Sea petroleum resources continued, but at a slower rate because of near saturation of the gas market, low oil prices, and estimated oil reserve limitations.

Austere measures taken by the Danish Government to limit domestic consumption and encourage exports in previous years, resulted in the stagnation of the consumer economy and an increase in the gross domestic product (GDP) of only .2%. Unemployment increased while private investment decreased as a result of increased concern about the economy. The Government that was elected in May did not alter the tight economic and fiscal policies set by the previous Government, anticipating that these existing policies would improve the economy.

European Community

Denmark was expected to benefit from the European Community's (EC) drive for a single market, because eliminating the value-added tax was expected to enhance consumer spending in trade-dependent economies similar to that of Denmark. Concern was raised over Denmark's indirect taxes, which needed harmonizing to EC levels. These taxes constitute 20% of total Government revenues. Direct foreign investment by other Nordic countries had greatly increased investment in recent years, to gain access to EC markets. Denmark's smaller size industries have exploited the export trade business and easily adapted to the technical requirements of other countries. These industries were thought to need structural realignment by internationalization to meet the challenges of the single EC Market.

Production and Trade

Production of North Sea oil and gas again increased significantly to record highs. Importation of most mineral fuels continued to decline. Imports of U.S. coal, however, more than doubled to $71 million and increased in market share to 25% from the 10% share in 1987. Exports to the United States declined to $1.1 billion or 5.7% of Danish exports. Imports from the United States increased 9%. The U.S. trade deficit with Denmark had been almost eliminated. Prospects were favorable for improving the U.S. trade balance with Denmark in 1989.

Danish exports of ferrous scrap increased 21% to a total of 222,000 tons and imports were down to 89,000 tons. The major trading partner for steel scrap was the Federal Republic of Germany. Some effort was made to keep steel scrap prices down to suppress the domestic demand and encourage exports.

Commodity Review

Industrial Minerals.—**Cement.**—A/S Aalborg Portland-Cement-Fabrik, Denmark's only cement producer, completed construction of its 4,000-ton-per-day, semidry, gray portland cement kiln at its Rordal plant in Aalborg. The new kiln, which replaced three smaller kilns, was operating at 4,700 tons per day by late summer. Aalborg, the world's largest producer, at 1.7 million tons, and exporter of white cement, indicated a 15% decline in total cement production. Domestic demand for cement decreased because building construction declined. Exports of white cement remained strong despite foreign price competition; exports increased to a record high of 376,000 tons and were expected to improve further in 1989 with additional shipments to the United Kingdom. Aalborg, Denmark's largest industrial consumer of coal, initiated new energy-saving processes resulting in a 20% savings in production costs. The company continued to increase both its trucking and ocean fleets for shipping of bulk cement, coal, and fly ash. Aalborg's fleet transported 1.23 million tons of bulk cement to distant destinations such as the United States. A total of 450,000 tons of fly ash from Danish powerplants was transported to cement and concrete industries in Denmark and Norway.

Fertilizer Materials.—A statutory order was signed by the Danish environmental minister that limits the cadmium content in fertilizers. The order specified a limit of 200 milligrams of cadmium per kilogram of potassium in 1990. The cadmium content was to be lowered to 110 milligrams per kilograms of potassium in 1998. This lower limit agreement negotiated with the domestic fertilizer industry would affect even the low cadmium phosphates from South Africa, which represented 26% of the 1987 imports. Alternate imports from Morocco and the United States were postulated as replacement sources.

Mineral Fuels.—The major objective of Denmark's energy policy continued to be the reduction of net oil imports. This goal had been partially met by conversion of most electrical powerplants to coal, development of Danish North Sea oil and gas production, and energy conservation. The Government postponed the scheduled third round of licensing until 1989 and altered the terms of offshore licenses to boost interest in licensing during this period of

TABLE 1

DENMARK: SALES OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987[p]	1988[e]
Cement, hydraulic	thousand tons	1,668	1,739	2,029	1,887	1,600
Clays:[e]						
Kaolin		14,000	13,000	[2]10,404	[2]9,304	10,000
Other, for ceramic uses		[2]4,168	[2]4,686	6,000	6,000	6,000
Cryolite[3]		20,300	17,900	18,000	17,200	18,000
Diatomaceous materials:						
Diatomite[e]		10,000	6,000	6,000	6,000	6,000
Moler		63,745	72,029	72,958	[e]66,000	66,000
Gas, natural[3]	million cubic feet	8,228	38,811	67,274	85,700	90,000
Iron and steel:[3]						
Steel, crude	thousand tons	548	528	632	606	[2]650
Semimanufactures	do.	462	511	539	538	550
Lead, metal including alloys, secondary[4]		13,019	4,503	[e]560	—	—
Lime, hydrated and quicklime	thousand tons	128	129	134	119	125
Peat	do.	32	39	48	[e]50	50
Petroleum:[3]						
Crude	thousand 42-gallon barrels	17,700	22,120	27,700	35,200	40,000
Refinery products:						
Gasoline	do.	10,438	10,226	11,110	[e]11,100	11,100
Jet fuel	do.	681	1,017	1,525	[e]1,100	1,100
Kerosene	do.	429	125	172	[e]200	200
Distillate fuel oil	do.	23,162	22,326	24,723	[e]23,700	24,000
Residual fuel oil	do.	13,498	12,256	13,792	[e]15,500	16,000
Liquefied petroleum gas	do.	1,656	1,506	1,863	[e]2,000	2,000
Naphtha	do.	1,320	1,401	1,647	[e]1,800	1,800
Bitumen	do.	533	521	347	[e]400	400
Refinery fuel and losses	do.	3,020	2,880	3,322	[e]2,300	2,300
Total	**do.**	**54,737**	**52,258**	**58,501**	**[r][e]58,100**	**58,900**
Salt[3]	thousand tons	523	532	564	531	530
Sand, industrial	thousand cubic meters	1,026	1,368	1,629	[e]1,600	1,600
Sand and gravel[3]	do.	23,200	24,600	28,500	32,100	32,000
Sodium carbonate	thousand tons	126	114	117	[e]120	120
Stone:						
Crushed:						
Flint	thousand cubic meters	47	54	59	[e]60	60
Limestone:						
Agricultural	thousand tons	2,163	1,882	1,972	[e]2,000	2,000
Industrial	do.	145	142	153	[e]150	150
Chalk	do.	220	203	249	[e]250	250
Other	thousand cubic meters	1,183	1,275	1,365	[e]1,400	1,400
Dimension (mostly granite)	do.	154	156	213	[e]200	200
Sulfur, byproduct		10,859	7,376	12,810	[e]13,000	13,000

[e]Estimated. [p]Preliminary. [r]Revised.
[1]Table includes data available through June 30, 1989.
[2]Reported figure.
[3]Data represent production.
[4]Includes antimonial lead.

low oil prices. The minimum share for the state company, Dopas, was reduced from 20% to 10%, which was similar to that of other North Sea countries. Royalties for new licenses in new areas were abolished. Adopting a United Kingdom practice of designating "linkage" areas to promote exploration, 94% of onshore and offshore areas were projected to be open for bids in 1989. All unlicensed areas also were included in the open bidding. In the Central Graben area, Dopas would continue 20% participation in projects producing up to 50,000 barrels per day; however, participation would increase to 40% for larger fields.

The emphasis to increase production from the Danish offshore resulted in an estimated 15% increase in oil production. However, the accumulated investment in North Sea petroleum development was approximately $5 billion and had not yet been recovered from production. The recovery from the 1986 oil price collapse had made little corrective headway through most of 1988. The Finance Ministry indicated that full recovery of the investment was not expected by until the early 1990's, depending on world market prices for oil.

Coal.—Danish policy had been to import coal from several countries to provide source stability. Denmark, the largest Nordic consumer of coal, used more than 12 million tons providing 98% of domestically produced electricity. Three U.S. companies signed contracts to provide additional coal to Elsam, Denmark's largest utility group, and to Aalborg Cement Co. Australian coal had become the major source after the termination of the Republic of South Africa's one-quarter import share, however the devaluation of the dollar and the lower cost of shipment has benefited the U. S. industry. The landed price in Denmark of U.S. coal was approximately 40% above that of Australian coal during early 1987. Natural gas from the Norwegian North Sea poses the greatest competition to the continued demand for coal to the Nordic area.

Natural Gas.—The Tyra Field in the Danish North Sea was the principal producer of Danish gas, which was piped to the mainland together with coproduct gas from Danish North Sea oil wells. Tyra also produced a significant quantity of condensate, roughly 1 million barrels per year, which was piped to the mainland via the Gorm Oilfield. The Government approved the development of Harald Field, previously known as Lulu and West Lulu. The projected $780 million 18-slot wellhead platform and 50 mile pipeline project was to access and deliver the 1.1 trillion cubic feet of reserves to the Government-owned gas distributor, Dansk Olie og Naturgas A/S (DONG). Two horizontal wells were approved by the Government for the Valdemar Field (Boje cluster) with tieback to Tyra East platform by a 13-mile, 8-inch pipeline. If the wells were found to be successful, four additional horizontal wells were possible for further development. Government approval was obtained for development by Dansk Undergrounds Consortium (DUC) of the Igor Gasfield, a satellite of the producing Dan Oilfield. However, the development schedule was not firm and was expected to be influenced by gas supply and demand. DONG began negotiations to procure more gas from domestic and Norwegian sources.

Petroleum.—Production of crude petroleum, all from the Danish North Sea, increased significantly as it had done each year since 1980. Construction of Dan-F, an extension of the Dan Field, was completed. Dan Field, operated by DUC was realizing a flow potential of 26,680 barrels per day in the first half of the year. DUC's 5,000 barrels per day enhancement program involved the drilling of horizontal wells from the complex. The exploration results from 16 wells drilled as offsets to Dan Field, however, were disappointing. Amoco's Raven Field to the north was still under evaluation. Amoco Denmark Exploration Company's small discovery in block 5504/1 made it the first non-DUC operator to find oil in the Danish sector. The overall Danish production exceeded 100,000 barrels per day for the first time. The estimated proven reserves were limited, but appeared to be sufficient to last until the end of the century.

DUC continued to control all significant gas and oilfield development and production in the Danish North Sea. The company consisted of the following company ownership: A.P. Moller (operator), 39%, Shell Olie og Gasundvinding Danmark BV, 46%, and Texaco A/S, 15%.

GREENLAND[3]

The Danish Government and Greenland Landsstyre signed an agreement to alter the principles of the Mineral Resources System for Greenland. The negotiations conducted by the Minister of Energy for the Danish Government and Greenland Home Rule Authorities agreed to equally share the first $71 million in revenues from mineral exploitation and to negotiate any income in excess of that amount. The company, Nunaoil A/S, owned jointly by both parties was to promote the advancement of industrial development of mineral resources in Greenland.

The Geological Survey of Greenland continued its field explorations for minerals in southern Greenland and continued with a program initiated by the Governments of Denmark and Greenland to attract foreign firms to exploit mineral deposits in the area. The Geological Survey confirmed the existence of a large deposit of columbium and also discovered lanthanum-bearing deposits. Encouraging results were reported by Canadian firms exploring on Greenland in specific areas.

TABLE 2

GREENLAND: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1984	1985	1986	1987	1988[P]
Cryolite, crude ore[2]	67,200	111,500	70,343	38,185	—
Lead: Concentrate, Pb content	17,800	17,800	16,200	20,500	23,120
Silver: In lead concentrate, Ag content thousand troy ounces	334	276	385	418	418
Zinc: Concentrate, Zn content	71,300	70,300	62,100	69,200	77,520

[P] Preliminary.
[1] Table includes data available through June 30, 1989.
[2] Shipments.

Commodity Review

Metals.—Boliden A/B continued ore extraction at Nunngarat, thereby assuring production of lead and zinc concentrates through 1989 at its Black Angel Mine. No significant exploration was conducted as the company concentrated on the enhancement recovery of the limited residuals during 1988.

Platinova Resources Ltd. is involved in two platinum prospects, and one is a joint venture with Boulder Gold N.L. of Sidney, Australia.

Industrial Minerals.—Platinova Resources Ltd., Highwood Resources Ltd., and Aber Resources Ltd. were developing a large deposit of zirconium, yttrium, and rare earths in an ice-free location near the southern tip of the island. Field work there consisted of diamond drilling to outline the reserve tonnage of the deposit. A bulk sample was shipped for pilot plant modeling.

Kryolitselskabet Oresund A/S shipped the last 15,000 tons of high-grade cryolite from a pit at Ivigtut. This last shipment of crude ore to Denmark marked the end of 131 years continuous mining activity at the pit. The company allowed the seawater to fill the pit containing 1.5 million of low grade reserves remaining, containing 12% cryolite and 20% fluorite. During 1988, deep drilling by Kryolitselskabet Oresund A/S intersected a cryolite-bearing granite similar to that which had been mined at Ivigtut. However, the company's position was that further mining was not viable because of the low mineral contents of the available ores. The prospecting and data material from Kryolitselskabet's archives were transferred to Greenland Geological Inspectorate.

A/S Carl Nielson completed a 2-year field and laboratory project on zircon and rare earths in southwest Greenland. Three million tons of eudialyte in four separate bodies were defined with a grade of 4% yttrium and from 2% to 3.5% ZrO_2. Bulk samples were taken to Denmark for pilot plant modeling; the eudialyte is the raw material used in an EC Euram project. This project was undertaken by several Danish groups to study the alternatives to yttrium stabilization of ceramic zirconia powders. Other research and development projects by Carl Nielson included a high-grade silica sand deposit for possible use by the glass industry. A mining concession had been granted for this project. A total of eight exploration concessions and three prospecting licenses were granted in 1988.

Mineral Fuels.—Reconnaissance seismic work was completed on the Ice Sheet by a consortium operated by A/S Arco Greenland. Deep drilling was postponed until 1990.

FINLAND[4]

The Finnish minerals industry and related manufacturing sectors continued to do well in 1988. The country continued to be a significant producer of mineral products including chromite ore, ferrochrome and stainless steel, industrial minerals, nickel and zinc. In particular, nickel concentrate production rose over 20%, mainly because of the presence of new mines. Chromite concentrate also showed an increase because of greater demand.

Finland's economy was out of equilibrium, and output growth was increasing based on domestic demand. This led to a strong import growth and diverted resources from the export sector, which operated near or at capacity during 1988. Real GDP increased 4.8% compared with 3.6% in 1987. Inflation rose to 5% for 1988 with a 4.5% unemployment rate.

The Mining Division of Outokumpu Oy was divided into two parts at the beginning of 1988. The domestic mining and exploration operations, along with those in Norway and Sweden, were combined to form the Nordic Mining Group (NMG), and foreign operations outside Finland, Norway, and Sweden were placed under the name Outokumpu Resources Inc. (ORI) with headquarters in London, England. Outokumpu ceased in-house field operations involving drilling, sampling, and geophysics. In the future these functions will be contracted out to other companies.

The Outokumpu Group, the largest mining and metallurgical company in Finland, had 80 subsidiaries in over 20 countries. Nearly 90% of Outokumpu Group sales were outside Finland, and one-third of Outokumpu's 15,000 employees worked abroad. The majority state-owned company was listed on the Helsinki stock exchange in October 1988.

In 1988, Outokumpu, together with other international companies, made a preliminary agreement to open the La Escondida Mine in Chile. Outokumpu would not be a shareholder in the mine, however, it was obligated to put approximately $50 million[5] toward the mine's startup costs. The credit was provided by KOP-BANK, and guaranteed by the Finnish Export Credit Co. The Transportation Workers Union of Finland threatened Outokumpu with a boycott of copper concentrate shipments if the political situation in Chile did not show improvement. Negotiations were continuing at yearend.

In 1988, Finland become a consultative party to the Convention on the Regulation of Antarctic Mineral Resource Activities (CRAMRA) Antarctic Agreement allowing the country to take part in antarctic mineral exploitation beginning in 1989.

The small size and openness of the Finnish economy means that international economic conditions have a greater impact on activities, such as mining, than do domestic factors. The increase in world market prices for basic metals was an incentive to reopen Finnish mines that were considered unprofitable earlier. Prospecting was also more attractive. Dwindling domestic reserves have forced the industry to look abroad, and to develop new, more effective production methods to remain competitive.

Production and Trade

The Finnish mining industry is dominated by two state-owned companies, Outokumpu and Kemira Oy. These companies, mines produced nearly one-half of the ore extracted in Finland. Oy Partek AB, privately owned, was the major Finnish limestone producer. Outokumpu specialized in base metals, and Kemira specialized in fertilizer and agriculture chemicals and operated the Siilinjarvi apatite mine. This mine was the only phosphate mine in Western Europe, and supplied the concentrate for Finnish fertilizer consumption.

Total ore excavated in Finland rose almost 5% compared with 1987. The production of metallic ores amounted to 6.1 million tons, same as 1987. Eight metal mines were in operation at the beginning of 1988; however, this number was reduced with the closure of the Rautuvaara and Hannukainen iron ore operations of Rautaruukki Oy. This signaled the end of iron ore mining in Finland. Three new mines were started in late 1988, which made a total of nine metal mines operating at yearend.

In 1988, there were 30 mines operating in the industrial mineral sector that produced almost 14 million tons of industrial minerals as compared with almost 13 million tons in 1987. These included apatite, feldspar, limestone, talc, quartz, and wollastonite.

About 35% of Finland's exports were direct products of the metallurgical, mining equipment, and machinery industries. Raw material imports included 80% of the iron concentrates, 75% of the copper concentrates, 70% of the zinc concentrates, and 50% of the nickel matte and concentrate needed to support the country's industries. Finland continued to be dependent on imports, mostly crude oil from the U.S.S.R., for about two-thirds of its energy supply.

Commodity Review

Metals.—**Chromium.**—Western Europe's only chromite mine was Outokumpu's Kemi Mine. The mine, together with a ferrochrome plant at Tornio, was a part of Outokumpu's Stainless Steel Division With estimated reserves of 150 million tons, Kemi ranked as one of the world's major chromite mines and provided a sound resource base for the Stainless Steel Division. In late 1988, Outokumpu announced it would expand ferrochrome production by 30%, to about 180,000 tons per year. The plan was to modernize the pelletizing and sintering plant of the Tornio Works and to increase capacity of the Kemi Mine. The Kemi Mine annually excavated about 1 million tons of chromite ore, which contained an average 26% chromium dioxide. The expansion was estimated to cost $20 million, and the new facilities were scheduled to be on-stream by 1990. The company intended to use all its production and to cease outside sales of unprocessed ore from the mine.

Copper.—Outokumpu completed another stage of its ongoing corporate reorganization plan in 1988 by placing all of its copper operations into a new independent company to become effective January 1, 1989. The company was to be named Outokumpu Copper Oy and be headquartered in Espoo, Finland.

The metallurgical plants, including the Pori Works copper refinery and fabrication facility, would become a wholly owned subsidiary of Outokumpu Copper and would operate under the new name of Poricopper Oy.

The new company would also include the overseas copper operations, such as the Metallverken Group of Sweden, Nippert Co. and Valleycast Inc. of the United States, a 21% minority holding in Iberica del Cobre of Spain, as well as marketing organizations in Belgium, the Federal Republic of Germany, Spain, Switzerland, and the United States.

Gold.—Outokumpu announced it would start operations at its first gold mine in Finland at the beginning of 1989. Overburden and waste have been stripped from the ore body. The Saattopora open pit mine is at Kittila in Finnish Lapland. Reserves were esti-

TABLE 3

FINLAND: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987	1988[p]
METALS						
Aluminum metal, secondary		17,100	21,000	22,200	25,700	29,900
Cadmium metal, refined		614	565	[r]523	687	703
Chromium: Chromite:						
Gross weight:						
Lump ore[e]	thousand tons	312	327	450	338	450
Concentrate	do.	119	167	[r]203	192	235
Foundry sand[e]	do.	15	12	[r]15	13	15
Total	**do.**	**446**	**506**	**678**	**543**	**700**
Cr_2O_3 content:						
Lump ore[e]	do.	[2]84	88	95	91	95
Concentrate	do.	47	67	[e]75	[e]77	85
Foundry sand[e]	do.	[2]7	6	5	6	10
Total	**do.**	**138**	**161**	**[e]175**	**[e]174**	**190**
Cobalt:						
Mine output, Co content		860	[r]1,092	627	190	200
Metal, refined		1,453	[r]2,230	1,348	497	220
Copper:						
Mine output, Cu content		30,834	27,897	25,987	20,398	20,200
Metal:						
Smelter		77,600	68,900	84,460	77,400	79,000
Refined		57,318	58,766	64,235	59,500	53,900
Gold metal	troy ounces	28,067	19,130	37,680	[e]58,000	65,425
Iron and steel:						
Iron ore, marketable, all types:[3]						
Gross weight	thousand tons	1,231	1,122	973	896	[e]556
Fe content	do.	806	738	635	588	[e]360
Metal:						
Pig iron	do.	2,044	1,891	1,978	2,063	2,174
Ferroalloys, ferrochromium	do.	59	133	134	143	156
Steel, crude	do.	2,632	2,518	2,586	2,669	2,798
Semimanufactures, rolled	do.	1,985	2,063	1,997	2,025	2,300
Lead:						
Mine output, Pb content		2,478	2,422	1,980	[e]2,400	1,900
Refined, secondary		[e]4,500	4,600	1,200	[e]1,200	[e]2,000
Mercury	76-pound flasks	2,292	3,630	4,239	4,178	3,770
Molybdenum metal		([4])	([4])	([4])	([4])	—
Nickel:						
Mine output, Ni content		6,918	8,547	11,886	10,557	[e]11,699
Metal, electrolytic		15,282	15,656	17,791	15,392	15,721

See footnotes at end of table.

TABLE 3—Continued

FINLAND: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987	1988[p]
METALS—Continued						
Platinum-group metals:						
Palladium	troy ounces	1,093	1,125	3,086	[e]3,100	3,407
Platinum	do.	1,061	1,125	3,858	[e]3,900	1,736
Selenium metal	kilograms	16,975	14,038	5,693	[e]10,000	28,935
Silver metal	thousand troy ounces	1,123	998	1,193	1,421	1,010
Vanadium: Mine output, V_2O_5 content		5,469	3,805	—	—	—
Zinc:						
Mine output, Zn content		60,200	60,606	60,351	55,100	63,900
Metal		158,819	160,377	155,397	151,500	156,000
INDUSTRIAL MINERALS						
Barite		8,704	8,690	6,969	11,000	11,000
Cement, hydraulic	thousand tons	1,645	1,608	1,422	1,426	1,504
Feldspar		56,265	52,940	47,049	52,000	50,000
Mica, flake		—	—	—	[e]5,000	[e]5,000
Lime	thousand tons	241	252	261	271	260
Nitrogen: N content of ammonia		68,700	65,100	66,800	50,300	43,000
Phosphate rock, apatite concentrate:						
Gross weight	thousand tons	477	512	527	553	584
P_2O_5 content	do.	176	178	185	195	215
Pyrite, gross weight	do.	426	493	547	621	615
Sodium sulfate[e]	do.	35	35	35	35	[e]35
Stone, crushed:						
Limestone and dolomite:						
For cement manufacture	do.	2,287	2,217	1,968	[e]1,750	2,150
For agriculture	do.	1,192	1,453	1,108	[e]1,050	1,107
For lime manufacture	do.	367	357	381	[e]330	420
Fine powders	do.	316	313	330	[e]290	330
Metallurgical	do.	45	26	13	[e]12	123
Total	**do.**	**4,207**	**4,366**	**[r]3,800**	**[e]3,432**	**4,130**
Quartz silica sand	do.	262	223	232	233	272
Sulfur:						
S content of pyrite	do.	214	248	276	313	300
Byproduct:						
Of metallurgy	do.	265	257	260	[e]230	240
Of petroleum	do.	45	[e]45	42	[e]40	47
Total	**do.**	**524**	**550**	**578**	**[e]583**	**587**
Sulfuric acid	do.	1,165	1,462	1,359	1,160	1,095
Talc	do.	327	319	284	319	379
Titania concentrate: Ilmenite:						
Gross weight	do.	167	53	—	—	—
TiO_2 content	do.	75	24	—	—	—

See footnotes at end of table.

TABLE 3—Continued

FINLAND: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987	1988[p]
INDUSTRIAL MINERALS—Continued						
Wollastonite		14,669	16,917	16,795	25,000	28,000
MINERALS FUELS AND RELATED MATERIALS						
Peat:						
For fuel use	thousand tons	2,713	3,140	[e]3,600	[e]2,100	[e]32,000
For agriculture and other uses	do.	246	346	[e]400	[r][e]350	[e]350
Petroleum refinery products	thousand 42-gallon barrels	73,500	72,500	65,300	73,400	72,000

[e]Estimated. [p]Preliminary. [r]Revised.
[1]Table includes data available through May 1, 1989.
[2]Reported figure.
[3]Includes approximately 30% of unused roasted pyrite (purple ore) from the Kokkola Works.
[4]Revised to zero.

mated to be 700,000 tons of ore grading 0.1 ounce of gold per ton and 0.3% copper. Mining was expected to last for at least 2 years.

The ore zones averaged 10 meters in thickness and had a dip of about 50°. The deposit was hosted by albite felsite rocks, with an ultrabasic or albite foot wall, and the hanging wall is formed by tuffites. The final open pit was expected to be 300 meters long by 150 meters in width and 70 meters deep.

The ore would be trucked 34 miles to the Rautuvaara concentrator that was purchased by Outokumpu in late 1988 from Rautaruukki Oy. Outokumpu had modified the concentrator to treat the Saattopora ore, and was expected to achieve a 90% gold recovery.

Iron and Steel.—Rautaruukki terminated its unprofitable mining operations at the end of 1988 by closing its last mine, the Rautuvaara Iron and Copper Mine. The company had closed its Hannukainen Mine earlier in the year. Rautaruukki was no longer involved in ore prospecting except for international coal exploration for its steel factories. At yearend, iron ore was no longer mined in Finland. However, there may be a new future for mining in the Kolari area. An iron ore deposit containing rare metals had been discovered about 40 kilometers south of the closed Rautuvaara Mine. The deposit was large, and the iron ore contained titanium and vanadium. There was considerable interest in the deposit because ore containing this combination of metals had not been found previously in Finland. Exploration was continuing at yearend.

Ovako Steel Oy AB revamped its secondary steelmaking and casting facilities at the scrap-based Imatra Steelworks. The equipment, which was commissioned in late 1988, included a ladle furnace, injection station, vacuum degasser, a bloom continuous caster, and a reheating furnace for the blooms. The estimated cost of the project was $120 million. This investment was expected to rationalize production and increase product quality. There was the possibility of raising production from 260,000 tons of crude steel and 200,000 tons of rolled products per year to 310,000 tons of steel, 210,000 tons of rolled products, and 45,000 tons of billets per year.

Outokumpu commissioned its new 500,000-ton-per-year hot strip stainless steel mill at the Tornio Works in early 1988. The company invested $170 million in the project. Outokumpu was considered to be the world's only stainless steelmaker to possess a complete integrated production line from chromite ore to finished steel at one site. The main reasons for building a hot-rolling mill for the Tornio Works were technical considerations, savings in transport charges, shorter throughput times, and ability to develop new grades of products.

Nickel.—In mid-1988, Outokumpu reopened the Hitura Mine, which had been closed since 1985. The mine has estimated nickel ore reserves of 600,000 tons. Production could be 3,000 to 4,000 tons per year of nickel concentrate. The Halvalia Mine restarted operations and the new underground nickel mine at Telkkala in 1988. Reserves at Telkkala were estimated at 350,000 tons grading 2% nickel and 0.6% copper. The startup of these mines resulted in a rise in nickel concentrate production of over 20%. The mines that were started up were all relatively small and were expected to be in production for 2 to 3 years. In February 1988, an oxygen plant explosion in Outokumpu's Harjavalta facilities put both a 50-ton-per-day nickel cathode smelter and a 300-ton-per-day copper anode smelter out of operation. The copper smelter was restarted using another oxygen plant; however, it was mid-1988 before production resumed at the nickel smelter. The plant was operating at approximately 60% capacity until a new oxygen plant could be constructed. Production losses were estimated at 650 tons of catalytic nickel. Although the quantity of nickel involved is not substantial in terms of total world nickel production, the Outokumpu nickel is a high-quality plating-grade nickel and significantly affected that segment of the market.

Other Metals.—Kajaani Oy continued exploration efforts on a silver deposit at Taivaljarvi in Sotkamo. The company was constructing a 350-meter-deep shaft to acquire more information. Taivaljarvi was the most promising silver deposit in Finland with an estimated 10 million tons of ore, 4 million tons of which contain over 3 ounces of silver per ton. At 1988 silver prices, the deposit would not be profitable; however, Kajaani had begun negotiations with Outokumpu to jointly exploit the deposit. Taivaljarvi also contained varying minor amounts of gold, lead, and zinc.

Outokumpu reported the discovery of a zinc ore body near its Pijhasalmi Mine. The deposit assayed around 8% to 10% zinc content; however, the deposit appeared to be small. Investigation was continuing at yearend. The company was also undertaking a pilot stoping operation on a small platinum-palladium deposit in the north of the country and was developing a recovery program to process the ore.

***Industrial Minerals.*—Phosphate Rock.** Kemira, the Lapponia Province, and the Northern Finland Research Center of the University of Oulu were investigating the profitability of the Sokli phosphate deposit in Lapland. Kemira estimated that 1.8 million tons of phosphorus concentrates per year could be produced from the Sokli Mine, which would give the mine a 20- to 25-year life expectancy. Annually, the Sokli Mine would produce three times as much phosphorus concentrate as Kemira's Siilinjarvi Mine, the largest phosphate rock mine in Finland. Since Siilinjarvi already produced more than Finland's domestic needs could accommodate, all of the Sokli Mine's production was expected to be exported. For reasons of cost, Kemira would not refine the phosphorus concentrate in Finland. Instead, the concentrate would be shipped via pipeline to Kemi and from there to Kemira's fertilizer factories in Belgium, Denmark, and Holland.

Other Industrial Minerals.—The Geologic Survey of Finland was prospecting for industrial minerals, especially lime, granite, and kaolin. A promising deposit of mica and one of granite was discovered in Vammala. The granite was of uniform quality but the extent of the deposit was unknown. In addition, a kaolin deposit in Virtasalmi was being investigated. The kaolin deposit was a significant one with several million tons of high kaolin content material.

Partek Oy, a major limestone producer in Finland, bought Myllykoski Oy's talc operation in Luikonlahti. The operation consisted of a talc factory and three talc quarries. The output amounted to around 75,000 tons annually and consisted mainly of talc products for the paper and paperboard industries.

Partek was part of a Nordic joint venture to build a lime kiln for reactive burnt lime production on Sweden's Gotland Island. Partek owned one-half of the Swedish limestone mine, which has an annual production of 2 million tons. The company entered into a cooperative agreement with the U.S.S.R. on industrial minerals development and also participated in a project for increasing the level of wollastonite refinement.

Other activities included the prospecting by Lohja Oy for industrial minerals; Partek, for lime and kaolin; Malmikaivos Oy, for pigments; Ruskealan Marmori, for lime; and Finn Metals for talc.

Mineral Fuels.—Finland was one of the world's highest per capita energy consumers due to its harsh climate and industrial infrastructure. In 1988, primary energy consumption totaled 29.7 million tons oil equivalent up 1.4% from the previous year. Use of oil as primary energy fell by 2% to 9.5 million tons oil equivalent. Oil was being replaced by nuclear- and coal-produced electricity.

In 1988, natural gas imports, all from the U.S.S.R. via pipeline, totaled 1.7 billion cubic meters, 7% more than 1987. All the natural gas imported from the U.S.S.R. is fed into Finnish pipelines from a compressor station north of Leningrad. The 700-kilometer-long pipeline network extends from the Soviet border inland to the cities of Tampere, Lahti, and Helsinki in Finland.

In 1988, the U.S.S.R. was constructing a parallel natural gas pipeline between Leningrad and the West Siberian deposits, and increasing storage facilities for natural gas. These projects were related to plans to transport Soviet natural gas to Sweden via southern Finland. Sweden was to decide in 1989 whether or not to buy Soviet natural gas. Regardless of the Swedish decision, Finland was planning to extend the pipeline network to the Finnish west coast at Turku.

Finland had no indigenous supply of hydrocarbon fuels other than peat. Around 10% of indigenous energy came from peat, and in 1988, peat supplied 3% of primary energy.

ICELAND[6]

Positive changes occurred in Iceland's metals and mineral industry in

1988. Primary aluminum, ferrosilicon, and cement production increased over 1987 levels. These industries constituted over 90% of the value of total mineral production. The improvement in the world markets for aluminum and ferrosilicon encouraged those plants in Iceland to expand output and, for the first time in years, to make a profit on their operations.

There was strong economic growth in 1987. The GDP increased by over 6% in real terms, but was expected to decline by 1% with little or no growth in 1988. This was mainly the result of lower fish catches combined with lower world prices for fish. The rate of inflation doubled from 13% in 1986 to almost 26% in 1988. Iceland's unit of currency, the krona, underwent three devaluations in 1988.

Iceland's main mineral industries were aluminum and ferrosilicon, and both were highly energy intensive. Iceland has installed hydroelectric power capacity of 4,200 gigawatt hours per year. The aluminum and ferrosilicon producers are the major users of this economical source of energy. To maintain the desired flexibility to respond to different energy demand developments required by energy-intensive industrialization, Landsvirkjun, the national power company, was constructing the 150-megawatt Blanda hydropower project, which was expected to be operational in 1991. The increasing energy demand of the present market will be met by this plant, and the Government will also be in a position to offer favorable rates to new energy-intensive customers.

Production and Trade

Production of aluminum and ferrosilicon increased. Sales and production by Sementsverksmidja Rikisins, the state cement factory, set a new record while there was a 5% drop in sales by Aburdaverksmidja Rikisins, the state fertilizer factory. Production of diatomite increased at Kisilidjan Corp. mines near Krafla, with a 15% increase in export sales. The trade deficit was expected to reach around $130 million.[7] This, combined with payment of interest on foreign loans, was expected to leave a 1988 balance-of-payments deficit of $250 million.

Commodity Review

Production of primary aluminum at Icelandic Aluminum (ISAL) increased

TABLE 4

ICELAND: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987	1988[p]
Aluminum metal, primary[2]		80,359	73,403	75,929	83,485	82,034
Cement, hydraulic[3]	thousand tons	118	114	111	127	134
Diatomite		27,265	29,388	22,897	22,897	25,142
Iron and steel: Ferrosilicon		60,976	60,328	66,787	60,184	70,051
Nitrogen: N content of ammonia		[e]7,000	7,532	7,980	9,039	8,812
Pumice and related volcanic material:						
Pumice		55,000	56,000	52,500	58,792	65,444
Scoria		[r] [e]675	[e]375	[e]375	271	351
Salt		950	1,350	704	1,830	[e]2,000
Sand:						
Basaltic	cubic meters	4,000	5,500	[e]5,000	5,400	2,300
Calcareous, shell	thousand cubic meters	115	100	129	115	135
Sand and gravel	do.	4,700	4,150	4,088	4,816	[e]4,200
Silica dust[4]		[3]7,221	[3]7,873	13,886	12,131	[e]10,000
Stone, crushed:						
Basaltic	thousand tons	90	80	77	114	91
Rhyolite		20,000	25,755	23,114	22,700	28,300

[e]Estimated. [p]Preliminary. [r]Revised.
[1] Table includes data available through May 31, 1989.
[2] Ingot and rolling billet production.
[3] Sales.
[4] Byproduct of ferrosilicon.

TABLE 5

ICELAND: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987	
			United States	Other (principal)
Abrasives, n.e.s: Natural: Corundum, emery, pumice, etc.	36,939	58,771	334	United Kingdom 20,161; Norway 17,499; West Germany 10,734.
Aluminum:				
Ash and residue containing aluminum	—	14	—	All to Netherlands.
Metal including alloys, unwrought	77,490	89,081	—	West Germany 28,339; Switzerland 22,275; United Kingdom 18,626.
Diatomite and other infusorial earths	23,423	23,214	—	West Germany 6,689; Italy 2,901; United Kingdom 2,194.
Fertilizer materials, manufactured:				
Nitrogenous	—	4	—	All to West Germany.
Unspecified and mixed	—	9	—	All to Sweden.
Iron and steel: Metal:				
Scrap	2,527	7,668	—	Spain 5,100; Netherlands 2,566.
Ferrosilicon	64,990	71,656	20,410	Japan 31,089; West Germany 9,733.
Stone, sand and gravel: Dimension stone, crude and partly worked	591	271	—	West Germany 161; Denmark 91; Netherlands 19.
Other: Base metals including alloys, scrap	635	845	—	Netherlands 716; Denmark 64; West Germany 36.

[1] Table prepared by P. J. Roetzel.

with a pretax profit of about $11 million expected. This was the best performance in the 22-year-old company's history. High prices for aluminum on the world market were the main reason for the record profit. As a result of the high market price, ISAL was paying the maximum price of 18.5 mills ($0.0185) per kilowatt hour for electricity. This raised Landsvirkjuno's earnings to more than $20 million.

In 1988, four European aluminum companies agreed to conduct a feasibility study for another aluminum smelter at Straumsvik, south of Reykjavik, near the plant already operated by ISAL. The $500,000 study, contracted out to the Bechtel Co. of the United States, was funded by Alumined Beheer of the Netherlands, Austria Metal of Austria, Granges of Sweden, and Alusuisse, the parent company of ISAL. The study focused on the feasibility of constructing a 90,000- to 110,000-ton-per-year aluminum smelter to go on-line in 1992. This would double Iceland's existing production, which already brought in around one-sixth of export earnings.

Several other foreign firms, including Norsk Hydro A/S, Norway; Alumax, United States; and Essenbau, Federal Republic of Germany, have contacted the Government in regards to possible construction of a third aluminum smelter.

Icelandic Alloys—owned by the Government of Iceland (55%), Elkem A/S of Norway (30%), and Sumitomo Corp. of Japan (15%)—produced an unexpectedly high profit in 1988. High market prices and rising demand contributed to this. Modifications, which have boosted plant capacity 20%, were also attributed to the upturn in performance.

TABLE 6

ICELAND: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS				
Aluminum:				
Ore and concentrate kilograms	—	100	—	All from United Kingdom.
Oxides and hydroxides	138,028	142,335	(2)	Australia 142,327; West Germany 8.
Metal including alloys:				
Scrap	1	—		
Unwrought	87	29	—	Mainly from United Kingdom.
Semimanufactures	1,197	1,442	33	Norway 314; Belgium-Luxembourg 270; West Germany 240.
Beryllium: Metal including alloys, all forms	(2)	—		
Chromium: Oxides and hydroxides kilograms	2,000	500	—	Mainly from West Germany.
Cobalt: Oxides and hydroxides value, thousands	(2)	$1	—	All from Sweden.
Columbium and tantalum: Metal including alloys, all forms: Tantalum	(2)	—		
Copper:				
Ore and concentrate	120	60	—	All from West Germany.
Metal including alloys:				
Unwrought	5	4	—	Mainly from Denmark.
Semimanufactures	218	218	12	West Germany 82; Sweden 56; United Kingdom 16.
Gold: Metal including alloys, unwrought and partly wrought value, thousands	$126	$174	$36	Switzerland $31; Netherlands $30; Republic of South Africa $23.
Iron and steel:				
Iron ore and concentrate excluding roasted pyrite	24,862	17,162	—	Norway 17,144; United Kingdom 18.
Metal:				
Pig iron, cast iron, related materials	327	381	17	Netherlands 303; United Kingdom 30.
Ferroalloys:				
Ferromanganese kilograms	—	300	—	All from Norway.
Ferrosilicon do.	—	300	—	Do.
Unspecified	6	9	—	U.S.S.R. 8; Sweden 1.
Steel, primary forms	641	1,236	—	Sweden 737; Netherlands 335; Czechoslovakia 98.
Semimanufactures:				
Bars, rods, angles, shapes, sections	18,952	23,663	4	Norway 7,642; Poland 4,519; Spain 2,480.
Universals, plates, sheets	12,863	14,889	1	Belgium-Luxembourg 2,981; West Germany 2,847; Norway 2,427.
Hoop and strip	579	1,085	23	Czechoslovakia 292; Norway 225; Belgium-Luxembourg 186.
Rails and accessories	68	13	—	West Germany 7; Italy 3; Denmark 2.
Wire	290	321	(2)	Belgium-Luxembourg 188; Denmark 29; Finland 25.
Tubes, pipes, fittings	7,506	6,622	157	Netherlands 1,909; West Germany 1,854; Czechoslovakia 649.

See footnotes at end of table.

TABLE 6—Continued

ICELAND: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS—Continued				
Iron and steel—Continued				
Metal—Continued				
Semimanufactures—Continued				
Castings and forgings, rough	156	280	—	Norway 142; Denmark 46; West Germany 40.
Lead:				
Oxides	16	13	—	West Germany 8; Sweden 2.
Metal including alloys:				
Scrap	—	10	—	All from Denmark.
Unwrought	246	297	—	United Kingdom 204; Denmark 66; Sweden 18.
Semimanufactures	30	56	(2)	West Germany 41; Belgium-Luxembourg 11; Denmark 4.
Magnesium: Metal including alloys:				
Unwrought	127	30	—	All from Norway.
Semimanufactures kilograms	(3)	300	—	All from West Germany.
Manganese: Oxides	4	6	—	Mainly from Netherlands.
Mercury 76-pound flasks	3	3	—	Mainly from Norway.
Nickel: Metal including alloys, semimanufactures	3	2	—	United Kingdom 1.
Platinum-group metals: Metals including alloys, unwrought and partly wrought value, thousands	$141	$181	$5	Switzerland $89; Netherlands $53; West Germany $25.
Silver: Metal including alloys, unwrought and partly wrought do.	$89	$156	$16	Sweden $45; Denmark $26; Switzerland $26.
Tin: Metal including alloys:				
Scrap	4	1	—	All from Belgium-Luxembourg.
Unwrought	1	(2)	—	All from United Kingdom.
Semimanufactures	9	5	(2)	Denmark 3; United Kingdom 1.
Titanium: Oxides	505	484	—	United Kingdom 316; Norway 85; West Germany 80.
Tungsten: Metal including alloys, all forms value, thousands	$12	$4	$3	United Kingdom $1.
Zinc:				
Oxides	11	10	—	West Germany 8; Norway 2.
Blue powder	12	14	—	Denmark 7; Norway 4; United Kingdom 3.
Metal including alloys:				
Scrap	—	3	—	All from Belgium-Luxembourg.
Unwrought	71	92	—	Norway 39; West Germany 36; Belgium-Luxembourg 15.
Semimanufactures	29	11	(2)	France 10.
Other: Base metals including alloys, all forms	13	2	—	West Germany 1.

See footnotes at end of table.

TABLE 6—Continued

ICELAND: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	34	98	11	Netherlands 51; Italy 25.
Artificial: Corundum	([2])	1	—	All from Denmark.
Grinding and polishing wheels and stones	34	40	([2])	West Germany 8; Italy 5; Sweden 5.
Barite and witherite	38	32	—	West Germany 20; Denmark 11.
Boron materials:				
Crude natural borates	10	—		
Oxides and acids kilograms	400	500	—	Mainly from West Germany.
Cement	181	158	2	Denmark 52; Belgium-Luxembourg 36; Sweden 36.
Chalk	290	290	—	United Kingdom 95; Norway 81; France 62.
Clays, crude	327	511	127	United Kingdom 315; Netherlands 42.
Cryolite and chiolite	50	—		
Diamond, natural:				
Gem, not set or strung value, thousands	$55	$84	—	Belgium-Luxembourg $59; Netherlands $8; Switzerland $7.
Industrial stones do.	$10	$12	—	Denmark $6; Belgium-Luxembourg $5.
Diatomite and other infusorial earth	62	2	([2])	France 1; Netherlands 1.
Feldspar, fluorspar, related materials kilograms	200	300	NA	NA.
Fertilizer materials: Manufactured:				
Ammonia	7,336	5,071	—	France 3,982; Norway 1,047.
Nitrogenous	146	667	2	West Germany 550; Norway 86; Denmark 24.
Phosphatic	1,263	1,535	—	All from Sweden.
Potassic	9,871	9,162	—	East Germany 8,412; Austria 750.
Unspecified and mixed	13,171	9,076	2	Morocco 5,778; Netherlands 2,845; West Germany 362.
Graphite, natural	18	15	—	Mainly from United Kingdom.
Gypsum and plaster	4,555	6,684	—	Sweden 6,642; Denmark 17.
Lime	510	512	—	United Kingdom 268; West Germany 224; Denmark 20.
Magnesite, crude	2	13	—	Mainly from Netherlands.
Mica:				
Crude including splittings and waste	30	16	—	Norway 15.
Worked including agglomerated splittings kilograms	100	100	—	Mainly from Switzerland.
Nitrates, crude	—	88	—	Norway 76; Denmark 12.
Phosphates, crude	12	16	—	Denmark 11.
Pigments, mineral: Iron oxides and hydroxides, processed	41	49	—	Denmark 20; West Germany 10; Spain 8.

See footnotes at end of table.

TABLE 6—Continued

ICELAND: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987	
				United States	Other (principal)
INDUSTRIAL MINERALS—Continued					
Precious and semiprecious stones other than diamond:					
Natural	value, thousands	$19	$12	—	West Germany $4; United Kingdom $2; Norway $1.
Synthetic	do.	$14	$14	—	West Germany $6; Belgium-Luxembourg $5.
Salt and brine		83,525	103,442	1	Spain 97,590; West Germany 3,455; United Kingdom 804.
Sodium compounds, n.e.s.:					
Carbonate, manufactured		1,493	1,189	—	France 775; United Kingdom 151; West Germany 110.
Sulfate, manufactured		126	120	([2])	Sweden 89; Denmark 19; West Germany 10.
Stone, sand and gravel:					
Dimension stone:					
Crude and partly worked		213	217	—	China 84; Norway 61; Italy 31.
Worked		545	1,093	—	Italy 578; Portugal 455; Denmark 21.
Dolomite, chiefly refractory-grade		344	957	—	Norway 928; Sweden 24.
Gravel and crushed rock		202	12,419	—	Norway 12,247; Italy 60.
Limestone other than dimension		155	151	—	Denmark 146; Sweden 5.
Quartz and quartzite		135,506	87,347	63	Spain 46,750; Norway 40,475.
Sand other than metal-bearing		264	372	([2])	Netherlands 95; Sweden 90; Denmark 81.
Sulfur:					
Elemental:					
Crude including native and byproduct		38	([4])	([4])	
Colloidal, precipitated, sublimed		1	3	—	Belgium-Luxembourg 2.
Dioxide		10	—		
Sulfuric acid		95	78	—	Denmark 65; Netherlands 7; West Germany 2.
Talc, steatite, soapstone, pyrophyllite		95	89	2	Norway 79; Sweden 2.
Other:					
Crude		1	75	—	Finland 29; Norway 24; Sweden 21.
Slag and dross, not metal-bearing		171	333	—	Norway 300; Netherlands 30.
MINERAL FUELS AND RELATED MATERIALS					
Asphalt and bitumen, natural		63	29	—	Belgium-Luxembourg 19; United Kingdom 5; Denmark 4.
Carbon black	kilograms	300	300	—	NA.
Coal:					
Anthracite		49,898	40,409	40,379	United Kingdom 30.
Bituminous		23,622	19,510	19,508	Denmark 2.
Briquets of anthracite and bituminous coal		—	22	12	Norway 10.

See footnotes at end of table.

TABLE 6—Continued

ICELAND: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987	
				United States	Other (principal)
MINERAL FUELS AND RELATED MATERIALS—Continued					
Coal—Continued					
Lignite including briquets		1,945	5	—	All from United Kingdom.
Coke and semicoke		39,602	31,977	—	Norway 25,726; East Germany 5,072; United Kingdom 1,106.
Peat including briquets and litter		192	238	—	Finland 113; Sweden 77; Netherlands 30.
Petroleum refinery products:					
Liquified petroleum gas	thousand 42-gallon barrels	11	11	(2)	Sweden 4; Norway 3; Denmark 2.
Gasoline	do.	1,026	1,023	—	U.S.S.R. 697; Netherlands 265; Belgium-Luxembourg 60.
Mineral jelly and wax	do.	3	3	(2)	United Kingdom 2.
Kerosene and jet fuel	do.	495	806	(2)	Netherlands 600; Belgium-Luxembourg 139; United Kingdom 67.
Distillate fuel oil	do.	1,889	2,133	(2)	U.S.S.R. 1,286; Netherlands 600; Belgium-Luxembourg 112.
Lubricants	do.	53	47	(2)	Netherlands 14; Belgium-Luxembourg 10; West Germany 8.
Residual fuel oil	do.	595	528	—	Mainly from U.S.S.R.
Bitumen and other residues	do.	111	102	—	All from Sweden.
Bituminous mixtures	do.	2	2	(2)	Mainly from United Kingdom.
Petroleum coke	do.	—	1	1	

NA Not available.

[1] Table prepared by P. J. Roetzel.

[2] Less than 1/2 unit.

[3] Less than 50 kilograms.

[4] Unreported quantity valued at $500, all from the United States.

NORWAY[8]

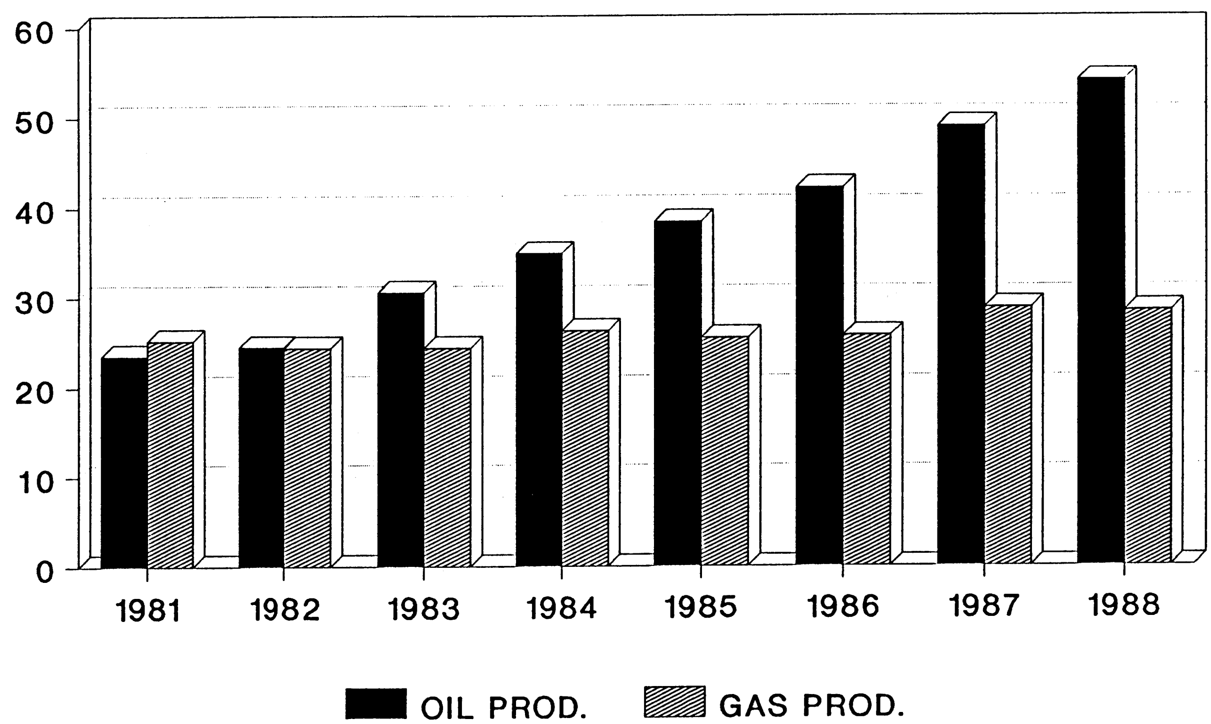
Production of primary aluminum and ferroalloys, each major energy-intensive industries, increased for the fourth consecutive year. The two Norwegian aluminum companies, Elkem and Norsk Hydro's, Hydro Aluminium A/S, made productivity improvements and rationalizations in both the aluminum and ferroalloy industries, which would have advantages on the European mainland in a 1992 market environment. Also, the Government restructured the steel industry and formed Norsk Jern Holding A/S (NJH) in accordance with the Parliamentary resolution of June 9, 1988, and White Paper No. 113 (1987-88). The State owned all NJH stock formed from the previous Norsk Jernverk A/S. The changes reflect the decision of the Government that steel production based on iron ore would cease, and all scrap-steel production would be concentrated at Mo i Rana. The goal was that after restructuring, NJH would operate without the support of the State and would be a viable and profitable company. The iron ore mine products from Rana Gruber were to be exported and to compete on the open market. However, since another source of manganese ore was unavailable, the Norwegian Government granted Elkem an extended exemption from the unilateral trade ban on South African manganese ores.

The petroleum production from 19 producing fields in the North Sea increased almost 10% in 1988, despite the continuation of the Government's mandated 7.5% production cutback (see figure 1). This cutback represented approximately 115,000 barrels per day. This reduction was not sufficient to offset record production levels attained

FIGURE 1

NORWEGIAN OIL AND GAS PRODUCTION

(Million metric tons oil equivalent)



Source: The Royal Ministry of Petroleum and Energy--Norway

by the addition of new production. For example, the first oil production from the Osperg Field amounted to 100,000 barrels per day, and was ahead of schedule. The project was completed below estimated cost. Norwegian oil production at the level of 590 million barrels was expected to continue until the mid-1990's, after which, new discoveries would be required to stabilize a downward production trend (see figure 2). In 1988, 397.94 million barrels of oil, 27.23 million barrels of natural gas liquids (NGL), and 1,002.94 billion cubic feet of gas were produced from the Norwegian sector of the North Sea. Of the oil produced, 14.8% remained in Norway. Exports were as follows: 29.7% to the United Kingdom, 14.1% to the Netherlands, 9.7% to the United States, and so forth.

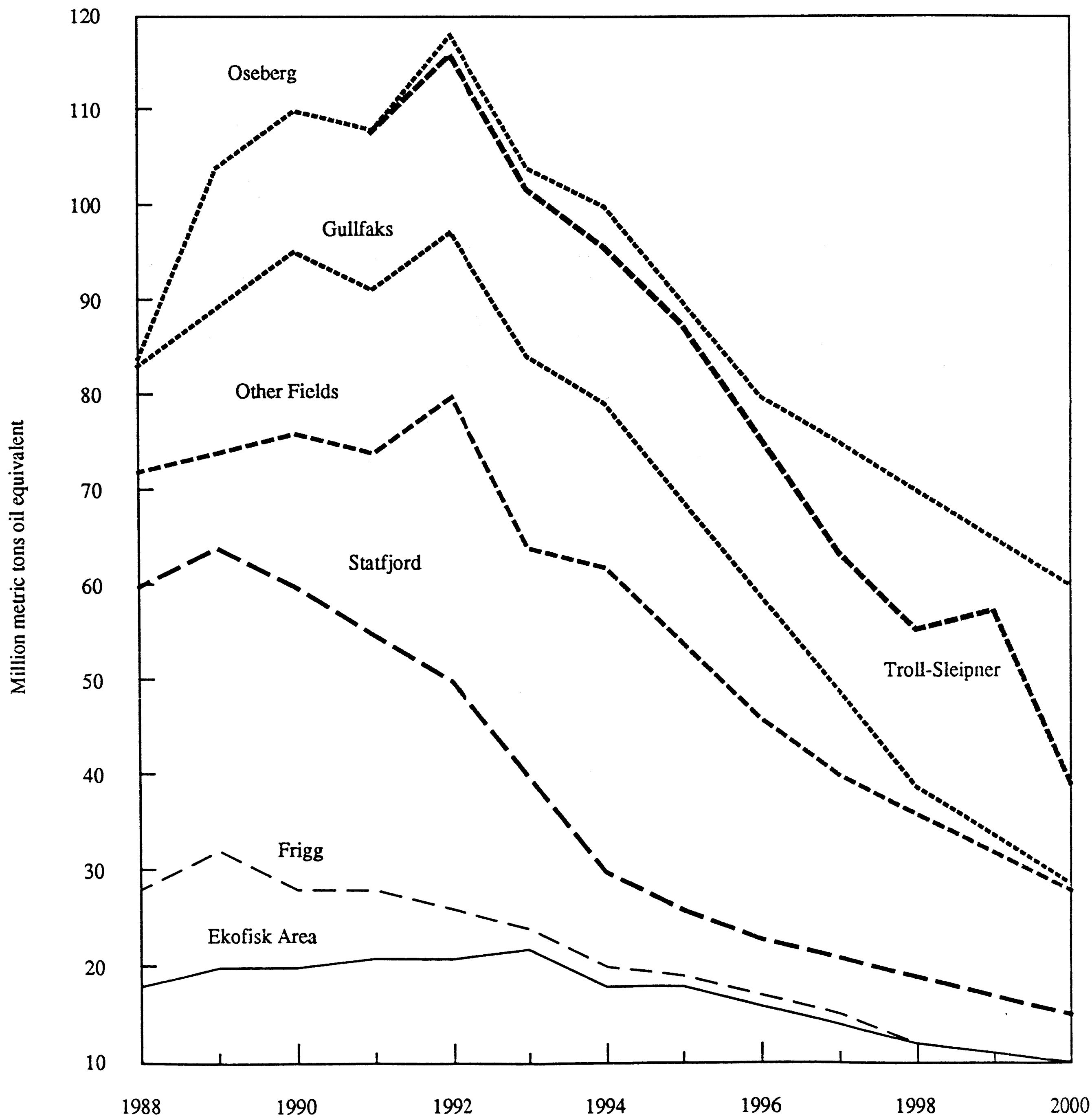
Sale of natural gas on long-term contracts to continental Europe continued with the agreement between the owners of Troll Field and the Spanish company, Enagas. Enron Co., an American company, Statoil A/S, and Norsk Hydro initiated a cooperation agreement to sell Norwegian LNG to the American market in the mid-1990's.

Exploratory drilling proved the most promising offshore area to be the Haltenbanken area of the Norwegian Sea with six new fields discovered. On the contrary, all 39 wells drilled in the Barents Sea have failed to find commercial oil reserves. The natural gas discoveries were classified as uneconomical, due to the high cost of off-

FIGURE 2

FORECAST OF NORWEGIAN PRODUCTION

(Million metric tons oil equivalent)



Source: The Royal Ministry of Petroleum and Energy--Norway.

shore production facilities, the environmental considerations, and the distance and costs to ship the products to market. To meet these requirements, the Government's short-term goal was to award additional blocks, in the Barents Sea, which had not been previously opened to exploration activities and would provide additional geologic information. In the 12th Round, phase A, 16 blocks were awarded in the North Sea; these mostly were localized around existing infrastructures, which was consistent with the priority for development adjacent to the present infrastructure. In the 12th License Round, phase B, in March 1988, 13 new blocks were awarded: 3 in the North Sea, 3 on Haltenbanken, 1 on Nordland II, and 6 in the Barents Sea. In September 1988, at the 12th Round, phase B, new key blocks were announced and were to be awarded in 1989. The goal was to place before the Norwegian Parliament, the Storting, in 1989, the issue of opening up Finnmark West, southern parts, Trons II and Trons III as well as the remaining areas of the Barents Sea. In 1988, the Storting approved the development of two fields, Snorre and Draugen, and revised and approved the Plan for development of Hod Field. At yearend, 9 fields were under development and 16 other fields under consideration for development.

Twenty-nine wells, eighteen exploration and eleven delineation wells, were initiated in the Norwegian waters, indicating a continuing decrease in activity since the high of 50 wells were drilled in 1985. Nineteen wells were drilled in the North Sea, six in the mid-Norwegian Continental Shelf, and four in the Barents Sea. Since the first well was drilled in 1966 in the Norwegian waters, a total of 598 wells, 429 exploration, and 169 delineation wells, have been drilled.

Norway's domestic market was sluggish and the pace of petroleum development in the North Sea was slower due to generally lower petroleum prices. The real GDP increased a modest 2.0%, unemployment increased to 3.2%, and inflation eased slightly to 6.2%. The tight economic policies of the Government contributed to an improvement in the overall current trade account balance. This balance improved from a \$4.85 billion[9] deficit to an approximate \$2.0 billion deficit in 1988. The import values increased by 2.4%, and export goods increased by 6.3%, in spite of a 15% decrease in oil prices from 1987.

Government Policies and Programs

Although Norway and other Nordic countries had not become members of the EC, trade agreements with the EC countries were in place. In fact, the Norwegian electorate elected in 1972 not to join the EC; however, this was before the big North Sea discoveries, which transformed the country and helped modernize many of its industries. Norwegian companies were in competition with EC countries for the North Sea business and had to adjust to EC standards and practices. The importance of the EC market has led to the formation of strategies that would allow Norwegian companies to take advantage and compete effectively in the 1992 market environment.

Production

The output of metals, particularly aluminum, primary steel, and ferroalloys, increased significantly due to the strong worldwide demand for metal products. The mining industry fared less favorably because of overseas competition and Government reorganizations. Output of crude oil continued to increase significantly, and the production of natural gas, limited by the availability of production facilities and pipelines, was expected to remain stable for the next few years.

Trade

Total exports of North Sea crude oil and natural gas decreased in value, in response to slightly lower prices for all hydrocarbon products. Total U.S. exports to Norway increased by 11% to \$932 million, and Norwegian exports to the United States, which included crude oil, metals, and fertilizers, increased marginally to \$1,561 million from \$1,514 million in 1987.

Commodity Review

Metals.—**Aluminum.**—Norsk Hydro acquired the remaining 30% interest in Hydro Aluminium, and made it a wholly owned subsidiary. This subsidiary produced 620,000 tons of primary aluminum at four wholly owned and one partially owned Norsk Hydro plant in Norway. The annual capacities of the company's four primary aluminum plants were as follows: Karmoy Fabrikker, 220,000 tons; Ardal Verk, 185,000 tons; Sunndal Verk, 140,000 tons; and Hoyanger Verk, 70,000 tons. Improvements at several smelters resulted in increased production of 19,000 tons over 1987 production levels. One-half of the total production goes to the company's own semifabricating plants in nine European countries and the United States. Norsk Aluminium A/S was reorganized into five groups with the addition of the Rolled Products and of the Technology groups to the previous three units of Metal, Extrusion, and Fabricating. The consumption and the price of aluminum increased strongly in 1988, resulting in additional production by yearend. The Extrusion Group's plants operated at full capacity due to the strong European market. The Rolled Products markets were also good; however, the rapid increase in prices led to pressures on profit margins.

Expansion of the Karmoy aluminum smelter, Karmoy Farbrikker, was completed and put into full production. The new rated capacity was 220,000 tons per year. Two old potlines, representing about 50% of capacity, were of the Soderberg design, and the remaining cells, which were totally enclosed to prevent excessive fume emission, used prebaked anodes in accordance with a modified Pechiney design. The Government approved a proposal to moder-

TABLE 7

NORWAY: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987	1988[p]
METALS						
Aluminum:						
Primary		765,083	742,686	725,813	806,092	864,190
Secondary		5,587	6,004	[e]6,000	[e]6,000	[e]6,000
Cadmium, smelter		150	159	154	147	169
Cobalt		1,191	1,637	1,574	1,576	1,852
Copper:						
Mine output, Cu content		25,042	18,969	21,887	21,984	15,877
Metal, primary plus secondary:						
Smelter		36,821	37,828	35,202	29,701	[3]31,729
Refined		30,323	31,074	30,457	29,386	[3]31,729
Iron and steel:						
Iron ore and concentrate:						
Gross weight	thousand tons	3,837	3,497	3,618	3,140	3,242
Fe content	do.	2,500	2,321	2,377	[e]2,060	2,126
Metal:						
Pig iron	do.	546	596	564	365	367
Ferroalloys:						
Ferromanganese		285,169	267,670	195,257	191,992	361,345
Ferrosilicomanganese		280,953	256,457	223,490	237,277	232,501
Ferrosilicon (75% basis)		437,164	397,776	352,572	336,168	380,976
Total		**1,003,286**	**921,903**	**753,788**	**765,437**	**974,822**
Steel, crude	thousand tons	920	958	836	837	907
Semimanufactures, rolled	do.	615	664	687	[e]700	[e]700
Lead, mine output, Pb content		3,967	3,597	3,366	3,100	[3]2,801
Magnesium, primary		49,301	54,704	56,864	56,907	50,317
Nickel:						
Mine output, Ni content		325	425	438	496	[e]500
Metal, primary		35,548	37,513	38,202	44,565	[3]52,547
Platinum-group metals[2]	troy ounces	44,529	44,079	51,440	[e]50,000	[e]50,000
Silicon metal		89,398	105,552	[e]100,000	[e]90,000	[e]90,000
Zinc:						
Mine output, Zn content		28,513	27,352	27,508	22,164	[3]17,783
Metal, primary		94,248	92,762	90,475	116,468	[3]121,156
INDUSTRIAL MINERALS						
Cement, hydraulic	thousand tons	1,547	1,343	1,625	1,639	[3]1,428
Feldspar		67,820	80,095	87,257	[e]90,000	[e]90,000
Gallium[e]	kilograms	—	—	—	1,000	1,000
Gold[e]	troy ounces	—	300	3,000	30,000	30,000
Graphite		10,067	2,684	—	—	—
Lime, hydrated, and quicklime[e]	thousand tons	130	100	100	100	100
Mica, flake[e]		4,000	4,000	3,000	3,000	3,000
Nepheline syenite	thousand tons	226	227	218	242	[e]250
Nitrogen: N content of ammonia	do.	636	458	300	347	424

See footnotes at end of table.

TABLE 7—Continued

NORWAY: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987	1988[p]
INDUSTRIAL MINERALS—Continued						
Olivine sand	thousand tons	1,772	1,989	2,537	1,912	[e]2,000
Pyrite	do.	428	395	380	358	[e]350
Stone, crushed:						
Dolomite	do.	534	555	[e]550	[e]550	[e]550
Limestone	do.	3,995	3,827	[e]4,000	[e]4,000	[e]4,000
Quartz and quartzite	do.	828	775	[e]800	[e]800	[e]800
Sulfur:						
Pyrite, S content	do.	203	193	181	[e]180	[e]170
Byproduct of:						
Metallurgy	do.	62	60	67	[e]85	[e]80
Petroleum	do.	8	10	[e]13	[e]10	[e]10
Total	**do.**	**273**	**263**	**261**	**[e]275**	**[e]260**
Talc, soapstone, steatite[e]	do.	[3]113	100	100	100	100
Titania:						
Ilmenite concentrate	do.	652	736	804	852	[e]875
TiO_2 content	do.	289	327	357	378	[e]385
MINERAL FUELS AND RELATED MATERIALS						
Coal, all grades	thousand tons	451	507	437	448	275
Coke, all grades	do.	337	313	313	284	[e]275
Gas:						
Manufactured	million cubic feet	73	—	—	—	—
Natural:						
Gross	billion cubic feet	1,144	1,202	1,119	1,216	[e]1,220
Marketable[4]	do.	964	983	973	1,076	[e]1,080
Marketed[5]	do.	944	898	829	998	1,003
Peat:[e]						
For agricultural use	thousand tons	30	30	30	30	30
For fuel use	do.	1	1	1	1	1
Petroleum:						
Crude[6]	thousand 42-gallon barrels	251,500	276,700	295,700	344,000	397,947
Natural gas liquids	do.	14,730	16,440	21,720	22,470	27,230
Refinery products:						
Naphtha	do.	3,429	3,834	3,618	4,419	[e]4,500
Gasoline	do.	11,849	11,466	10,548	12,248	[e]12,500
Kerosene	do.	4,687	5,906	5,549	6,402	[e]6,500
Distillate fuel oil	do.	24,767	26,811	27,199	33,756	[e]35,000
Residual fuel oil	do.	6,693	4,942	5,934	6,973	[e]7,000
Other	do.	3,972	3,897	3,380	4,050	[e]4,200
Refinery fuel and losses	do.	3,642	4,277	3,823	3,795	[e]4,000
Total	**do.**	**59,039**	**61,133**	**60,051**	**71,643**	**[e]73,700**

[e]Estimated. [p]Preliminary. [r]Revised.
[1]Table includes data available through Sept. 15, 1989.
[2]Data represent exports, part of which may be derived from imported materials.
[3]Reported figure.
[4]Gross less gas reinjected and flared.
[5]Reported as total methane sales.
[6]Excluding natural gas liquids. The crude oil entry in 1985 Norway chapter included natural gas liquids content.

TABLE 8

NORWAY: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
METALS				
Aluminum:				
Ore and concentrate	60	1,400	—	All to Sweden.
Oxides and hydroxides	12,642	17,764	—	United Kingdom 17,661; Sweden 86.
Metal including alloys:				
Scrap	31,126	38,156	—	West Germany 14,621; Sweden 8,876; Netherlands 6,218.
Unwrought	646,539	757,615	4,211	West Germany 206,253; Netherlands 138,007; United Kingdom 116,021.
Semimanufactures	85,833	100,430	3,748	United Kingdom 19,765; Sweden 13,852; Denmark 13,570.
Beryllium: Metal including alloys, all forms	—	(2)	—	All to Denmark.
Cadmium: Metal including alloys, all forms	162	135	27	Sweden 47; West Germany 35.
Chromium: Oxides and hydroxides	—	1	—	Mainly to Sweden.
Cobalt:				
Oxides and hydroxides	(2)	—		
Metal including alloys, all forms	1,638	1,613	715	Netherlands 330; Japan 216.
Copper:				
Ore and concentrate	106,237	115,880	—	Finland 52,388; West Germany 48,110; Sweden 12,356.
Matte and speiss including cement copper	—	(2)	—	All to Singapore.
Oxides and hydroxides	NA	3,513	NA	NA.
Sulfate	NA	123	—	All to U.S.S.R.
Ash and residue containing copper	NA	3,108	NA	Spain 2,210; Republic of Korea 848.
Metal including alloys:				
Scrap	7,316	9,683	—	West Germany 5,282; Belgium-Luxembourg 1,516; Denmark 861.
Unwrought	34,558	30,865	186	West Germany 8,214; Sweden 6,409; United Kingdom 6,292.
Semimanufactures	2,640	2,794	23	Sweden 761; Denmark 534; West Germany 406.
Gold:				
Waste and sweepings value, thousands	$927	$1,179	NA	West Germany $643; Switzerland $198; United Kingdom $185.
Metal including alloys, unwrought and partly wrought troy ounces	10,192	23,341	NA	West Germany 8,005; Sweden 5,112; France 4,212.
Iron and steel:				
Iron ore and concentrate:				
Excluding roasted pyrite thousand tons	2,532	2,530	—	United Kingdom 1,181; West Germany 446; France 339.
Pyrite, roasted do.	8	28	—	Denmark 25; Netherlands 3.

See footnotes at end of table.

TABLE 8—Continued

NORWAY: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987	
			United States	Other (principal)
METALS—Continued				
Iron and steel—Continued				
Metal:				
Scrap	7,704	11,897	1	West Germany 2,224; Sweden 2,135; United Kingdom 2,052.
Pig iron, cast iron, related materials	22,898	14,453	—	United Kingdom 10,847; Sweden 2,007; Spain 993.
Ferroalloys:				
Ferrochromium	—	4	—	NA.
Ferromanganese	162,265	176,850	21,418	West Germany 29,275; United Kingdom 19,894.
Ferrosilicomanganese	202,090	215,810	26,458	West Germany 44,190; Belgium-Luxembourg 38,285; France 27,266.
Ferrosilicon	339,711	334,761	16,662	West Germany 102,023; Japan 75,350; United Kingdom 48,516.
Silicon metal	NA	81,066	50	West Germany 33,139; United Kingdom 11,062; Japan 10,209.
Unspecified	11,515	11,125	—	United Kingdom 4,507; France 1,965; West Germany 1,545.
Steel, primary forms	41,353	122,410	41,259	Netherlands 26,651; Italy 22,667.
Semimanufactures:				
Bars, rods, angles, shapes, sections	299,127	399,127	106,658	West Germany 89,724; United Kingdom 50,406.
Universals, plates, sheets	150,097	149,237	14,824	United Kingdom 35,402; Sweden 33,269; Denmark 27,707.
Hoop and strip	16,350	20,059	34	Sweden 17,360; Denmark 1,861; United Kingdom 424.
Rails and accessories	2,223	3,012	—	Italy 1,700; Sweden 653; Netherlands 613.
Wire	9,798	10,047	2,418	United Kingdom 1,823; Sweden 859; West Germany 849.
Tubes, pipes, fittings	56,428	61,442	360	Sweden 32,901; Denmark 7,370; Finland 6,957.
Castings and forgings, rough	3,198	3,965	3	Sweden 3,470; United Kingdom 133; Switzerland 130.
Lead:				
Ore and concentrate	7,180	6,026	—	All to West Germany.
Oxides	16	—		
Metal including alloys:				
Scrap	7,171	8,308	—	Sweden 7,785; West Germany 172.
Unwrought	28	35	—	Mainly to Sweden.
Semimanufactures	1	3	—	All to Sweden.
Magnesium: Metal including alloys:				
Scrap	103	149	—	All to West Germany.
Unwrought value, thousands	$146,530	$150,645	NA	NA.

See footnotes at end of table.

TABLE 8—Continued

NORWAY: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
METALS—Continued				
Magnesium—Continued				
Semimanufactures	164	1,202	1,088	United Kingdom 42; Switzerland 29.
Manganese: Ore and concentrate, metallurgical-grade	505	5	—	All to Sweden.
Mercury 76-pound flasks	870	2,118	—	West Germany 1,131; Spain 783.
Molybdenum: Metal including alloys, all forms	1	—		
Nickel:				
Ore and concentrate	11,871	8,991	—	All to Finland.
Matte and speiss	—	(2)	NA	NA.
Metal including alloys:				
Scrap	108	91	50	Austria 40; West Germany 1.
Unwrought	37,917	44,125	19,359	Netherlands 7,673; Japan 3,383.
Semimanufactures	30	859	—	Netherlands 575; Finland 186; Austria 34.
Platinum-group metals: Metals including alloys, unwrought and partly wrought troy ounces	51,441	63,498	514	West Germany 33,372; United Kingdom 14,146; France 9,742.
Silver:				
Waste and sweepings[3] value, thousands	$2,761	$3,381	—	West Germany $1,821; United Kingdom $1,516.
Metal including alloys, unwrought and partly wrought thousand troy ounces	1,200	1,040	(2)	Sweden 467; Denmark 249; Canada 200.
Tin: Metal including alloys:				
Scrap	12	21	—	United Kingdom 13; Sweden 8.
Unwrought	5	5	—	Sweden 4; Finland 1.
Semimanufactures	23	22	(2)	West Germany 19; United Kingdom 3.
Titanium:				
Ore and concentrate	693,265	715,915	NA	NA.
Oxides	1,253	6,740	508	West Germany 5,007; Sweden 958.
Tungsten: Metal including alloys, all forms	(2)	(2)	—	Mainly to Sweden.
Uranium and thorium: Metals including alloys, waste and scrap	NA	3	3	
Zinc:				
Ore and concentrate	8,355	7,185	—	All to West Germany.
Oxides	3,004	3,358	—	United Kingdom 2,461; West Germany 377; Sweden 187.
Ash and residue containing zinc	NA	347	NA	NA.
Metal including alloys:				
Scrap	539	590	—	Sweden 307; United Kingdom 207; India 55.
Unwrought	77,235	106,196	20,695	West Germany 23,701; Sweden 20,034.
Semimanufactures	6,636	7,779	17	Netherlands 1,283; West Germany 1,001; Singapore 998.

See footnotes at end of table.

TABLE 8—Continued

NORWAY: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
METALS—Continued				
Other:				
Ashes and residues	18,134	22,485	(2)	France 9,955; Belgium-Luxembourg 4,104; West Germany 2,925.
Base metals including alloys, all forms	r59	29	NA	NA.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	22	63	—	Iceland 38; Tanzania 25.
Artificial:				
Corundum	4	6	—	Egypt 2; Netherlands 1; United Arab Emirates 1.
Silicon carbide	NA	60,208	NA	NA.
Dust and powder of precious and semiprecious stones including diamond kilograms	1	6	—	Mainly to Sweden.
Grinding and polishing wheels and stones	690	516	20	Sweden 185; Finland 128.
Asbestos, crude	1	—		
Barite and witherite	10,053	22,613	—	United Kingdom 14,520; Denmark 7,115; Sweden 892.
Boron materials: Crude natural borates	—	1	—	All to France.
Cement	653	865	NA	Sweden 827.
Chalk	3	(2)	NA	NA.
Clays, crude	103	630	—	Sweden 592; Denmark 33.
Cryolite and chiolite	2	2	—	All to Sweden.
Diamond, natural:				
Gem, not set or strung value, thousands	$103	$228	—	Belgium-Luxembourg $172; United Kingdom $40.
Industrial stones do.	$13	—		
Diatomite and other infusorial earth	(2)	11	—	Mainly to Qatar.
Feldspar, fluorspar, related materials:				
Feldspar	74,185	74,953	—	West Germany 17,538; United Kingdom 15,700; Netherlands 12,749.
Leucite, nepheline, nepheline syenite	228,662	256,005	—	Netherlands 99,365; United Kingdom 46,042; West Germany 37,945.
Fertilizer materials:				
Crude, n.e.s.	1	—		
Manufactured:				
Ammonia value, thousands	$1,608	$651	NA	NA.
Nitrogenous do.	$81,677	$85,391	NA	NA.
Potassic do.	$3	$2	—	All to West Germany.
Unspecified and mixed do.	$155,247	$178,595	NA	NA.
Graphite, natural	954	56	NA	NA.
Gypsum and plaster	29	19	—	All to Sweden.

See footnotes at end of table.

TABLE 8—Continued

NORWAY: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
INDUSTRIAL MINERALS—Continued				
Lime	4,860	8,015	—	Liberia 7,000; Denmark 961.
Magnesium compounds	8,689	4,170	NA	NA.
Mica:				
Crude including splittings and waste	1,422	1,916	—	West Germany 681; Netherlands 537; Sweden 140.
Worked including agglomerated splittings	([2])	([2])	—	All to Sweden.
Phosphates, crude	—	2,400	—	All to Denmark.
Phosphorus, elemental	NA	80	—	All to Hungary.
Pigments, mineral: Iron oxides and hydroxides, processed	44	28	—	West Germany 15; Thailand 10; Malaysia 3.
Precious and semiprecious stones other than diamond:				
Natural kilograms	3,991	3,306	—	Mainly to Denmark and West Germany.
Synthetic do.	490	—		
Pyrite, unroasted	172,650	108,080	—	West Germany 52,985; Sweden 21,663; Turkey 18,237.
Salt and brine	2,487	1,377	—	Sweden 775; West Germany 600.
Sodium compounds, n.e.s.:				
Carbonate, manufactured	23	9	—	Sweden 8.
Sulfate, manufactured	([2])	13	NA	NA.
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked	270,184	113,906	1,228	Italy 37,533; France 32,744; Spain 13,070.
Worked	11,819	16,116	57	Netherlands 13,785; Sweden 602.
Dolomite, chiefly refractory-grade	168,259	182,161	NA	NA.
Gravel and crushed rock	4,120,216	4,333,300	853	West Germany 1,391,496; Denmark 640,929; Netherlands 563,285.
Limestone other than dimension	4,446	10,832	—	United Kingdom 5,979; Sweden 4,007.
Quartz and quartzite	123,961	47,401	—	Iceland 45,665; Sweden 1,010.
Sand other than metal-bearing	3,386	18,437	—	United Kingdom 17,556; United Arab Emirates 400.
Sulfur:				
Elemental:				
Crude including native and byproduct	2,643	739	—	West Germany 695; Sweden 39.
Colloidal, precipitated, sublimed	2,751	2,799	—	All to Sweden.
Dioxide including trioxide	NA	8,509	NA	Sweden 7,935.
Sulfuric acid value, thousands	$8,283	$7,755	NA	NA.
Talc, steatite, soapstone, pyrophyllite	42,702	45,100	—	United Kingdom 11,171; West Germany 9,895; Netherlands 8,837.

See footnotes at end of table.

TABLE 8—Continued

NORWAY: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
INDUSTRIAL MINERALS—Continued					
Other:					
Crude		788	2,176	—	Italy 1,713; Sweden 436.
Slag and dross, not metal-bearing		17,698	57,211	—	Denmark 23,381; France 9,955; Sweden 9,160.
MINERAL FUELS AND RELATED MATERIALS					
Asphalt and bitumen, natural		1,565	1,425	—	West Germany 1,229; Iceland 144.
Carbon black		6	19	(2)	Sweden 18.
Coal: Anthracite and bituminous		122,726	203,239	NA	West Germany 81,070; France 51,510; United Kingdom 33,234.
Coke and semicoke		124,984	159,252	—	Sweden 56,674; Finland 29,656; Iceland 21,483.
Gas, natural: Gaseous	million cubic feet	900,943	982,576	—	West Germany 544,580; United Kingdom 437,996.
Peat including briquets and litter		385	2,618	—	Denmark 1,366; United Kingdom 771; Belgium-Luxembourg 375.
Petroleum:					
Crude	thousand 42-gallon barrels	264,366	310,762	9,876	United Kingdom 173,889; Netherlands 43,653; Sweden 29,626.
Refinery products:					
Liquefied petroleum gas	do.	1,543	10,969	1,003	Sweden 2,521; Netherlands 1,718; United Kingdom 1,453.
Gasoline, motor	do.	5,302	5,235	25	Sweden 3,242; Netherlands 605; Belgium-Luxembourg 409.
Mineral jelly and wax	do.	(2)	(2)	NA	NA.
Kerosene and jet fuel	do.	1,634	2,071	15	Sweden 824; Netherlands 443; United Kingdom 392.
Distillate fuel oil	do.	5,230	6,998	65	Sweden 2,619; East Germany 1,912; United Kingdom 927.
Lubricants	do.	47	695	8	Sweden 296; United Kingdom 208; Belgium-Luxembourg 67.
Residual fuel oil	do.	6,318	3,693	25	East Germany 1,216; Sweden 870; U.S.S.R. 818.
Bitumen and other residues	do.	24	634	NA	Netherlands 466; West Germany 59; Malta 36.
Bituminous mixtures	do.	4	88	(2)	Sweden 82; Netherlands 2; West Germany 1.
Petroleum coke	do.	446	1,684	1,224	United Kingdom 370; Netherlands 67.

NA Not available.

[1] Table prepared by Gio Jacarepaqua.

[2] Less than 1/2 unit.

[3] May include other precious metals.

TABLE 9

NORWAY: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS				
Aluminum:				
Ore and concentrate	5,871	5,792	—	Greece 5,768; Netherlands 20.
Oxides and hydroxides thousand tons	1,496	1,645	50	Suriname 678; Australia 345; Venezuela 181.
Metal including alloys:				
Scrap	3,213	1,417	—	Denmark 810; West Germany 262; Sweden 168.
Unwrought	35,118	57,146	741	Romania 16,748; U.S.S.R. 13,261; Brazil 9,278.
Semimanufactures	54,410	36,518	131	West Germany 12,364; Sweden 7,262; Belgium-Luxembourg 3,105.
Antimony: Metal including alloys, all forms	26	55	NA	China 43.
Beryllium: Metal including alloys, all forms	([2])	21	—	West Germany 20; Sweden 1.
Chromium:				
Ore and concentrate	520	760	—	Turkey 476; Finland 131; West Germany 56.
Oxides and hydroxides	152	191	([2])	West Germany 180; China 10.
Metal including alloys, all forms	NA	39	NA	NA.
Cobalt:				
Oxides and hydroxides	1	1	—	Mainly from China.
Metal including alloys, all forms	370	1	NA	NA.
Columbium and tantalum: Metal including alloys, semimanufactures: Tantalum	([2])	([2])	([2])	Mainly from Switzerland.
Copper:				
Matte and speiss including cement copper	584	27	—	Belgium-Luxembourg 23; Sweden 4.
Oxides and hydroxides	NA	42	NA	NA.
Sulfate	NA	2,032	NA	U.S.S.R. 1,134; West Germany 311; Hungary 305.
Metal including alloys:				
Scrap	56	309	176	Sweden 124.
Unwrought	3,080	2,940	—	West Germany 985; Sweden 759; United Kingdom 638.
Semimanufactures	31,352	28,466	54	Belgium-Luxembourg 8,153; Sweden 7,440; West Germany 7,304.
Gold:				
Waste and sweepings value, thousands	$639	$1,864	—	Sweden $1,551; West Germany $306.
Metal including alloys, unwrought and partly wrought troy ounces	24,209	17,811	932	West Germany 10,738; United Kingdom 1,833; Switzerland 1,479.
Iron and steel:				
Iron ore and concentrate excluding roasted pyrite	17,715	20,637	—	All from Sweden.
Metal:				
Scrap	6,145	32,528	604	West Germany 29,674; Denmark 1,433; Sweden 648.

See footnotes at end of table.

TABLE 9—Continued

NORWAY: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS—Continued				
Iron and steel—Continued				
Metal—Continued				
Pig iron, cast iron, related materials	7,432	6,798	1	Sweden 2,978; United Kingdom 1,370; Canada 862.
Ferroalloys:				
Ferrochromium	830	652	NA	Sweden 585; West Germany 28.
Ferromanganese	—	3,130	—	France 3,129.
Ferromolybdenum	NA	52	NA	United Kingdom 23.
Ferrosilicomanganese	NA	2,401	—	France 1,401; West Germany 1,000.
Ferrosilicon	995	630	NA	West Germany 392; Sweden 225.
Ferrotitanium	NA	8	NA	NA.
Ferrotungsten	NA	6	NA	NA.
Ferrovanadium	NA	30	6	West Germany 10; Austria 6; Brazil 6.
Silicon metal	NA	30	NA	NA.
Unspecified	564	208	38	Italy 63; West Germany 49.
Steel, primary forms	131,162	146,636	([2])	West Germany 59,165; Netherlands 57,850; France 11,388.
Semimanufactures:				
Bars, rods, angles, shapes, sections	276,329	257,836	5	Sweden 59,015; West Germany 46,009; Belgium-Luxembourg 27,567.
Universals, plates, sheets	517,587	450,386	92	Sweden 113,555; United Kingdom 67,059; Belgium-Luxembourg 64,865.
Hoop and strip	36,148	36,082	1	West Germany 10,778; Sweden 9,355; United Kingdom 3,547.
Rails and accessories	17,407	10,784	—	Sweden 9,132; United Kingdom 674; West Germany 525.
Wire	20,047	18,497	58	Belgium-Luxembourg 5,447; Sweden 5,206; France 2,984.
Tubes, pipes, fittings	200,530	191,699	910	Japan 48,937; West Germany 39,129; United Kingdom 24,076.
Castings and forgings, rough	5,429	5,575	1	Sweden 2,296; Denmark 2,090; West Germany 288.
Lead:				
Oxides	175	79	([2])	West Germany 62; United Kingdom 15.
Metal including alloys:				
Scrap	—	10	—	All from Denmark.
Unwrought	14,231	13,468	—	Sweden 11,880; United Kingdom 1,311; Netherlands 140.
Semimanufactures	2,763	1,664	([2])	Netherlands 917; West Germany 350; Belgium-Luxembourg 177.
Magnesium: Metal including alloys:				
Scrap	([2])	73	—	United Kingdom 51; Netherlands 21.

See footnotes at end of table.

TABLE 9—Continued

NORWAY: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS—Continued					
Magnesium—Continued					
Unwrought		r335	1,385	1,090	Netherlands 177; United Kingdom 53.
Semimanufactures		64	44	—	United Kingdom 26; West Germany 15.
Manganese:					
Ore and concentrate, metallurgical-grade		817,544	628,173	265	Gabon 253,575; Republic of South Africa 135,562; France 93,693.
Oxides		1,290	1,523	—	Netherlands 924; Belgium-Luxembourg 479.
Metal including alloys, all forms		1,315	1,641	344	Belgium-Luxembourg 486; Republic of South Africa 405.
Mercury	76-pound flasks	87	232	—	West Germany 116; China 87.
Molybdenum: Metal including alloys, all forms		7	1	(2)	Mainly from United Kingdom.
Nickel:					
Ore and concentrate		—	25	(2)	Mainly from Australia.
Matte and speiss		101,073	92,110	—	Canada 60,958; Botswana 29,510; Zimbabwe 747.
Metal including alloys:					
Scrap		12	11	—	All from United Kingdom.
Unwrought		154	64	—	United Kingdom 53; Belgium-Luxembourg 5; Finland 4.
Semimanufactures		292	264	17	United Kingdom 77; West Germany 76; Switzerland 35.
Platinum-group metals: Metals including alloys, unwrought and partly wrought	troy ounces	21,509	25,270	1,029	U.S.S.R. 9,710; United Kingdom 6,719; Switzerland 4,598.
Silver:					
Waste and sweepings[3]	value, thousands	$4,525	$5,584	—	Sweden $3,084; United Kingdom $1,648; Finland $234.
Metal including alloys, unwrought and partly wrought	thousand troy ounces	2,349	1,902	(2)	West Germany 834; United Kingdom 443; Switzerland 294.
Tin: Metal including alloys:					
Scrap		1	—		
Unwrought		562	481	—	United Kingdom 284; Sweden 65; Netherlands 63.
Semimanufactures		185	177	(2)	United Kingdom 75; West Germany 57; Sweden 25.
Titanium:					
Ore and concentrate		NA	1	—	Mainly from United Kingdom.
Oxides		1,668	777	—	West Germany 471; Netherlands 225; Finland 50.
Tungsten: Metal including alloys, all forms		2	7	(2)	West Germany 4; United Kingdom 1.
Uranium and thorium: Metals including alloys, all forms		(2)	1	1	

See footnotes at end of table.

TABLE 9—Continued

NORWAY: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS—Continued				
Zinc:				
Ore and concentrate	110,468	171,939	—	Sweden 103,036; Canada 58,599; Denmark 5,549.
Oxides	2,503	2,728	—	East Germany 2,070; Sweden 216; West Germany 207.
Ash and residue containing zinc	NA	17,754	109	Sweden 15,995; Denmark 1,755.
Metal including alloys:				
Scrap	5,900	3,959	1	Denmark 1,564; Finland 1,354; Sweden 1,035.
Unwrought	377	855	—	Finland 346; West Germany 276; Sweden 102.
Semimanufactures	1,012	812	(2)	France 270; West Germany 231; Poland 110.
Other:				
Ores and concentrates	3,926	26,462	56	Sweden 26,406.
Ashes and residues	266,610	309,046	12	West Germany 243,742; East Germany 62,268; France 2,968.
Base metals including alloys, all forms	r124	87	14	West Germany 46; Sweden 4.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	12,420	18,507	56	Iceland 17,582; United Kingdom 293; West Germany 167.
Artificial:				
Corundum	610	825	—	West Germany 589; United Kingdom 104; Hungary 53.
Silicon carbide	NA	94	NA	West Germany 82.
Dust and powder of precious and semiprecious stones including diamond value, thousands	$11	$27	$20	Netherlands $4; United Kingdom $3.
Grinding and polishing wheels and stones	1,046	955	15	Austria 235; West Germany 201; Sweden 189.
Asbestos, crude	1	11	11	
Barite and witherite	116,489	111,194	20	Morocco 87,590; Ireland 16,511; United Kingdom 6,062.
Boron materials:				
Crude natural borates	25	10	—	Mainly from Sweden.
Oxides and acids	388	374	246	France 94.
Cement	559,886	592,881	92	Sweden 353,091; Poland 89,701; West Germany 62,896.
Chalk	8,044	8,783	22	Denmark 5,026; Sweden 2,669; France 617.
Clays, crude	r119,712	133,883	5,650	United Kingdom 90,484; Greece 19,215; Czechoslovakia 6,298.
Cryolite and chiolite	4,848	3,674	—	Denmark 3,256; Netherlands 418.

See footnotes at end of table.

TABLE 9—Continued

NORWAY: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
INDUSTRIAL MINERALS—Continued					
Diamond natural:					
Gem, not set or strung	value, thousands	$3,545	$4,000	$20	Belgium-Luxembourg $2,139; United Kingdom $700; West Germany $297.
Industrial stones	do.	$280	$23	—	Netherlands $13; United Kingdom $5; Sweden $4.
Diatomite and other infusorial earth		1,986	2,020	146	Iceland 1,066; Denmark 230; Spain 229.
Feldspar, fluorspar, related materials:					
Feldspar		187	82	—	NA.
Fluorspar		47,022	46,804	—	NA.
Fertilizer materials:					
Crude, n.e.s.		1	3	—	Mainly from Finland.
Manufactured:					
Ammonia		231,409	144,551	81,701	U.S.S.R. 42,288; Netherlands 10,278.
Nitrogenous		12,085	[4]22,162	([2])	Sweden 20,045; Denmark 1,123; Austria 230.
Phosphatic		2,568	1,793	—	Sweden 1,652; Netherlands 70.
Potassic		317,670	305,527	—	France 73,294; Spain 58,485; West Germany 47,930.
Unspecified and mixed		43,961	45,443	3	Belgium-Luxembourg 34,170; Sweden 3,918; West Germany 3,033.
Graphite, natural		8,211	233	1	Sweden 142; West Germany 56.
Gypsum and plaster		211,318	230,805	—	Spain 182,452; Sweden 22,262; France 15,210.
Kyanite and related materials		1,763	322	—	Netherlands 151.
Lime		33,750	27,797	1	Denmark 20,575; Sweden 5,950; United Kingdom 468.
Magnesium compounds:					
Magnesite, crude including oxides		6,911	9,292	2	China 4,173; Austria 2,078; Sweden 1,478.
Sulfate		NA	61,204	—	West Germany 44,367; East Germany 16,676.
Mica:					
Crude including splittings and waste		1,284	1,882	37	India 1,715; Netherlands 95.
Worked including agglomerated splittings		63	55	—	Switzerland 25; France 11; Belgium-Luxembourg 10.
Nitrates, crude		156	77	—	All from West Germany.
Phosphates, crude		445,807	475,426	56,754	Sweden 215,741; Morocco 100,260.
Phosphorus, elemental		NA	8	NA	NA.
Pigments, mineral: Iron oxides and hydroxides, processed		2,450	3,135	—	West Germany 2,934; Spain 94; Netherlands 42.

See footnotes at end of table.

TABLE 9—Continued

NORWAY: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
INDUSTRIAL MINERALS—Continued				
Precious and semiprecious stones other than diamond:				
Natural value, thousands	$431	$714	$12	Sweden $210; West Germany $136; United Kingdom $104.
Synthetic:				
Diamond do.	NA	$9	—	Mainly from France.
Other do.	$36	$50	$1	United Kingdom $24; Switzerland $18.
Pyrite, unroasted	3,948	—		
Salt and brine	555,603	596,368	6	Netherlands 373,355; Spain 62,730; United Kingdom 44,939.
Sodium compounds, n.e.s.:				
Carbonate, manufactured	48,869	47,552	590	Poland 18,539; Netherlands 10,297; West Germany 10,278.
Sulfate, manufactured	7,433	7,146	NA	Sweden 6,661; West Germany 220.
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked	10,149	9,963	1	Sweden 4,005; Portugal 3,389; Italy 1,177.
Worked	23,544	22,723	(2)	Portugal 11,320; Italy 3,962; Sweden 3,844.
Dolomite, chiefly refractory-grade	8,211	9,372	(2)	Sweden 5,662; United Kingdom 3,399; West Germany 286.
Gravel and crushed rock	63,225	74,000	—	Sweden 67,696; Denmark 5,398; Italy 362.
Limestone other than dimension	216,133	208,991	—	United Kingdom 122,417; France 70,178; Denmark 7,527.
Quartz and quartzite	589,369	641,980	3	Sweden 368,902; Spain 269,349; Belgium-Luxembourg 3,430.
Sand other than metal-bearing	209,636	200,223	245	Belgium-Luxembourg 126,913; Sweden 49,767; Denmark 15,872.
Sulfur:				
Elemental:				
Crude including native and byproduct	6,138	3,371	—	Sweden 3,225; West Germany 132.
Colloidal, precipitated, sublimed	11	30	—	United Kingdom 20; West Germany 10.
Dioxide including trioxide	—	4,126	NA	Sweden 4,114.
Sulfuric acid	1,937	149	(2)	Denmark 101; Sweden 39.
Talc, steatite, soapstone, pyrophyllite	6,302	6,207	63	Finland 2,126; India 2,125; Sweden 747.
Other:				
Crude	71,084	9,993	8	Sweden 7,097; Spain 1,282; Greece 1,100.
Slag and dross, not metal-bearing	164,431	175,095	—	Denmark 146,303; Sweden 14,461; Netherlands 9,566.
MINERAL FUELS AND RELATED MATERIALS				
Asphalt and bitumen, natural	58	92	92	
Carbon black	5,857	5,223	41	Sweden 2,889; Netherlands 1,378; United Kingdom 581.

See footnotes at end of table.

TABLE 9—Continued

NORWAY: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
MINERAL FUELS AND RELATED MATERIALS—Continued					
Coal:					
Anthracite and bituminous		769,563	726,512	182,600	Poland 146,411; United Kingdom 103,855.
Briquets of anthracite and bituminous coal		2,000	18,918	10,403	West Germany 8,435.
Lignite including briquets		11	10	—	All from West Germany.
Coke and semicoke		600,709	503,677	1,994	United Kingdom 248,760; West Germany 81,205; East Germany 47,695.
Peat including briquets and litter		20,710	16,624	—	Sweden 16,421; Finland 144.
Petroleum:					
Crude	thousand 42-gallon barrels	14,794	19,547	—	United Kingdom 11,684; Denmark 3,312; U.S.S.R. 2,632.
Refinery products:					
Liquefied petroleum gas	do.	2,726	3,236	NA	NA.
Gasoline, motor	do.	6,678	5,235	25	Sweden 3,242; Netherlands 605; Belgium-Luxembourg 409.
Mineral jelly and wax	do.	73	68	NA	West Germany 49; United Kingdom 7; China 5.
Kerosene and jet fuel	do.	2,345	2,071	15	Sweden 824; Netherlands 443; United Kingdom 392.
Distillate fuel oil	do.	8,600	6,998	65	Sweden 2,619; East Germany 1,912; United Kingdom 927.
Lubricants	do.	683	695	8	Sweden 296; United Kingdom 208; Belgium-Luxembourg 67.
Residual fuel oil	do.	5,356	3,693	25	East Germany 1,216; Sweden 870; U.S.S.R. 818.
Bitumen and other residues	do.	1,323	3,436	1,413	Sweden 1,159; United Kingdom 416.
Bituminous mixtures	do.	132	88	([2])	Sweden 82; Netherlands 2; West Germany 1.
Petroleum coke	do.	2,007	1,684	1,224	United Kingdom 370; Netherlands 67.

[r] Revised. NA Not available.
[1] Table prepared by Gio Jacarepaqua.
[2] Less than 1/2 unit.
[3] May include other precious metals.
[4] Excludes unreported quantity of urea valued at $5,176,000.

ize the cast house at Sunndal; this was to be completed in 1989. Other company efforts to stabilize smelter operations and increase labor productivity began to show rewards during the year, and these improvements were expected to continue into 1989. The increased consumption and production of aluminum led to a tight raw materials market. In response to this, Norsk Hydro acquired a 35% interest in the Alpart alumina refinery in Jamaica, which would entitle Norsk Hydro to 350,000 tons per year of the aluminum output from the plant. This plant, which had been out of production since 1985, was restarted and was expected to produce 1 million tons per year of alumina by 1990. The Extrusion Group of Hydro Aluminum owned 17 extrusion plants in Europe and the United States. At yearend, sales of 214,000 tons of product were recorded and reflected a 12% increase over the 1987 sales volume. The company, one of Western Europe's leading aluminum extruders with an annual capacity of about 200,000 tons, signed an agreement to acquire the German company Wicona. Wicona was one of Europe's leading companies in the production and marketing of building systems made from aluminum extrusions. To meet the increased market demand, several of the Norwegian extrusion plants were reorganized and strengthened in 1988.

Hydro Aluminium's Rolled Products Group included a foil mill in Copenhagen, rolling mills at Karmoy and Holmestrand, and a coating line in Holmestrand. The Group's total production increased to 85,000 tons, 14,000 tons more than in the previous year. Aluminum sheet rolling facilities consisted of the newly enlarged 90,000 tons per year, Nordisk Holmestrand; the hot and cold mills at Holmestrand, 55,000 tons per year; and at Karmoy, 30,000 tons per year.

Three other aluminum smelters, in addition to Hydro Aluminium's four units, operated in Norway. There were two plants at Mosjoen and Lista, owned by Elkem (50%) and the Aluminum Co. of America (50%), and the third plant at Husnes owned by Sor-Norge Aluminium A/S. Elkem sold 5% in its Norwegian plants for interest in Alcoa's Alcoa Nederland BV, and in return Alcoa received the 11% in British fabricating plant owned by Elkem. This exchange solidifies Elkem's marketing entry into the European market. The 25,000-ton-per-year increased capacity and modernization at the Mosjoen smelter was expected to reduce energy consumption and to comply with environmental regulations, but had to meet a 1989 completion date. In midyear, the Government considered the construction of a 200,000-ton-per-year aluminum smelter at Mo i Rana to employ workers who lost jobs in the steel reorganization. Hydro Aluminium held talks with the Government on the feasibility of this plan. If a new plant was built, it would increase Norway's 850,000 tons per year primary aluminum production capacity. About 15% of the present production was converted into aluminum products in Norway, and the remainder was exported, primarily to Western Europe.

Ferroalloys.—The restructuring and consolidation continued among the Norwegian ferrosilicon producers. Two large electric iron-smelting furnaces (furnaces Nos. 5 and 6) at Mo i Rana, which closed at yearend 1987 because of low iron prices, were converted for ferrosilicon production under the name Rana Metall KS to take advantage of the improving ferroalloy prices. Production from the furnaces was expected to begin in 1989 with the Fesil Group A/S holding a 90% interest in the plant and NJH a 10% interest. This new facility at full capacity was expected to add some 70,000 tons of ferrosilicon production, which was targeted to the global market. The infrastructure and transformers from the old iron plant could be utilized; however, the furnaces were to be rebuilt. Two other furnaces, Nos. 1 and 2, were transferred to Norsk Ferrokrom A/S for ferrochrome production, and Elkem was expected to elect to participate in the company formed to produce this ferroalloy.

Several steel industry plants in Norway experienced problems during the year, which resulted in lost production. A fire destroyed the control room at the Tyssedal pig iron plant and several months were required for repairs. This plant, which was capable of producing 100,000 tons per year, had been only operating at 50% capacity before the fire. A blast in the PEA plant, in Porsgrunn, resulted in the loss of 8,000 to 10,000 tons of siliconmanganese and resulted in increased market prices due to the lost production in the already tight European market. This production loss could not be offset by Elkem's plants at Sauda in Norway or from North America, because these plants were operating at full production capacity. Elkem considered the expansion of high-purity silicon capacity at its Bremanagar plant, and the conversion of a 5,000- to 6,000-ton-per-year furnace to high purity silicon production at the Meraker plant. Another unutilized 10,000-ton-per-year capacity, which exists at this same plant, however, was not considered for utilization.

Silicon metal was produced by Elkem in Norway from three plants (Bremanger, Fiskaa, and Meraker) with 100,000-ton-per-year capacity. The high-grade quartz ores were imported from Spain. Elkem produced about 27% of the Western World's market; the company was experiencing increasing competition from South American and Chinese sources. Elkem has been losing market shares in the United States, which received more imports from South America. In the Japanese market, Elkem's market was increasingly influenced by Chinese exports. Due to this competition, Elkem has redefined its product market to the higher quality metals and to the requirements of the chemical industry.

Gallium.—Elkem was estimated to produce 10% of the world's gallium from a 5-ton-per-year, 99.95% purity gallium metal plant at its Bremenger ferrosilicon smelter facility in Norway. This plant received the gallium waste products from its two aluminum smelters in Norway. Elkem also owned 87% in the British company Crystalox Ltd. and was developing its own patented gallium refining process at its plant in the United Kingdom. This company was associated with the Oxford academic environment and employed approximately 30 people, specializing in advanced refining equipment and crystal growth technology. The refined material is used to manufacture gallium arsenide for use in fast semiconductors that are less vulnerable to the effects of radiation.

Iron Ore.—A/S Sydvaranger produced 44,000 tons less pellets in 1988 and experienced further decreases in output for a variety of factors. The removal of a large amount of overburden from the Ostmalmen and frost constriction in the ore bins constrained the delivery of ore. Mine production was down to 3,046,000 tons from 3,393,000 in 1987. Bjornevatn North contributed 41.3% of the 1988 production total before the mine was closed and access to Bjornevatn East was opened. Bjornevtn East and Jerntoppen (35.5% and 23.2% of 1988 production, respectively) were the only two mines operating at yearend. Average magnetic iron content was 31.1%, up from 29.29% in 1987; 2.2 tons of rock were mined for each ton of concentrate. The company was anticipating a 15% increase in pellet price for 1989. The company has devoted funds for research and development of new products from its quality iron ore. The company has succeeded in developing "super ore concentrate" for making iron powder and has begun construction of a plant where production was expected to in 1989.

The iron ore operations of A/S Norsk Jernverk (NJ) (Rana Gruber) in the Mo i Rana area were realigned under the same Parliamentary reorganization as the steel industry. The closure of the ironmaking plant at Norsk Jernverk will weaken the financial strength of mining operations at Rana Gruber. The iron ores, hematite and magnetite, quarried in the Dunderland valley at Ortjell were concentrated at a plant in Mo i Rana, an ice-free harbor, an important factor for the export of the iron concentrates through the new terminal completed last year. Even though the supply of concentrates exceeded demand, a 13% price increase had been negotiated for the ore, which was especially important since the largest customer, Rana Gruber iron works, was realigned out of ironmaking. The 7.03 million tons of ore quarried in 1988 yielded 1 million tons of concentrates, down from the 1.4 million produced in 1987, owing to periods of low concentrate production.

The other remaining Norwegian iron ore producer, a private firm, was the smaller Fosdalens Bergverks A/S.

Magnesium.—A modernization and streamlining program was initiated at the Norsk Hydro Porsgrunn production facility because more stringent environmental standards were imposed to reduce chlorinated hydrocarbons discharge into the water. The plant production was reduced from 60,000 to 50,000 tons per year owing to the dismantling of some older units. The cost of the modernization was to be realized through increased productivity and reduced production costs. Furthermore, the worldwide market conditions were positive for magnesium as production capacity was fully utilized and a 7% projected growth was expected. To meet future requirements and take advantage of the Free Trade Agreement between Canada and the United States, Norsk Hydro decided in 1987 to construct a new plant at Becancour in Quebec, Canada. The 40,000-ton-per-year primary magnesium plant cost more than estimated; its targeted completion date, which was slated for summer 1989, was not met. Also, additional capital would be required to increase the capacity to the planned 60,000-ton-per-year rating. This additional capacity in Canada would increase the company's rated capacity to 100,000 tons of the total 250,000 tons of magnesium consumed in the Western World. Norsk Hydro has been a strong promoter of the use of magnesium in other industries, such as structural casting and desulfuring of iron and steel.

Nickel—Falconbridge Ltd. signed a contract with two Yugoslav companies to take delivery of nickel matte from the Soviet complex at Norilsk for the Kristiansand refinery in Norway. The 3-year contract is for a minimum of 20,000 tons per year of matte of 40% nickel and 35% copper.

Steel.—The crude steel production increased to 723,000 tons from the 654,000 tons produced in 1987. However, the electric steelmaking and rolling plants at Christiania Spigerverk were scheduled to be closed on July 1, 1989, as was the iron-based steelmaking facility at Mo i Rana. Other operations involving wire, nails, and reinforcing products at Christiania were to continue. The export market offset the sluggish domestic market, which showed a 7% drop in reinforcing steel demand down from 225,000 to 210,000 tons and a beam demand down 25%. Sales for ship building sections increased 40%; however, the North Sea market was poor in 1988. The modern rolling mill at Ytre Laksevag near Bergen, which produced tinplate, passed the 100,000-ton production mark. Most of the production was slated for the export market for canned foods usage. The hot-rolled strip prices increased 15% to 20% and contributed to a turnover of almost $15 million. Wire and nail production by Christiania Spigerverk A/S from plants at Nydalen, Mandal, and Hinnavagen was sluggish, owing to the low construction and industry activity in Norway and to irregular deliveries of raw materials to the plants toward yearend.

Zinc.—A/S Sydvaranger's 75-year-old Killingdal Mine and the Bergverkselskapet Mine were closed permanently in the past for economic reasons. Sydvaranger's other zinc mine, A/S Bleikvassli Gruber, continued operating and showed good results owing to higher prices of the product. From the 162,328 tons of crude ore production, 11,423 tons of zinc, and 5,072 tons of lead concentrates were produced, up slightly from the 162,611 tons produced in 1987. The remainder of Norway's concentrate was produced by Orkla-Borregard A/S; that production was to cease on December 31, 1988. Folldal Verk A/S and Norsulfid A/S were the two companies affected. The 50% ownership in Norsulfid A/S was transferred to Outokumpu Oy. Norzink A/S production in its Eitrheim Smelter at Odda encountered fewer operating and startup problems than experienced last year. As a result, annual production was increased to 122,127 tons of zinc metal. The company operated profitably due to the increased demand and price of zinc, earning $15.7 million. Zinc dust from the Larvik Group turned out to be the most profitable; however, zinc oxide also improved over last year. Production of zinc dust and oxides was 12,586 tons. Total sales for Norzink increased to $165 million from the $123.5 million in 1987. The company stated concerns about increases in the future price of power.

***Industrial Minerals.*—Cement.**—A/S Norcem, Norway's only cement producer, merged with Aker Engineering A/S to form A/S Aker-Norcem, Norway's largest privately owned industrial group and largest offshore petroleum construction and contracting company. Cement production increased significantly at the Dalen plant in Brevik, as a result of plant modernization. Concern about pollution had prompted the additional purchase of pollution control equipment at the plant.

Feldspar and Nepheline Syenite.—Norfloat A/S was one of Western Europe's major suppliers of feldspar and continued to account for at least 80% of Norway's production. Its pegmatite quarries and beneficiation plant were near Lillesand about 20 miles east of Kristiansand in southern Norway. Mined and comminuted raw material is processed into its mineral components, sodium feldspar, potassium feldspar, quartz, and byproduct mica by flotation and magnetic separation. The reserves were estimated to be large. Production, mostly for export to Western Europe's glass and ceramic industries, was 35,000 tons of sodium feldspar and 28,000 tons of potash feldspar.

Norsk Nefelin, a mining entity owned by Elkem, produced approximately 270,000 tons per year from its efficient underground mine on the island of Stjernoy in the Alta Fjord in the Norwegian Arctic. The comminuted and screened ore was purified by magnetic separation. As Western Europe's only producer of nepheline syenite with major reserves, the company was the major supplier of the product to the glass and ceramics industries of Western Europe, especially in the Federal Republic of Germany, the United Kingdom, France, and Belgium and Luxembourg, in order of volume. The glass industry was the major user for the profitable operation. A new product, micronized nepheline syenite, had received a positive response in the paint-filler market.

Megon & Co. A/S operated a 30- to 50-ton-per-year yttrium and scandium oxide extraction plant at Kjeller, near Oslo. The two rare-earth oxides used in red phosphors and lasers could have further applications in superconductors.

Fertilizers.—Norsk Hydro, the world's largest fertilizer producer, was contemplating the construction of a new world-class ammonia plant in Norway to utilize North Sea gas. North Sea gas landed at Karsto or associated gas from the new oilfields in the Haltenbanken area would provide the feed stock for the proposed plant in Porsgrunn. The increase in the present plant's capacity from 360,000 tons per year to 900,000 tons per year and a switch to methane from the ethane and propane presently used was to begin in the mid-1990's. Last year a plant commissioned in the Netherlands reduced the company's ammonia deficit to 10%. However, this new plant was to provide other economic advantages by replacing older less efficient capacity, for example, a 115,000 electric ammonia unit at Rjukan that had been uneconomic and had produced under its capacity for several years, and the electrolytic (120,000 tons per year) plant at Glomfjord, which was due for closure and its electricity diverted to other projects. This newly enlarged Porsgrunn plant was to be the only remaining Norwegian ammonia plant. Norsk Hydro planned to close plants in Sweden (60,000 tons per year at Koping) and in France (250,000-ton-per-year plant at Pierrefitte, operated by the subsidiary Cofaz renamed Norsk Hydro Azote). The closure would represent a 25% decrease in Hydro's ammonia production in France. Also scheduled to close were three units for nitric, sulfuric, and phosphoric acid at Ambares. This closure was to coincide with the startup of a new unit at Ambes. The 1,150-ton-per-day nitric acid and 1,500-ton-per-day ammonia nitrate facilities were to be built by NSM of Belgium. The rationalization by Norsk Hydro represents a trimming of losses by the subsidiary, Cofaz. Norsk Hydro's other European ammonia production includes a 550,000-ton-per-year plant in the Federal Republic of Germany, 700,000 tons per year in France, and a 1,500,000-ton-per-year plant in Sluiskil in the Netherlands.

Quartz—Minnor A/S, an ill-fated joint venture started in 1987 at Drag in northern Norway, was to produce ultrapure quartz for the electronics industry. The project was cancelled due to the difficulty in attaining the degree of purity required, and production ceased. Microsillica, a very fine silicon dioxide dust, a waste byproduct produced by Elkem, was sold to a variety of different industries for uses in plastics, concrete additive, and insulation.

Titania.—The $170 million TiO_2 slag plant at Tyssedal produced approximately 10% of the world's supply of TiO_2 from its electrical smelting furnace. The plant had been designed by Elkem to produce 108,000 tons per year of high-purity pig iron in addition to 200,000 tons per year of 75% TiO_2 slag. Feed material was to be a 44% TiO_2 ilmenite concentrate mined and beneficiated by the U.S.-owned Titania A/S in southern Norway. The slag produced from this concentrate can be converted to TiO_2 pigment only by the sulfate process and is not suitable for conversion by the more environmentally acceptable chloride process. KSI and Titania, a minority owner of KSI, sponsored research at the University of Trondheim to overcome this problem associated with Titania's ore. Technical problems had delayed the full production from the plant and the Government was requested to provide additional funds of $30.3 million until the plant is working satisfactory.

Mineral Fuels.—**Coal.**—Store Norsk Spitsbergen Kullompani A/S, the Government coal operation, continued to produce coal on the island of Spitsbergen. This island, which is north of the Arctic Circle, had only two mines in operation after a smaller and newer coal mine at Svea ceased operations owing to deficit problems. This mine was being maintained, however, and the company duties were being split between the Federal and local governments. In general, the coal requirements of the Norwegian steel industry were reduced owing to restructuring and elimination of the iron ore base steel industry at Mo i Rana. The coal production was down from the 400,000 to 500,000 tons produced in recent years to only 275,000 tons produced in 1988.

Natural Gas.—In 1988, the Norwegian Petroleum Directorate estimated a decline in net remaining reserves as compared to previous years. The net reserves in 1988 were estimated to be 723 million barrels of oil less; however, net gas reserves increased by almost 10,000 billion cubic feet to 83.3 trillion cubic feet. The natural gas produced in the Norwegian waters was either reinjected into one of the oilfields to improve recovery from that field or transshipped by one of three pipelines to shore. Viability of gas projects in the central North Sea ultimately could depend on negotiations started in 1988 between British Gas and Den Norske State Oljesselskap A/S (Statoil) representing the group of Norwegian gas producers. The new gasfields anticipated to be of significance were Sleipner and Troll Fields. Statoil let the contract for Sleipner's gravity base for the platform, which was scheduled to produce 725 million cubic feet per day of gas and 125,000 barrels per day of liquids in 1993, and the Norsk Shell's Troll project, which was to provide gas in 1996. The gas was to be transmitted through the Zeepipe connecting these fields to Zeebrugge in Belgium. The Storting approved this operational plan for the group to lay the 40-inch line. However, the heavily indebted Statoil was reported reconsidering the $2.3 billion project to develop Sleipner Field. Troll Field, the much larger field, and its associated pipeline, estimated to have cost $60 billion at 1986 dollars, was less valuable to the company as gas prices weakened.

A large portion of Norway's natural gas continued to be sold through the Frigg collection and transmission system. An agreement between Norway and the United Kingdom on the joint exploitation of the Frigg Field established the Norwegian share of the field at 60.82%. Production from the Norwegian, East Frigg Field and the British Alwyn Field was added to the system in 1988, joining the other offset Norwegian fields of North East Frigg and Odin. The Frigg Field production had apparently begun to decline in 1987 and was anticipated to be depleted in the first part of the 1990's. From the initial 2.5 million barrels of oil and 3,743 billion cubic feet of gas (Norwegian share of reserves), 1.258 million barrels of oil and 247 billion cubic feet of gas remain; this was barely 50% of the oil and 6.6% of the gas. Total remaining reserves from Norwegian interests of the Frigg complex (Norwegian fields supplying gas for transmission) were estimated to be 1,258 million barrels of oil and 1,299 billion cubic feet of gas. At the pipeline capacity of 2,350 million cubic feet per day, the remaining gas reserves would suffice for only a few years. The British fields of Piper, Tartan, and newly added Alwyn, were not included in the reserves for the 195-mile pipeline from Frigg; the pipeline was completed in 1978.

Statoil began production October 3, 1988, from the Trommeliten Field by subsea completions. The gas production was piped to Edda Field and then on to Ekofisk for processing. The intention was to inject the gas for reservoir preservation and for liquids absorption until 1991, after which the gas was to be piped to Karsto, Norway for local use in a gas-fired power station or other uses.

The largest gasfield in the Norwegian waters to date is the Troll complex, which consists of the Troll West and Troll East structures. Production was estimated to begin in 1996 at the rate of between 582.7 and 752.2 billion cubic feet per year. This production rate would be approximately equal to 66% of the present day rate from the Norwegian sector. This is five times more gas production than that from the next largest field, Ekofisk. The investment in Troll Field was $3.7 billion by yearend 1988. Actual production was thought to require a novel platform design, probably using reinforced concrete instead of steel because of the great water depth of approximately 1,000 feet and the soft sea floor. The Government decided near yearend 1986 that Shell, Statoil, and Norsk Hydro would share responsibility for operation of the Troll and Sleipner Fields during their development. Interests in the Troll Field development were: Statoil, 50%; Shell, 35%; Conoco, 5%; Mobil, 5%; and Norsk Hydro, 5%. Estimated cost of the Sleipner development project was $1.9 billion. Sleipner East, which contained about 25% of the total Sleipner reserves, was to be developed first, because some of the gas in other parts of the field contained carbon dioxide. Interest division in this development was as follows: Statoil, 50%; Esso Norge A/S, 40%; and Norsk Hydro, 10%. Sleipner West was also one of the fields under consideration for development; Statoil and the Government were considering the postponement of this field for financial reasons. The Sleipner Gasfield's $2.3 billion price for development was less attractive because of falling gas prices. Esso Norge A/S the operator with a large interest in Sleipner West Field, voiced concerns about the delayed development plans.

The first two fields recommended for development in the Haltenbanken area were Heidrun and Draugen Fields. The Storting approved the Draugen development plans in December 1988, for the use of a monocolumn platform with a concrete gravity base structure. Five platform and two subsea wells were planned for the field in over 850 feet of water. The other field, Heidrun, was recommended for staged development by which early subsea production facilities would provide the cash flow and the reservoir experience early in the field development. The plan was for phase 1 to produce 60,000 barrels per day for 3 to 4 years beginning in 1990, followed by the main development of the field in phase 2. Phase 3 would drain the northern areas by subsea completions followed by the last phase. Phase 4 is the draining of the gas cap. The gas in the early phases would be reinjected until a pipeline was laid to the mid-Norwegian coast, around Molde or Trondheim for sales in Scandinavia or a tie-in to other lines. The cost of the pipeline was estimated at $415 million and the terminal at $340 to $850 million. The 280 billion cubic feet per year gas trunkline would allow natural gas liquids to be separated at the terminal; however, the sea-bottom pipeline must be designed to account for conditions of crossing an iceberg scoured ocean floor.

Saga Petroleum A/S was nearly ready to also declare commercial Migard, which is in the Haltenbanken region of the offshore Norwegian waters. This field is important in the overall development of the area, as so far it has the largest recoverable reserves, namely, 4,500 billion cubic feet of gas. The condensate production could account for as much as 110 million barrels of liquids from wells capable of producing at rates of 100 million cubic feet per day and from the field, which is capable of producing for 15 to 35 years.

Norpipe A/S pipeline connects Ekofisk Field to the European gas market via Emden, Federal Republic of Germany, and oil to the United Kingdom landfall at Tesside.

Petroleum.—Sales revenues decreased and provided only 9% gross national product in 1988, compared to 19% at the peak in 1985. Petroleum sales represented 25% of the exports from Norway.

The estimated remaining petroleum reserves from the Norwegian North Sea amounted to 10.1 billion barrels of oil and natural gas liquids. New petroleum reserves added in 1988 were greater than production; 1.0 billion barrels of new reserves were found, compared to the production of 0.5 billion barrels during the year. However, several producing fields that had reserves changed: Ula oil was up 31%, Oseberg oil was down 7%, Oseberg gas was up 17%, and Statfjord oil was up 8%. About 77% of the North Sea oil reserves were in the Oseberg, Statfjord, Gullfaks, Ekofisk, and Snorre Fields, in order of volume. Phillips Petroleum Co. Norway discovered oil in the Jurassic section below the chalk where most of Ekofisk oil and gas had been found. This was considered a significant discovery and could lead to extended reserves and field life, if commercial reserves were to be defined under existing fields in the Southern North Sea.

In the Oseberg Field, Norsk Hydro completed the concrete gravity platform, installed the offshore unit, and initiated production in December. Initial production was 100,000 barrels per day and was anticipated to peak at 300,000 barrels per day, when the third platform, which was approved earlier in 1988, was installed and on-stream in 1991. The Oseberg Field consists of three structures, Alpha, Alpha North, and Gamma. Because Alpha and Gamma Fields had a gas cap, the pressure maintenance method was changed from water to gas injection for reservoir preservation. The purchase of 882 billion cubic feet of gas from a Troll Field subsea module for reinjection into the field was estimated to result in the additional recovery of 94 million barrels oil. The oil production was transported to Sture in Oygarden, Norway, via the Osebverg Transport System. This was the first oil landed in Norway and was delivered on December 20, 1988, by the 28-inch 72-mile line from platform A. The line capacity was rated at 400,000 barrels per day with the oil pumps on the platform.

Statfjord, the largest producing oilfield in Europe, accounted for 56% of Norway's crude output in 1988. The production amounted to 850,000 barrels of oil per day from the three production platforms via the associated loading platforms, which transferred oil into tankers. The gas was transmitted to land by either the Statpipe or Norpipe transmission lines.

Statoil's development of the Gullfaks Field proceeded on schedule, with the addition of the B platform in February 1988. Platform A, an integrated drilling and producing unit with a daily capacity of 250,000 barrels of oil, was in 450 feet of water. Platform B, a drilling and water injection unit, was also installed in 450 feet of water. Platform C, the second production unit, was to be placed in 700 feet of water in 1989, increasing the total field production capacity to 485,000 barrels per day in the early 1990's. Oil was to be loaded into tankers, and the gas was to be sent through the Statpipe system via the Statfjord C platform.

Production from Ekofisk, now Norway's third largest producing oilfield, continued to decline and accounted for 10% of total crude production. The fifth phase of development for the field, in response to the field's declining production, was to inject water from platform 2/4-K in 1987. It was estimated to enhance recovery by the production of 170 million barrels of additional oil. Furthermore, the Edda platform was modified to inject gas from the Tommeliten Field into the reservoir in an attempt to maintain reservoir pressure, which caused the field subsidence of 14 feet. Due to the subsidence, additional plans were made to expand the water injection project to the southern portion of the field as well as to the upper reservoir. The recovery of an additional 1,164 million barrels of oil was anticipated. The feasibility of injecting nitrogen into the reservoir also was being studied for pressure maintenance of the field and to counteract the subsidence. In 1987, field subsidence had continued with no significant decrease in the rate of subsidence despite the injection of 108 billion cubic feet of natural gas into the field during 1985 and 1986. This injection project was terminated in October 1986, when total subsidence reached 12.5 feet. Production continued, and a decision was made by the operator, Phillips Petroleum Co. Norway A/S, to mechanically raise the platform in summer 1987 at a cost of $.5 billion. Furthermore, Phillips elected to construct a 448-foot diameter concrete wall around the main Ekofisk production storage tank to protect the facilities from the subsidence.

Snorre Field, operated by Saga Petroleum A/S, was to be the first tension legged platform in the North Sea. This new type of production platform was to be placed in the southern portion of the field first. As of December 31, 1988, approximately $151.5 million had been invested in the field, where the water depth is over 960 feet. The oil produced was to be piped to Statfjord for processing and loading.

The Ula Field reserve estimates had increased 59% since 1987; a 31% increase in 1988 represented an additional 75.5 million barrels oil. The gas produced was transmitted via Cod Field to Ekofisk. The Ula pipeline, which was laid in 1984 to Ekofisk, transmits the oil to Ekofisk Center and into Norpipe for landing at Teesside.

Statoil's Veslefrikk Field, which had a 65,000 barrels per day floating production unit, was on schedule, and first production was in 1989. The 226 million barrels oil reserve field was a combination of a fixed steel wellhead platform and floating production facilities connected by a flexible bridge. The drilling platform West Vision was to be converted for the field production facilities. The oil was to be delivered to Oseberg by a new pipeline for further transmission through the OTS.

The Murchisen Field interest was adjusted, and the Norwegian interest decreased from 25.06% to 22.2%; this resulted in a Norwegian production share of only 10,000 barrels per day. The liquid fraction was piped through to Brent Field in the United Kingdom sector for transmission to the Shetlands.

Oil production from Valhall, which has produced since 1982, was to be boosted by the production tie-in of Hod Field 8 miles south. The tie-in would access additional reserves of the 25 million barrels of oil by the use of an unmanned platform. The production was to begin in 1990 and was to be controlled from Valhall; the product was to be sent by two phase flow to Valhall for processing.

Statoil, the Government company, needed to reduce indebtedness as it approached 90% capitalization. One of the problems was the number, size, and interest of costs in offshore development projects, and the cost of the large Mongstad refinery and terminal project. This modernization cost $1 billion more than had been expected.

SWEDEN[10]

The Swedish economy continued its strong performance in 1988. The GDP increased 2.8% to $179 billion,[11] industrial investment increased 10% to $6.6 billion, industrial production rose 4%, and the jobless rate decreased 1.6%. The budget outcome, which in 1982 stood at a deficit of 13% of the GDP, came out of the red and showed a surplus of 1% of the GDP for the first time in 25 years. The price paid for this prosperity was an inflation rate of 6.5%, which was 2% to 3% higher than that of competitive countries. A weakening balance of payments was reflected in the current account balance, which was a negative $2.2 billion at yearend.

Sweden has relaxed its foreign exchange controls in recent years so that only minimum requirements remain. The Government intends to remove all foreign exchange regulations except those required for tax and statistical information. Final deregulation was expected in mid-1989 when permission will be granted for foreign banks to establish branch offices in Sweden.

The mineral industry accounted for approximately 3% of Sweden's GDP. More than 90% of the value of the $5 billion per year industry was metals mining, smelting, and refining. Industrial minerals made up the remaining 10%. Steel continued to account for the majority of the value of the metals industry, followed by iron ore, ferrochrome, aluminum, and copper, in order of value. Cement, crushed stone, and sulfur were the major industrial minerals produced.

Production and Trade

Although there were no significant changes in the mining industry, there was an increase in capital investment. This was part of an ongoing effort to improve productivity and efficiency. Major efforts were directed toward automation and mechanization. Complex sulfide ores and gold ores were the main targets of increased prospecting, exploration, and development work.

The Swedish Government announced it had allocated $3.5 million to Boliden Minerals AB's mining expansion program, with further guarantee of an additional $16 million to be paid by 1999. Sweden's Ministry of Trade and Industry and Boliden agreed in March 1988 on the development of 15 mining projects in northern and central Sweden. The total cost of the project was estimated at $300 million. As a result of the program, ore production, mainly copper and gold, was expected to rise 10%. Boliden was planning to invest approximately $500 million into 21 mining projects including exploration, new mines, and concentrator plants, over the next 10 years. Boliden operated 16 mines and 8 concentrators at yearend.

Namden for Statens Gravegendom (NSG), Sweden's state mining board, announced that it was considering two companies, Newmont Mining Co. of the United States and Outokumpu Oy of Finland, to develop the copper and gold deposit at Pahtohavaare in Swedish Lapland. The value of the Pahtohavaare ore deposit was estimated by NSG to be worth $250 million.

Trade is vital to Sweden. The country's combined imports and exports of goods and services account for almost two-thirds of its GDP. Total Swedish exports of goods grew 3.7%. Exports of manufactured goods grew almost 5%. Exports of nonferrous metals rose but petroleum derivatives exports fell sharply.

Sweden's import of crude oil decreased 7% in volume and 26% in value. Import volume of refined products rose 4%, but decreased in value 9%. Total import volume of petroleum products went down 4%, and value dropped 20%. This decrease in value is attributed to the lower 1988 oil prices.

The import of natural gas steadily increased. Natural gas imports increased 100 million cubic meters, and totaled 373 million cubic meters. Sweden's sole supply of natural gas came from the Danish North Sea Field Tyra. Talks with two other potential suppliers, the U.S.S.R. and Norway, were progressing as the natural gas pipeline network was being extended closer to Stockholm on Sweden's east coast.

By 1989, all energy producing plants burning fossil fuels will have a ceiling for sulfur emissions of 0.19% sulfur per megajoule of fuel. This corresponds to an 0.8% sulfur content in residual heating fuels. By 1993, all oil, peat, and coal-fired plants will have stricter emission requirements: Plants with annual emissions of more than 400 tons of sulfur will be restricted to 0.05 gram sulfur per megajoule of fuel; other plants will be restricted to 0.10 gram sulfur per megajoule of fuel.

Commodity Review

Metals.—**Copper.**—After securing the Government's official financial backing, Boliden proceeded with a mining package of 15 projects. The plan's main objective was copper production, which was expected to increase by around 10,000 tons per year over the next 4 years. Boliden's goal is to obtain target of securing 50% of the feed for its 85,000-ton-per-year Ronnskar copper smelter with ore produced by company mines. A major part of the package involves extending the life of the Aitak copper mine by about 10 years and boosting production from 11 to 14 million tons per year. This project was scheduled to be completed by 1991. Other projects include development work at Akersborg, Kedtrask and Kankberg, and deepening mines at Boliden, Kristineberg, and Garpenberg.

The new ore dressing plant at Stora Kopparbet AB's Falun Mine, which was completed in midyear, will treat ore from the Falun Mine and the Svardsjo Mine. The plant was redesigned to increase capacity from 200,000 to 250,000 tons per year of ore. The plant, considered to be the most modern in Sweden, utilizes autogenous grinding. The plant can handle almost any ore mined by the company and incorporates the latest in environmental technology.

Ferrochrome.—Swedechrome AB brought its new plasma arc high-carbon ferrochrome smelter in Malmo to 50% of production capacity after overcoming operational problems earlier in the year. The problems were mainly with subsidiary systems such as dust control, gas coolers, and injection equipment. A new dust recirculation system was installed to meet stringent environmental regulations. The company expects the plant to reach its full operating rate of 80,000 tons per year by yearend 1989.

Gold.—Terra Mining AB officially opened its Bjorkdal open pit mine in October 1988 at Hebberfors in northern Sweden. Terra Mining is owned 50% by Norsk Hydro, 35% by Euroventures Nordica A/S, and 15% by Christer Lofren. Production at the mine was estimated to be around 32,000 troy ounces per year. Proven reserves were estimated to be 1.5 million tons averaging 0.1 ounce of gold per ton.

Boliden Minerals planned to begin developing its Akerberg gold deposit in northern Sweden in the first part of 1989. The drilling program had outlined 1 million tons of ore containing an average grade of 0.1 ounce of gold per ton. Current plans are for an open pit mine, expected to produce 20,000 ounces of gold per year. The Akerborg ore would be processed at the nearby Enasen plant.

Boliden also was planning a $4 million drilling and seismic program at Petiknes, near the Akerberg site. The company had located promising gold mineralization in an estimated 1 million tons of ore. The mineralization is 200 meters below surface and would require development of an underground mine. Boliden produces about 112,000 ounces of gold per year, mostly as a byproduct from its complex ore bodies, which primarily contain copper and zinc.

Iron Ore.—Loussavaara Kiirunavaara AB (LKAB), Sweden's major iron ore producer, increased production 11%. The largest source of this production was the Kiruna operation, including the Svappavarka Mine. The remainder was produced at the Malmberger operation. Development work at the Kiruna Mine was increased 40%. Similar work is to be done at the Malmberger Mine in 1989. LKAB was planning to increase

TABLE 10

SWEDEN: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987[p]	1988[e]
METALS						
Aluminum:						
Primary		82,771	83,509	77,667	81,480	98,597
Secondary		17,557	17,545	18,144	8,820	18,000
Arsenic: Trioxide, refined[e]		10,000	10,000	10,000	10,000	10,000
Copper:						
Mine output, Cu content		86,898	90,495	87,387	85,016	82,600
Metal:						
Smelter:						
Primary		79,775	74,668	83,358	92,909	75,600
Secondary		22,895	26,017	19,142	12,669	14,700
Total smelter		**102,670**	**100,685**	**102,500**	**105,578**	**90,300**
Refined:						
Primary		56,440	46,997	68,688	80,877	74,700
Secondary[e]		7,464	17,655	15,773	11,028	12,000
Total refined		**63,904**	**64,652**	**84,461**	**91,905**	**86,700**
Gold:						
Mine output, Au content	troy ounces	141,600	148,900	[e]130,000	[e]130,000	135,000
Metal, primary[2]	do.	106,200	138,000	[e]120,000	[e]120,000	120,000
Iron and steel:						
Iron ore and concentrate:						
Gross weight	thousand tons	18,123	20,454	20,489	19,707	[3]20,440
Fe content	do.	11,780	13,500	13,520	13,006	13,470
Metal:						
Pig iron and sponge iron	do.	2,323	2,523	2,539	2,314	2,494
Ferroalloys:						
Ferrochromium		134,028	135,453	126,144	111,815	110,000
Ferrochromium-silicon		30,633	26,243	17,024	—	—
Ferromolybdenum		229	161	—	—	—
Ferrosilicon		23,278	28,279	19,969	19,949	20,000
Ferrotungsten		180	—	—	—	—
Total		**188,348**	**190,136**	**163,137**	**131,764**	**130,000**
Steel crude	thousand tons	4,705	4,813	4,710	4,595	4,779
Semimanufactures, rolled	do.	3,988	4,254	4,005	[e]4,000	4,100
Lead:						
Mine output, Pb content		80,760	75,894	88,903	90,423	91,000
Metal:						
Smelter:						
Primary:						
Crude		15,878	15,535	6,512	1,439	1,500
Refined		49,758	43,221	49,160	61,229	62,000
Total primary		**65,636**	**58,756**	**55,672**	**62,668**	**63,500**

See footnotes at end of table.

TABLE 10—Continued

SWEDEN: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987[p]	1988[e]
METALS—Continued						
Metal—Continued						
Smelter—Continued						
Secondary		27,737	25,861	27,783	30,185	32,000
Total smelter		**93,373**	**84,617**	**83,455**	**92,853**	**95,500**
Refined:						
Primary		49,758	43,222	49,160	61,229	60,000
Secondary		27,737	25,861	27,783	30,185	30,000
Total refined		**77,495**	**69,083**	**76,943**	**91,414**	**90,000**
Molybdenum, oxide, roasted, Mo content		1,064	1,486	2,170	2,121	2,000
Selenium, elemental, refined		68	46	[e]50	[e]50	50
Silicon metal		20,206	19,755	[e]20,000	[e]20,000	20,000
Silver:						
Mine output, Ag content	thousand troy ounces	7,676	7,442	7,555	6,912	6,211
Metal, primary[2]	do.	5,370	5,073	[e]5,250	[e]4,800	4,600
Tungsten, mine output, W content		385	402	357	574	320
Zinc; Mine output, Zn content		210,037	216,403	219,289	218,570	[3]186,900
INDUSTRIAL MINERALS						
Cement, hydraulic	thousand tons	2,393	2,124	2,119	2,238	2,200
Clays: Kaolin		196	106	60	[e]100	100
Feldspar, salable, crude and ground		49,833	41,720	35,160	34,226	36,000
Fluorspar concentrate		3,454	3,169	265	220	[3]225
Kyanite		—	2,200	[e]5,000	[e]5,000	6,000
Lime, mostly quicklime	thousand tons	648	649	656	590	400
Nitrogen: N content of ammonia	do.	49	18	46	41	([4])
Phosphate rock (byproduct):						
Gross weight	do.	133	187	192	221	[3]142
P_2O_5 content	do.	51	71	71	82	60
Pyrite, gross weight	do.	418	407	447	429	[3]355
Quartz		17,539	17,298	[e]17,000	[e]17,000	18,000
Sodium sulfate[e]	thousand tons	100	100	100	100	100
Stone:						
Dimension, mostly unfinished:						
Granite	thousand tons	138	148	169	135	140
Limestone	do.	15	15	[e]15	[e]15	20
Sandstone	do.	4	3	[e]3	[e]3	5
Slate	do.	22	21	21	20	20
Crushed:						
Dolomite	do.	830	963	780	606	600
Granite	do.	9,873	8,060	6,888	7,313	7,200
Limestone:						
For cement manufacture	do.	842	765	913	943	950

See footnotes at end of table.

TABLE 10—Continued

SWEDEN: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987[p]	1988[e]
INDUSTRIAL MINERALS—Continued						
Stone—Continued						
Crushed—Continued						
Limestone—Continued						
For lime manufacture	do.	687	1,997	[e]2,000	[e]2,000	2,000
For other construction and industrial uses	do.	2,039	2,068	[e]2,100	[e]2,100	2,000
Chalk (ground)	do.	40	40	39	37	38
Marl	do.	2,718	2,314	[e]2,500	[e]2,500	2,500
For agricultural uses (ground)	do.	296	306	300	[e]300	300
For other uses (ground)	do.	108	94	[e]100	[e]100	100
Total	**do.**	**6,730**	**7,584**	**7,952**	**[e]7,940**	**7,888**
Quartzite	do.	1,533	1,466	7,128	1,297	1,400
Sandstone	do.	138	123	[e]125	45	50
Other	do.	666	690	[e]700	[e]700	700
Sulfur:						
S content of pyrite	do.	212	210	227	[e]220	200
Byproduct:						
From metallurgy	do.	122	123	125	[e]130	125
From petroleum	do.	26	23	49	[e]50	45
Total	**do.**	**360**	**356**	**401**	**[e]400**	**370**
Sulfuric acid	do.	930	960	1,001	985	1,000
Talc and steatite		17,882	14,400	2,000	16,981	16,000
MINERAL FUELS AND RELATED MATERIALS						
Carbon black	thousand tons	26	31	[e]30	[e]30	30
Coke, metallurgical	do.	1,236	1,247	[e]1,200	[e]1,200	1,200
Peat, for agricultural use[e]	do.	60	60	60	60	60
Petroleum:						
Crude	thousand 42-gallon barrels	98	60	30	24	15
Refinery products:						
Liquefied petroleum gas	do.	1,891	2,088	2,714	2,448	2,500
Naphtha	do.	1,700	1,096	1,530	1,726	2,640
Gasoline, motor	do.	27,931	25,466	26,868	[e]31,118	37,600
Jet fuel	do.	3,784	4,112	3,544	[e]4,704	6,600
Kerosene	do.	116	202	170	[e]256	395
Distillate fuel oil	do.	34,137	34,480	40,761	41,552	44,230
Residual fuel oil	do.	27,999	27,206	28,025	26,207	25,785
Other	do.	4,853	5,252	5,485	5,872	6,000
Refinery fuel and losses	do.	5,175	8,010	6,630	7,448	7,500
Total	**do.**	**107,586**	**107,912**	**115,727**	**[e]121,331**	**133,250**

[e] Estimated. [p] Preliminary.
[1] Table includes data available through July 1, 1989.
[2] Includes only that recovered from indigenous ores excluding scrap.
[3] Reported figure.
[4] Plant closed.

pellet-making capacity in its three plants in Kiruna, Malmberger, and Svappavarka by about 700,000 tons per year. When expansion is completed, the company's overall pellet capacity will be 11 million tons per year.

Mining operations ceased at Svappavaara for 5 weeks in midyear. LKAB extensively rehabilitated the plant and installed new equipment. The pellet plant capacity was increased to 3.3 million tons per year. New equipment for loading pellets onto railway cars was installed. A fluorine flume purification plant and exhaust gas recovery furnace also were constructed.

Silicon.—KemaNord decreased silicon production at its Ljumgaverk plant from 24,000 tons per year to 14,000 tons per year in the last quarter of 1988. The company was unable to negotiate a lower cost power contract with the Government. The Government's new energy policy aims to increase the average price of power for the industry by 33% to 35% over the next 3 years. The company, whose power contract expired at yearend, maintained that it could not absorb escalating energy costs. KemaNord shut down one of its two furnaces and announced that it was switching its emphasis to high-grade silicon used in the chemical and aluminum industries.

Steel.—After a relatively slow year in 1987, business increased for the Swedish steel industry. The industry operated close to capacity. Most companies showed profits. Companies made substantial investments in environmental protection equipment to meet stricter operating criteria.

In early 1988, a new steel group was formed when Welbond AB was created from Smedjebacken-Boxholm AB, Halmstad Jarnverks AB, and Forsbacka Jernverk AB. The Welbond Group, now with the name Fundia AB, is scrap based and was expected to be a major manufacturer of long steel products in commercial grades.

Svenskt Stal (SSAB) implemented a reorganization prior to a public stock issue, the date of which was unknown at yearend. SSAB planned to concentrate on strip mill products. New divisions instituted were SSAB Strip Mill AB, SSAB Heavy Plate AB, and SSAB Bar Steel AB.

SSAB announced its decision to close several units in 1989 including the electromelting shop and wire rod mill at Domnarvet, the small section mill and two continuous casting machines at Lulea, and the hot strip mill at Surahammer. These shutdowns were expected to result in the loss of 2,500 jobs.

The proposed closure of SSAB's two electric arc furnaces at Domnarvet and Ovako Steel Oy AB's electric furnace at Hallefors would cut ferrous scrap import requirements by around 500,000 tons per year. Because Sweden imports around 750,000 tons per year, import requirements would drop to around 250,000 tons per year. The export ban on Swedish scrap could be lifted when the closures take place.

***Industrial Minerals.*—Cement.**—The cement producer Allentown Cement Co. and the ready-mixed concrete manufacturer Vineland Co., both of the United States, and Castle Ltd. of the United Kingdom were purchased by the Euroc group of Sweden and the Aker Group of Norway. The international diversification by Aker and Euroc was coordinated through the joint venture Scancem AB. The establishment of Scancem resulted in the formation of one of the largest international cement enterprises. By acquiring Castle Cement, Scancem gained 25% of the United Kingdom's cement market. Both U.S. companies are also strongly positioned in their U.S. markets.

Mineral Fuels.—According to Vattenfall, the state power authority, Sweden faces the prospect of a doubling of cost of energy production. A major cause of this price increase is the planned phaseout of its nuclear power program. This phaseout is to start in 1995. Nuclear power currently accounts for about 50% of the country's energy supply. Vattenfall estimated that energy prices would increase 40% by the mid-1990's. The effect of the higher prices would be felt across a wide range of services. Two reactors due to be closed by the mid-1990's include one of four at the Ringhals station and one of two at Barseback. Forestry, metals, and mining industries would be hit particularly hard.

Sweden plans to buy natural gas to replace the nuclear energy power stations. Negotiations were underway at yearend between Vattenfall, the Finnish state owned oil company Neste Oy, Norway's Statoil, and the U.S.S.R. To justify the cost of a pipeline from the Norwegian gasfields, Neste estimated a market of 5 billion cubic meters per year would be required. Through this pipeline, Sweden would be connected to the European gas grid, which would act as a stabilizing price factor for Sweden's industry that competes with the EC market.

Swedegas and Neste Oy held discussions to determine volumes and prices for Soviet gas via pipeline from Finland to Sweden. A Baltic Sea crossing from Uusikaupunki to Gavle, chosen as the best route for the pipeline, was estimated to cost $242 million.

There was renewed interest in Baltic Sea petroleum prospecting after seismic investigation confirmed oil deposits of an estimated 60 million barrels. Two Swedish oil companies, Hydrocarbon International (HCI) and Gotlandsolja AB (GOAB), formed Grauten Oil AB. The company will drill for gas and oil deposits in the Baltic Sea sector and on the island of Gotland. Grauten expects to perform 110 test drillings over the next 3 years at an estimated cost of $3.3 million.

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[1] Prepared by Donald E. Buck, Jr., physical scientist, Division of International Minerals.

[2] Where necessary, values have been converted from Danish krone (DKr) to U.S. dollars at the rate of

DKr7.02=US$1.00, the average for 1988.

[3] Prepared by Donald E. Buck, Jr., physical scientist, Division of International Minerals.

[4] Prepared by Harold R. Newman, physical scientist, Division of International Minerals.

[5] Where necessary, values have been converted from finnmarks (Fmk) to U.S. dollars at the rate of Fmk4.19=US$1.00, the average rate for 1988.

[6] Prepared by Harold R. Newman, physical scientist, Division of International Minerals.

[7] Where necessary, values have been converted from Icelandic krona (Ikr) to U.S. dollars at the 1988 average rate of Ikr43.00=US$1.00.

[8] Prepared by Donald E. Buck, Jr., physical scientist, Division of International Minerals.

[9] Where necessary, values were converted from Norwegian kroner (NOK) to U.S. dollars at the rate of NOK6.6=US$1.00, the average for 1988.

[10] Prepared by Harold R. Newman, physical scientist, Division of International Minerals.

[11] Where necessary, values have been converted from Swedish kronor (SKr) to U.S. dollars at the rate of SKr6.12=US$1.00, the average for 1988.

THE MINERAL INDUSTRIES OF

SOUTHERN EUROPE

By John G. Panulas, George A. Rabchevsky, and Richard M. Levine

ITALY[1]

Italy's mining activities accounted for an estimated 4% of the country's 1988 gross national product (GNP) of about $467 billion. Italy continued to be a major producer of the world's pumice (50%), feldspar (22%), cement (4%), asbestos (3%), bentonite (3%), fluorspar (3%), and magnesite (2%).

The mining and processing sectors comprised both Government-owned and private-sector enterprises. The state entities included petroleum producer Ente Nazionale Idrocaruri (ENI) and its affiliates Societa per Azioni Minero-Metallurgiche (SAMIM) and Azienda Generali Italiana Petroli-Minière S.p.A. (AGIP Minière); the iron and steel conglomerate Finanziaria Siderurgica S.p.A. (Finsider) and its subsidiaries Nuovo Italsider S.p.A., Dalmine S.p.A., Deltasider, and Acciaieria Piombino. The major privately owned companies of the mineral industry were Societa Mineraria e Metallurgica di Pertusola S.A. (Pertusola), which produces lead and zinc, and Acciaiere Lombarde Falck (Falck), which manufactures steel.

Production

The Italian mining industry showed little growth in 1988. Production of metallic minerals fell slightly. Smelter and refinery production of most metals generally remained constant. Output of industrial minerals registered negligible growth. Likewise, industrial mineral products posted only small gains. In general, petroleum and natural gas sustained their previous output levels.

Trade

The table outlines the impact of selected classes of minerals commodities on Italy's balance-of-payments position in relation to other European Community (EC) member nations and the world. The figures are for 1987, the latest year for which data were available.

Commodity Review

Metals.—**Iron and Steel.**—Italy's steel consumption amounted to 25.4 million tons, the highest level since 1980. The country became a net importer of steel for the first time since 1973. Italy's steel industry was confronted with two major issues, one of which was restructuring.

The board of Italy's state-run steel group, Finsider, approved a 3-year corporate plan that restructured the group into two new companies. One company would sell or close unprofitable plants. The following were to be auctioned to the private sector: the Trieste pig iron works, Marghera section mill, the Delta Vardano merchant bar mill, two wire plants at Naples and Salerno, and a subsidiary company, Sisma, that produces nuts and bolts. The proceeds would be applied to payment of Finsider's debts.

Slated for closure were Italsider's Campi steelworks at Genoa, Deltasider's Sesto San Giovanni works at Milan and Turin, and the Terni bar mill. These closures would result in the elimination of 3.4 million tons of raw steel capacity, 1.2 million tons of hot-rolled products, and 700,000 tons of cold-rolled products.

The second company, named Ilva, consolidated Finsider's profitable operations at Taranto (flat products), Piombino (long products), Dalmine (seamless tubes), Terni (special and stainless flat products), More Ligure (cold-rolled sheets), Cornigliano (coated products), Torre Annunziata (welded tubes), and Condore (drawn bars). Ilva's work force

Mineral Commodity		Exports to EC	Imports from EC	Net gain or (loss)	Exports to the world	Imports from the world	Net gain or (loss)
Crude industrial minerals:							
Asbestos	value, thousands	$7,168	$2,771	$4,397	$10,785	$20,893	$(10,108)
Feldspar	do.	4,234	8,339	(4,105)	7,678	13,702	(6,024)
Magnesite	do.	18,953	18,473	480	33,402	34,778	(1,376)
Other	do.	98,697	318,972	(220,275)	253,288	686,729	(433,441)
Total	**do.**	**129,052**	**348,555**	**(219,503)**	**305,153**	**756,102**	**(450,949)**
Metalliferous ores	do.	61,370	623,915	(562,545)	87,502	1,545,160	(1,457,658)
Nonmetallic mineral manufactures:							
Cement	do.	4,389	26,739	(22,350)	27,936	40,421	(12,485)
Other	do.	2,208,705	1,047,016	(1,161,689)	4,272,597	1,475,453	2,797,144
Total	**do.**	**2,213,094**	**1,073,755**	**1,139,339**	**4,300,533**	**1,515,874**	**2,784,659**
Metals:							
Iron and steel	do.	2,095,016	2,864,431	(769,415)	4,113,985	4,175,435	(61,450)
Nonferrous metals	do.	682,198	1,581,779	(899,581)	1,059,032	2,850,662	(1,791,630)
Total	**do.**	**2,777,214**	**4,446,210**	**(1,668,996)**	**5,173,017**	**7,026,097**	**(1,853,080)**
Mineral fuels	do.	1,136,434	1,476,591	(340,157)	2,842,458	16,664,018	(13,821,560)

TABLE 1

ITALY: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987[p]	1988[e]
METALS						
Aluminum:						
Alumina		607,274	555,319	618,374	699,635	[2]708,158
Metal:						
Primary		230,207	221,055	242,632	228,230	[2]221,644
Secondary		283,000	282,000	301,000	335,000	335,000
Antimony:						
Mine output, Sb content		244	495	305	[e]300	[2]308
Metal, total		1,121	1,039	715	[e]700	[2]731
Bismuth metal		26	54	66	[e]70	[2]32
Cadmium metal, smelter		452	526	411	325	[2]705
Copper:						
Mine output, Cu content		875	130	—	—	—
Metal, refined, all kinds		50,300	64,300	64,800	[e]65,000	65,000
Iron and steel: Metal:						
Pig iron	thousand tons	11,628	11,658	11,898	11,334	11,000
Ferroalloys:						
Blast furnace:						
Ferromanganese		36,092	50,111	48,002	[r e]40,000	39,000
Spiegeleisen		935	1,001	1,151	[e]1,200	1,200
Silicon pig iron (10%-12% Si)		342	686	968	[e]1,000	1,000
Electric furnace:						
Ferrochromium		49,942	57,654	55,939	[e]56,000	87,000
Ferromanganese		15,651	17,166	11,653	[e]12,000	12,000
Ferrosilicon		71,157	75,302	62,799	[e]63,000	51,000
Silicomanganese		72,779	64,858	66,083	[e]67,000	69,000
Silicon metal		22,812	17,812	18,904	[r e]16,500	17,000
Other		50,755	15,862	14,022	[e]14,000	19,000
Total		**320,465**	**300,452**	**279,521**	**[r e]270,700**	**296,200**
Steel, crude	thousand tons	24,061	23,744	22,882	22,819	24,000
Semimanufactures:						
Wire rod	do.	2,027	2,256	2,293	2,368	2,200
Sections	do.	6,874	7,135	3,223	3,458	5,000
Plates and sheets	do.	5,836	5,062	9,748	9,887	9,000
Hoop and strip	do.	461	526	735	762	700
Railway track material	do.	234	280	264	281	250
Ingots, semimanufactures, solids for tubes	do.	948	1,198	1,073	1,126	1,100
Castings and forgings	do.	435	326	341	325	350
Other	do.	1,524	1,383	1,454	1,526	1,400
Total	**do.**	**18,339**	**18,166**	**19,131**	**19,733**	**20,000**

See footnotes at end of table.

TABLE 1—Continued

ITALY: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987[p]	1988[e]
METALS—Continued						
Lead:						
Mine output, Pb content		20,883	15,622	11,119	19,284	[2]16,503
Metal, refined:						
Primary		37,558	29,538	29,333	56,900	[2]40,640
Secondary		102,900	96,700	101,700	111,400	[2]111,600
Magnesium						
Mine output, Mg content		9,300	9,831	9,046	9,520	[2]6,878
Metal, primary		7,491	7,863	12,417	7,173	[2]5,436
Manganese, mine output:						
Gross weight		9,582	8,621	6,396	[e]3,400	[2]9,701
Mn content		2,858	2,586	1,689	[e]1,000	[2]2,538
Silver metal	thousand troy ounces	1,554	2,301	1,813	2,668	[2]2,929
Zinc:						
Mine output, Zn content		42,288	45,438	26,303	26,101	[2]37,150
Metal, primary		169,672	215,644	229,397	229,988	[2]242,117
INDUSTRIAL MINERALS						
Asbestos		147,272	136,006	115,208	118,352	[2]94,549
Barite		107,128	128,356	114,132	81,643	[2]77,061
Bromine[e]		500	600	450	[r]450	450
Cement, hydraulic	thousand tons	37,782	36,677	35,340	36,200	[2]37,257
Clays, crude:						
Bentonite	do.	309	304	300	313	[2]301
Refractory excluding kaolinitic earth	do.	332	400	381	375	[2]454
Fuller's earth	do.	30	30	31	40	[2]38
Kaolin	do.	53	60	35	57	[2]71
Kaolinitic earth	do.	25	26	21	22	[2]19
Diatomite[e]		28,000	30,000	27,000	27,000	28,000
Feldspar		985,573	1,115,575	1,237,058	1,173,663	[2]1,367,776
Fluorspar:						
Acid-grade		110,330	95,450	90,900	80,300	[2]81,700
Metallurgical-grade		77,931	56,762	54,536	56,600	[2]58,157
Total		**188,261**	**152,212**	**145,436**	**136,900**	**[2]139,857**
Gypsum	thousand tons	[r]1,004	[r]1,281	1,220	1,233	[2]1,300
Lime, hydrated and quicklime	do.	2,402	2,276	1,913	2,172	[2]2,250
Nitrogen: N content of ammonia	do.	1,210	1,217	[e]1,200	[e]1,200	1,300
Perlite[e]		80,000	80,000	[r]73,000	70,000	70,000
Pigments, mineral: Iron oxides, natural[e]		800	850	875	900	900
Potash, crude salts:						
Gross weight	thousand tons	1,481	1,701	1,261	1,401	[2]1,576
K_2O equivalent	do.	162	205	158	168	[2]197

See footnotes at end of table.

TABLE 1—Continued

ITALY: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987[p]	1988[e]
INDUSTRIAL MINERALS—Continued						
Pumice and related materials:						
Pumice and pumiceous lapilli	thousand tons	903	[e]750	[e]700	725	[2]730
Pozzolan[e]	do.	[2]5,712	5,000	4,500	5,000	5,000
Pyrite, all types, gross weight	do.	443	690	761	[e]770	[2]774
Salt:						
Marine, crude[3]	do.	723	570	574	571	[2]680
Rock and brine	do.	3,255	3,176	3,433	3,500	[2]3,691
Sand and gravel:[e]						
Volcanic sand	do.	[2]115	110	100	100	100
Silica sand	do.	[2]4,415	4,400	4,200	4,300	4,300
Other sand and gravel	do.	[2]120,694	122,000	123,000	122,000	123,000
Sodium and potassium compounds:						
Caustic soda		[e]8,000	[e]8,500	10,427	12,162	11,000
Sodium carbonate[e]	do.	90	90	80	[2]85	85
Sodium sulfate[e]	do.	80	80	75	80	80
Stone:						
Dimension:[e 4]						
Calcareous:						
Alabaster and onyx	do.	[2]17	20	20	20	20
Marble in blocks:						
White	do.	[2]1,777	1,500	1,600	1,600	1,600
Colored	do.	[2]1,756	1,800	1,800	1,800	1,800
Schist (calcareous)	do.	[2]510	500	500	500	500
Travertine	do.	[2]1,066	1,100	1,100	1,100	1,100
Tufa	do.	[2]5,207	5,000	4,500	4,500	4,500
Other:						
Gneiss	do.	[2]319	300	300	300	300
Granite	do.	[2]2,385	2,500	2,500	2,500	2,500
Lava, basalt, trachyte	do.	[2]8,799	7,000	8,000	8,000	8,000
Porphyry	do.	[2]1,205	1,200	1,200	1,200	1,200
Sandstone	do.	[2]1,855	1,800	1,800	1,800	1,800
Slate	do.	[2]124	120	120	120	120
Tuff, volcanic	do.	[2]5,930	5,900	5,800	5,800	5,800
Crushed and broken:						
Dolomite[e]	do.	[2]887	900	850	850	850
Limestone[e]	do.	[2]117,025	120,000	110,000	110,000	110,000
Marl for cement	do.	11,502	11,458	10,574	[e]11,000	11,000
Serpentine[e]	do.	[2]1,204	1,500	1,500	1,500	1,500
Quartz and quartzite[e]	do.	[2]316	300	250	250	250
Strontium minerals: Celestite		—	4,611	4,667	177	—

See footnotes at end of table.

TABLE 1—Continued

ITALY: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987[p]	1988[e]
INDUSTRIAL MINERALS—Continued						
Sulfur:						
Gross weight of ore	thousand tons	20	5	—	—	—
Recovered as elemental and in compounds:						
Elemental from ore	do.	8	1	—	—	—
S content of pyrite	do.	192	280	309	[e]300	300
Byproduct, oil refining[e]	do.	10	10	10	10	10
Byproduct, other sources[e]	do.	190	190	175	180	180
Total	**do.**	**400**	**481**	**494**	**[e]490**	**490**
Talc and related materials		142,727	129,614	151,206	148,028	[2]158,722
MINERAL FUELS AND RELATED MATERIALS						
Asphalt and bituminous rock, natural		91,988	88,700	65,889	[e]66,000	[2]56,907
Carbon black[e]		160,000	150,000	155,000	156,000	155,000
Coal:						
Lignite	thousand tons	1,806	1,892	1,573	[e]1,600	1,600
Subbituminous (Sulcis coal)		8,112	18,773	13,708	[e]13,700	[2]48,408
Coke, metallurgical	thousand tons	6,920	7,377	7,156	6,751	7,000
Gas, natural, marketed	million cubic feet	488,650	503,058	563,735	[e]564,000	[2]587,386
Natural gas liquids	thousand 42-gallon barrels	383	360	[e]400	[e]400	400
Petroleum:						
Crude	do.	15,635	16,024	17,230	[e]17,000	[2]32,714
Refinery products:						
Liquefied petroleum gas	do.	21,286	19,964	21,274	28,314	[2]30,712
Gasoline, all kinds	do.	123,522	124,617	131,538	137,989	[2]139,102
Naphtha	do.	22,876	27,175	33,932	18,921	[2]15,806
Jet fuel	do.	8,664	9,400	11,336	11,056	[2]14,128
Kerosene	do.	18,514	17,042	27,729	28,760	[2]30,349
Distillate fuel oil	do.	171,557	169,499	203,046	190,946	[2]188,685
Residual fuel oil	do.	173,466	146,087	156,916	156,090	[2]156,783
Other	do.	40,957	43,988	45,150	46,263	[2]49,287
Refinery fuel and losses	do.	48,631	36,735	29,407	37,443	[2]45,367
Total	**do.**	**629,473**	**594,507**	**660,328**	**655,782**	**670,219**

[e]Estimated. [p]Preliminary. [r]Revised.
[1]Table includes data available through July 1989.
[2]Reported figure.
[3]Does not include production from Sardinia and Sicily estimated at 200,000 tons annually.
[4]Output of limestone and serpentine for dimension stone use is included with "Stone: Crushed and broken."

was reduced from 78,000 to 63,000. The labor force was to be further reduced to 50,000 before yearend. The personnel reductions and reduced capacity of the new company were expected to halve operational losses from $1.2 million[2] in 1987 to $600,000 in 1988.

A second issue concerned state aid to Italy's iron and steel industry. It was not clear if the EC would permit state aid of $5.6 million to Ilva to facilitate its restructuring effort. EC concern was that Ilva's Bagnoli operations, near Naples, would not be curtailed sufficiently. The melting shop at Bagnoli, which produced 1 million tons of hot-rolled coil annually, was scheduled for closure. The elimination of 2,500 jobs at Bagnoli caused worker protests. The Italian Government responded by postponing indefinitely any decision about closing Bagnoli, indicating that Bagnoli would remain open if it became profitable. This contradicted a December EC resolution that the first $4 million of Italian state aid would be delivered upon closure of Bagnoli's liquid steel facilities. The Italian Government indicated, however, that state aid would not be linked to the closure at Bagnoli.

Earlier in the year, the EC determined that the sustained granting of credit by publicly controlled Italian banks to Finsider was illegal, was tantamount to state aid, and did not correspond to market practice. The EC found the loans in violation of article 88 and article 4(c) of the European Coal and Steel Community Treaty that prohibits such activity.

Lead and Zinc.—At the Monteponi Mine, run by the Giovanni and Benedetto division of Società Italiana Minière, survey work confirming further ore deposits was completed. Most of the survey work was done 200 feet below the mine surface. The Monteponi Mine produced 350,000 tons of crude sulfides, of which 12,200 tons contained lead metal.

At the Marx and Nebida ore bodies in Sardinia, also operated by Società Italiana Minière, bore holes driven 50 feet below the mine surface revealed extensive mineralization that could be developed. Average grades were determined to be 3.31% zinc and 2.25% lead.

At SAMIM's Porto Vesme electrolytic zinc plant in Sardinia, 77,000 tons of electrolytic zinc in cathodes was produced. In addition, 35,000 tons of decoppered lead was produced. Much of the decoppered lead output was sent to SAMIM's San Garino plant for treatment. A reorganization at that plant enabled SAMIM to treat the entire decoppered lead output from Porto Vesme.

Magnesium.—Italian Magnesium and Magnesium Alloy Co. began to rebuild the smelting plant at the company's Dosseni Mine facility in Trento Province. Consequently, output volume at the mine was reduced to 62,500 tons of crude ore. Metal content of that ore amounted to 6,800 tons.

Industrial Minerals.—**Asbestos.**—At Amiantifera di Balangero S.p.A.'s Balangero Mine near Turin, a new transport shaft was built and a new conveyor belt assembled that would link a secondary crusher with the primary crusher located at a newly constructed concourse 630 feet above sea level. About 89,000 tons of fiber was derived by treating the crude Balangero ore.

Cement.—Italy's cement industry saw numerous modifications and improvements to existing plants.

Presacementi overhauled its number 3 kiln at its Robilante plant in southern Italy. The kiln was equipped with a tertiary air precalcining and cooling system, with a view toward producing 4,000 tons per day of clinker. A kiln control system also was installed.

Cementerie Italiane del Sud S.p.A. changed its Vibo Valentia works from wet to dry process and added a raw mill.

Italcementi installed a preheater kiln capable of producing 2,000 tons per day in its Vibo Valentia plant at the southern tip of Italy. At its Sicily plant, the company installed an 1,800-ton-per-day kiln.

Colacem installed an 1,800-ton-per-day preheater kiln in its Gubio plant. Unicem installed a new, 60-ton-per-hour finish mill at Barletta, on the southeast coast of Italy.

Dimension Stone.—In terms of tonnage, dimension stone continued to be the most important industrial mineral produced in Italy. There were an estimated 3,000 to 4,000 dimension stone quarries throughout the country. The most significant white-marble-producing area was in the Apuan Alpo in Tuscany, near the town of Carrara. The Lombardy region, the Po Valley, Venetia, Puglia, Sicily, and Lazio were important colored-marble-producing areas. The major domestic uses of dimension stone were in the construction and monument industries. Increasingly, Italian dimension stone producers focused their work on value-added products and shaping, cutting, and polishing imported stone.

Fluorspar.—At Mineraria Silius's Gennas Tres Montes and Moscadroxin Mines, surveys, taken at 200 and 250 feet above sea level, indicated a significant increase in reserves.

Pyrite.—At New Solmine's Scarlino plant, a number of ecological programs were undertaken. These included converting catalyzers from single to double absorption, to considerably reduce sulfur emissions; replacing waste dumps and slurry ponds over 50 hectares with floral landscape; and constructing a new water-treatment plant. At Scarlino, 933,000 tons of sulfuric acid was produced, a 74,000-ton increase.

Salt.—At Montedipe's Tunipa del Salto Mine, four new wells were drilled. Three of the four wells were intended for "blanket" use. In blanket use, a predetermined amount of oil is introduced into the well. The oil floats on top of the brine, precluding dissolution of the rock salt in the upper segment of the cavern.

Mineral Fuels.—**Coal.**—At Nuraxi Figus, construction of a new washing plant began. Capacity of the new plant was estimated to be 1.7 million tons of washed coal per year. At Sulcis, work continued on assembling the main descending shaft in the facility, as well as excavating of underground roadways. The coal produced at Sulcis resulted from development work and amounted to 264,000 tons of crude output. That output was then treated at Seruci and yielded 50,000 tons of washed coal.

Geothermal Energy.—Deep prospecting for geologic, hydrologic, and chemical finds took place in the Larderello, Monte Amiata, and Torre Alfina regions of Italy. About 29,300 meters of boreholes was drilled in three areas. Five of the boreholes drilled at Larderello and three at Monte Amiata produced positive results, the details of which were not available.

AUSTRIA[3]

Austria has a long mining tradition. Even though Austria has a variety of mineral resources, the country is small, and reserves have declined considerably. Base metals, coal, graphite, iron ore, magnesite, salt, and tungsten were the backbones of the mining industry. Steelmaking and production of antimony, with some lead and zinc, were the main processing industries. Austria imported many of the raw materials necessary for its domestic processing requirements. Basic refractories continued to be among the principal industrial mineral exports.

Except for brown coal mining, Austria's mining industry performed satisfactorily in 1988. Some branches were able to increase production. The mining sector's contribution to gross domestic product (GDP) declined to about $500 million,[4] from $540 million in 1987. Mining thus made up 0.4% of GDP in both real and nominal terms. Employment in mining dropped from 9,688 in 1987 to 9,000 in 1988. Of those, 4,445 were employed in mining companies belonging to State-owned industries.

Tourism was a major factor in Austria's economy. The Austrian tourist industry, one of the oldest in the world, brought in 88 million visitors in 1988. Visitors from the EC countries accounted for almost 90% of the tourists staying in Austria.

Austrian GDP rose 4.2%, after an 8-year period during which the average annual growth rate barely exceeded 1.5%. Austria outperformed all the main Western European economies. Inflation rose only slightly, to 2%. Total employment also rose for the first time since 1979, a trend expected to bring down the unemployment rate from 5.3% in 1988 to 4.9% in 1989 and 1990. In absolute terms, there were about 160,000 unemployed people in 1988. The annual average employment numbered 2,808,000 workers in 1988, a post World War II record. At yearend, more than 1 million employees worked 38 or 38.5 hours per week.

Since the nationalization laws came into being some 40 years ago, Austria has become the country with the highest proportion of publicly owned companies of all the Organization for Economic Cooperation and Development (OECD) countries. The companies of the Osterreichische Industrieholding AG (OIAG) were responsible for 20% of the country's industrial output.

Impelled by heavy losses during 1985 and 1986 in OIAG's nationalized industries including such companies as Voest-Alpine AG (VA) (steel), Austria Metall AG (nonferrous metals), Chemie Linz AG (chemicals), and Elin Union AG (electrics and electronics), the Austrian Government in 1987 and 1988 undertook major steps to improve negative fiscal performance. Parliament provided a legal basis for the operation of a holding group, providing $2.67 billion to cover the costs of the restructuring process. The Government also brought in new management, retaining a 51% stake in the State-run company while selling the remaining 49% to the public in stages.

OIAG formed 7 divisional holding companies covering 350 companies for the steel, electrics and electronics, nonferrous metals, mining, machinery and plant construction, oil and gas, and chemicals industries. Each holding company controlled the activities of the group belonging to its industry. The divisional holding companies were to direct the activities of their subsidiaries, decide on investments and key personnel, and issue general guidelines for their industries. OIAG was to direct their activities and decide on investment flows, finances, dividends, organizational structure, joint ventures, and acquisitions. The new divisional holding companies included the following: Voest-Alpine Stahl Holding AG (steel), with 30,332 employees as of April 1988; Maschinen-und Anlagenbau Osterreichische Mineralolverwaltungs Holding AG (machinery), with 15,765 employees; Osterreichische Mineralolverwaltungs AG (OMV) (oil and gas), with 9,783 employees; Elektrotechnik und Elektronik Industrie Holding AG (electronics), with 11,544 employees; Austria Metall AG (nonferrous metals), with 5,103 employees; Chemie Holding AG (chemicals), with 5,839 employees; and OIAG Bergbauholding AG, or OBAG (mining), with 5,497 employees.

In 1987, gross revenues for the OIAG group were listed as $12.36 billion, with exports recorded as $4.74 billion. The group employed 93,373 people. The 1988 restructuring involved laying off more than 20,000 workers, some 20% of the OIAG's total labor force, which was slimmed down to 88,220 people.[5] OIAG still accounted for more than 10% of Austria's GNP and almost one-fifth of Austria's exports in 1988. Minerex AG, a geological consulting company wholly owned by OIAG, ceased its activities in March 1988, laying off all of its employees.

A separate holding company for the State-owned mining companies, OBAG, held 100% of the shares in Bleiberger Bergwerks-Union AG, Wolfsegg-Traunthaler Kohlenwerks AG, Graz-Koflacher Eisenbahn-und Bergbau GmbH, the VA's iron ore company in Erzberg, and 40% of the shares in Salzach-Kohlenbergbau-Gesellschaft mbH.

Production

In Austria, there were 90 operating mines and quarries, of which 21 were underground mines, 58 were surface mines, 7 were both underground and surface, and 4 were boreholes for salt solution minings. There were 9,688 workers employed by the minerals industries.

Total plant and equipment investment grew 5.3% in real terms, after rising only 1.8% a year earlier. Despite positive trends in industry, such as good profits and high capacity utilization, industrial investment stagnated in 1988. After declining 1.8% in 1987, industrial production grew a substantial 6.5% in 1988. This was the highest growth since 1979. Producers of raw materials and semifinished goods benefited from booming foreign trade throughout 1988.

Voest-Alpine Maschinenbau GmbH carried out field tests with its newly developed Voest-Alpine Surface Miner in an Austrian gypsum mine. The Miner was designed to cut medium-to-hard overburden and minerals such as anthracite, bituminous, and lignite coal; phosphate; gypsum; limestone; clay; and marl. Excavated material was loaded directly from the machine into trucks.[6]

Trade

Exports were of central importance to Austria's economic well-being. Austria remained a member of the European Free Trade Association and had important trade links to Eastern Europe. Austria's economy also was closely tied to the EC. About 64% of Austrian exports went to Community countries, and 70% of Austria's imports came from them. Total exports to other countries accounted for about 9%. The Federal Republic of Germany and France were Austria's two most important trading partners. Total imports rose in value by 9%.

About 40% of all goods and services produced was exported. Raw materials and energy exports showed a slight decline after a strong rise registered in the previous year. Because of its internalization process, the OIAG group accounted for 17% of Austria's exports.

Total exports grew by 9% in real terms. In 1988, exports to the EC expanded by 12.6%, to the Eastern European bloc by 13.3%, to the member states of the Organization of Petroleum Exporting Countries by 14.4%, and to the United States by 10.8%. The U.S. market accounted for 3.5% of Austria's exports.

In 1988, VA received orders from the U.S.S.R. totaling about $650 million; almost one-half of the orders were for the third expansion phase of the Zhlobin steel tire cord plant in Byelorussia.[7] VA also received orders from Poland for the installation of a vibrating pickling plant, from Bulgaria for a continuous slab caster, and from Czechoslovakia for a pipe finishing plant.

Austria's Treibacher Chemische Werke AG signed a joint-venture agreement with Greenbushes Ltd. of Australia for the production and marketing of tantalum and niobium carbide products.

Commodity Review

Metals.—**Iron Ore and Steel.**—The only iron ore producer in Austria, VA, drastically cut the labor force at its mine in Erzberg. Underground operations ceased, while surface operations supplied about 25% to 30% of domestic iron ore requirements. Most of VA's iron ore was imported from the U.S.S.R., with some from Sweden and Canada, in declining order. Operating losses were reduced considerably after severe personnel cuts. A December 1988 amendment of the 1979 mining promotion act made the Erzberg Mine eligible for the mining subsidy program and secured its survival for some years at least. The mining industry subsidies, which totaled $8.54 million for 1988 and $17.1 million for 1989, were granted for exploration, to cover losses, and to close mines. The subsidies program conformed to EC regulations. The Erzberg Mine may survive until the year 2000, but its survival depends largely on the continued operation of the Donawitz steel plant utilizing its new KVA steel process. If Donawitz closes, the Erzberg Mine is unlikely to survive.

The Donawitz steel plant belonged to OIAG's Voest company. On average, the plant has lost $81.3 million annually since 1975. There were hopes that the losses could be gradually reduced by the introduction of a new steelmaking process (KVA), developed jointly with Klockner AG of the Federal Republic of Germany. The KVA steel process uses a much higher share of scrap than traditional production methods. Donawitz also reduced its labor force by 1,200, to 2,200 workers in 1988. Reportedly, an economic analysis showed that the new process and other rationalization measures are not sufficient to restore profitable performance; in any case, a Government subsidy of $219.5 million was necessary in 1988. Planners were considering closing the Donawitz works in 1991, despite the measures already taken. The works would probably have to be shut down in any case, should Austria eventually become an EC member. The decision to invest in the KVA process, therefore, seemed based on political rather than economic considerations.

Voest developed a new ironmaking technology called Corex. A 60,000-metric-ton-per-year Corex pilot plant was operating in Austria. Voest was also designing and building the first such commercial-size direct coal reduc-

TABLE 2

AUSTRIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons, unless otherwise specified)

Commodity		1984	1985	1986	1987[p]	1988[p]
METALS						
Aluminum metal:						
Primary		95,833	94,106	92,453	93,414	95,494
Secondary		[r]21,500	[r]21,100	24,700	19,800	29,400
Total		**[r]117,333**	**[r]115,206**	**117,153**	**113,214**	**124,894**
Antimony, mine output, Sb content of concentrate		523	477	514	322	228
Cadmium metal		49	52	52	26	26
Copper:						
Smelter, secondary		24,600	25,900	25,500	38,700	38,400
Refined:						
Primary		9,592	8,207	7,067	3,855	3,551
Secondary		34,293	34,966	32,579	32,924	38,378
Total		**43,885**	**43,173**	**39,646**	**36,779**	**41,929**
Germanium, Ge content of concentrate	kilograms	4,800	5,500	6,300	6,700	6,000
Iron and steel:						
Iron ore and concentrate:						
Gross weight	thousand tons	3,600	3,270	3,120	3,061	2,301
Fe content	do.	1,138	1,019	976	954	727
Metal:						
Pig iron	do.	3,745	3,704	3,349	3,451	3,665
Ferroalloys, electric-furnace	do.	13	12	12	12	12
Crude steel	do.	4,870	4,660	4,292	4,301	4,560
Semimanufactures	do.	3,842	3,760	3,462	3,432	3,752
Lead:						
Mine output, Pb content of concentrate		4,151	[r]6,129	4,662	5,246	2,281
Metal:						
Smelter:						
Primary		1,707	1,930	1,500	3,400	[e]5,000
Secondary		16,476	15,601	15,000	15,700	[e]17,404
Total		**18,183**	**17,531**	**16,500**	**19,100**	**[e]22,404**
Refined:						
Primary[e]		10,000	10,000	6,000	[r]6,800	8,200
Secondary		16,200	15,500	19,000	16,000	16,700
Total		**26,200**	**25,500**	**25,000**	**22,800**	**24,900**
Manganese, Mn content of domestic iron ore		67,101	60,074	58,945	57,486	40,917
Tungsten, mine output, W content of concentrate		1,632	1,481	1,387	1,250	[e]1,230
Zinc:						
Mine output, Zn content of concentrate		20,879	21,704	16,290	15,735	17,051
Metal, refined		24,000	25,000	24,000	24,300	23,900
INDUSTRIAL MINERALS						
Cement, hydraulic	thousand tons	4,899	4,560	4,569	4,522	[e]4,600

See footnotes at end of table.

TABLE 2—Continued

AUSTRIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons, unless otherwise specified)

Commodity		1984	1985	1986	1987[p]	1988[p]
INDUSTRIAL MINERALS—Continued						
Clay:						
Illite		285,553	212,678	268,451	275,921	[e]276,000
Kaolin:						
Crude		455,695	500,844	444,852	444,927	[e]445,000
Marketable		99,541	100,151	46,291	188,533	[e]189,000
Other		18,058	49,161	33,037	12,961	[e]13,000
Feldspar, crude		2,554	13,570	2,850	4,692	[e]5,000
Graphite, crude		43,789	30,764	36,167	39,391	[e]39,500
Gypsum and anhydrite, crude		740,117	693,993	701,749	664,452	721,745
Lime	thousand tons	1,262	1,301	1,275	1,378	1,545
Magnesite:						
Crude	do.	1,183	1,255	1,084	947	1,122
Sintered or dead-burned	do.	377	389	315	345	360
Caustic calcined	do.	93	75	73	58	67
Nitrogen: N content of ammonia[e]	do.	500	500	450	450	450
Pigments, mineral: Micaceous iron oxide		[e]11,500	11,583	11,730	10,807	9,938
Pumice (trass)		9,666	6,981	5,808	6,922	7,359
Salt:						
Rock	thousand tons	1	1	2	1	1
In brine:						
Evaporated	do.	419	438	486	484	413
Other[e]	do.	[r]241	[r]254	215	180	[e]230
Total	**do.**	**[r]660**	**[r]692**	**701**	**664**	**643**
Sand and gravel:						
Quartz sand	do.	782	735	798	684	756
Other sand and gravel	do.	15,387	14,593	8,861	9,322	14,700
Total	**do.**	**16,169**	**15,328**	**9,659**	**10,006**	**15,456**
Sodium compounds, n.e.s.:[e]						
Carbonate, synthetic	do.	150	150	150	150	130
Sulfate, synthetic	do.	50	50	55	55	50
Stone:[2]						
Dolomite	do.	981	1,291	1,308	1,406	1,521
Quartz and quartzite	do.	223	176	196	196	167
Other, including limestone and marble	do.	11,903	11,667	9,250	9,540	12,324
Total	**do.**	**13,107**	**13,134**	**10,754**	**11,142**	**14,012**
Sulfur:						
Byproduct:						
Of metallurgy		10,113	11,204	10,986	10,448	11,331
Of petroleum and natural gas		28,342	24,250	29,348	24,946	36,217
From gypsum and anhydrite		26,449	26,547	23,837	13,091	—
Total		**64,904**	**62,001**	**64,171**	**48,485**	**47,548**

See footnotes at end of table.

TABLE 2—Continued

AUSTRIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons, unless otherwise specified)

Commodity		1984	1985	1986	1987[p]	1988[p]
INDUSTRIAL MINERALS—Continued						
Talc and soapstone		134,011	131,454	133,319	129,959	132,974
MINERAL FUELS AND RELATED MATERIALS						
Coal, brown and lignite	thousand tons	2,901	3,081	2,969	2,786	2,129
Coke	do.	1,854	1,751	1,744	1,727	1,744
Gas, natural:						
Gross	million cubic feet	44,931	41,102	39,269	41,223	44,657
Marketed	do.	37,084	34,325	32,537	34,330	[e]35,000
Oil shale		970	620	400	1,090	210
Petroleum:						
Crude	thousand 42-gallon barrels	8,404	7,999	7,783	7,410	8,196
Refinery products:						
Gasoline	do.	17,499	18,184	18,023	20,054	20,223
Kerosene and jet fuel	do.	1,461	1,452	1,381	1,546	1,706
Distillate fuel oil	do.	15,538	16,482	18,582	18,917	22,334
Residual fuel oil	do.	13,064	16,040	13,530	12,411	[e]12,400
Lubricants	do.	557	604	1,591	(3)	—
Liquefied petroleum gas	do.	5,509	5,479	5,145	6,476	[e]6,000
Bitumen	do.	1,658	1,363	1,427	1,382	1,427
Unspecified	do.	235	182	220	82	[e]100
Refinery fuel and losses	do.	3,090	3,292	3,502	3,620	[e]3,500
Total	**do.**	**58,611**	**63,078**	**63,401**	**64,488**	**[e]67,690**

[e]Estimated. [p]Preliminary. [r]Revised.
[1]Table includes data available through Aug. 1989.
[2]Excluding stone used by the cement and iron and steel industries.
[3]Revised to zero.

tion plant to operate at the South African Iron and Steel Industrial Corp. (ISCOR) in Pretoria, the Republic of South Africa. Reportedly, ISCOR started up a 300,000-ton-per-year plant at the end of 1988. The only other plant using the Corex technology was a smaller pilot plant at Kahl, the Federal Republic of Germany. Voest also established a new Brazilian subsidiary to introduce its Corex ironmaking in Latin America. The United States was a possible location for the first Corex second-generation plant.

Austrian special steel producer Bohler AG completed the expansion of its production facilities for press plate at Murzzuschlag. Bohler was the largest foreign subsidiary of Vereinigte Edelstahlwerke AG. From 90% to 95% of its total sheets and plates were exported to 51 countries. The major markets were Western Europe and the Far East. Bohler has also secured an order for valve steel for delivery to the Soviet car industry. This followed previous valve steel sales to the Federal Republic of Germany, as well as high-speed steel shipments to the U.S.S.R.[8]

Lead and Zinc.—The only operating lead and zinc mine at Bleiberg-Kreuth was run by the nationalized Bleiberger Bergwerks-Union AG (BBU). In 1988, BBU cut its work force of 379 workers by over 50%. It concentrated its underground mining in smaller areas, restricting operations to a few larger ore bodies. BBU virtually shut down its operations at Bad Bleiberg. BBU also owned the lithium deposit at Koralpen.

Molybdenum.—Reportedly, a new computer-controlled mill was installed several years ago at Metallwerk Plansee GmbH for rolling molybdenum flat products. Austria was 100% dependent on imports for its molybdenum requirements, imports purchased mostly from the Federal Republic of Germany, with some from the United Kingdom and Italy; Austria imported about 31,000 pounds of molybdenum contained in concentrate. The new mill

TABLE 3

AUSTRIA: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987 United States	Destinations, 1987 Other (principal)
METALS				
Aluminum:				
Ore and concentrate	626	277	—	All to West Germany.
Metal including alloys:				
Unwrought	31,317	39,447	—	West Germany 14,282; Italy 7,588; France 6,752.
Semimanufactures	102,564	113,955	1,368	West Germany 43,450; Italy 12,863; Switzerland 8,719.
Copper:				
Matte and speiss including cement copper	2	NA		
Metal including alloys:				
Unwrought	24,327	23,846	—	Italy 12,502; West Germany 8,090; Iraq 1,026.
Semimanufactures	18,869	23,003	210	West Germany 7,539; Italy 5,014; France 2,546.
Iron and steel:				
Iron ore and concentrate excluding roasted pyrite	7,769	67	—	All to Brazil.
Metal:				
Scrap	22,305	92,200	—	Italy 79,426; West Germany 8,852.
Pig iron, cast iron, related materials	7,671	7,016	182	France 2,021; West Germany 1,716; Italy 664.
Ferroalloys, unspecified	12,857	13,322	360	Italy 1,916; West Germany 1,670; India 1,640.
Steel, primary forms	324,261	355,226	41,882	West Germany 189,144; Italy 53,027.
Semimanufactures:				
Bars, rods, angles, shapes, sections	338,956	338,882	2,390	Italy 103,316; West Germany 102,195; France 37,361.
Universals, plates, sheets	1,453,391	1,558,365	52,718	West Germany 418,826; U.S.S.R. 355,429; Italy 271,681.
Hoop and strip	181,268	182,537	428	West Germany 67,481; Switzerland 23,398; Yugoslavia 22,666.
Rails and accessories	62,686	90,391	4	Switzerland 29,967; India 14,280; Peru 8,588.
Wire	53,090	61,223	2,677	West Germany 28,593; Italy 9,040; Switzerland 6,107.
Tubes, pipes, fittings	415,516	488,342	20,857	U.S.S.R. 203,889; West Germany 84,830; Italy 31,183.
Castings and forgings, rough	12,091	12,308	322	West Germany 6,586; Italy 1,163; Switzerland 892.
Lead:				
Ore and concentrate	—	1,022	—	All to Yugoslavia.

See footnotes at end of table.

TABLE 3—Continued

AUSTRIA: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
METALS—Continued				
Lead—Continued				
Metal including alloys:				
Unwrought	1,126	1,935	—	Italy 161; Switzerland 484; West Germany 192.
Semimanufactures	68	25	—	West Germany 10; Belgium-Luxembourg 4; Saudi Arabia 4.
Nickel:				
Matte and speiss	56	23	—	All to Yugoslavia.
Metal including alloys:				
Unwrought	29	2	—	Greece 1; Yugoslavia 1.
Semimanufactures	821	488	17	West Germany 125; Bulgaria 57; Argentina 37.
Platinum-group metals: Metals including alloys, unwrought and partly wrought value, thousands	$2,960	$5,851	$24	West Germany $4,172; Yugoslavia $676; United Kingdom $649.
Silver: Metal including alloys, unwrought and partly wrought do.	$5,242	$45,473	—	West Germany $41,354; Switzerland $2,351.
Tin: Metal including alloys:				
Unwrought	17	26	—	Mainly to West Germany.
Semimanufactures	([2])	43	—	Yugoslavia 33; Belgium-Luxembourg 8.
Zinc: Metal including alloys:				
Unwrought	4,035	4,704	—	Italy 2,550; Yugoslavia 1,613; West Germany 343.
Semimanufactures	165	197	16	West Germany 93; Belgium-Luxembourg 25; Italy 25.
Other:				
Ores and concentrates	754	888	63	Italy 452; Netherlands 125; West Germany 116.
Base metals including alloys, all forms	8,891	8,656	101	Italy 2,564; West Germany 2,285; United Kingdom 1,877.
Waste and sweepings of unspecified precious metals value, thousands	$6,615	$5,943	—	West Germany $5,140; France $455; Italy $238.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	140	172	—	West Germany 168; Yugoslavia 4.
Dust and powder of precious and semiprecious stones including diamond value, thousands	$17	$59	$4	West Germany $53; Poland $2.
Grinding and polishing wheels and stones	13,831	12,665	182	West Germany 2,364; Italy 1,488; France 982.
Asbestos, crude	9	—		
Barite and witherite	3	3	3	
Boron materials: Crude natural borates	3	100	—	All to Yugoslavia.
Cement	21,944	10,355	—	West Germany 7,340; Italy 2,238; France 450.

See footnotes at end of table.

TABLE 3—Continued

AUSTRIA: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Destinations, 1987 United States	Destinations, 1987 Other (principal)
INDUSTRIAL MINERALS—Continued					
Chalk		2,592	4,627	3	Hungary 3,513; Czechoslovakia 781.
Clays, crude		74,655	69,673	1	West Germany 31,674; Hungary 29,264.
Diamond:					
Gem, not set or strung	value, thousands	$741	$444	$92	Switzerland $169; Israel $78.
Industrial stones	do.	$75	$248	—	Hungary $133; Czechoslovakia $90; Poland $13.
Diatomite and other infusorial earth		2,203	2,653	—	Hungary 903; Bulgaria 575; Yugoslavia 522.
Fertilizer materials:					
Crude, n.e.s.		13,078	6,894	—	Czechoslovakia 6,523; Switzerland 305.
Manufactured		730,312	899,407	52	West Germany 440,696; Italy 152,729; Czechoslovakia 95,634.
Graphite, natural		10,284	8,330	74	West Germany 3,353; Poland 1,930; Italy 928.
Gypsum and plaster		119,295	117,279	—	West Germany 115,543; Italy 1,641.
Lime		1,249	3,211	—	West Germany 3,104; Hungary 56.
Magnesium compounds: Magnesite, crude		138,304	141,261	7,688	Venezuela 32,780; West Germany 30,939; France 17,367.
Mica:					
Crude including splittings and waste		1,659	371	—	West Germany 275; Italy 55; Yugoslavia 20.
Worked including agglomerated splittings		247	279	([2])	West Germany 68; India 44; Yugoslavia 29.
Precious and semiprecious stones other than diamond:					
Natural	value, thousands	$450	$392	$59	West Germany $112; Switzerland $102.
Synthetic	do.	$6,428	$8,146	$1,213	West Germany $1,759; Egypt $1,735.
Pyrite, unroasted		7	139	—	West Germany 137; Italy 3.
Salt and brine		1,621	2,727	—	Italy 991; West Germany 866; Hungary 772.
Stone, sand and gravel:					
Dimension stone:					
Crude and partly worked		144,351	156,472	20	West Germany 97,033; Switzerland 56,576.
Worked		66,150	39,393	105	West Germany 31,914; Switzerland 6,012.
Dolomite, chiefly refractory-grade		29,569	30,595	—	West Germany 23,191; Venezuela 6,700.
Gravel and crushed rock		691,135	772,816	17	Switzerland 456,074; West Germany 287,039.
Limestone other than dimension		917	724	—	All to West Germany.
Quartz and quartzite		52	32	—	Czechoslovakia 16; Switzerland 13.
Sand other than metal-bearing		97,709	116,792	—	West Germany 77,810; Switzerland 35,693.
Sulfur: Elemental: Crude including native and byproduct		419	76	—	Hungary 56; Yugoslavia 11; West Germany 10.
Talc, steatite, soapstone, pyrophyllite		113,369	120,177	47	West Germany 59,223; Italy 18,272; Switzerland 10,284.

See footnotes at end of table.

TABLE 3—Continued

AUSTRIA: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
INDUSTRIAL MINERALS—Continued					
Other:					
Crude		20,475	12,317	132	West Germany 5,243; United Kingdom 2,011; Switzerland 1,179.
Slag and dross, not metal-bearing		92,220	93,622	—	West Germany 90,648; Switzerland 2,366.
MINERAL FUELS AND RELATED MATERIALS					
Asphalt and bitumen, natural		2	51	—	Italy 18; U.S.S.R. 14; Iraq 9.
Coal:					
Anthracite and bituminous		50	21	—	All to Yugoslavia.
Briquets of anthracite and bituminous coal		83	72	—	All to Switzerland.
Lignite including briquets		5,437	4,433	—	West Germany 4,365; Switzerland 68.
Coke and semicoke		5,107	4,574	—	West Germany 4,518; Switzerland 56.
Peat including briquets and litter		10,580	14,983	—	Italy 8,742; West Germany 6,058.
Petroleum:					
Crude	42-gallon barrels	—	7	—	All to West Germany.
Refinery products:					
Liquefied petroleum gas	thousand 42-gallon barrels	49	82	—	Italy 59; Yugoslavia 18.
Gasoline, motor	do.	1,585	2,731	—	Mainly to West Germany.
Mineral jelly and wax	do.	130	46	—	Netherlands 38; Switzerland 4.
Kerosene and jet fuel	do.	26	96	([2])	Yugoslavia 59; West Germany 35.
Distillate fuel oil	do.	164	35	—	West Germany 28; Yugoslavia 4; Romania 3.
Lubricants	do.	430	396	([2])	Hungary 121; Czechoslovakia 103; Turkey 36.
Residual fuel oil	do.	1,383	([2])	—	All to Yugoslavia.
Bitumen and other residues	do.	30	19	—	West Germany 9; Switzerland 3; Malta 3.
Bituminous mixtures	do.	42	30	([2])	Algeria 14; West Germany 11.
Petroleum coke	do.	1	2	—	All to Yugoslavia.

NA Not available.
[1] Table prepared by P.J. Roetzel.
[2] Less than 1/2 unit.

machinery was capable of rolling molybdenum plates and sheets up to 40 millimeters thick, 850 millimeters wide, and 3,000 millimeters long. The mill was supplied to Plansee by the Federal Republic of Germany heavy equipment manufacturer Mannesmann Demag AG. Its products were shipped to worldwide markets for use in the automobile and aerospace industries and for use as an alloying additive for minerals applications.

Plansee is an Austrian high-technology firm with headquarters in Reutte, near the Plansee, Tirol. The site of Reutte was chosen, not for its beauty, but for the availability of hydroelectric power at the nearby Plansee. The company employed 1,850 workers in 1988. The family-owned company was founded in 1921 by Paul Schwarzkopf. Plansee sold hard metals and high-melting-point metals and composites based on molybdenum, niobium, rhenium, tantalum, and tungsten. Plansee developed processes, including those utilizing powder metallurgy, to work these metals. Plansee was the largest powder metallurgy firm in Europe. The firm turned out about 50,000 different products, including cutting tools. Over 90% of its sales were

TABLE 4

AUSTRIA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS				
Aluminum:				
Ore and concentrate	312,800	315,644	151	West Germany 173,354; Hungary 53,945; France 47,940.
Metal including alloys:				
Unwrought	93,413	81,133	2	West Germany 42,884; Norway 17,742; France 3,512.
Semimanufactures	54,559	63,506	17	West Germany 24,047; Switzerland 9,302; Italy 8,108.
Copper:				
Ore and concentrate	—	52	—	United Kingdom 31; Italy 21.
Metal including alloys:				
Unwrought	12,499	8,901	35	Republic of South Africa 4,274; West Germany 2,392; Zimbabwe 530.
Semimanufactures	77,504	79,027	40	West Germany 42,633; Italy 9,282; United Kingdom 6,995.
Iron and steel:				
Iron ore and concentrate:				
Excluding roasted pyrite thousand tons	3,201	3,311	—	U.S.S.R. 1,237; Sweden 885; Canada 413.
Pyrite, roasted do.	13	27	—	Mainly from Yugoslavia.
Metal:				
Scrap	115,029	68,523	25	West Germany 34,885; Czechoslovakia 21,117; U.S.S.R. 8,348.
Pig iron, cast iron, related materials	43,815	41,815	2	Canada 12,355; West Germany 10,781; U.S.S.R. 7,383.
Ferroalloys	68,237	63,502	164	West Germany 11,309; Norway 10,384; Czechoslovakia 3,570.
Steel, primary forms	230,101	162,192	8	Hungary 76,920; West Germany 41,060; Czechoslovakia 35,657.
Semimanufactures:				
Bars, rods, angles, shapes, sections	326,229	342,458	57	Italy 118,208; West Germany 112,149; Switzerland 29,924.
Universals, plates, sheets	280,380	270,984	83	West Germany 115,131; Belgium-Luxembourg 48,686; Italy 20,398.
Hoop and strip	98,820	98,679	52	West Germany 57,361; Italy 16,325; Switzerland 7,938.
Rails and accessories	2,734	2,521	1	West Germany 2,098; Switzerland 154.
Wire	36,617	41,361	4	Belgium-Luxembourg 14,034; West Germany 11,503; Italy 6,669.
Tubes, pipes, fittings	228,840	241,058	51	Italy 84,830; West Germany 84,715; East Germany 12,239.
Castings and forgings, rough	14,744	14,482	1	West Germany 10,964; Italy 1,218.
Lead:				
Ore and concentrate	4,124	1,152	—	Italy 1,052; Spain 100.

See footnotes at end of table.

TABLE 4—Continued

AUSTRIA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987	
			United States	Other (principal)
METALS—Continued				
Lead—Continued				
Metal including alloys:				
Unwrought	38,516	31,476	261	West Germany 8,282; United Kingdom 7,429; Republic of South Africa 5,330.
Semimanufactures	997	825	—	West Germany 762; Belgium-Luxembourg 25.
Manganese: Ore and concentrate, metallurgical-grade	437	472	—	Australia 225; Netherlands 182.
Nickel:				
Matte and speiss	907	405	15	Netherlands 178; Republic of South Africa 58; Norway 48.
Metal including alloys:				
Unwrought	3,029	2,815	13	Republic of South Africa 621; U.S.S.R. 340; Canada 313.
Semimanufactures	679	580	43	West Germany 379; United Kingdom 49.
Platinum-group metals: Metals including alloys, unwrought and partly wrought value, thousands	$4,426	$9,534	$2,498	West Germany $4,482; United Kingdom $735.
Silver:				
Waste and sweepings[2] do.	$133	$142	—	All from Yugoslavia.
Metal including alloys, unwrought and partly wrought do.	$14,922	$33,499	$7	West Germany $24,041; Belgium-Luxembourg $6,939; Yugoslavia $960.
Tin: Metal including alloys:				
Unwrought	523	512	15	West Germany 217; China 128; Thailand 38.
Semimanufactures	152	170	([3])	West Germany 142; Netherlands 20.
Zinc:				
Ore and concentrate	10,133	16,688	—	Netherlands 16,687.
Metal including alloys:				
Unwrought	11,433	10,282	—	West Germany 4,437; Belgium-Luxembourg 3,159; Netherlands 1,281.
Semimanufactures	4,091	4,980	—	West Germany 2,701; Belgium-Luxembourg 1,056; France 584.
Other:				
Ores and concentrates	63,485	53,351	3,694	Republic of South Africa 34,360; Cuba 3,298.
Base metals including alloys, all forms	19,014	3,960	121	U.S.S.R. 2,729; West Germany 304; Republic of South Africa 226.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	622	1,656	18	Italy 706; Turkey 472; West Germany 359.
Dust and powder of precious and semiprecious stones including diamond value, thousands	$8,668	$9,002	$8,188	Switzerland $417; Ireland $220.
Grinding and polishing wheels and stones	1,705	1,726	2	West Germany 863; Italy 317; Spain 150.

See footnotes at end of table.

TABLE 4—Continued

AUSTRIA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
INDUSTRIAL MINERALS—Continued				
Asbestos, crude	15,148	17,749	7	Canada 10,600; U.S.S.R. 3,699; Zimbabwe 1,990.
Barite and witherite	9,067	3,112	—	West Germany 2,173; Turkey 501; Czechoslovakia 369.
Boron materials: Crude natural borates	17,862	17,523	3,013	Turkey 14,304; Netherlands 204.
Cement	88,551	94,364	8	Yugoslavia 38,181; Poland 19,547; Italy 14,031.
Chalk	12,000	10,188	1	Italy 7,256; France 1,477; West Germany 1,353.
Clays, crude	188,215	198,278	3,114	West Germany 76,605; Czechoslovakia 63,357; Brazil 26,868.
Cryolite and chiolite	204	191	—	Denmark 190.
Diamond:				
Gem, not set or strung value, thousands	$5,362	$7,465	$135	Israel $3,003; Belgium-Luxembourg $2,325; India $651.
Industrial stones do.	$654	$548	$8	West Germany $193; Hungary $87; Republic of South Africa $69.
Diatomite and other infusorial earth	14,271	13,049	1,506	Czechoslovakia 4,938; Denmark 2,842; Hungary 1,654.
Fertilizer materials:				
Crude, n.e.s.	439,697	366,170	34,379	Algeria 144,634; Syria 112,437.
Manufactured	651,679	606,194	13,603	West Germany 213,426; East Germany 89,412; France 75,375.
Graphite, natural	4,966	2,083	11	China 1,472; West Germany 260; Republic of Korea 182.
Gypsum and plaster	12,749	12,381	([3])	West Germany 11,799; Italy 379.
Lime	3,802	4,253	—	Yugoslavia 2,750; West Germany 581; Poland 416.
Magnesium compounds	122,064	108,652	3	Turkey 33,339; Italy 21,780; Mexico 13,906.
Mica:				
Crude including splittings and waste	183	221	—	West Germany 90; Norway 58; Sweden 36.
Worked including agglomerated splittings	226	246	([3])	France 124; Belgium-Luxembourg 56; India 23,
Precious and semiprecious stones other than diamond:				
Natural value, thousands	$3,121	$3,844	$48	West Germany $1,748; Switzerland $544; Belgium-Luxembourg $362.
Synthetic do.	$2,531	$1,764	$249	Switzerland $466; U.S.S.R. $340.
Pyrite, unroasted	668	655	—	Italy 475; West Germany 175.
Salt and brine	211	642	([3])	West Germany 541; France 63.

See footnotes at end of table.

TABLE 4—Continued

AUSTRIA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
INDUSTRIAL MINERALS—Continued				
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked	43,003	48,656	13	Italy 24,301; Republic of South Africa 6,308; France 3,485.
Worked	61,319	73,637	—	Italy 54,713; West Germany 9,643; Yugoslavia 3,580.
Dolomite, chiefly refractory-grade	10,894	9,969	—	West Germany 8,795; Italy 813.
Gravel and crushed rock	204,855	217,478	—	West Germany 189,213; Italy 21,977; Hungary 4,614.
Limestone other than dimension	1,610	2,288	—	Yugoslavia 1,626; West Germany 575.
Quartz and quartzite	25,881	19,007	—	West Germany 9,528; Hungary 8,511.
Sand other than metal-bearing	366,563	374,586	2	Czechoslovakia 180,068; West Germany 178,928; Hungary 7,053.
Sulfur: Elemental: Crude including native and byproduct	90,590	82,590	—	Poland 30,936; West Germany 23,351; Hungary 19,198.
Talc, steatite, soapstone, pyrophyllite	6,198	10,698	1	India 4,451; Australia 3,175; France 2,268.
Other:				
Crude	72,967	74,109	1,228	Hungary 25,013; West Germany 21,173; Greece 8,572.
Slag and dross, not metal-bearing	41,900	25,859	([3])	West Germany 15,977; Italy 7,314; Yugoslavia 1,159.
MINERAL FUELS AND RELATED MATERIALS				
Asphalt and bitumen, natural	2,654	1,933	58	Trinidad and Tobago 1,366; West Germany 244; Hungary 215.
Coal:				
Anthracite and bituminous thousand tons	3,731	4,133	495	Poland 898; U.S.S.R. 812; Czechoslovakia 591.
Briquets of anthracite and bituminous coal do.	22	22	—	West Germany 21; Belgium-Luxembourg 1.
Lignite including briquets do.	686	494	—	East Germany 290; West Germany 189.
Coke and semicoke do.	889	843	—	Czechoslovakia 267; West Germany 170; Poland 156.
Peat including briquets and litter	62,687	66,854	—	West Germany 47,222; U.S.S.R. 12,907; Hungary 3,224.
Petroleum:				
Crude thousand 42-gallon barrels	45,244	46,536	—	Libya 13,261; Iraq 5,638; Algeria 4,849.
Refinery products:				
Liquefied petroleum gas do.	36,392	35,503	([3])	U.S.S.R. 33,052; West Germany 1,432; Hungary 695.
Gasoline, motor do.	4,522	4,368	—	Italy 2,043; West Germany 1,310; Hungary 687.
Mineral jelly and wax do.	123	124	([3])	West Germany 47; Poland 31; Hungary 27.
Kerosene and jet fuel do.	754	929	([3])	Hungary 591; Czechoslovakia 144; West Germany 121.

See footnotes at end of table.

TABLE 4—Continued

AUSTRIA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987	
				United States	Other (principal)
MINERAL FUELS AND RELATED MATERIALS—Continued					
Petroleum—Continued					
Refinery products—Continued					
Distillate fuel oil	thousand 42-gallon barrels	3,368	2,985	1	Hungary 923; Czechoslovakia 899; West Germany 573.
Lubricants	do.	5,402	7,924	9	Hungary 4,113; Czechoslovakia 1,515; Yugoslavia 985.
Residual fuel oil	do.	7,399	6,153	—	Czechoslovakia 2,653; West Germany 2,064; Yugoslavia 1,299.
Bitumen and other residues	do.	1,981	1,860	—	West Germany 927; Yugoslavia 445; Hungary 283.
Bituminous mixtures	do.	32	64	([3])	West Germany 54; Netherlands 5; Italy 3.
Petroleum coke	do.	484	571	166	West Germany 271; U.S.S.R. 46.

[1] Table prepared by P. J. Roetzel.
[2] May include other precious metals.
[3] Less than 1/2 unit.

abroad, mainly to EC countries, the United States, and Japan. Only a small percentage of exports went to Eastern Europe.

Tungsten.—Austria was one of the major international producers of tungsten, which is produced in a mine at Mittersill that is operated by Wolfram Bergbau-und Huttengesellschaft mbH. The Mittersill mine in the beautiful Salzburg mountains is exceptional because only the mine entry is visible on the mountain slope. All other operations except the settling pond are located underground; the mine is situated in a national park. Mining work started in 1975 at an altitude of more than 2,000 meters as an open pit operation, which is now entirely underground.

In 1988, the underground mine excavated 500,000 tons of rock. Mittersill was one of Europe's three tungsten mines, the two others being in Portugal and Sweden. The Austria scheelite ore contained an average of only 0.5% of tungsten. Ore reserves were estimated to be 10 million tons. Because of the hardness of the rock, the drill bit sometimes had to be replaced every 20 meters. After drilling, blasting, and primary crushing, the ore was transported to the concentrator along a 2.7-kilometer underground conveyor belt. Despite a decline in production during the last 5 years, the company still produced good financial results. Of the nearly 96 people employed, 66 worked in the underground mine and processing mill.

Other Metals.—BBU, which mined antimony, lead, and zinc ores, closed some uneconomical pits. While still showing a loss, BBU's situation improved in 1988, because of higher world zinc prices. BBU's lead and zinc deposits were expected to last beyond the year 2000. BBU planned to close its antimony mine in Schlaining, Burgenland Province, in 1990. Following reorganization, BBU was expected to operate profitably again within the next 2 to 3 years. BBU was developing new business activities, including converting its closed-down tunnels for use by tourists seeking adventure, health care, and recuperation.

***Industrial Minerals.*—Fertilizer Materials.**—Restructuring of Austria's largest chemical industry, formerly known as Chemie Linz AG, now the Chemie Holding AG, led to an overall positive cash flow of approximately $37.4 million in the first half of 1988. The company produced fertilizers, gypsum, pharmaceuticals, and plastics. The company reduced its work force, and was planning to lay off 3,000 of its 8,500 employees; 1,000 of them were cut in 1987. The same range of products was retained.[9]

Graphite.—Nearly all the graphite produced in Austria was amorphous. Austria was the leading producer of graphite in Western Europe, followed by the Federal Republic of Germany. Most of the production was carried out in Steiermark, Styria, and Niederosterreich, Lower Austria. Industrie-und

Bergbaugesellschaft Pryssok u. Co. KG operated opencast mines at Donnau, Muehldorf, and Spitz. Production capacity was about 30,000 tons per year of microcrystalline graphite, grading 50% carbon. All of this production was sold to the Austrian steel industry. Another company, Grafitbergbau Kaiserberg Franz Mayr-Meinhof & Co., produced about 14,000 tons of graphite per year from its mine at Kaiserberg-Leims, near St. Michael. About 90% of the company's products were exported, mostly to EC and COMECON countries.[10] Some highly refined products were also exported to developing countries. In addition to traditional iron and steel applications, Grafitbergbau was promoting graphite as an additive for high-technology products. The company was planning an expansion of its five grinding and flotation facilities and the construction of a new laboratory.[11]

Lithium.—The OIAG subsidiary Minerex, which was responsible for exploring works for lithium in the Koralpe area, was liquidated in 1988. Its activities were all transferred to BBU. A market study showed that, despite the excellent lithium content at Koralpe, present low market prices for lithium did not allow profitable mining. However, BBU was negotiating with joint-venture partners because lithium mining on the Koralpe was expected to be profitable in the medium term.

Magnesite.—The largest producer of magnesite in Austria, Osterreichische-Amerikanische Magnesit AG, or Radex AG, became a private Austrian company through its purchase by an Austrian investor. The company was previously owned by the General Refractories Co. of Philadelphia, Pennsylvania, United States.

Radex performed quite well. In 1988, Radex increased its net sales by 6.2%. Investments in fixed assets were more than twice as high as in the previous few years. This fact was reflected in exports to the United States, which had not existed previously and amounted to $813,000 in 1988. The Radex plant in Greece was expected to be expanded with a $12.2 million investment for rock wool production. Also, Radex bought a 10% share of Ceramico Caroni in Venezuela, which was in the center of the fast-growing aluminum industry, also a customer for Radex's refractories. Magnesite for consumption in Venezuela was to be shipped from Austria, since no magnesite has been found in Venezuela to date. In Indonesia, Radex engaged in a joint venture; Radex held 30%, the Government of Indonesia held 10%, and the rest was held by two Indonesian partners. In Australia, Radex obtained a 10% share in one of the country's biggest magnesite deposits; 50% was held by Queensland Metals Mining and 40% by Pancontinental, which in turn held a 20% share in Radex. Radex spent more than 4% of its refractories turnover on research and development, a rather high share for a magnesite producer.

Other Industrial Minerals.—Cement, clay minerals, salt, sand and gravel, sodium sulfate, and thallium were other industrial minerals produced in Austria. Except for salt, all these minerals continued to be produced with increased output.

Magnolithe GmbH operated a dunite quarry at St. Stefan, near Leoben in Styria. The raw material was transported by truck to the company's plant at St. Lorenzen, near Knittelfeld, 15 kilometers from the quarry. The dunite was sintered in a rotary kiln having a capacity of about 38,000 tons per year. Actual output was about 24,000 tons per year. The sintered material was then crushed and graded for a number of applications.[12]

Mineral Fuels.—The principal aim of the Austrian energy research and development program was to reduce dependence on imported primary energy. Major efforts have been initiated in energy conservation, new and environmentally benign techniques, and renewable energy source technologies. Austria emphasized the development of fluidized-bed combustion technology and encouraged research on the nature and reduction of emissions of airborne pollutants from industry, traffic, and combustion of biomass. Austria collaborated in international research projects.

Coal.—Austrian coal mines were still in trouble. Wolfsegg-Traunthaler Kohlenwerks AG (WTK) was almost closed in 1988, but was instead scheduled to be phased out over the following 3 to 6 years because of dwindling deposits and the infeasibility of strip mining. Salzach-Kohlenbergbau-Gesellschaft mbH (SAKOG) closed the Trimmelkam pit but continued operating its other pits. SAKOG will survive until the year 2000 but not much beyond that. After losing important markets in Carinthia and Salzburg Provinces, due to stringent clean air acts, SAKOG had only the Province of Upper Austria left in which to sell its coal to households. The Riederbach powerplant was still a SAKOG customer. The Graz-Koflacher Eisenbahn- und Bergbaugesellschaft mbH (GKB) also had problems; in addition to the Zangtal pit, GKB operated the open strip in Oberdorf and only one pit, the Karlschacht, scheduled to be closed around 1990.

Brown coal was mined from the Trimmelkam deposit in the West Styrian mining area near Koflach, northwest of Salzburg, and in the region of the Hausruck Range at Ampflwang. The largest Austrian coal company was GKB, a subsidiary of Voest, in the West Styrian mining area. GKB's output came from opencast mines at Oberdorf and Zangtal, and from underground mines at Zangtal and Karlschacht. At the Zangtal opencast pit, the brown coal was mined from a residual pillar in the top seam. The mining started in April 1987; slopes near a Federal highway and in the vicinity of buildings were reinforced with anchored steel pilings. Coal from the Zangtal underground mine was extracted by longwall workings from a small pillar and from the main coal seam. At the Karlschacht underground mine, there were five Alpine-miners of the AMN 50 type extracting coal by stripping in five levels. At the end of 1987, GKB employed 1,184 workers and 213 office staffers.

The second largest coal company, SAKOG, closed its Trimmelkam underground mine, mined the Taksdorf opencast pit, and was exploring in the Weilhart Field. The third largest company, WTK, operated the Schmitzberg and Hinterschlagen underground mines near Ampflwang in the Hausruck Range and opencast pits at Heissler and Innerleiten. At the end of 1987, the total number of workers was 659 people, of whom 555 were laborers.[13]

Natural Gas.—Natural gas was produced by OMV, which accounted for about 60% of total output, and by Rohol-Aufsuchungs GmbH (RAG), which produced 40% of output. For the first time in 5 years, domestic gas production increased by about 8% in 1988, largely due to the newly developed gas and condensate field Hoeflein in the Vienna basin. OMV handled all gas imports and managed gas transport lines. OMV made a gas discovery at the Molln-1 well in the Alps, east of Salzburg. The find was 15 miles northeast of the Gruenau-1 oil discovery made in 1987.[14]

The RAG's wildcat 1 Weizberg in western Austria, flowed gas at the rate of 7 million cubic feet per day during an open hole test. The company was a 50-50 joint venture of Royal Dutch-Shell Group and Mobil Corp.

The Austrian gas transit pipelines, Trans-Austria-Gasleitung (TAG) and West-Austria-Gasleitung, shipped 13.1 billion cubic meters of natural gas from the U.S.S.R. to gas companies in France, Italy, and Yugoslavia. A second pipeline (TAG II) was built parallel to TAG, increasing transport capacity from 10 to 20 billion cubic meters per year.

Petroleum.—Indigenous production of oil decreased in 1986 and 1987 while imports of crude oil and oil products increased by 4.1% in 1986. In 1988, production increased substantially. Austria's only refinery, in Schwechat near Vienna, had an annual capacity of 10 million metric tons and an 80% utilization rate, which is a relatively high rate for Europe. The refinery was supplied with imported crude oil by a single pipeline from Italy. Libya was the most important supplier of crude oil.

OMV sold 15% to private market, while OIAG retained ownership of the remaining 85% share. OMV was increasing its exploration and drilling activities abroad to decrease its dependence on oil imports.

The recent amendment of the oil stockpiling and reporting law requires that all oil companies and importers keep 16% of their mandatory storage obligations with the Erdol Lagergesellschaft (ELG), a stockholding entity created some years ago. This practice should enhance the availability of emergency stocks in a supply disruption without conflicting with the commercial interests of the holder. The further increase of the ELG stocks and their eventual availability in a crisis was expected to improve the emergency response capability of Austria.

Mobil and Shell made a petroleum discovery near Salzburg at the Muhlreith-1 well, drilled by their jointly owned subsidiary Rohol-Aufsuchungs. A test produced oil at a rate equivalent to 2,500 barrels per day.

SWITZERLAND[15]

Although Switzerland lies in a rugged mountain region in Central Europe covering about 41,000 square kilometers, it is devoid of any significant mineral resources. Most of the mineral deposits were small and diversified, but mining activity had virtually stopped long ago because of uneconomic deposits. Switzerland's two aluminum producers were at Valais, a bilingual canton famous for its ski slopes and mountains. The general geology of Switzerland had been studied in detail, but mineral exploration to assess the country's grades of ores and reserves was as yet incomplete. An office for the geological survey, as a specialized Government agency, did not exist, nor was there a Government agency or bureau for mines and mining. The country was subdivided into five major geological provinces by geologists. Each province was correlated to the presence of mineral occurrences; they are listed from north to south as follows: the Jura, the Molasse Basin, the Cretaceous Alps, the Hercynian Massifs, and the Penninic, Austroalpine, and southern Alps. Most of the ore occurrences were in the last three Provinces. Unemployment was essentially nonexistent, even dropping slightly in 1988, and there was a shortage of skilled labor. At the end of June 1988, the unemployment rate stood at 0.7%, while job vacancies increased by 10%. The number of foreign workers increased during the past few years in all sectors of industry, amounting to about 27% at the end of June 1988. Salaries were among the highest in the world.

Production

All metallic commodities, such as aluminum, secondary lead, and steel were produced from imported raw materials; domestic mineral industry was limited to a few construction minerals and salt. Except for hydroelectric power and a small quantity of natural gas production, all mineral fuels were also imported. Economic growth increased slightly over the previous year and was estimated to have grown by about 2.6% in terms of the GDP. Switzerland's exports of goods and services amounted to more than 43% of its GDP. Industrial production grew by just 1% in 1987 and recovered to nearly a 3% average annual increase in 1988. Tourism and banking composed almost the sole input to the economy with only a small percentage contributed by the aluminum and steel industries. The industrial minerals mined domestically remained at essentially the same production level for the past 3 years, while steel and petroleum refinery products continued a slow but gradual decline. On November 12, 1988, the only major Swiss aluminum company, Swiss Aluminium Ltd., celebrated its 100th anniversary.

Trade

Trade was vital for a country with few natural resources and a small domestic market. Switzerland had become a center for a great number of international trading companies. Some were Swiss firms with a long trading history, and others were relatively recent arrivals from abroad. Based in Lausanne, Borzx S.A. traded fuel products such as metallurgical and petroleum coke and coal. These fuels were mostly imported from the United States and resold mainly to Mediterranean countries, including Spain and Italy. Marc Rich S.A. was one of the best known companies in Switzerland specializing in oil and metals with 40 offices around the world. A large number of other traders in metal had offices in Switzerland. Norway's metal producer, Norsk Hydro A/S, operated an office in Lausanne, and Belgium's Société Générale de Belgique S.A. also had a trading office in the same city. They joined a number of domestic light metal traders in Lausanne, such as Intermetal and Minmeta, and others in Geneva, such as Minemet.[16]

A landlocked country, Switzerland used the ports of Belgium, France, the Federal Republic of Germany, Italy, and the Netherlands for exports and imports. Principal trade partners were France, the Federal Republic of Germany, Italy, and the United Kingdom (all members of the EC), Austria, and the United States. The Federal Republic of Germany was the largest bilateral trade partner and one with which the Swiss ran a substantial deficit. Although not a member of the EC, Switzerland opted to follow a policy of "external adaptation" to EC conditions and requirements. The EC accounted for 50% of Switzerland's total exports and 70% of all imports. About 9% to 10% of Swiss exports went to the United States. Exports by the metallurgical and machine-building industries were strong, and the jewelry and precious stones sectors also recorded growth. Precious stones were imported for resale. The strength and growth of the overall Swiss economy during the past year spurred the increase of U.S. imports by about 13%. Switzerland ranked fifth in importance as a foreign investor in the United States. Switzerland invested in 750 U.S. firms and employed 181,729 U.S. citizens.

Commodity Review

Metals.—**Aluminum.**—The two Swiss aluminum companies, Swiss Aluminium Ltd. (Alusuisse) and the smaller Usine d'Aluminium Martigny S.A., continued to show progress for the third year. Alusuisse produced aluminum metal, fabricated metals, and chemicals, based on imported alumina and bauxite. The company marked its 100th anniversary on November 12, 1988. It had started 2 years after primary aluminum was successfully produced in Europe for the first time by fused-salt electrolysis. Since 1986, when the company was almost bankrupt, restructuring had been undertaken to return to profitability. The labor force was cut, money-losing companies abroad were divested, and operational costs were reduced. The company limited its activities in aluminum and chemicals. The company became profitable again in 1988, and simultaneously improved its productivity and quality. Alusuisse reported profits of $211 million[17] in 1988, and earnings were up 22.4% over those of 1987. The company's Aluminum Div. accounted for about 70% of consolidated group sales, which increased 17.9% from 1987 and amounted to about $4 billion. The company's Chemicals Div. was operated through Lonza Ltd., an association that had lasted for 25 years.[18]

Alusuisse's three plants, in the Valais Canton at Chippis, Fierre, and Steg, employed 2,174 people, who earned $87 million in wages. The company's facilities included a new power generating plant. The establishment of electrochemical and metallurgical industries in the Valais was due mainly to the availability of hydropower. Alusuisse and Lonza decided to build their own power station. One hundred years ago, the Rheinkraftwerk Neuhausen, the first power station on the Lonza River was built for aluminum and chemicals production. After the construction of the powerplant, the first metal in Chippis was produced in 1908. A third power station was completed in 1909. By 1918, the aluminum company had a production capacity of 12,000 tons of primary aluminum, with 2,000 employees, and became one of the most important exporters in Switzerland. In 1988, Alusuisse and Lonza owned power stations in Australia, Austria, the Federal Republic of Germany, and Switzerland.

Alusuisse operated plants in the Federal Republic of Germany at Bergheim, Rheinfelden, and Singen, and was associated with Iceland for its supply of metals. In 1987, Alusuisse employed 24,467 workers in its operations worldwide. The company operated a bauxite mine for the production of alumina at Gove in Australia for shipment to its smelters in Switzerland. The operation at Gove dated to about 1970, and, by 1988, about 1.4 million tons of alumina was produced and exported annually, of which about 70% was owned by Alusuisse. About 250,000 tons annually, in excess of the company's requirements, was either sold to third-party customers or was used in barter or telling contracts to cover shortfalls of primary aluminum for their own fabricating plants. Another Alusuisse subsidiary, Sieromco Inc., an

TABLE 5

SWITZERLAND: PRODUCTION OF MINERAL COMMODITIES[1]

(Thousand metric tons unless otherwise specified)

Commodity[2]		1984	1985	1986	1987[p]	1988[e]
METALS						
Aluminum, smelter, primary	tons	79,173	72,742	80,259	73,169	75,000
Iron and steel:						
Pig iron and blast furnace ferroalloys		54	66	79	70	70
Electric-furnace ferroalloys[e]		5	5	5	5	5
Steel, crude		978	987	1,075	870	825
Semimanufactures, rolled products		800	950	980	[r e]1,000	1,100
Lead, refined, secondary	tons	2,000	2,000	2,000	2,000	2,000
INDUSTRIAL MINERALS						
Cement, hydraulic		4,181	4,254	4,393	4,617	4,700
Gypsum[e]		220	220	200	230	230
Lime		41	37	35	40	42
Nitrogen: N content of ammonia[e]		33	31	30	39	35
Salt		372	374	389	390	[3]392
Sodium compounds, n.e.s.: Carbonate[e]	tons	44	45	43	23	—
Sulfur, from petroleum refining	do.	2,878	2,638	3,201	3,533	3,550
MINERAL FUELS AND RELATED MATERIALS						
Gas:						
Manufactured	million cubic feet	1,098	1,154	1,162	[e]1,170	1,200
Natural	do.	—	700	600	1,100	1,300
Petroleum refinery products:[4]						
Liquefied petroleum gas	thousand 42-gallon barrels	1,609	1,677	1,546	1,817	[3]1,986
Gasoline, all kinds	do.	8,610	8,650	8,723	8,765	[3]8,695
Naphtha	do.	74	38	31	6	[3]9
Jet fuel	do.	2,030	1,936	2,099	2,286	[3]1,949
Kerosene	do.	26	32	31	30	[3]19
Distillate fuel oil	do.	13,095	13,450	13,521	12,863	[3]11,887
Residual fuel oil	do.	4,862	4,590	4,579	3,917	[3]4,322
Bitumen	do.	839	721	892	931	[3]904
Other refinery products	do.	—	2	2	5	[3]5
Refinery fuel and losses	do.	1,221	1,191	1,291	1,311	[3]1,133
Total[5]	**do.**	**32,366**	**32,287**	**32,715**	**31,931**	**30,909**

[e]Estimated. [p]Preliminary. [r]Revised.
[1]Table includes data available through Apr. 1989.
[2]In addition to the commodities listed, a variety of crude construction materials (common clay, sand and gravel, and stone) is produced, but output is not reported, and available general information is inadequate to make reliable estimates of output levels.
[3]Reported figure.
[4]Table revised to conform to reporting format in Erdoel-Vereinigun/Union Petroliere, Zurich, Annual Yearbook.
[5]Total of listed products only.

ore and metal company in Sierra Leone, employed about 800 workers. The company mined and shipped about 1.4 million tons of washed bauxite, primarily to Lonza's Martinwerk. A contract covering the subsidiary's mining operation was extended in 1987 for another 10 years and was ratified by Sierra Leone's Parliament in 1988. The proven reserves were estimated at a million tons of bauxite, and another 10 to 15 million tons of bauxite were delineated as possible resources. Lonza Inc., which operated since 1969, has many locations in the United States and employed about 1,500 workers.

Metallwerke Refonda AG, established in 1939, was the only recycling plant in Switzerland. Alusuisse bought the company in 1975. It processed about 30,000 tons of aluminum scrap annually into 27,000 tons of casting alloy ingots. Refonda employed about 140 people in administration, production, and sales.

Iron and Steel.—All of the country's needs for iron ore and concentrates for the production of pig iron and scrap for the production of crude steel were met by imports. The largest Swiss steel and engineering company, Von Roll Ltd., at Gerlafinger in the northwestern canton of Solothurn, increased its total trade turnover by 45% to $1.3 billion, largely because of the acquisition of cable producer Isola Ltd. New orders rose 25%, and the company expected to double profits, with steel production representing about 35% of its income. The company's two plants, operating at Gerlafinger and Monteforno, planned to reduce their combined capacities by 100,000 tons per year. Von Roll's subsidiary in the United States, the minimill New Jersey Steel Inc., installed a new mill, manufactured in the Federal Republic of Germany, to raise capacity to 410,000 tons per year. To strengthen its position in the Federal Republic of Germany and the EC, Von Roll purchased Dielektra GmbH, an electronics group in Cologne, the Federal Republic of Germany. Dielektra employed 470 people. Von Roll also manufactured products in France, Italy, and Spain and distributed them through subsidiaries in Belgium, the Federal Republic of Germany, and the United Kingdom. The company also had a sales office in Hong Kong for distribution in the Far East.

Von Mosse Stahl AG, the second largest steel company in Switzerland, diversified out of steel. The company, based in Lucerne, restructured its 300,000 tons per year capacity steel operation into a separate division. The company's subsidiary, Pantex Stahl AG, began work on the reinforcement mesh system for tunnel construction and with channel tunnel contractors from Japan, the United Kingdom, and the United States. The company acquired a minority stake in a Connecticut steel company and planned to acquire new technology and access to North American markets.

Switzerland's minimill, Ferrowohlen AG, was established in 1955 to produce about 150,000 tons per year of rod and bar. No steel slabs were produced in Switzerland. There was speculation that Ferrowohlen was installing a hot strip mill at its plant in Wohlen in 1988, thus making its debut in wide hot coil production.[19]

Pestalozzi & Co. celebrated its 200th anniversary in the metals industry. The company, which began as a small iron and steel distribution business in Zurich, by 1988 employed more than 500 workers. The company continued to be family-owned. About 50% of the turnover came from steel, 25% from tools and machines, and 25% from plastic products and plumbing materials.[20]

Industrial Minerals.—Except for exploration for precious metals and stones and small extraction of natural gas, mining was limited to industrial minerals, such as construction materials, gypsum, and salt. However, none were produced in appreciable quantities. Most industrial minerals, especially cement, recorded a continuous but gradual growth. The production of sodium carbonate, which was halved in 1987, ceased completely in 1988.

In general, producers of calcium carbonate in Europe had their production operations in their country of origin. There were, however, two major exceptions, the Omya Group of companies, owned by Pluess-Stauffer AG of Switzerland, and ECC Calcium Carbonates Ltd., part of English China Clays Group. Both were active internationally. Omya had operations in Austria, France, the Federal Republic of Germany, Portugal, Spain, and the United Kingdom. Omya has long been regarded as one of the pioneers of ultrafine grinding of calcium carbonate and is one of the largest producers of calcium carbonate fillers in the world. In Finland, Oy Forby AB was a joint venture between Omya's Pluess-Stauffer and Karl Forsstrom AB, which began in 1981. Omya's Finnish partner mined the limestone underground at its Forby operations.[21]

Mineral Fuels.—In Switzerland, 61.8% of the electrical energy was generated by hydropower. Alusuisse/Lonza contributed a portion of its electrical energy overflow to the network. Switzerland continued to be a net exporter of electricity and increased its net exports by 14%, although imports from France remained considerable during the winter. Nuclear energy was produced by five nuclear power stations, generating about 36.5% of the total electrical output. In September 1988, the Parliament proposed to abandon the Kaiseraugust nuclear power project. It seemed unlikely that any nuclear power station will be built in Switzerland in the next decade. The burning of coal and hydrocarbons, such as crude oil and natural gas, was discouraged.

Switzerland imported all of its oil requirements. Approximately two-thirds of imports were oil products, of which 84% came from the EC. The major share of crude oil was imported from Libya and amounted to 45% of the total; Norway and the United Kingdom provided 16%. Exploration activities were restructured for the third exploration program covering the period 1988–92.

Gas consumption increased in 1988. Most gas needs were imported from the Netherlands and the Norwegian sectors of the North Sea through supply companies in the Federal Republic of Germany. Gas imports from the U.S.S.R. provided about 16% of the demand.

Solid fuels consumption continued to decrease. Coal, which was entirely imported, accounted for one-third of solid fuels and was mainly used in the industrial minerals industry. Two-thirds of solid fuels were domestic wood, which was used basically for residential heating.

MALTA[22]

Mineral production on the island country of Malta consisted of lime, limestone, and salt. The demand for all other fuels, metals, and industrial minerals was met by imports. Malta acquired a portion of its export earnings by serving as a bunkering and transshipment point for petroleum and refinery products.

In 1988, Malta was into its second year of rule under the Government of the Christian Democratic Party, which defeated the labor-oriented Nationalist Party in elections held in May 1987. At the end of the Nationalist Party's 16-year rule, almost one-half of Malta's work force was employed by the state sector, which generated about 40% of the GNP. The new Government was engaged in a gradual program to diminish the role of the state sector proportional to the private sector in the economy.

The new Government is also committed to obtaining full membership for Malta in the EC. Malta was already an associate member of the EC. The Government was preparing to submit a formal application for full membership to the EC before the end of its present term of office in 1992.

Along with seeking full membership in the EC, the Government of the Christian Democratic Party had undertaken initiatives to promote manufacturing, shipping, the service industries, and tourism. In conjunction with these initiatives, legislation was passed that provided a framework for increased investment in manufacturing, the development of a major offshore business center, and the creation of a free port at the Marsaxlokk development.

To promote manufacturing, the Industrial Development Act was passed in June; it offered major incentives to foreign investors. The Government was particularly desirous of promoting high-tech industries including electronics, automotive components, light engineering, chemicals, plastics, computers, and telecommunications.

To further industrial development, the Malta Development Corp. was formed. It was a Government agency run by local industries with the purpose of promoting industry and serving as a liaison for industry with the Government. To support industrial development, a large program was under way to upgrade the country's infrastructure. The program included installing state-of-the-art telecommunications, investing in a new powerplant, laying roads, improving the water supply, and constructing a new terminal at the Luqa Airport.

The program for creating a free port at Marsaxlokk, when accomplished, would enhance Malta's attraction as a transshipment hub in the Mediterranean. To meet additional transshipment demand at Marsaxlokk, construction had begun of an oil products terminal with an initial capacity of 200,000 cubic meters.

In 1988, Malta resumed its program to promote offshore oil development. In March, the Government of Malta invited international oil drilling companies to submit proposals for concessionary oil exploration in 2 blocks of the Area 3 zone covering a total of 15,200 square kilometers. This area borders Italy's large Vega oilfield in the Mediterranean. The deadline for submission of tenders was July.

Malta's offshore exploration activities suffered a major setback in 1980 as a result of a boundary dispute with Libya concerning the median line for offshore development. The dispute was resolved in 1986 following a ruling in 1985 by the International Court of Justice. However, the area where the Government was now

TABLE 6

MALTA: ESTIMATED PRODUCTION OF MINERAL COMMODITIES[1]

Commodity		1984[2]	1985	1986	1987	1988
Lime	cubic meters	5,474	5,500	5,500	5,500	5,500
Limestone	thousand cubic meters	652	700	650	600	600
Salt	metric tons	92	100	100	100	100

[1] Table includes data available through June 30, 1989.
[2] Reported figure.

TABLE 7

MALTA: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
METALS					
Aluminum: Metal including alloys:					
Scrap		293	835	—	Italy 817; Netherlands 16; United Kingdom 2.
Unwrought	value, thousands	—	$290	—	All to Italy.
Semimanufactures	do.	$1,659	$5,463	—	Italy $5,347; West Germany $100.
Copper: Metal including alloys:					
Scrap		170	360	—	Italy 269; Republic of Korea 38; West Germany 37.
Semimanufactures	value, thousands	$2	—		
Iron and steel: Metal:					
Scrap		5,427	10,566	—	Italy 10,132; United Kingdom 249; Denmark 89.
Steel, primary forms		2	—		
Semimanufactures:					
Wire	value, thousands	$16	$17	—	Ireland $13; United Kingdom $4.
Tubes, pipes, fittings	do.	$83	—		
Casting and forgings, rough	do.	$745	$371	—	Belgium-Luxembourg $265; U.S.S.R. $76; Algeria $30.
Lead: Metal including alloys, scrap	do.	$82	$81	—	Italy $38; United Kingdom $27; Netherlands $10.
Nickel: Metal including alloys:					
Scrap		7	4	—	West Germany 2; United Kingdom 2.
Semimanufactures	value, thousands	$2	—		
Tin: Metal including alloys:					
Scrap	do.	—	$3	—	All to Italy.
Semimanufactures	do.	$1	—		
Zinc: Metal including alloys:					
Scrap		61	29	—	All to United Kingdom.
Semimanufactures		([2])	—		
Other: Ashes and residues	value, thousands	$6	$8	—	All to West Germany.
INDUSTRIAL MINERALS					
Abrasives, n.e.s.: Grinding and polishing wheels and stones	value, thousands	$696	$905	—	Australia $336; West Germany $274; Yugoslavia $128.
Diamond: Gem, not set or strung	do.	$3,392	$3,580	—	All to Belgium-Luxembourg.
Fertilizer materials: Crude, n.e.s.	do.	$17	$18	—	All to Italy.
Stone, sand and gravel: Dimension stone:					
Crude and partly worked	do.	$14	—		
Worked	do.	$9	$35	—	France $20; United Kingdom $11; Italy $3.
MINERALS FUELS AND RELATED MATERIALS					
Petroleum refinery products:					
Lubricants	value, thousands	$4	$3	—	All to United Kingdom.
Bitumen and other residues	42-gallon barrels	88	6,060	—	All to Italy.

[1] Table prepared by staff, Branch of Geographic Data.
[2] Less than 1/2 unit.

TABLE 8

MALTA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987	
				United States	Other (principal)
METALS					
Aluminum:					
Oxides and hydroxides	value, thousands	$19	$49	—	Ireland $34; France $9.
Metal including alloys:					
Scrap		1	101	—	All from Yugoslavia.
Unwrought	value, thousands	$521	$1,078	$157	Italy $503; France $272.
Semimanufactures	do.	$7,487	$10,875	$85	Italy $6,920; West Germany $1,607; Netherlands $983.
Arsenic: Metal including alloys, all forms	do.	$1	—		
Chromium: Oxides and hydroxides	do.	$16	$7	—	United Kingdom $6; West Germany $1.
Copper: Metal including alloys:					
Unwrought	do.	$116	$20	—	All from Italy.
Semimanufactures	do.	$1,478	$1,870	$23	United Kingdom $1,036; France $286; West Germany $228.
Iron and steel:					
Iron ore and concentrate: Pyrite, roasted	do.	$2	$2	—	All from Yugoslavia.
Metal:					
Scrap		529	329	20	Netherlands 176; United Kingdom 102.
Pig iron, cast iron, related materials	do.	$486	$305	—	Greece $179; Czechoslovakia $45; United Kingdom $39.
Ferroalloys:					
Ferromanganese	do.	$1	$3	—	All from United Kingdom.
Unspecified	do.	$41	—		
Steel, primary forms	do.	$1,618	$1,223	—	Greece $539; Spain $233; Turkey $224.
Semimanufactures:					
Bars, rods, angles, shapes, sections	do.	$7,131	$4,478	$1	United Kingdom $1,957; Italy $741; Belgium-Luxembourg $688.
Universals, plates, sheets	do.	$7,988	$7,686	—	West Germany $1,849; Czechoslovakia $1,711; Belgium-Luxembourg $1,091.
Hoop and strip	do.	$235	$182	—	Italy $96; West Germany $75.
Rails and accessories	do.	$8	$13	—	United Kingdom $8; Netherlands $5.
Wire	do.	$998	$1,580	—	Italy $648; United Kingdom $381; Poland $148.
Tubes, pipes, fittings	do.	$5,204	$4,596	$2	West Germany $1,034; United Kingdom $906; Italy $775.
Castings and forgings, rough	do.	([2])	$103	—	Hong Kong $29; Czechoslovakia $23; Poland $22.
Lead:					
Oxides	do.	$60	$137	—	United Kingdom $94; West Germany $42; Italy $1.

See footnotes at end of table.

TABLE 8—Continued

MALTA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987 United States	Sources, 1987 Other (principal)
METALS—Continued					
Lead—Continued					
Metal including alloys:					
Unwrought	value, thousands	$123	$144	—	United Kingdom $132; Belgium-Luxembourg $11.
Semimanufactures	do.	$27	$72	$1	United Kingdom $44; Belgium-Luxembourg $22.
Magnesium: Metal including alloys:					
Scrap		([2])	—		
Unwrought		([2])	—		
Semimanufactures	value, thousands	$2	$3	—	All from West Germany.
Manganese: Oxides	do.	$2	—		
Mercury	do.	([2])	$1	—	NA.
Nickel: Metal including alloys:					
Unwrought	do.	$14	$104	—	United Kingdom $103; West Germany $1.
Semimanufactures	do.	$246	$509	—	United Kingdom $270; West Germany $143; Ireland $73.
Platinum-group metals: Metals including alloys, unwrought and partly wrought	do.	([2])	—		
Silver:					
Waste and sweepings	do.	$2	—		
Metal including alloys, unwrought and partly wrought	do.	$179	$197	—	United Kingdom $121; West Germany $59; Italy $10.
Tin: Metal including alloys:					
Unwrought	do.	$9	$1	—	All from United Kingdom.
Semimanufactures	do.	$1,300	$864	—	Italy $519; United Kingdom $260; France $36.
Titanium: Oxides	do.	$521	$666	$253	United Kingdom $243; West Germany $157.
Tungsten: Metal including alloys, all forms	do.	—	$27	—	All from United Kingdom.
Uranium and/or thorium: Metal including alloys, all forms	do.	—	$1	—	All from West Germany.
Zinc:					
Oxides	do.	$45	$59	—	Netherlands $35; Norway $11; West Germany $5.
Metal including alloys:					
Scrap		1	29	—	All from Italy.
Unwrought	value, thousands	$132	$105	—	United Kingdom $48; France $38; Belgium-Luxembourg $15.
Semimanufactures	do.	$84	$104	—	Belgium-Luxembourg $46; Italy $23; United Kingdom $11.
Other:					
Ores and concentrates	do.	—	$1	—	All from Yugoslavia.
Base metals including alloys, all forms	do.	$2	$11	—	All from Italy.

See footnotes at end of table.

TABLE 8—Continued

MALTA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
INDUSTRIAL MINERALS					
Abrasives, n.e.s.:					
Natural: Corundum, emery, pumice, etc	value, thousands	$96	$263	—	Italy $122; Greece $81; Turkey $37.
Artificial: Corundum	do.	$28	$45	—	Yugoslavia $44; West Germany $1.
Dust and powder of precious and semiprecious stones including diamond	do.	$13	$12	—	Belgium-Luxembourg $9; Ghana $3.
Grinding and polishing wheels and stones	do.	$531	$803	$2	Italy $323; Yugoslavia $220; West Germany $89.
Barite and witherite	do.	$59	$4	—	West Germany $2; United Kingdom $2.
Boron materials:					
Crude natural borates	do.	(2)	—		
Oxides and acids	do.	$3	$2	—	West Germany $1; Italy $1.
Cement		162,840	158,984	—	U.S.S.R. 83,891; Bulgaria 41,911; Tunisia 11,234.
Chalk	value, thousands	$56	$90	—	United Kingdom $42; France $16; Italy $12.
Clays, crude		406	567	—	United Kingdom 281; Italy 265; West Germany 14.
Cryolite and chiolite	value, thousands	$2	$9	—	All from Yugoslavia.
Diamond:					
Gem, not set or strung	do.	$4,242	$3,429	—	Ghana $1,899; Angola $624; Switzerland $521.
Industrial stones	do.	$331	$7	—	Belgium-Luxembourg $5; Ghana $2.
Diatomite and other infusorial earth	do.	$32	$65	—	West Germany $28; Italy $26; France $5.
Feldspar, fluorspar, related materials:					
Fluorspar	do.	(2)	—		
Fertilizer materials:					
Crude, n.e.s.		2,907	—		
Manufactured:					
Ammonia	value, thousands	$20	$20	—	United Kingdom $10; France $7.
Nitrogenous		2,032	2,199	—	Italy 2,086; West Germany 100.
Phosphatic	value, thousands	$5	$5	—	Netherlands $3; Belgium-Luxembourg $1.
Potassic	do.	—	$3	—	All from Netherlands.
Unspecified and mixed		415	333	—	Belgium-Luxembourg 228; West Germany 49; United Kingdom 35.
Graphite, natural		(2)	—		
Gypsum and plaster	value, thousands	$38	$45	—	Spain $28; West Germany $9; United Kingdom $7.
Lime	do.	$1	$46	—	United Kingdom $36; Italy $10.
Magnesium compounds	do.	$1	$1	—	All from United Kingdom.
Mica:					
Crude including splittings and waste	do.	$9	$27	—	United Kingdom $25; Italy $2.

See footnotes at end of table.

TABLE 8—Continued

MALTA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
INDUSTRIAL MINERALS—Continued					
Mica—Continued					
Worked including agglomerated splittings	value, thousands	$1	—		
Pigments, mineral:					
Natural, crude	do.	$11	$6	—	All from United Kingdom.
Iron oxides and hydroxides, processed	do.	$26	$22	—	West Germany $9; United Kingdom $7; Italy $4.
Precious and semiprecious stones other than diamond:					
Natural	do.	$8	$13	$3	Austria $2; West Germany $1.
Synthetic	do.	$3	$8	$2	West Germany $5; Austria $1.
Pyrite, unroasted		—	7	—	All from Yugoslavia.
Salt and brine	value, thousands	$277	$100	—	United Kingdom $93; West Germany $4; Italy $2.
Sodium compounds, n.e.s.: Carbonate, manufactured		140	78	—	Bulgaria 60; West Germany 18.
Stone, sand and gravel:					
Dimension stone:					
Crude and partly worked	value, thousands	$1,914	$2,589	—	Italy $2,565; Portugal $24.
Worked	do.	$28	$30	—	Italy $28; West Germany $1; United Kingdom $1.
Dolomite, chiefly refractory-grade	do.	—	$1	—	All from Norway.
Gravel and crushed rock	do.	$828	$828	$2	Italy $811; Belgium-Luxembourg $7.
Quartz and quartzite	do.	$21	$8	—	Belgium-Luxembourg $7; United Kingdom $1.
Sand other than metal-bearing	do.	$149	$77	—	United Kingdom $38; Italy $28; Belgium-Luxembourg $10.
Sulfur:					
Elemental: Colloidal, precipitated, sublimed		93	81	—	Italy 80; United Kingdom 1.
Dioxide	value, thousands	$4	—		
Sulfuric acid	do.	$114	$82	—	Netherlands $41; United Kingdom $34; Italy $7.
Talc, steatite, soapstone, pyrophyllite	do.	$61	$87	—	Italy $51; Norway $19; United Kingdom $8.
Other:					
Crude	do.	$6	$8	—	United Kingdom $4; Netherlands $3; Austrial $1.
Slag and dross, not metal-bearing	do.	—	$8	—	All from Greece.
MINERAL FUELS AND RELATED MATERIALS					
Asphalt and bitumen, natural		2	501	1	Austria 500.
Carbon:					
Carbon black	value, thousands	$286	$299	$12	Italy $117; West Germany $98; Canada $69.
Gas carbon	do.	$9	—		

See footnotes at end of table.

TABLE 8—Continued

MALTA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
MINERAL FUELS AND RELATED MATERIALS—Continued					
Coal:					
Anthracite and bituminous	value, thousands	$6,554	$5,701	—	United Kingdom $3,216; Spain $2,485.
Briquets of anthracite and bituminous coal	do.	$11	$16	—	Australia $11; United Kingdom $5.
Lignite including briquets	do.	$1	—		
Coke and semicoke	do.	$8	$11	—	United Kingdom $7; Italy $4.
Peat including briquets and litter	do.	$70	$125	—	Netherlands $44; United Kingdom $43; Ireland $31.
Petroleum refinery products:					
Mineral jelly and wax	do.	$380	$448	—	Hungary $200; Italy $127; United Kingdom $71.
Lubricants	do.	$3,171	$3,207	$65	Belgium-Luxembourg $1,008; Italy $914; United Kingdom $881.
Bitumen and other residues	42-gallon barrels	38,872	34,542	6	Austria 34,518; Denmark 12; United Kingdom 6.
Bituminous mixtures	value, thousands	$240	$413	—	Austria $284; United Kingdom $68; France $49.

NA Not available.
[1] Table prepared by staff, Branch of Geographic Data.
[2] Less than 1/2 unit.

promoting exploration, was not part of the disputed area.

[1] Prepared by John G. Panulas, physical scientist, Division of International Minerals.

[2] Where necessary, values have been converted from Italian lira to U.S. dollars at the rate of Lit1350=US$1.00, the average rate in 1988.

[3] Prepared by George A. Rabchevsky, physical scientist, Division of International Minerals.

[4] Values have been converted from Austrian Schillings (S) to U.S. dollars at the rate of S12.30=US$1.00, the average rate in 1988.

[5] Financial Times (London). May 16, 1989, Section III, pp. I-IV.

[6] Mining Magazine (London). Dec. 1988, p. 513.

[7] Mining Journal (London). July 14, 1989, p. 22.

[8] Metal Bulletin (London). Oct. 27, 1988, p. 25.

[9] Journal of Commerce (London). Oct. 17, 1988, pp. 8A–9A.

[10] Comecon is an organization of 10 countries whose economies are centrally planned. Comecon aims for economic cooperation and coordination among the following member countries: Bulgaria, Cuba, Czechoslovakia, the German Democratic Republic, Hungary, Mongolia, Poland, Romania, the U.S.S.R., and Vietnam. Yugoslavia has permanent observer status.

[11] Industrial Minerals (London). Dec. 1988, p. 37.

[12] ———. Jan. 1989, p. 27.

[13] Gluckauf (Essen). V. 124, No. 7, 1988, p. 216.

[14] Petroleum Economist (London). Sept. 1988, p. 306.

[15] Prepared by George A. Rabchevsky, physical scientist, Division of International Minerals.

[16] Muncey, S. A Swiss Specialty. Countertrade & Barter (London), Aug.-Sept. 1988, pp. 15–20.

[17] Where necessary, values have been converted from Swiss francs (SwF) to U.S. dollars at the rate of SwF1.45=US$1.00, the average in 1988.

[18] The Sun (Zurich). Internal Alusuisse Group Periodical. Alusuisse—Our Future Began 100 Years Ago. (Zurich). No. 21, Nov. 1988.

[19] Metal Bulletin (London). May 12, 1988, p. 29.

[20] ———. Nov. 1988, p. 63.

[21] Dickson T. White Carbonate Fillers. An Ocean of Difference. Ind. Miner. (London), Aug. 1987, p. 73.

[22] Prepared by Richard M. Levine, foreign mineral specialist, Division of International Minerals.

THE MINERAL INDUSTRY OF THE

U.S.S.R.[1]

By Richard M. Levine[2]

Restructuring "perestroyka" did not appear to have a significant effect on mineral production or trade in 1988, and the policy of openness "glasnost" did not extend to the release of mineral production and trade data, most of which still remained secret. An attempt was made to introduce greater economic autonomy and managerial responsibility in the mineral industry. There was also discussion in the Soviet press of reevaluating Soviet mineral production and trade policy. These measures could bring about significant changes in the Soviet mineral industry in future years. However, in 1988, the new economic reforms were far from accomplishing the economic transformation envisaged, and the economy suffered severe losses from the earthquake in Armenia.

In 1988, reportedly, production of cement, mineral fertilizers, oil, and crude steel remained practically the same. There were small increases in the production of coal, rolled steel, and steel pipes, and a large increase in natural gas production. The fact that the plan was usually fulfilled when production remained level indicated that the Soviets were trying to stabilize the level of output for a number of mineral commodities.

A reevaluation was occurring of the Soviet mineral policy that traditionally sought to increase production of minerals at almost any cost to achieve mineral self-sufficiency. The policy was also to supply the needs of allied countries in order to integrate their economies with that of the U.S.S.R. Questions were being raised regarding the inefficiency and waste of resources that resulted. Discussions of high level officials were appearing in the press regarding the finite nature of mineral resources and, thus, the need for their efficient utilization. An article in Pravda by V. Dolgikh, a candidate member of the Politburo, stated, "There is still a stereotype in economic practice according to which it is customary to consider that we have a great deal of resources, that our subterranean storerooms are inexhaustible, and that raw materials and fuel are almost a gift to us and can be expended thoughtlessly. These false notions must be destroyed resolutely and as quickly as possible." He further stated, "What is the use of increasing output in the raw materials and fuel and energy sectors if the increase is 'eaten up' as a result of the irrational, wasteful use of resources. A further tilt in this direction imposes a very heavy burden on the economy."[3]

Much discussion was addressed to the issue of improving the quality of steel products to the level of the advanced industrial countries. This would result in a reduction in metal consumption in machine manufacturing. Less fuel would be required to produce and run the machinery, and less fuel and ore would need to be extracted, resulting in a continuously spiraling increase in efficiency. Comparisons with the United States were made. Reportedly, "The U.S.S.R. expends three times more metal than does the United States on the production of comparable products."[4] In the near term, it was planned to stabilize the production of a number of mineral commodities. This was a sharp break with the traditional method of Soviet planning that sought to continuously increase mineral output.

Articles appeared in the Soviet press criticizing the policy of keeping mineral production, trade, and reserve data secret as a vestige of the Stalin era. An article in Izvestiya stated, "It is characteristic that the publication of data about gold as with a mass of other statistics ended when the cult of personality was formed together with the cult of secrecy."[5] Another article in Sotsialisticheskaya industriya (Socialist Industry) stated, "One of our favorite 'spheres' of secrecy is our resources . . . it is clear how little logic there is in protecting the contents and volume of stocks of minerals. Who will steal them? And who is interested if we take 15 to 20 years to develop them using our own efforts."[6] Calls for publishing mineral statistics including gold statistics in the Soviet press could presage the release of more data on mineral production, trade, and reserves, although no actual release of data had yet occurred.

In an effort to come to terms with the use of forced labor in the development of many mineral projects under Stalin, memorials to the victims of such projects were proposed. For example, a special account was opened at a bank in Noril'sk in East Siberia to accept contributions for a memorial to the victims of the construction of the major mining and metallurgical facility at Noril'sk. According to a report in Izvestiya, it would be, "A memorial to the people who lived the nightmare of the huts of Noril'sk. Tens of thousands upon tens of thousands of people rounded up from all over the country became the involuntary builders of the gigantic metallurgical complex and the city (of Noril'sk) in the snow-covered wasteland. Many died from work that was beyond their strength, from scurvy, from respiratory diseases. Many were shot."[7] A similar report was published in Radyans'ka Ukraina (Soviet Ukraine) about the conditions of the forced laborers in the Kolyma gold fields in the Soviet Far East where there were few survivors.[8]

Another area where secrecy was lifted involved the publication of data concerning the size of the labor force in various sectors of mining and fuel extraction. The statistical compendium Trud v. SSSR (Labor in the U.S.S.R.) published in 1988 stated that, in 1987, there was a total of 751,000 industrial and production personnel (promyshlenno-proizvodstvennyi personal) in the nonferrous metallurgy sector, 1.456 million in the ferrous metallurgy sector, 1.273 million in the coal industry, 164,000 in the oil-extraction industry, and 36,000 in the gas extraction industry.[9] However, the term "industrial and production personnel" does not include the total work force in these sectors.

In 1988, the Union-Republic Ministry of the Construction Materials Industry was changed into an All-Union Ministry, thereby abolishing the subordinate ministries for construction materials in the republics. The Ministry of the Construction Materials Industry was responsible for mining, processing, and production of a large number of construction materials including asbestos, cement, ceramics, and glass.

A reorganization resulted in a unique form of management being introduced for the gold and diamond mining and production sectors, which were removed from the control of the Ministry of Nonferrous Metallurgy and formed into a new Main Directorate of Precious Metals and Diamonds. The Directorate was not subordinate to any ministry but directly subordinate to the U.S.S.R. Council of Ministers. The new Directorate was generally referred to by its acronymn Glavalmazzoloto (Main Diamond and Gold Directorate).

Glavalmazzoloto controlled all mining enterprises, ore and metal processing plants, secondary processing plants, finished-goods and jewelry making plants, and scientific research and auxiliary organizations supporting these activities. Glavalmazzoloto was also responsible for foreign sales of its jewelry, although, reportedly, all gold bullion sales were still channeled through the Vneshekonombank. In the jewelry-making sector of Glavalmazzoloto, there were 20 associations and plants employing about 30,000 people producing all forms of jewelry using precious metals and stones. Jewelry for export was produced by 8 of the 20 associations and plants.[10]

In 1988, the Soviets issued a precious metals coin series for sale in the West commemorating the 1,000-year anniversary of the conversion of Kiyevan Rus' to Christianity. The series included platinum, palladium, and silver coins. The sale of Soviet gold coins in the United States was prohibited in 1986 according to the provisions of the Comprehensive Anti-Apartheid Act of 1986.

A great tragedy occurred in December when an earthquake struck Armenia, causing massive destruction in the cities of Leninakan, Spitak, Kirovakan, Stepanavan, and numerous villages. More than 25,000 people were reported killed, tens of thousands injured, and hundreds of thousands left homeless. Much criticism was directed at the faulty construction methods and poor-quality building materials which may have intensified the damage. Mine rescue teams that came to assist the victims of the earthquake received high praise for their efforts.

THE 1989 PLAN

The plan for 1989 called for continuing the policy of stabilizing iron ore, pig iron, and coke production near their current levels. Efforts were to be directed toward more efficient use of resources, including more comprehensive processing of ore, greater use of secondary materials, and improved technology. The last named would include increasing the percentage of steel produced by electric and oxygen converter furnaces as well as by continuous casting.

In nonferrous metallurgy, the major task set was developing the ore base. The main cause for the slowdown in the rate of development of nonferrous metallurgy was attributed to the lag in construction of mining and concentration enterprises as well as the need to modernize existing enterprises. The lag in development of new mines necessitated the intensive selective mining of the richest sectors of fields, resulting in depletion of reserves at existing enterprises. This was especially pronounced in the copper, lead-zinc, and tungsten-molybdenum subbranches.

Depletion of reserves at a number of major enterprises made it necessary to lower standards and mine poorer ores not included in the plan, including the ore in the dumps in complexes such as the Balkhash copper, Zyryanovsk lead-zinc, Leninogorsk mixed sulfide, Agarak copper-molybdenum, and others. Because the lag in the development of the ore base resulted in under delivery of raw materials to processing enterprises, there was reduced use of production capacities at a number of beneficiation and metallurgical plants. Also, the decrease in ore quality made it necessary to increase the amount of mined material and to introduce more powerful, high productivity equipment.

The plan for the 1986-90 period called for the most substantial increase in mining capacity in the copper, lead-zinc, tin, and tungsten-molybdenum subbranches. Tasks set for the nonferrous sector included hastening the introduction of new mining capacity and making maximum use of existing production capacity. The latter would include more comprehensive recovery of ore constituents (eliminating the faulty practice of developing only the richest sections of deposits), and improving the level of technology in nonferrous metal mining through the use of better mining equipment and better technologies for ore processing.[11]

EXPLORATION AND GEOLOGY

In the U.S.S.R., geological work was conducted by 11 ministries, a series of institutes of the U.S.S.R. Academy of Sciences, and separate organizations of the All-Union Central Council of Professional Unions (VTsSPS). Nevertheless, more than 70% of geological work was conducted by the U.S.S.R. Ministry of Geology, which employed 678,000 geological workers out of a national total of more than 800,000, with more than 300,000 of them directly involved in exploration. Within the country, 156 universities and institutes of higher learning prepared geological cadre, and another 205 technical schools were also involved in training geological cadre.[12]

Reportedly, in 1988, the state plan for growth in reserves was fulfilled for all minerals and was also fulfilled for the 3-year period 1985–88. Nevertheless, serious inadequecies were reported in exploration work at some oil and gas deposits in the European North and West Siberia and in expanding the reserve base at existing nickel enterprises on the Kola Peninsula and tungsten enterprises in the North Caucasus.[13]

In 1988, the U.S.S.R. Ministry of Geology concluded almost 160 contracts with foreign countries, and almost 5,000 Soviet geologists rendered technical assistance to foreign geological services. Five geological and two oil-prospecting expeditions were exploring sites in Mongolia, South Yemem, and Ethiopia. Soviet specialists helped discover new oil and gold deposits in Cuba, oil and gas deposits in Afghanistan, bauxite deposits in Guinea, gold deposits in Nicaragua, coal deposits in Mozambique, and mercury deposits in Algeria. During 1989, special attention in the field of exploration would be given to Mongolia, Vietnam, and Cuba. The Soviets would also begin new exploration work in North Korea, Malaysia, and Benin while continuing work on earlier discovered deposits in Ethiopia, Algeria, Guinea, Ghana, and a number of other countries.[14]

The U.S.S.R. Main Administration of Geology and Cartography admitted that for perceived security reasons since the 1930's, virtually all Soviet maps for public distribution were deliberately falsified in a number of ways including omitting or misplacing natural or man-made features and changing boundaries. Directives now called for releasing accurate maps.

The U.S.S.R., reportedly, was preparing to publish geological survey maps of Africa, Southeast Asia, and the Middle East. Also, maps of Cuba's oil and gas deposits and a metallogenic map of Cuba reportedly were ready for press, and a book entitled "The Geology of Cuba" was scheduled for publication in December.[15]

In 1988, the All Union Mapping Association "Soyuzkarta" announced signing contracts with the following foreign countries: Nicaragua, for revising maps of the country's whole territory; Afghanistan, for rendering technical assistance on developing a national geodetic service and conducting topographic work; Mozambique, for rendering technical assistance in developing Mozambique's geodetic service and training that country's specialists; Angola, for revising the country's maps and undertaking topographic and geodetic surveys; and Australia for cooperation in the sphere of cartography, which includes preparing photographic documents based on satellite imagery of Australia, Oceania, and Southeast Asia.

In 1988, the Munich-based Applied Remote Sensing Company (GAF) acquired the right to market Soviet high-resolution satellite imagery to the West. The Soviet images had a resolution of up to 5 meters. However, the Soviet system Cosmos, reportedly, required that the imagery be digitized in order to allow enhancement, therefore, making the Soviet system, in some ways, comparable to a 10-meter resolution system. The Soviet Cosmos system, however, appeared to be highly competitive in terms of quality and price.

A protocol establishing the first Soviet-U.S. enterprise for producing geophysical equipment was signed in September. The U.S. firms involved specialized in ecologically safe equipment for studying the earth's depths.

The Supreme Soviet ratified an agreement for the creation of a joint organization for seabed prospecting and mining called Interokeanmetal. The organization was comprised of Bulgaria, Cuba, Czechoslovakia, the GDR, Poland, the U.S.S.R., and Vietnam, all members of the Council for Mutual Economic Assistance (CMEA) trading bloc.[16] At yearend, the Soviet research ship "Professor Fedynskiy" completed its first voyage for Interokeanmetal after prospecting 6 months in the Pacific Ocean where pictures were taken of various parts of the ocean floor as preparation, it was claimed, for deep-sea mining.[17] Also, during the year, the Soviets announced completion of a first-of-its-kind atlas of seabed deposits in the world's oceans based on the results of Soviet and foreign expeditions over many years.[18]

After completing sea trials, Finland's Rauma-Repola delivered two deep-sea research vessels to the U.S.S.R. Each was capable of working at water depths down to 20,000 feet, thus permitting access to 98% of the area of the world's oceans. The vessels were designed for research and exploration of the ocean floor and were equipped with sampling devices and a wide range of measuring and monitoring equipment for this purpose. In November, documents were signed for establishing a joint Soviet-British enterprise, "Intershelf", for exploration of oil and gas deposits on the ocean shelf. The signatories included the U.S.S.R. Industrial Construction Bank, the Kuybyshev Moscow Construction Engineering Institute, and the J. P. Kenny Co. of the United Kingdom.

ENVIRONMENT

One of the major ecological crises facing the Soviet Union was the drying up of the Aral Sea, once the world's fourth-largest lake and now the sixth largest, as large amounts of water from the Aral Sea's tributaries were diverted for irrigation purposes. The sharp decrease in the Aral Sea's size and volume resulted in numerous ecological problems. Salt-laden duststorms carrying toxic salts from the dried bed of the Aral Sea contaminated farmlands and the drinking water supply, causing numerous health problems. Also, the decrease in water volume was abetting the decline of the fishing industry and changing the Aral Sea's moderating effect on the climate, thus affecting cotton growing. The issue of the Aral

Sea was being treated in the Soviet press as an extremely serious ecological problem. Unless the drying up of the Aral Sea was halted and reversed, it was predicted that the Aral Sea could turn into several lifeless brine lakes by early in the next century.

In an issue involving possible mineral contamination, a mysterious disease affecting children in the Ukraine in the city of Chernovtsy was linked to the fact that aluminum, barium, lead oxide, mercury, and especially thallium were present in the environment in abnormally high levels.[19] More than 80 children had been hospitalized with symptoms described as hair loss and disorders of the central nervous system. The source of the excess thallium was not known, although it was reported in the press that work at several local industrial plants where thallium was used had been halted.[20] Nevertheless, the role of thallium in the children's illness has been disputed by both Soviet and Western medical specialists.

Numerous issues of environmental concern regarding mineral development and processing were reported by the Soviet press and media. Prominent among them were issues concerning nuclear power development throughout the country, nickel processing on the Kola Peninsula, aluminum production in Siberia, phosphate mining in Estonia, gas processing at Astrakhan, and sodium sulfate development in Turkmenistan. These issues will be dealt with in more detail in this report in the following sections dealing with the specific mineral industries. As evidence of the growing environmental consciousness in the country, in January, the Central Committee of the Communist Party of the Soviet Union and the U.S.S.R. Council of Ministers adopted a decree "On the Radical Restructuring of Environmental Protection in the Country" in which it was declared necessary "to adopt decisive measures for protection and utilization of land at its depths, water resources, atmospheric air, and the animal world."[21]

PRODUCTION

Statistics on output, enterprise capacity, and production plans in physical units of output for nonferrous, precious and rare metals, and some industrial minerals were classified as state secrets. Soviet trade data on precious metals had not been available for decades, and, in 1976, the Soviets stopped publishing trade statistics for nonferrous metals. Production and trade data were available for some ferrous metals, industrial minerals, and fuels.

TRADE

The course of restructuring involved discussing the need to change the U.S.S.R.'s trade policy. The Minister for Foreign Economic Relations, Konstantin Katushev, discussing the need for restructuring in the country's trade structure, stated that the U.S.S.R. which "launched the first satellite, is a world leader in space research, was the first to develop lasers and build a nuclear powerplant and is one of the two major military powers, finds itself reduced to the role of an exporter of fossil fuels and raw materials. This can be seen as nothing short of a sad paradox in a string of other distortions." He further stated, "The long-running policy of increasing oil and gas exports which reached 70% of all our trade in the 1970's, has distorted the pattern of our trade, making it one product oriented," and that, "the monopoly of domestic producers of machinery and equipment led to lower quality and competitiveness in international markets."[22] Restructuring, according to the Minister, should emphasize increasing exports of manufactured goods.

A Decree on the Foreign Activity of Enterprises, which would take effect in 1989, granted "all enterprises, associations, production cooperatives, and other organizations whose work can compete on the world market the right to conduct export-import operations directly." The decree further weakened the former system whereby all foreign trade was conducted by the former Ministry of Foreign Trade. This new right apparently required official approval, and the marketing of most mineral commodities in 1989 still would remain under the control of centralized trade organizations. Also, the law did away with the requirement that foreign firms may hold only a 49% interest in joint ventures with Soviet firms, and the share of the foreign firms' holdings would now be open to negotiations.[23]

In 1988, 191 joint ventures on the territory of the U.S.S.R. between Soviet and foreign organizations were negotiated. Of these, 164 were with market-economy countries and 27 were with non-market-economy countries. As part of the Soviet effort to export more processed and manufactured goods instead of raw materials, the minerals sector of the country was trying to increase production of petrochemicals for export. The sector had agreed to a number of petrochemical joint ventures with Western firms.

In another change, Soviet newspapers began printing advertising by Western firms. Such advertising appeared to provide a public relations as well as a commercial function. For example, one full-page advertisement was by a French firm that had signed a contract for renovating an aluminum-fabricated-products plant in Armenia.

In April 1988, a delegation of U.S. Government officials led by the Secretary of Commerce attended a meeting of the Joint U.S.-U.S.S.R. Commercial Commission, which oversaw development of bilateral trade. A "Joint Statement" was signed affirming the desire of both sides to increase trade and economic cooperation. In May, the United States eased restrictions on exports of energy-generating, medical, and construction equipment to the

TABLE 1

U.S.S.R.: ESTIMATED[1] PRODUCTION OF MINERAL COMMODITIES[2]

(Thousand metric tons unless otherwise specified)

COMMODITY		1984	1985	1986	1987	1988
METALS						
Aluminum:						
Ore and concentrate:						
Bauxite, 26% to 57% alumina		4,600	4,600	4,600	4,600	4,600
Nepheline concentrate, 25% to 30% alumina		1,600	[3]1,615	[3]1,638	[3]1,660	1,640
Alunite ore, 16% to 18% alumina		615	615	620	625	625
Alumina		[r]4,200	[r]4,300	[r]4,400	[r]4,400	4,600
Metal, smelter:						
Primary		[r]2,200	[r]2,300	[r]2,400	2,400	2,500
Secondary		[r]350	[r]375	[r]400	[r]400	425
Total		**2,550**	**[r]2,675**	**[r]2,800**	**[r]2,800**	**2,925**
Antimony, mine output, recoverable Sb content	tons	9,300	9,400	9,500	9,600	9,600
Arsenic, white (As_2O_3)	do.	8,000	8,100	8,100	8,100	8,100
Beryllium: Beryl, cobbed, 10% to 20% BeO	do.	1,900	1,900	2,000	2,000	2,000
Bismuth, mine output, recoverable Bi content	do.	82	83	84	85	85
Cadmium metal, smelter	do.	3,000	3,000	3,000	3,000	2,900
Chromium:						
Chrome ore, crude[3]		[r]3,550	[r]3,864	[r]4,033	[r]4,060	4,131
Chrome ore, marketable		[r]3,100	[3]3,360	[3]3,640	[3]3,570	3,700
Cobalt:						
Mine output, recoverable Co content	tons	2,600	2,700	2,800	[r]2,900	3,000
Metal, smelter	do.	4,700	4,800	5,300	5,300	5,400
Copper:						
Ore:						
Gross weight, 0.5% to 2% Cu		85,000	86,000	89,000	91,000	93,000
Cu content, recoverable		590	600	620	630	640
Metal:						
Blister:						
Primary		735	750	770	[r]790	800
Secondary		141	[r]145	145	147	150
Refined:						
Primary		790	810	830	840	850
Secondary		141	143	145	147	150
Gold, mine output, Au content	thousand troy ounces	8,650	8,700	8,850	[r]8,850	9,000
Iron and steel:						
Iron ore, 55% to 63% Fe[3]		247,104	247,639	249,959	250,874	249,737
Iron ore, Fe content[3]		134,809	136,000	137,000	138,000	137,000
Agglomerated products:[4]						
Sinter		151,000	[r][3]151,000	[3]154,466	[3]154,000	154,000
Pellets		63,100	[r][3]65,400	66,476	[3]67,500	67,500

See footnotes at end of table.

TABLE 1—Continued

U.S.S.R.: ESTIMATED[1] PRODUCTION OF MINERAL COMMODITIES[2]

(Thousand metric tons unless otherwise specified)

COMMODITY		1984	1985	1986	1987	1988
METALS—Continued						
Iron and steel—Continued						
Metal:						
Pig iron and blast-furnace ferroalloys:						
Pig iron for steelmaking[3]		103,469	102,840	105,881	106,026	107,008
Foundry pig iron[4]		6,800	6,500	[3]7,200	[3]7,200	6,900
Spiegeleisen[5]		[r]20	[3]19	[3]20	[3]19	20
Ferromanganese[5]		550	[3]574	601	[3]593	600
Ferrophosphorous		26	[3]26	[3]26	[3]25	25
Total[3,6]		**110,893**	**109,977**	**113,840**	**113,877**	**114,558**
Electric-furnace ferroalloys		2,300	2,300	2,400	2,500	2,600
Crude steel[3]		154,238	154,668	160,550	161,887	163,037
Rolled steel[3]		107,299	108,274	111,996	114,081	115,958
Semimanufactures:						
Wire rods[3]		8,400	8,836	8,715	8,800	9,000
Pipe stock[3]		6,400	5,586	6,565	6,878	7,000
Tubes from ingots[3]		1,931	1,930	1,963	1,929	1,947
Selected end products:						
Total pipes and tubes[3]		**18,883**	**19,354**	**19,817**	**20,346**	**20,840**
Cold-rolled sheet[3]		[e]10,000	10,203	10,516	10,795	11,214
Lead:						
Mine output, recoverable Pb content		440	440	440	440	440
Metal, smelter:						
Primary		[r]480	[r]485	[r]485	[r]475	447
Secondary		260	265	270	275	280
Magnesium metal, including secondary		85	87	89	90	91
Manganese concentrate:[3]						
Gross weight		10,089	9,900	9,300	9,400	9,200
Mn content		2,994	2,900	2,800	2,800	2,700
Mercury metal, including secondary 76-pound flasks		64,000	65,000	66,000	67,000	67,000
Molybdenum, mine output, Mo content	tons	11,200	11,300	11,400	11,500	11,500
Nickel:						
Mine output, Ni content		175	[r]185	[r]195	[r]205	215
Metal, smelter		[r]185	[r]200	[r]210	[r]220	234
Platinum-group metals, mine output, Pt content	thousand troy ounces	3,700	3,800	[r]3,900	[r]4,000	4,100
Silver metal including secondary	do.	47,400	47,900	48,200	[r]48,500	49,000
Tin:						
Mine output, recoverable Sn content	tons	12,000	13,500	14,500	16,000	16,000
Metal, smelter:						
Primary	do.	14,000	16,000	16,000	[r]18,500	18,500
Secondary	do.	3,600	3,700	3,800	4,000	4,000
Total	**do.**	**17,600**	**19,700**	**19,800**	**[r]22,500**	**22,500**

See footnotes at end of table.

TABLE 1—Continued

U.S.S.R.: ESTIMATED[1] PRODUCTION OF MINERAL COMMODITIES[2]

(Thousand metric tons unless otherwise specified)

COMMODITY		1984	1985	1986	1987	1988
METALS—Continued						
Titanium:						
Concentrates:						
Ilmenite	tons	440,000	445,000	450,000	455,000	460,000
Rutile	do.	10,000	10,000	10,000	10,000	10,000
Metal	do.	41,500	43,000	43,500	[r]44,000	46,000
Tungsten concentrate, W content	do.	9,100	9,200	9,200	9,200	9,200
Vanadium metal	do.	9,500	9,500	9,600	9,600	9,600
Zinc:						
Mine output, recoverable Zn content		810	810	810	810	810
Metal:						
Primary		900	900	900	[r]910	848
Secondary		95	100	105	110	115
Zirconium metal		80	85	85	90	90
INDUSTRIAL MINERALS						
Asbestos, grades I–VII		2,500	2,500	2,400	[r,3]2,552	2,600
Barite		530	540	540	540	540
Boron minerals and compounds:						
Gross weight		200	200	200	200	200
B_2O_3 content		40	40	40	40	40
Bromine		70	70	65	65	65
Cement, hydraulic[3]		129,866	130,722	135,119	137,404	139,499
Clays: Kaolin including china clay		[r]2,000	[r]2,000	[r]2,000	[r]2,000	[r]2,000
Corundum, natural	tons	8,700	8,700	8,700	8,700	8,700
Diamond:						
Gem[7]	thousand carats	4,300	4,400	4,400	4,400	4,500
Industrial	do.	6,400	6,400	6,400	6,400	6,500
Total	**do.**	**10,700**	**10,800**	**10,800**	**10,800**	**11,000**
Diatomite		240	245	250	255	260
Feldspar		330	[r]330	[r]330	[r]330	330
Fluorspar, ore		[r]1,400	[r]1,400	[r,3]1,400	[r]1,400	1,400
Fluorspar, concentrate (55% to 96.4% CaF_2)	tons	[r]410,500	[r]410,500	[r,3]410,500	[r]410,500	410,500
Graphite		80	82	[r]84	84	84
Gypsum		4,200	[3]4,223	[3]4,599	[3]4,781	4,800
Iodine	tons	2,000	2,000	2,000	2,000	2,000
Lime, dead-burned[3]		29,500	29,200	30,122	30,121	30,100
Lithium minerals, not further specified		55	55	55	55	55
Magnesite:						
Crude		4,400	4,400	4,300	4,300	4,200
Marketable product		[r]2,000	[r]1,975	[r]1,925	1,875	1,825
Mica		49	50	50	50	50
Nitrogen: N content of ammonia		[r]17,700	[r]18,300	[r]19,600	[r]20,000	20,100

See footnotes at end of table.

TABLE 1—Continued

U.S.S.R.: ESTIMATED[1] PRODUCTION OF MINERAL COMMODITIES[2]

(Thousand metric tons unless otherwise specified)

COMMODITY	1984	1985	1986	1987	1988
INDUSTRIAL MINERALS—Continued					
Perlite	600	600	600	600	600
Phosphate rock:					
Crude ore:					
Apatite, 15% P_2O_5	55,000	62,000	62,000	65,000	67,000
Sedimentary rock	26,400	26,400	26,400	26,600	27,000
Total	**81,400**	**88,400**	**88,400**	**91,600**	**94,000**
Concentrate:					
Apatite, 37% to 39.6% P_2O_5	20,100	[3]20,555	20,700	20,800	20,700
Sedimentary rock, 19% to 30% P_2O_5	13,200	13,200	13,200	13,300	13,500
Total	**33,300**	**33,755**	**33,900**	**34,100**	**34,300**
Potash:					
Ore, gross weight	[r]66,000	[r]66,000	[r]63,000	69,000	68,000
K_2O equivalent[3]	9,776	10,367	10,228	10,888	11,301
Pyrite, gross weight	6,100	[3]5,543	[3]4,769	[3]4,893	4,900
Salt, all types[3]	16,500	16,100	15,300	15,400	14,800
Sodium compounds, n.e.s.:					
Carbonate[3]	5,116	[8]4,916	[8]5,032	[r 8]5,051	[8]4,989
Sulfate:					
Natural	360	360	360	360	375
Manufactured	250	260	260	260	270
Sulfur:					
Frasch	900	[r]900	1,100	1,100	1,100
Other native	1,800	1,800	1,900	1,900	1,900
S content of pyrite[9]	2,650	2,421	2,090	2,150	2,150
Byproduct:					
Of metallurgy	1,700	1,700	1,700	1,650	1,700
Of natural gas[3]	[e]1,850	1,974	1,618	2,397	3,288
Of petroleum	350	350	400	450	450
Total	**9,250**	**[r]9,145**	**[r]8,808**	**[r]9,647**	**10,588**
Sulfuric acid[3]	25,338	26,037	27,847	28,531	29,372
Talc	520	520	520	530	530
MINERAL FUELS AND RELATED MATERIALS					
Coal:					
Anthracite	71,000	[r 3]71,300	[r 3]71,400	[3]71,500	71,500
Bituminous	485,500	[r]497,700	[r]516,600	523,500	528,500
Lignite and brown coal[3]	155,800	157,000	163,000	165,000	172,000
Total coal[3 10]	**712,300**	**726,000**	**[r]751,000**	**760,000**	**772,000**
Coke: Coke oven, beehive, breeze, gas coke[3]	[e r]81,000	[r]81,261	[r]83,135	83,038	81,916
Fuel briquets [3]	[r]5,400	4,900	4,900	5,000	6,200

See footnotes at end of table.

TABLE 1—Continued

U.S.S.R.: ESTIMATED[1] PRODUCTION OF MINERAL COMMODITIES[2]

(Thousand metric tons unless otherwise specified)

COMMODITY		1984	1985	1986	1987	1988
MINERAL FUELS AND RELATED MATERIALS—Continued						
Gas, natural, marketed:						
As reported[3]	million cubic meters	587,400	643,000	686,000	727,000	770,000
Converted	million cubic feet	20,700,000	22,700,000	24,200,000	25,700,000	27,200,000
Oil shale[3]		33,204	32,076	30,099	30,081	28,000
Peat:						
Agricultural use		155,000	155,000	160,000	160,000	160,000
Fuel use[3]		17,500	16,000	19,500	11,400	17,500
Petroleum:						
Crude:						
As reported, gravimetric units[3]		612,710	595,291	614,753	624,177	624,323
Converted, volumetric units	thousand 42-gallon barrels	4,500,000	4,380,000	4,520,000	4,590,000	4,590,000
Refinery products[11]		460,390	447,975	461,334	r472,053	475,000

e Estimated. r Revised.
[1] Production estimated unless otherwise specified.
[2] Includes data available through Dec. 19, 1989.
[3] Reported in Soviet sources.
[4] Reported in United Nations sources.
[5] Estimate based on total of spiegeleisen and blast-furnace ferromanganese reported by United Nations sources.
[6] Data may not add to total shown because not all items comprising total are listed.
[7] Series changed in 1984 to include near gem and cheap gem quality.
[8] Reported series changed to exclude potash. It is assumed that the Soviet series for soda ash published prior to 1984 contained a small percentage of potash.
[9] Pyrite series derived from reported Soviet data for pyrite production in gross weight.
[10] Run-of-mine coal.
[11] Not distributed by type and therefore not suitable for conversion to volumetric units. Data apparently include all energy and nonenergy products but exclude losses.

U.S.S.R. At the Soviet Export Goods Exhibition that opened in New York in December, the Soviet exhibit contained mining equipment and technology for export including loading machines, self-propelled rotary-drilling rigs, hydraulic excavators, and semicontinuous casting technologies for light alloys.

The European Community (EC) and the CMEA formally recognized each other in a joint declaration on June 24. According to a Soviet official, the declaration was intended to open the way to broad economic and scientific cooperation among the European nations. The establishment of relations between the EC and CMEA would permit relations between the CMEA and EC organizations as well as individual CMEA countries with the EC. In November, the first consultations were held between delegations from the U.S.S.R. and the EC for working out an agreement to establish business cooperation between the U.S.S.R. and EC.

COMMODITY REVIEW

Metals

Aluminum.—In 1988, attention was focused on environmental pollution caused by aluminum plants. Reportedly, at the Krasnoyarsk aluminum plant in East Siberia, the air was considered dangerous to breathe for a radius of 20 kilometers around the plant. At the Bratsk, Irkutsk, and Novokuznetsk aluminum plants in Siberia, serious pollution problems were also reported, as well as at the Sumgait aluminum plant in Azerbaidzhan.[24]

In 1988, the French firm Pechiney entered into a joint-venture agreement to renovate and expand the Kanaker aluminum products plant, in Armenia, which produced foil, wire, and other fabricated products. In 1984, Kanaker ceased production of primary aluminum owing to environmental problems in the nearby city of Yerevan. A Pechiney subsidiary, Cebal, and a group of banks led by Credit Lyonnais would provide 25% of the investment, including new equipment and technical assistance, and the Soviets would provide the remaining 75%. Cebal would be allowed to export 19% of the plant output by 1995. Pechiney's chairman stated that the aim of the renovation was to triple the plant's current output of 23,000 tons per year in 3 years.

The Australian aluminum producer Comalco Ltd. signed an agreement with the U.S.S.R. Ministry of Nonferrous Metallurgy to conduct a feasibility study for constructing an aluminum smelter and refinery on the east coast of the U.S.S.R. The smelter and refinery under consideration would process 2 million tons per year of bauxite for producing 1 million tons per year of alumina and 500,000 tons per year of aluminum. The bauxite would come from the Weipa operations of Comalco in north Queensland, and it was expected that Comalco would receive aluminum as repayment. Comalco was awaiting the results of the feasibility study before deciding whether to proceed with the project.

The Swiss aluminum firm, Alusuisse S.A., received the right to sublicense the basic patents of a Soviet group of inventors for the method and equipment of continuous and semicontinuous aluminum magnetic casting, which was designed to improve product quality and reduce metal losses. Alusuisse developed its own technology of aluminum alloy electromagnetic casting on the basis of the Soviet license.

Cadmium.—The U.S.S.R. was preparing to establish its own nickel-cadmium battery-production industry, having acquired the requisite technology from Société d' Accumulateurs Fixas et de Traction of France. The U.S.S.R. was considered to be a potentially large consumer of these batteries, which are able to withstand extremes of temperature and could be used in sectors such as the railroad system.

Chromium.—The U.S.S.R. was engaged in a significant expansion of chrome ore production capacity with the development of the 2-million-ton-per-year capacity Molodezhnaya underground mine. Chrome ore production

TABLE 2

U.S.S.R.: MINERAL TRADE WITH THE UNITED STATES IN 1988

Commodity		Quantity (metric tons unless otherwise specified)	Value (dollars)
U.S. exports:			
Aluminum oxide—alumina		1	2,000
Chromic acid		94	276,950
Iron oxide and hydroxide		100	60,198
Manganese oxides except pigment grade		118	97,980
Platinum metal—not rolled, including alloy, other	kilograms	62	602,000
Iron and steel:			
Angles, sections, shapes, etc.	do.	227	2,248
Turnplate		15,565	9,588,027
Wire of iron or steel		1	6,804
Iron and steel pipes, tubes, blanks		18,796	15,364,292
Pipe and tube fittings of iron or steel	kilograms	14	2,687
Other, iron and steel	do.	3,629	5,487
Abrasives, refined, other	do.	1,996	4,224
Abrasives, wheels, other	do.	801	4,200
Asbestos gaskets		329	500,000
Asbestos packing and seals		125	470,500
Carbon black		33	363,904
Articles of carbon or graphite, other		NA	51,250
Granite and articles of granite, NSPF		NA	4,500
Graphite electrodes		5,661	11,918,146
Sodium carbonate, calcined—soda ash		1,082	190,800
Petroleum refinery products:			
Distillate fuel oils, heavy type	barrels	25,007	447,300
Aviation engine lubricating oil	do.	225,927	11,761,443
Automotive diesel marine engine lubricating oil	do.	2,539	89,900
Lubricating oils, NSPF except WHT MIN	do.	29,060	1,221,172
White mineral oils, except medium grade	do.	47,765	4,536,227
Insulating or transformer oils	do.	604,639	24,002,247
Quenching or cutting oils	do.	716	50,085
Petroleum asphalt		101	59,000
Petroleum coke, calcined		78,476	9,675,765
Mixtures of hydrocarbons, NSPF from petroleum		NA	531,018
U.S. imports:			
Aluminum unwrought not alloyed		267	485,376
Aluminum waste and scrap		16,877	29,118,002
Calcium metal, unwrought, waste and scrap		221	743,281
Chrome oxide no more than 40%		13,016	592,756
Chrome oxide, 40% or more		5,000	392,000
Copper sulfate		1,557	852,397

See footnotes at end of table.

TABLE 2—Continued

U.S.S.R.: MINERAL TRADE WITH THE UNITED STATES IN 1988

Commodity		Quantity (metric tons unless otherwise specified)	Value (dollars)
U.S. imports—Continued			
Gold bullion, refined, Au content	kilograms	26	385,647
Iron and steel:			
Ferrosilicon, 30% to 60% Si over 2% Mg		11,605	5,759,049
Ferrosilicon, 30% to 60% Si, other		12,519	6,221,424
Iron and steel ingots, blooms, billets, slabs		42,709	6,946,269
Platinum group metals:			
Platinum grains and nuggets, Pt content	kilograms	76	1,218,504
Platinum (sponge), Pt content	do.	1,115	15,001,753
Palladium, unwrought, Pd content	do.	7,836	31,540,898
Rhodium, unwrought, Rh content	do.	1,183	45,769,611
Platinum, semimanufactured, Pt content	do.	298	4,923,535
Palladium, semimanufactured, Pd content	do.	3,457	14,230,118
Rhodium, semimanufactured, Rh content	do.	140	1,258,837
Rare-earth oxide except cerium oxide	do.	13,822	850,075
Rare-earth metals including scandium and yttrium	do.	403	59,765
Silver dore, refined, Ag content	do.	1,747	686,373
Zirconium, unwrought other than alloy		31	317,761
Abrasives, natural and artificial, other	kilograms	18	20,550
Ammonia, anhydrous		855,625	63,263,357
Barium carbonate-natural (witherite) ground		15	17,590
Diamond, precious and semiprecious stones:			
Rough or uncut diamonds, natural	carats	149	291,000
Diamonds not over 1/2 carat	do.	12	3,891
Industrial diamond powder or dust, natural	do.	3,264,874	1,294,110
Industrial diamond powder or dust, synthetic	do.	430,000	114,400
Rubies	do.	65	1,369
Sapphires	do.	90	1,176
Other precious or semiprecious stones natural		NA	27,131
Precious stones NSPF		NA	3,500
Other precious or semiprecious stones, cut but not set		NA	6,357
Semiprecious stones and articles of such stones		NA	2,769
Synthetic materials of gemstone quality carats		7,800	3,900
Potassium chloride or muriate of potash		276,622	24,183,107
Pigments containing carbon black		73	119,265
Quartzite		4	7,007
Sulfur ore		710	42,933
Petroleum and refinery products:			
Crude petroleum under 25° gravity	barrels	1,131,969	10,236,568

See footnotes at end of table.

was increasing with the commissioning of capacity at Molodezhnaya. Chrome ore exports were also increasing, and the U.S.S.R., reportedly, increased chrome exports by more than 20% in 1988.

The Donskoy chrome ore mining and beneficiation complex in Kazakhstan produced more than 95% of the country's chrome ore. Open pit mining was centered at four pits, the Yuzhniy, 40 Years of the Kazakh S.S.R., Ob'yedinyennyy, and Mirnyy. Extraction had stopped at at least 13 other open pits because of depleted reserves.[25]

Owing to the depletion of ore in the open pits, there was intensive development of the Molodezhnaya underground mine, exploiting the deeper part of the 40 Years of the Kazakh S.S.R. deposit. In 1987, Molodezhnaya produced 1 million tons of ore; 300,000 tons per year of capacity was being developed in 1988. Molodezhnaya was being developed in two stages. The first stage, commissioned in 1982, had a design capacity of 800,000 tons per year of chrome ore, and total capacity was planned at 2 million tons per year. Molodezhnaya was the first large underground mine in the U.S.S.R. for chrome ore extraction.

In addition, the depletion of rich chrome ore in the open pits necessitated increasing capacity for ore beneficiation. The average chromic oxide content in crude ore decreased from 51.8% in 1976 to 47.1% in 1987, and the depth of open pit mining increased during this period from 82 to 140 meters. The percentage of ore extracted by underground mining at Donskoy was increasing rapidly with plans calling for it to increase from 26% in 1987 to 36% in 1988.[26]

Problems were occurring in assimilating capacity at the new No. 2 crushing-beneficiation plant at Donskoy, the first stage of which went into operation in 1987 with a design capacity of 600,000 tons per year. The No. 1 crushing-beneficiation plant had increased its capacity from 575,000 tons per year of concentrate to 615,000 tons

TABLE 2—Continued

U.S.S.R.: MINERAL TRADE WITH THE UNITED STATES IN 1988

Commodity		Quantity (metric tons unless otherwise specified)	Value (dollars)
U.S. imports—Continued			
Petroleum and refinery products—Continued			
Gasoline, unleaded	barrels	390,399	7,702,114
Motor fuel, NES	do.	380	5,231
Fuel oil:			
Under 25° API, No. 4-type fuel oil	do.	708,854	7,309,820
Under 25° API, heavy fuel oil	do.	4,187,255	43,008,889
Over 25° API, light fuel oil	do.	6,907,574	121,832,278
Over 25° API, heavy fuel oil	do.	121,180	1,936,464

NA Not available.

TABLE 3

U.S.S.R.: ESTIMATED PRODUCTION, TRADE, AND CONSUMPTION OF MINERAL COMMODITIES IN 1988

(Thousand metric tons unless otherwise specified)

Commodity		Production	Exports	Imports	Apparent[1] consumption
METALS					
Aluminum:					
Bauxite		4,600	—	5,000	9,600
Nepheline concentrate		1,670	—	—	1,670
Alunite		625	—	—	625
Alumina		4,600	—	1,000	5,600
Metal:					
Unwrought and semimanufactured		2,500	700	—	1,800
Secondary		425	25	—	400
Antimony	metric tons	9,600	400	—	9,200
Arsenic, white (As_2O_3)	do.	8,100	(2)	—	8,100
Beryllium, 10% to 20% BeO	do.	2,000	(2)	(2)	2,000
Bismuth	do.	85	(2)	200	285
Cadmium	do.	3,000	100	—	2,900
Chrome ore		3,700	[3]632	—	3,068
Cobalt	tons	3,000	—	2,400	5,400
Copper:					
Mine output, Cu content		640	(2)	160	800
Unwrought, unalloyed, semimanufactured		800	200	(2)	600
Secondary		150	7	(2)	143
Gold	thousand troy ounces	9,000	9,650	—	(4)

See footnotes at end of table.

in 1986, and plans called for its capacity to be eventually increased to 1 million tons per year of concentrate.

The Donskoy complex contained 97% of the country's explored chrome reserves and 100% of the reserves of rich ore. The major portion of extracted ore was high quality with an average chromic oxide content of between 40% and 60%. Owing to the concentration of practically all of the chrome ore reserves in one location, it was declared necessary to improve the distribution of chrome ore reserves.[27]

As can be seen from table 6, mining conditions were significantly worsening at Donskoy as the percentage of crude chrome ore to total mined material decreased from 58.4% in the 1938–40 period to only 6.9% during the 1986–90 period. This resulted in more than 90% of the material mined in chrome ore extraction being sent to dumps. It was foreseen that all mining at Donskoy would eventually be underground. Exploitation of the Molodezhanaya underground mine began in 1982 and development was proceeding of the Tsentral'naya underground mine, with a projected capacity of 5 million tons per year of chrome ore. Tsentral'naya was scheduled for commissioning in 1991. Ore from the Molodezhnaya Mine was being sent to a crushing-sorting plant and to a beneficiation plant. Commercial ore from the crushing-sorting plant had an average chromic oxide content of 46.2%, and the concentrate produced from the beneficiation plant had an average chromic oxide content of 51%.

In conjunction with increasing chrome ore production, the Soviet Union also appeared to be planning to increase ferrochrome production. It had been contacting Japanese and European firms regarding the purchase of plant and production equipment. Also, plans called for substituting chrome plate production for tin plate because tin was in short supply. A pilot plant with a total annual capacity of 150,000 tons of chrome plate had been con-

TABLE 3—Continued

U.S.S.R.: ESTIMATED PRODUCTION, TRADE, AND CONSUMPTION OF MINERAL COMMODITIES IN 1988

(Thousand metric tons unless otherwise specified)

Commodity		Production	Exports	Imports	Apparent[1] consumption
METALS—Continued					
Iron and steel:					
Iron ore		[3]249,737	[3,5]43,063	(2)	206,674
Pig Iron and blast furnace ferroalloys		[3]114,558	[3]6,141	[3]29	108,446
Steel:					
Crude		[3]163,037	(2)	(2)	163,037
Rolled		[3]115,958	[3]8,517	[3]5,261	112,702
Pipes		[3]20,840	[3]397	[3]4,743	25,186
Electric furnace ferroalloys		2,600	[3]850	[3]29	1,779
Lead:					
Mine output, Pb content		440	—	[3]7	447
Primary		447	[3]12	[3]25	460
Secondary		280	10	—	270
Magnesium metal		91	2	(2)	89
Manganese concentrate		9,100	[3]982	500	8,618
Mercury	76-pound flasks	67,000	2,500	—	64,500
Molybdenum	tons	11,500	(2)	1,200	12,700
Nickel:					
Mine output, Ni content		215	—	19	234
Smelter		234	70	—	164
Platinum-group metals	thousand troy ounces	4,000	2,100	—	1,900
Silver	do.	48,400	—	1,500	49,900
Tin:					
Mine output, Sn content	tons	16,000	—	2,500	18,500
Primary	do.	18,500	—	10,000	28,500
Secondary	do.	4,000	—	—	4,000
Titanium metal	do.	46,000	6,000	—	40,000
Tungsten	do.	9,200	(2)	7,200	16,400
Zinc:					
Mine output, Zn content		810	—	[3]38	848
Primary		848	[3]28	[3]54	874
Secondary		115	—	—	115
INDUSTRIAL MINERALS					
Asbestos		2,600	400	(2)	2,200
Barite		540	—	400	940
Cement		[3]139,499	[3]2,223	[3]1,083	138,359
Clays		3,000	(2)	(2)	3,000

See footnotes at end of table.

structed at the Lys'venskiy metallurgical plant in the Ukraine, a plant which also produced tin plate.

Copper.—In Kazakhstan, which contains about one-half of the country's copper reserves and produced about one-third of the country's copper, the following developments were reported. At the Dzhezkazgan mining and metallurgical complex, an effort was being made to maintain output despite a sharp slowdown in mine development and a continuing decrease in the copper content of the ore, necessitating extracting ever larger quantities of ore. Dzhezhazgan consisted of three underground mining directorates, an open pit mining directorate with two large open pits, three beneficiation plants, copper smelting and refining plants, a scientific research institute, and a whole series of auxiliary shops. Approximately 80% of the ore at Dzhezkazgan was extracted from underground mines. In 1988, the Dzhezkazgan geological exploration expedition began preliminary exploration of the new Zhamanaybadskoye copper deposit. The ore is as deep as 700 meters, but the copper content of that ore is two to three times higher than that being extracted.[28]

At the Balkhash copper production association in Kazakhstan, a full-cycle copper production complex, there was a 25% decrease in output from 1979 to 1985.[29] Balkhash failed for more than a decade to meet its goals for copper production.[30] In an effort to meet its output targets "at any cost," Balkhash was receiving ore and blister and anode copper from other enterprises. At the same time, it was shipping its copper concentrate to other enterprises, a practice which was considered highly uneconomic.[31]

Balkhash consisted of three mining directorates, the Kounrad, Sayansk, and Vostochno-Kounrad. The majority of reserves at the Kounrad directorate, which administered the Kounrad open pit, were depleted. However, considerable reserves were reported below the

TABLE 3—Continued

U.S.S.R.: ESTIMATED PRODUCTION, TRADE, AND CONSUMPTION OF MINERAL COMMODITIES IN 1988

(Thousand metric tons unless otherwise specified)

Commodity		Production	Exports	Imports	Apparent[1] consumption
INDUSTRIAL MINERALS—Continued					
Diamond:					
Gem	thousand carats	4,400	3,500	(2)	900
Industrial stones	do.	6,500	700	(2)	5,800
Diatomite		260	(2)	(2)	260
Feldspar		330	—	20	350
Fertilizer materials:					
Nitrogen: N content		21,000	5,000	(2)	16,000
Phosphate rock		34,300	3,200	—	31,100
Potash, K_2O equivalent		[3]11,300	[3]2,409	—	8,891
Fluorspar	tons	410,500	—	850,000	1,260,500
Graphite		84	(2)	(2)	84
Gypsum		4,800	20	(2)	4,780
Lime, dead-burned		30,100	150	(2)	29,950
Magnesite, marketable		1,825	7	710	2,528
Mica		50	—	5	55
Perlite		600	110	—	490
Salt, all types		[3]14,800	[3]345	(2)	14,455
Sulfur, all types		10,588	150	800	11,238
Sulfuric acid		[3]29,372	[3]308	100	29,164
Talc		530	1	1	530
MINERAL FUELS AND RELATED MATERIALS					
Coal:					
Anthracite and bituminous		[3]600,000	[3]39,385	[3]11,900	572,515
Lignite and brown coal		[3]172,000	(2)	(2)	172,000
Coke		84,000	[3]2,315	[3]1,800	83,485
Gas, natural	million cubic meters	[3]770,000	88,000	[3]1,043	683,403
Oil shale		28,000	—	—	28,000
Peat:					
Agricultural		160,000	150	—	159,850
Fuel use		17,500	—	—	17,500
Petroleum:					
Crude		[3]624,323	[3]144,196	[3]19,845	499,972
Refinery products		475,000	[3]60,993	[3]1,912	415,919

[1] Includes amount available for consumption and stockpiling based on 1986 production and trade, and excludes consumption from stockpiles from previous years.
[2] Less than 1/2 unit.
[3] Reported in Soviet sources.
[4] Exports equaled or exceeded production.
[5] Includes concentrates and pellets.

design level of the open pit, and these could be used to extend the working period of the pit. Kounrad was maintaining production by mining ore previously classified as uneconomic and by leaching material in dumps. Plans were being formulated to deepen the open pit.

At the Vostochno-Kounrad mining directorate, which extracted molybdenum ore, the majority of economic reserves were depleted, and mining had begun of adjacent noneconomic reserves. Reserves were also being depleted at the Sayansk mining directorate consisting of the Sayak 1, Tatsau, and Sayak 3 open pits.

Plans calling for renovating the Kounrad and Sayansk mining directorates envisaged extending their working period to the year 2000, but levels of

TABLE 4

U.S.S.R.: ESTIMATED NET EXPORTS OF SELECTED MINERALS AND METALS AS A PERCENT OF CONSUMPTION IN 1988[1]

Commodity	Percent of consumption
Aluminum	33
Asbestos	18
Chromium ore	21
Diamond, gem	400
Gas, natural	13
Gold	(2)
Iron ore and concentrate	21
Nickel	31
Nitrogen	31
Perlite	22
Petroleum:	
Crude	25
Refinery products	14
Platinum-group metals	111
Potash	27
Titanium metal	15

[1] Selection made from commodities for which exports make up 5% or more of consumption. Includes consumption of secondary metal.
[2] Exports equaled or exceeded production.

TABLE 5

U.S.S.R.: ESTIMATED NET IMPORT RELIANCE OF SELECTED MINERALS AND METALS AS A PERCENT OF CONSUMPTION IN 1988[1]

Commodity	Percent of consumption	Principal sources
Barite	43	Bulgaria, North Korea, Turkey.
Bauxite and Alumina	60	Greece, Guinea, Hungary, India, Italy, Jamaica, Japan, Yugoslavia.
Bismuth	70	NA.
Cobalt	44	Cuba, Zaire.
Fluorspar	67	Mongolia.
Iron and steel, high-quality products	7	Austria, Belgium-Luxembourg, France, West Germany, Italy, Japan, Spain.
Magnesite, marketable	28	North Korea.
Mica	9	India.
Molybdenum	9	Mongolia.
Sulfur	6	Poland.
Tin	38	Indonesia, Malaysia, Singapore, United Kingdom.
Tungsten	43	China, Mongolia, North Korea.
Zinc	6	Bulgaria, Finland, Italy, Peru, Poland, Spain, Sweden.

NA Not available.
[1] Includes consumption of secondary metal.

output could be sustained only until 1993 owing to decreasing ore grades.[32] To relieve shortages of raw material, Balkhash would be supplemented by raw material from the Boshchekul' mining and beneficiation complex scheduled for commissioning in 1993. Later plans called for Balkhash to be supplemented by raw material from the Aktogay mining and beneficiation complex. Development was slated to begin at the Aktogay deposit in 1991, and production was to begin in the year 2000.[33]

The Noril'sk mining and metallurgical complex in Krasnoyarsk Kray, East Siberia, significantly increased copper production in recent years. The complex reported a 50% increase in copper production during the 1981-84 period.[34] During a visit to Krasnoyarsk Kray in September, General Secretary Gorbachev stated that the Krasnoyarsk region where Noril'sk was the only copper producing enterprise produced one-third of the country's copper output, although he did not specify if this was copper in ore or metal.[35]

At the Zangezur copper-molybdenum complex in Armenia, tests began of the recently commissioned conveyor belt from the open pit to the flotation plant. The commissioning of the conveyor belt, which freed about 200 workers from heavy labor, completed the renovation of this enterprise.[36]

Regarding cooperation with other countries, Finland's Nokia Corp. concluded talks for establishing a joint-venture copper-wire production plant near Moscow. The joint venture, named Elkat, would be designed to produce 100,000 tons per year of copper wire, and commissioning was planned for 1991. According to an agreement signed by the Soviet Union and Afghanistan in September, the U.S.S.R. was to assist Afghanistan in completing a feasibility study for developing a copper deposit, including designing and constructing a beneficiation plant.[37]

In an adverse action, in July, the Commission of the European Commu-

TABLE 6

CRUDE CHROME ORE PRODUCTION AT THE DONSKOY MINING AND BENEFICIATION COMPLEX

Year	Extracted crude ore (thousand (metric tons)	Percent of Cr_2O_3 in crude ore	Crude ore as a percent of total material mined
1938–40	264	54.5	58.4
1941–45	1,288	53.5	42.3
1946–50	2,447	53.2	27.2
1951–55	2,496	52.2	23.8
1956–60	5,584	52.5	20.0
1961–65	11,696	50.3	24.4
1966–70	15,375	50.3	18.9
1971–75	17,348	51.8	14.8
1976–80	16,002	49.1	10.7
1981–85	16,985	48.2	10.2
1986–90[1]	13,711	46.9	6.9

[1] Projected for 1988-90.

Source: Gornyy Zhurnal (Mining Journal) (Moscow). No. 6, June 1988, p. 19.

TABLE 7

ANNUAL OPEN PIT AND UNDERGROUND CRUDE CHROME ORE EXTRACTION AT THE DONSKOY MINING AND BENEFICIATION COMPLEX

(Thousand metric tons)

Year	Open pit extraction quantity	Underground extraction quantity	Total quantity
1981	3,056	—	3,056
1982	3,327	—	3,327
1983	3,311	114	3,425
1984	3,182	267	3,449
1985	3,266	435	3,701
1986	3,197	733	3,930

Source: Gornyy Zhurnal (Mining Journal) (Moscow). No. 6, June 1988, p. 18.

nity imposed a provisional antidumping duty on imports of copper sulfate originating in Bulgaria and the U.S.S.R. The duty for the U.S.S.R. was 20% of the net price per ton free at Community frontier before duty.

Ferroalloys.—Ferroalloy production increased greatly in a period of one and one-half decades. From 1970 to 1985, approximately 30 electric furnaces were commissioned at the Chelyabinsk, Nikopol', Yermak, and Zestafoni complexes. Also, renovation of ferroalloy production capacity occurred at the Cherepovets, Kuznetsk, Stakhanovskiy, and Zaporozh'ye plants. However, ferroalloy production capacity exceeded the expansion of the raw material base, particularly for manganese. Although the U.S.S.R. was the world leader in the production of ferroalloys, it was deficient in the production of specialized ferroalloys. For the 1986-90 period, plans called for stabilizing output of ferroalloys while concentrating on production of specialized ferroalloys such as calcium-silicon, medium carbon ferromanganese, and high-purity ferrosilicon. During the 1986-87 period, reportedly, there was a 250,000 ton increase in ferroalloy production.[38]

Gallium.—In June, it was announced that the Pavlodar alumina plant in Kazakhstan began gallium production.[39] In a project that would involve large amounts of gallium, scientists from the Soviet Union and the United States were scheduled to begin a joint experiment 2½ miles inside the Andyrchi Mountain in the Caucasus Mountain Range. The scientists planned to search for a class of low-energy neutrinos that were thought to be produced when hydrogen fuses into helium, a process that was thought to account for most of the sun's power. The neutrino detector would use 70 tons of gallium, 55 tons of which would be sent to the site by the Soviets and 15 tons of which were estimated to be in the heart of the mountain. Annual world production of gallium was estimated at only about 30 tons. The observations would begin as soon as 30 tons of gallium were in place, and startup was expected in the fall. Also, a similar European experiment was scheduled for late 1989 in Italy's Grand Sasso tunnel, west of Rome, using 30 tons of gallium. In the Soviet-U.S. experiment, for which the U.S.S.R. was providing the gallium, the compound gallium chloride, which makes the most easily analyzed neutrino detector, would not be used. The Soviets, instead, would supply pure gallium because they apparently wanted to maintain easy access to this metal.

Gold.—In 1988, gold-producing enterprises were removed from the control of the Ministry of Nonferrous Metals and formed into the new Main Diamond and Gold Directorate (Glavalmazzoloto) not subordinate to any ministry but directly subordinate to the Council of Ministries. The new Directorate controlled all mining, metal processing, secondary production, and jewelry production, and was empowered to engage in foreign trade in jewelry. However, all foreign trade in gold bullion was still channeled through the Vneshekonombank. Also included in the new Directorate were 164 gold-mining artels, which were profit-seeking mining enterprises, and were operated similar to private enterprises in many ways.

Much concern had been expressed in the Soviet press during the past 2 years about the activity of the gold-mining artels which produced one-third of the country's gold.[40] Complaints were raised that the artels were involved in crimes and corruption, and more than 200 officials and workers were convicted of crimes in the operation of artels including theft of gold. Nevertheless, it was also recognized that, despite accusations of environmentally destructive practices, wasteful mining practices, and violations of labor standards,[41] the artels mined the same amount of gold three to four times as cheaply as state enterprises. The artels also provided much better use and maintenance of equipment and had far higher labor productivity.[42]

In Uzbekistan in Soviet Central Asia, plans for the 1991-95 period called for constructing a new gold extraction plant and developing a new gold mine in Tashkent Oblast'. The city of Angren was named as the distribution point for the new developments.[43]

Also, an increasing loss of faith in the ruble combined with discussions of inflation, ruble devaluation, and a rumored rise in the domestic price of gold triggered a rush on gold articles in stores. Long lines formed at jewelry stores long before they were opened, and articles with gold disappeared from shelves, resulting in a severe shortage of wedding rings.

With the advent of glasnost, articles appeared in the Soviet press about the lack of necessity for keeping data on the mineral industry secret, including the gold-mining industry. One article specifically entitled "Gold, Problems and Paradoxes of this Precious Metal" in Izvestiya attributed the secrecy on the gold industry to the "cult of secrecy" that formed together with the "cult of personality" during the Stalin era, and claimed that Soviet specialists must turn to Western sources to obtain data on their own country.[44]

Also, with the advent of glasnost, the tragic history of gold-mining development during the Stalin era in the Soviet Far East at Kolyma, where millions of prison laborers died, was discussed in the Soviet press. A letter published in Radyans'ka Ukraina (National Ukraine) described "Of how of every 100 inmates at Kolyma, only 2 or 3 survived . . . For failure to cope with the daily quota to wheel out of the pit 200 to 250 barrows full of gold-bearing ore, the inmates used to be delivered up 'to the mosquitos,' that means stripped and exposed to the stings of blood-thirsty midges, and then sent to the so-called units with aggrevated conditions. It was death that awaited them there. Awful thin soup was served once a day. Dying people, roped, used to be carted along with dead bodies to the pits to die. People were shot dead just for entertainment."[45] Reporting of this type had been occurring for several years. Frankly confronting the past appeared to be part of a healing process deemed necessary for the transformation of Soviet society.

Iron Ore.—Iron ore production was planned to be decreased slightly. Plans called for developing no new additional iron ore mines until the year 2010; rather, production was to be maintained at existing mines, and concentrate quality was to be improved. Priority development was to occur at the Kursk Magnetic Anomaly (KMA), the country's second largest iron ore producing region. It contained about 40% of the country's iron ore reserves and produced about 17% of the country's iron ore.[46] In the Krivoy Rog basin, the country's largest iron ore producing region accounting for more than 40% of the country's output, production had been decreasing and large investments were required to maintain output levels. One method planned to maintain output at Krivoy Rog was to utilize production of oxidized ferruginous quartzites recovered as a byproduct of open pit mining of nonoxidized quartzites and stored in special dumps.[47]

Iron and Steel.—In 1988, production of crude steel increased by less than 1% while production of rolled steel increased 2% and steel pipe 3%. This was in accord with the Soviet program to concentrate on producing more specialty steels and to increase the efficient use of steel rather than striving to increase total steel production. Efforts, however, to modernize steel production were being hampered by delays in constructing minimills; only three were in operation. Delays were experienced in installing continuous casting equipment and plans for the installation for the 1986-90 period were less than 50% accomplished.[48] Despite plans to have continuous casting account for between 80% to 85% of steel production by the year 2000, continuous castings' share of total steel output was still below 20% in 1988.

The share of continuously cast steel was planned to increase from 16.1% in 1987 to 18.2%, although it actually increased to only 16.6% in 1988. Steel produced in oxygen converter furnaces was to increase from 33.6% in 1987 to 37.1% in 1988, and in electric furnaces from 13.4% to 13.6%. In 1988, plans called for increasing output of cold rolled sheets, coated sheets, tin plate, strip for cathode-ray tubes, formed sections, and heat-hardened rolled products. Production of heat-hardened rolled products was planned to increase by 14.6%, rolled products from low alloy steel by 3.4%, and tin plate and sheet by 3.4%

Plans for modernization of the steel industry by the year 2000 included eliminating open-hearth production (which accounted for over 50% of steel production), improving metal quality characteristics by constructing new rolling mills and renovating existing rolling mills, and implementing a broad range plan for environmental pollution control.

Replacement of open-hearth furnaces with oxygen converter furnaces was occurring at two of the country's largest steel plants, the Magnitogorsk and Krivoy Roy plants. At the Magnitogorsk plant, which produced about 16 million tons of steel per year, a 9-million-ton-per-year oxygen converter shop would replace an equal amount of existing open-hearth capacity. At the Krivoy Rog plant, oxygen-converter production would replace all open-hearth production, and there would be a slight decrease in the plant's capacity from 18 million tons per year to 16.5 million tons per year. In addition, expansion of both oxygen converter and electric-furnace capacity was occurring at a large number of other steel plants in the country.

Although the U.S.S.R. was a net importer of primary steel products, in 1988, Soviet steel exports to the United States for the first time reached commercial levels with 23,000 tons of carbon steel arriving in one shipment. The high U.S. duty rate on Soviet steel exports was considered a factor holding back steel exports to the United States.

Tin-plate production in the U.S.S.R. in recent years increased significantly and, in 1988, was about 800,000 tons with the target set to reach 850,000 tons by 1990.[49] Recent expansion of tin-plate production capacity at the Karaganda steel complex had led to a one-third increase in the country's tin-plate output in the past 5 years.

Lead and Zinc.—A large percentage of the country's lead and zinc was mined in the Soviet Central Asian Republic of Kazakhstan, which reportedly produced 60% of the country's lead and 40% of its zinc.[50] These percentages were somewhat lower than those published a decade ago, which reported Kazakhstan's share of lead output as more than 70% and zinc output as about 50%. Plans also called for increasing capacity for lead and zinc production during the 1991-95 period in the Soviet Central Asian Republic of Uzbekistan. It was planned to compensate for the depletion of open pit reserves at Uchkulach by developing an underground mine at the Dalnyy section and also by expanding capacity in the Altyn-Topkan mining region.

Magnesium.—Owing to the commissioning in December 1987 of new capacity at the Ust'-Kamenogorsk titanium-magnesium plant in Kazakhstan, which was one of the country's largest magnesium producers, plans called for magnesium production at Ust'-Kamenogorsk to increase by 4% in 1990 over the 1985 production level.[51] Ust'-Kamenogorsk produced magnesium metal by the electrolysis of magnesium chloride with the raw material, carnallite, which was transported a considerable distance by rail from Soligorsk in the Urals. The carnallite metal yield was low, and, in the past, recommendations had been made that much closer sources of magnesium from brine from salt lakes be used.

Manganese.—Manganese production decreased in 1988. At the Chiatura complex in Georgia, which accounted for more than 20% of the country's output and was the country's main source of high-grade manganese ore, production reportedly decreased by 12%, in comparison with 1987, to 1.839 million tons of manganese concentrate. Nevertheless, the plan target for Chiatura for 1988 was exceeded indicating that the Soviets were accounting in their planning for depleting reserves at Chiatura.[52] Despite the apparent continuation of production problems, reported manganese exports increased by 268,000 tons, a 38% increase, after having fallen by 387,000 tons in 1987.

The decrease in the supply of domestic, high-grade manganese ore adversely affected ferromanganese production. The complaint was raised that the quality of ferromanganese produced was below that of foreign countries owing to its high phosphorus and silicon content and low manganese content. This problem was attributed to inadequate supplies of high-grade manganese ore. The problem of producing manganese ferroalloys of the required quality was, reportedly, the most important and urgent problem facing the ferroalloy industry.[53] To improve production of low phosphorus manganese alloys, it was recommended that ore from the Ushkatyn III deposit under development in Kazakhstan be used more widely. Successful tests were conducted at the Nikopol ferroalloys plant using Ushkatyn concentrates.[54]

Soviet plans to obtain ferromanganese from abroad seemed to have suffered a setback when the Provale project plans to produce substantial quantities of manganese ferroalloys in the Carajas region of northeastern Brazil underwent another major change. In fall 1987, firm agreements appeared to have been reached between the three partners of the Provale project: State-controlled Cia. Vale do Rio Doce, the private Brazilian company Prometal Produtos Metalurgicos S.A. (Prometal), and the U.S.S.R. In 1990, a new plant feeding off Carajas manganese ore was to have begun shipping 165,000 tons of manganese ferroalloys per year, one-half of which was to have gone to the Soviet Union in each of the first 12 years of operation. Prometal, however, left the project and proposed to set up a comparable plant of its own in the Carajas region, thereby destroying the previous agreement.

Nickel.—Some expansion occurred in the Soviet nickel industry in 1988. The Severonikel complex at Monchegorsk on the Kola Peninsula commissioned a new nickel-cutting line. Efforts were made in recent years to increase nickel-cutting capacity to increase the marketability of Soviet nickel exports as well as to produce a higher value-added product. The Soviets had been marketing primarily uncut cathodes in past years, but began adding nickel-cutting capacity to produce cathodes cut to standard sizes. Much of the addition of nickel-cutting capacity occurred at the Severonikel complex, which exported 30% of its output.[55]

Nickel reserves on the Kola Peninsula and in the Urals were being depleted. In 1988, reportedly, efforts were unsuccessful in expanding the reserve base at the Pechenga and Severonikel complexes on the Kola Peninsula.[56] The major area for the expansion of nickel mining was Noril'sk in Krasnoyarsk Kray, East Siberia, where there was a major mining and metallurgical complex. General Secretary Gorbachev, upon a visit to Krasnoyarsk Kray in September, stated that this region produced about one-third of the country's nickel output.[57] He did not specify, however, if this was nickel in ore and semifinished products or refined nickel, although it would appear to be refined nickel. During the 1980's, there was a considerable increase in nickel mining at Noril'sk, and, reportedly, nickel production increasing 40% between 1981-84, primarily from a series of new, large, deep mines. Also, processing-capacity expansion occurred at Noril'sk in the early 1980's with the addition of the Nadezhda flash smelter. It was built in conjunction with Finland's Outokumpu Oy and was, reportedly, capable of producing about 70,000 tons per year of nickel in converter matte. However, no new nickel-refining capacity appeared to have been commissioned at Noril'sk.

The nickel enterprises on the Kola Peninsula processed a significant quantity of Noril'sk ore and converter matte. In 1988, 57.4% of the material processed at Severonikel was ore and converter matte shipped in from Noril'sk, and only 39.6% of the material processed was of Kola origin. In addition, small shipments of nickel material were being transported to Severonikel for processing from as far away as the Ufaley nickel complex in the Urals.[58] The Noril'sk ore processed at Severonikel, reportedly, contained 3.5% nickel plus copper, 24% to 28% sulfur, and 40% to 50% iron.[59] The ore and coverter matte that Severonikel processed from Noril'sk to obtain nickel also contained significant quantities of copper, cobalt, platinum-group metals, precious metals, and other valuable byproducts.[60]

Pollution from nickel processing on the Kola Peninsula was a matter of serious concern to the Soviet Union and to its Scandinavian neighbors, and measures were being taken to curb the pollution from smelting and refining. At the Pechenga complex, modernization was occurring with the addition of ore grinding, flotation and chemical sections supplied by Finland's Outokumpu Oy. Here, pollution had reached the point where it was declared that it could be necessary at times to restrict or even halt smelting operations.[61] Also, at the Severonikel Association smelter and refinery at Monchegorsk, which was responsible for more pollution because of its larger processing capacity, smelting operations were to be halted when monitoring devices indicated dangerous levels of pollution.[62] Pollution from nickel smelting in the form of sulfurous gases and particulate outfall from heavy metals including nickel, copper, and cobalt was affecting the air, soil, water, vegetation, wildlife, and human health. The occurrence of respiratory illness near Monchegorsk was reportedly twice that of the average for the Russian Republic (RSFSR). A target date of 1993 had been set for reducing emissions to an acceptable level, which was about one-half the current level.[63] One method being undertaken for controlling emissions was increasing the amount of metal processed in autogenous smelters, which effectively reduced the emission of sulfur-laden gases by more efficiently separating them for use in sulfur byproducts.

In 1988, Soviet nickel exports appeared to reach another record amount. Soviet nickel exports were a major factor in world nickel trade, and the Soviets maintained the higher level of exports that they established in the mid 1980's. Also, in 1988, nickel of Soviet origin again began entering the United States despite the U.S. ban on Soviet nickel imports. The ban had been in effect since 1984 because the U.S.S.R. would not certify that its nickel shipments did not contain Cuban nickel. In 1988, the Canadian nickel producer Falconbridge Ltd. obtained U.S. Government clearance to export to the United States nickel produced from Soviet nickel matte from its plant in Norway. The clearance was obtained after a determination was made that the Soviet matte refined in Norway did not contain Cuban material. This clearance would have to be renewed in 1989.

The Soviets were openly discussing the high price that they were paying Cuba for imports including nickel. A leading Soviet economist, in an interview, questioned subsidizing Cuba by paying 400% of the world price for Cuban sugar and 1,000% of the world price for Cuban nickel.[64]

Tin.—The tin industry needed to apply improved technology for tin recovery, as reportedly, one-third of the tin in ore was lost in beneficiation.[65] At the Khingan tin mining complex in Khabarovsk Kray in the Soviet Far East, modernization, reportedly, enabled the complex to achieve the highest proportion of tin recovery from ore in the Soviet tin industry. Tin use in tin-plate production reportedly averaged 10 kilograms per ton, which was two to three times higher than in advanced industrial market economy countries. The high tin expenditure was attributed to the use of the hot dipping method, which still comprised 15% of tin-plate production, and to the fact that, unlike Western countries, the Soviets used far less thin tin plate for beverage containers.[66] In an effort to conserve tin, which was in short supply, a pilot plant based on a new Soviet technology for chrome-plate production was installed at the Lysven'skiy metallurgical plant in the Ukraine. The plant was to produce 150,000 tons per year of chrome plate, which was to replace tin plate.[67]

Titanium.—At the Ust'-Kamenogorsk titanium-magnesium complex in Kazakhstan, one of the country's largest titanium producers, new production capacity was commissioned in December 1987. Based on this new capacity, it was planned to increase titanium production at Ust'-Kamenogorsk by one-third over the 1985 production level.[68]

Tungsten.—Tungsten was one of the few metals for which the U.S.S.R. was dependent on imports, and China was apparently the country's major supplier. Although the Soviets did not publish trade data on tungsten in their foreign trade statistical yearbook "Vneshnyaya Torgovlya SSSR," the Soviet monthly journal "Foreign Trade" reported that, between 1981 and 1987, the U.S.S.R. imported 47,000 tons of tungsten concentrates from China.[69]

In 1981, reportedly, efforts to expand tungsten reserves were unsuccessful at two complexes, the Tyrny-Auz complex in the Caucasus, which was the country's major tungsten producer, and the Iul'tin complex in East Siberia. Reserves at both complexes were reported low owing to depletion.[70] Also, it was deemed necessary to apply improved technology in the tungsten industry in tungsten recovery. Approximately one-fourth of the tungsten in ore was being lost in beneficiation.[71]

Vanadium.—Soviet vanadium production, which started during the 1930's, increased dramatically during the 1960's with the commissioning of the Kachkanar mining and beneficiation complex. Titaniferous magnetite ore from Kachkanar was the largest source of raw material for vanadium production. Kachkanar ores are relatively poor in iron and other components but are near the surface and easy to beneficiate. Another advantage of these ores is their low phosphorus and sulfur content. Concentrates from these ores contain between 60% to 62% iron, and the vanadium pentoxide content generally does not exceed 0.5%.[72]

Owing to the high iron content and low vanadium content of the concentrates, pyrometallurgical processing was used. The processing included beneficiation, pelletizing, and blast-furnace smelting to produce vanadium-containing pig iron. Converter processing of this pig iron yielded a vanadium-rich slag from which commercial grade vanadium pentoxide was extracted. Because of the many processing steps and the significant losses during each step, the vanadium extraction coefficient for the entire procedure was low, averaging about 30%. Increasing this extraction coefficient was considered one of the main problems in increasing vanadium production.[73]

Considering that the extraction coefficients for a number of steps were near their theoretical limits, new processing methods were being investigated for vanadium-bearing ores. Hydrometallurgical (chemical) processing was in use abroad and a chemical process was developed in the U.S.S.R. for processing Kachkanar titaniferous magnetite ores. However, chemical processing of the ores was not efficient owing to the low initial vanadium content of the ores. During blast-furnace smelting, problems of vanadium extraction were of lesser importance because 80% of the vanadium was retained in the pig iron.[74]

The percentage of vanadium extraction during hydrometallurgical processing of vanadium slag was 71%, which was relatively low, and had not improved in recent years. Furthermore, the percentage of recovery of toxic byproducts was low and the purity of the end product was unsatisfactory. It was declared an urgent need to develop more efficient methods for extracting vanadium from converter slags.[75]

At the second stage of the Kachkanar complex, which was slated for development, the ores have a 50% higher titanium dioxide content and would necessitate new procedures for pellet production.[76]

Industrial Minerals

Asbestos.—Although the health hazards associated with mining and utilizing asbestos were recognized, claims were made, that if proper precautions were taken, the risks could be reduced to an acceptable level. Furthermore, it was claimed that finding a substitute for asbestos was a complicated problem. Substitutes lacked the full range of advantageous properties of asbestos, could pose their own possible health hazards, and were more expensive. A program was underway in the country to conduct research regarding health and safety problems with asbestos.[77]

In 1988, the Uralasbest complex, which produced more than 50% of the country's asbestos, produced 1.165 million tons of asbestos grades 1 through 6. To produce this amount required mining 191.1 million tons of ore and overburden, from which 32.6 million tons of ore was extracted. Uralasbest produced 70% of the country's output of the grades of asbestos used in manufacturing asbestos cement pipes. It exported its output to 24 countries.

Cement.—Despite the country's large cement production, the country had a severe cement shortage. Problems were occurring in assimilating labor- and energy-saving technology, particularly in installing dry-processing lines. Plans for the 1986–90 period for the installation of these lines were not being met. In 1988, dry processing accounted for 16.3% of total cement production.[78] Progress in reequipping cement plants, reportedly, was being hindered by lagging production in cement industry machine manufacturing. One-fourth of the equipment in the cement industry was more than 40 years old.[79]

Diamonds.—The sale of cut diamonds was an important source of hard currency earnings for the U.S.S.R. Diamonds were cut in Moscow and Smolensk, and the cut diamonds were marketed by the Soviet company Rusalmaz. Wholesale traders from Antwerp were major buyers of Soviet cut diamonds. The Soviets also sold diamonds to other purchasers including the Swiss firm, Samurai, traders in pearls and gemstones, which had business relations with Japan and other countries in the Far East. Soviet diamond cutters were renowned for their skills, and Soviet cut diamonds were known for their beauty and sparkle. Nevertheless, the Soviets were said to lose profits by not being up to date on fashions in jewelry. This was attributed to a lack of flexibility in the management of their diamond industry resulting in an inability to adjust quickly to market demand.[80]

The Kabardino-Balkar diamond instrument plant assisted in developing and produced a significant number of drilling instruments with drill bits using high strength synthetic diamonds. The patent for producing these drill bits had been purchased by many Western countries including Canada, Japan, and the United States.[81]

Fluorspar.—The major fluorspar containing deposits in the U.S.S.R. are the Kalanguyskoye, Abagaytuyskoye, Usuglinskoye, and Solonechnoye in the Trans-Baikal region; the Suppatashskoye Khaydarkanskoye, and Naugarzanskoye in Soviet Central Asia; the Khinganskoye, Pogranichnoye, and Voznesenskoye in the Soviet Far East; and the Tyrny-auz deposit in the North Caucasus. Reserves of fluorspar ore in categories A, B, and C_1 at the beginning of 1986 totaled 98.6 million tons.[82]

Fluorspar was mined by open pit at the Yaroslov mining and beneficiation complex and by underground mining at Kalanguyskiy fluorspar mining and beneficiation complex. The Takobskiy fluorspar complex in Tadzhikistan and the Kyakhtinskiy mining administration in Buryatiya were processing imported ore exclusively. The Kalanguyskiy complex also processed some imported ore. In 1986, the fluorspar beneficiation plants processed 1.6 million tons of ore, from which the Yaroslav complex produced 285,000 tons of concentrate averaging 91.7% CaF_2, and the Kalanguyskiy complex produced 65,000 tons of concentrate averaging 70.7% CaF_2. In 1986, the country reportedly produced 410,500 tons of fluorspar concentrate ranging from 55% to 96.4% CaF_2.[83] Total ore extraction was 1.4 million tons.[84]

The major source of Soviet fluorspar was the Mongolsovtsvetmet (Mongolian Soviet Nonferrous Metals) association in Mongolia which supplied about 70% of the U.S.S.R. fluorspar consumption. The association was staffed by about 2,700 Mongolian citizens and 1,500 Soviet citizens, and administered by management from both countries. The association, which had both open pit and underground mines, was established primarily to exploit fluorspar reserves, and, in addition, was involved in developing gold reserves. Practically all fluorspar production, which totaled 554,600 tons in 1980, 765,700 tons in 1985, and a planned 920,700 tons in 1988, was exported to the U.S.S.R. In 1988, ore beneficiation was initiated at Mongolsovtsvetmet and plans called for about one-half of the ore output to be processed at Mongolsovtsvetmet's beneficiation plant.[85]

Lime.—At the Dankovskiy dolomite complex, in the northeastern section of Lipetsk Oblast' in the Ukraine, commercial exploitation of the deposit began in 1932. The deposit was one of the largest in reserves in the European part of the country. Since 1963, the Dankovskiy complex had supplied metallurgical complexes and plants in the central region of the country with limestone flux. In 1975, in an effort to make better use of its raw material, the complex began producing lime for agriculture and, in 1980, began producing lime powder. The complex was conducting a trial industrial experiment for producing raw materials for refractory production. In 1987, the complex produced 3.843 million tons of commercial product, including 2.550 million tons of limestone flux, 942,000 tons of agricultural lime, and 351,000 tons of lime powder. By 1990, production of agricultural lime was planned to increase to between 1 to 1.2 million tons and of lime powder to 800,000 tons. Both lime and lime powder were byproducts of limestone flux production, and future refractory dolomite production might also contribute to production of these byproducts.[86] Refractory dolomite reserves in the Ukraine were practically depleted, and production from Dankovskiy would help alleviate the shortage of refractory dolomite.

Magnesite.—The plan for the period 1985 to the year 2000 called for over doubling the percentage of steel produced in electric and oxygen-converter furnaces. This would necessitate a significant increase in consumption of magnesium refractories produced from high quality concentrates. The Satkinskoye group of deposits in the Urals supplied 99% of Soviet magnesite, and about one-half of the country's production of magnesite refractories production was in the Ukraine. The Satkinskoye group of deposits, which had long supplied the country's needs, was being depleted of magnesite reserves of types 1 and 2, and total magnesite production at Satkinskoye had fallen by 17%.[87] In addition, in the Karagay section of the deposit, mining had to be conducted underground.[88]

The most promising area for new magnesite development was in East Siberia, which had 66% of the reserves of high-quality magnesite. The Savinskoye deposit in the Cheremkhovskiy region of Irkutsk Oblast' of Siberia was of special interest as it contained 27% of the country's economic reserves of magnesite. This deposit is in a difficult-to-reach region with a severe climate and lacks an adequate labor force, but the European part of the country and Kazakhstan lack magnesite deposits with the quantity and quality of reserves necessary for supplying the country's needs.[89] The country was a net importer of magnesite, and a significant percentage of the country's magnesite consumption was based on imported magnesite from North Korea.[90]

Nitrogen.—Plans called for increasing ammonia production by 33% in 1990 and by 50% in 1995 in comparison with 1985, and for increasing production of nitrogenous fertilizers by 20% in 1990 and by 40% in 1995 in comparison with 1985.[91] Part of the planned ammonia production increase for 1990 was to be accomplished by modifying existing ammonia production units, increasing their capacity from 450,000 tons per year to 475,000 tons per year. These modifications would cause a total increase in capacity for the country of 700,000 tons per year. By 1995, it was intended to again modify these units to increase their capacity to 500,000 tons per year.[92] In 1988, a contract was signed with Japan's Toyo Engineering Corp. and Mitsui & Co. Ltd. for technical specifications and equipment to modernize four ammonia production plants at Nevinnomysk, Novgorod, Novomoskovsk, and Severodonetsk. Equipment deliveries were to be completed in 1989.

During 1988, plans were proceeding for installing urea units with a capacity of 330,000 tons per year. These units were to be purchased from Czechoslovakia and built in accordance with the design of the Netherlands' firm Stamicarbon B. V. During the 1991-95 period, plans called for installing 400,000-ton-per-year urea production units supplied by Czechoslovakia as well as Soviet designed and constructed urea production units with a capacity of 450,000 tons per year.[93]

Perlite.—The U.S.S.R. was the world's largest perlite producer, producing more than 600,000 tons annually. The Aragats complex in Armenia accounted for the most of the country's output. In 1988, a Soviet-Cypriot joint enterprise (Aragats Perlite Industries) was formed on the basis of the Aragats perlite complex and the Cyprus firm United Perlite Industries. The new enterprise would produce perlite for purifying purposes including filler powder for sale on the world market.

Phosphate.—The largest, highest quality source of phosphate raw material was the Khibiny apatite deposit on the Kola Peninsula. The apatite concentrate produced contained about 39% P_2O_5 and was suitable for practically all phosphorus-containing fertilizers. However, these reserves were being depleted, and the proportion of Khibiny phosphate in the total phosphate raw material supply was projected to decrease from 65.8% in 1985 to 60.3%

in 1990, and to 37.4% in the year 2000.[94] During the year, the second stage of the Number 3 concentrator was commissioned at Khibiny; the first stage was commissioned in 1984. The apatite concentrate from the Kovdor complex, also on the Kola Peninsula, was characterized by a P_2O_5 content of between 34% to 36%; but it had a high MgO content of 5%, which hindered the extraction of phosphoric acid and the production of phosphorus fertilizer. Kovdor apatite concentrate was, therefore, processed into defluorinated feed phosphate.[95]

The Karatau complex in Kazakhstan contained one-third of the country's economic reserves of phosphate with a P_2O_5 content ranging between 21% and 29%. Phosphorites with a P_2O_5 content of more than 24.5% were used for the production of phosphoric acid and ammonium phosphate; and phosphorites with a lesser P_2O_5 content were used to produce yellow phosphorus and ground phosphate for direct application. Plans called for increasing phosphate production at Karatau from 18.2% of the total phosphate raw material supply in 1985 to 20.1% in 1990, and to 28.3% in the year 2000.[96]

The Chilisay phosphorite deposit, which was under development in Kazakhstan, ranked third in the country in terms of P_2O_5 in phosphate reserves; however, the ore quality was poorer than at Karatau. At Chilisay, plans called for development of the Dzhera-Sardarinsk group of phosphorite deposits for obtaining concentrate with more than 28% P_2O_5 for use in phosphoric acid production and for phosphorus-containing fertilizers. Prior to the commissioning of the concentration plant at Chilisay, washed phosphate with a 17% P_2O_5 content was being used. Development of the Chilisay complex was considerably delayed. Plans originally called for commissioning the first stage during the 1976–80 period; however, the actual commissioning did not occur until 1987. By March 1988, plans called for the first stage of the Chilisay complex to produce at design capacity, but this goal was not achieved. Rather, in the summer of 1988, the beneficiation plant, reportedly, was working at only one-half capacity. Plans for completing development at Chilisay were uncertain owing to the large number of still unresolved technical problems.[97]

Mining at the Kingisepp phosphate deposit in Leningrad Oblast' began in 1963. The northern sector was already depleted; the southern sector had been under exploitation since 1975. Design capacity for ore extraction at Kingisepp was 8.1 million tons per year, but, in 1987, production was only 6.8 million tons. In 1988, mining occurred at six open pits; a seventh open pit was planned. Production at Kingisepp was averaging between 330,000 to 390,000 tons per year of P_2O_5 in ground phosphate for direct application. Annual ore extraction averaged 6.5 million tons.

A group of phosphorite deposits, including the Polpinsk, Yegoryevsk, and Verkhne-Kamsk produced ground phosphate for direct application with a P_2O_5 content of between 19% to 22%. The use of phosphate for direct application was considered very important, and plans called for its supply to agriculture to double during the 1986–90 period.

Development of phosphorus-containing fertilizer was based not only on the domestic raw-material supply, but also on imported superphosphoric acid from the United States. Plans for the 1986–90 period called for the use of imported Moroccan phosphate rock with a 31% to 33% P_2O_5 content and Syrian phosphate rock with a 29% to 30% P_2O_5 content. However, the Syrian material contained 0.2% chlorine, which made its processing into phosphoric acid and fertilizers problematic.

Plans called for production of phosphorus-containing fertilizers, ground phosphate for direct application, and feed phosphate to total 11.9 million tons P_2O_5 in 1990 and to total between 16 and 16.5 million tons P_2O_5 in the year 2000. In 1990, this would be a 38% increase over the 1985 production level, and in the year 2000, a 92% increase over the 1985 level. These planned growth rates were greater than those planned for total fertilizer production and were contingent upon the exploitation of new deposits with low-grade ore and adverse mining conditions. Thus, it was projected that the cost of producing 1 ton of P_2O_5 would increase by 50% by the year 2000.[98]

The issue of whether it was even desirable to increase phosphate extraction was raised. A Soviet commentator stated that the U.S.S.R. produced 60% more phosphate than the United States. However, efficiency was much lower, and only about one-half the mineral fertilizer produced in the country reached the fields owing to transport, storage, and other losses. Thus, a major consideration would be to stop devoting resources to increasing production, but rather to concentrate on using fertilizer more efficiently.[99]

Although the plan for 1986–90 called for development of the Seligdar apatite deposit in southern Yakutia, plans to develop this deposit had been postponed. Plans called for Seligdar to produce 30 million tons per year of ore yielding 1.267 million tons P_2O_5. This would serve the needs of Siberia and the Soviet Far East where there was no phosphate fertilizer production. If Seligdar were to produce at its design capacity, it would satisfy the phosphate raw material demand for this region.[100]

Serious issues involving environmental pollution were raised concerning phosphate development. In Estonia, the Maardu deposit near Tallin produced ground phosphate for direct application, accounting for the major part of Estonia's phosphate production. Open pit mining at this deposit reportedly had caused "severe damage" to Estonia's economy from air and water pollution. The area near Maardu was described as a "moonscape."[101] The Maardu deposit, however, was almost depleted, and extraction was projected to stop during the 1991-95 period.[102]

At two major new deposits in Estonia in the Rakvere area, 100 to 150 kilometers east of Tallin, plans called for beginning development at Tools and Kabala. At Tools, the phosphate could be open pit mined, but Kabala would require underground mining.[103] However, due to environmental considerations, which aroused a great deal of concern in Estonia, plans to develop these projects had been halted while additional research was being conducted on ecologically safe methods of extraction. Although this research was scheduled for completion in 1989 when a decision on whether to proceed was to be made, development, even if it were to proceed, would probably not begin until after the year 2000.[104] Further evidence that environmental concerns were having an impact on the country's phosphate supply was the planned closing of the Kokand superphosphate plant in Uzbekistan, reportedly, for environmental concerns.[105]

Because of the great extent of phosphate mining and particularly the increasing extraction of poorer ores, the accumulation of wastes in dump sites was becoming a serious problem. In 1988, as part of an effort to address this problem, documents were prepared for a joint enterprise, Tekhnikord, between the French firm SNMI in Avignon and the U.S.S.R. State Scientific Research Institute of Mining and Chemical Raw Materials (GIGKHS). This joint venture would process the wastes from processing apatite-nepheline ore on the Kola Peninsula. Metal spray coatings and composites with high resistance to heat, wear, and corrosion and high antifriction properties would be produced. The French firm would supply its "Tekhnikord" cellulose bonding composite and some of the equipment.

Potash.—In the U.S.S.R., which claimed to have the world's largest potash reserves, plans called for potash extraction to increase to 13.2 million tons K_2O in 1990, almost a 30% increase over the 1985 production level.[106] To produce this amount of K_2O would require mining about 85 million tons of potash ore in 1990.[107] An emphasis was to be placed on expanding potassium fertilizer production, and a 60% increase in the production of these fertilizers was planned by the year 2000 over the 1987 level.

Environmental issues were coming to the fore in the potash extraction industry. The Starobin deposit in Byelorussia was mined by the Byeloruskaliy complex and was the largest source of Soviet potash, producing more than 50% of the country's output. Concentrated salt brines from processing potash ore were stored in tailings reservoirs. A similar reservoir holding such tailings collapsed at the Stebnik mine in the Ukraine in 1983, resulting in a major environmental catastrophe. At Byeloruskaliy, these reservoirs were much larger than at Stebnik, which produced less than 3% of the country's potash. In an effort to avert a catastrophe in Byelorussia, which would dwarf the one in the Ukraine, the Byeloruskaliy complex began a program in 1988 to bury these wastes. A series of deep boreholes was being drilled, and plans called for eventually using deep-well injection to dispose of 10 million tons of wastes annually at Byeloruskaliy. Along with the dangers from the bursting of tailings reservoirs, environmental problems at Byeloruskaliy were occurring from airborne emissions and runoffs from spoils piles. Also, emissions of salt-laden dust and gases from the potash beneficiation plant, saline discharges into rivers, and the possible penetration of brines into ground waters used for the public and industrial water supply posed other serious environmental threats in need of monitoring.[108]

Pollution problems were reported not only from potash mining operations but also from potash transport. At the port of Ventspils on the Baltic Sea, one of the country's major ports for exporting potash, acute atmospheric pollution was reported from dust from potash. Soviet potash is reputedly high in dust content, and, to counter these problems, potash sent to Ventspils from the Urals was beginning to arrive with the dust removed. Also, it was planned to commission a filtering facility at Ventspils.

Salt.—At the Mozyr salt complex in Byelorussia, a total renovation was completed that enabled the complex to overcome shortcomings caused by initial design and construction problems and to reach its design capacity. This would increase Mozyr's output by 360,000 tons in 1988 over 1987.

Semiprecious Stones.—The foreign trade association Eksportsamotsvety, which was created at the end of 1987, had increased the country's exports of semiprecious stones by 30% over the 1987 level. Exportsamotsvety signed protocols of intent to conduct joint ventures with Austria's A. Seisenbacher GmbH and Italy's Cesari Rappresentanza for producing and selling articles made with semiprecious stones on the world market.[109]

Sodium Sulfate.—In 1988, production of sodium sulfate in Turkmenistan, one of the country's major producing regions, increased by 3% over the 1987 level to 267,600 tons.[110] Nevertheless, this figure was 4% below the planned target figure indicating that plans called for significantly increasing production from Turkmenistan's major sodium sulfate deposit. This deposit on the Kara-Bogaz-Gol Gulf off the eastern shore of the Caspian Sea had experienced an enormous manmade ecological catastrophe. In 1980, because of concern for the declining water level in the Caspian Sea, a dam was constructed across the strait through which water flowed from the Caspian Sea into the Kara-Bogaz-Gol Gulf. As a result, the gulf was drying up, and winds carried sulfate dust hundreds of kilometers, greatly contaminating the region. The people in surrounding towns and villages had left the region, leaving behind what were described as "ghost towns."[111] Efforts to increase water flow to the lagoon had not solved the problem. Soviet scientists predicted that unless adequate water reached the gulf in the near future, 80% of the valuable minerals in the gulf would be irretrievably lost.[112] Mining operations at Kara-Bogaz-Gol still continued on the bottom of the gulf, and during the year, a 37,500-ton-per-year capacity sodium sulfate production unit was commissioned.

Sulfur.—In Turkmenistan, at the Gaurdak native sulfur deposit, production decreased by 3%, in comparison with 1987, to 540,600 tons. The planned target was still exceeded by 10%, indicating that the Soviets were accounting in their planning for depleting reserves at Gaurdak.[113] Production figures from native sulfur deposits in the Ukraine were not published on a regular basis.

Sulfur produced as a byproduct of natural gas production was the country's largest source of sulfur. Production from natural gas would increase significantly as new processing units at sour-gas deposits under development came on-stream, or achieved design capacity. In March, four Western firms, Occidental Petroleum Corp., of the United States, Italy's Anichem S.P.A. and Montedison S.P.A., and Japan's Marubeni Corp. signed a protocol of intent to jointly develop and operate a petrochemical complex. The feedstock would be from associated sour gas from the Tengiz oilfield, which was under development in Kazakhstan. The petrochemical complex would take about 3 years to build, and, in addition to petrochemicals, would produce about 1 million tons per year of commercial-grade sulfur.

At the Astrakhan sour gas deposit under development north of the Caspian Sea, reportedly, in May, the first stage achieved its design capacity. It would process 105 billion cubic feet per year of sour gas, yielding 2 million tons per year of sulfur. Development of the second stage was occurring with equal capacity, and it was projected that the U.S.S.R. would switch from being a net importer to a net exporter of sulfur, based on these new production capacities.

Mineral Fuels

The U.S.S.R. program for energy development called for providing a long-term stable level of oil recovery at or near its current high level. Natural gas production was projected to peak at the beginning of the 21st century. In order to stabilize oil production and to increase and then stabilize natural gas production substantial capital investment would be required. This would result from the depletion of fields, the more complex geological conditions for extraction, the necessity to develop new fields of lower quality, and the costs for developing and maintaining infrastructure. The last named included pipeline transport networks in the distant and harsh environment of West Siberia where oil and gas production was and would continue to be concentrated. It was debatable whether increased coal production could substitute for oil and natural gas. The new coal reserves are low quality and are in the eastern part of the country in areas with poor infrastructure development and far from the major industrial consumers. Thus, the country faced a number of economic dilemmas in its future use of fossil fuels, and was assessing the alternatives of using nuclear power and nonconventional energy resources. Nuclear power was considered to be the most realistic alternative to fossil fuels. However, the country faced widespread opposition to nuclear power development in the wake of the Chernobyl' disaster, and public pressure had been successful in delaying and halting nuclear powerplant development.

Because of increasing costs and the planned limits on fuel extraction, an important priority for the country was to implement a program for energy conservation. This program would require restructuring industry to produce a less energy-intensive product mix as well as initiating a series of incentives for industry and private consumers to seek methods for saving energy. It was planned that a significant portion of the future increased energy demands would be met through conservation.

TABLE 8

U.S.S.R.: ESTIMATED PRIMARY ENERGY BALANCE IN 1988

(Million metric tons of standard coal equivalent[1])

	Production	Exports	Imports	Apparent[1] consumption
Coal (lignite, anthracite, bituminous, coke)	467	42	14	439
Heat and electric[2] energy (geothermal hydropower and nuclear power)	142	13	—	129
Fuelwood	23	—	—	23
Natural and associated gas	890	101	1	790
Oil, crude and petroleum products	893	293	31	631
Oil shale	9	—	—	9
Peat	6	—	—	6
Total	**2,430**	**449**	**46**	**2,027**

[1] Standard coal equivalent calculated at 7,000 kilocalories per kilogram. Figures in table calculated based on conversion factors for energy and fuels derived from the Soviet annual statistical yearbook series Narodnoye Khozyaystvo S.S.S.R.
[2] Electricity exports and imports calculated on the basis of energy generated from all sources.

Coal.—In 1989, coal production increased by 2% to 772 million tons of raw coal. Coal production in the Donets Basin (Donbas) in the Ukraine, the country's largest and oldest coal-producing region, fell by 0.1%, in comparison with 1987, to 192 million tons. The production target was exceeded by 2%, indicating that the Soviets were accounting for decreasing coal production in the Ukraine in their planning.[114]

In Kazakhstan, where major expansion of subbituminous coal production was occurring with the open pit development of the Ekibastuz coal basin, production increased by 0.7% to 143 million tons. The Ekibastuz basin produced more than 90 million tons of coal in 1988 in comparison with 87.5 million tons in 1987. Plans called for Ekibastuz to produce 94 million tons in 1990. During 1988, the fourth and final stage of the Vostochniy open pit was commissioned at Ekibastuz; Vostochniy was being developed in four stages, each with a design capacity of 7.5 million tons per year. Also, in Pavlodar Oblast' in Kazakhstan, in late 1987, mining began at the Maykuben deposit; at full capacity five mines would produce 20 million tons per year of coal.

In the Russian Republic (RSFSR), coal output increased by 3%, in comparison with 1987, to 425 million tons.[115] The RSFSR is by far the country's largest republic in area; it contains a number of the country's coal basins including the country's second largest, the Kuznetzk basin (Kuzbas) where plans called for the majority of the country's increase in coal production to occur. In 1988, production in the Kuzbas totaled 156 million tons, in comparison with 150 million tons in 1987. Plans called for production in the Kuzbas to increase to between 220 to 240 million tons in the year 2005. Underground mine output in the Kuzbas was planned to increase from 90 million tons in 1987 to 110 million tons in the year 2005.[116] Thus, most of the increased coal production in the Kuzbas was planned to come from open pits.

Explored coal reserves accounted for more than 70% of all mineral fuel reserves. The U.S.S.R.'s energy development program called for a more rapid development of coal production. The largest consumer would remain the electric powerplants, which would increase their percentage of coal consumption from 50% to 70% of the coal supply.[117]

At the same time, the demand for coking coal was planned to decrease owing to a decrease in pig-iron production and to measures to economize on fuel use in steelmaking. Another issue facing the coal industry was improving coal quality, and plans for the year 2010 called for increasing by 60% to 70% the volume of coal processed at washeries and briquetting plants.[118]

As of January 1988, coal was extracted from 521 underground mines and 92 open pits. About one-half of the underground mines were put into operation before 1960. Of these, 129 mines were deeper than 700 meters and 33 mines were deeper than 1,000 meters. There were approximately 850,000 persons working in underground mines.[119] Although most of the increase in coal production was to come from open pits, up to the year 2000, underground mining would still account for about one-half of the coal extracted. Renovating existing underground mines as well as developing new ones would be required.[120]

Fatalities in coal-mining accidents averaged about 600 per year, and 90% to 95% of the fatalities occurred in underground mining.[121] The Donbas, which produced about 25% of the country's coal, averaged more than 200 fatalities annually.[122] In 1988, fatal injuries occurred at 289 underground mines, although 58% of all mine accidents occurred at 121 mines. About 80% of the underground mines, reportedly, were hazardous because of methane, and 35% of the underground mines were in the most hazardous category for methane. Also, at 70% of the underground mines, coal dust at working seams presented an explosion hazard, and 174 underground mines were classified as dangerous in terms of rock bursts and gas explosions. More emphasis, it was stated, needed to be placed on adherence to safety rules, given the inherently complex and hazardous conditions.[123] In December, a special collegium of the U.S.S.R. Procurator was convened to examine the inordinately high level of injuries in the coal industry. As part of a program to improve mine safety, the Soviet Union and the West German firm, Dragerwerk, agreed to establish a joint enterprise in Donetsk for producing self-rescuers. The U.S.S.R. had a severe shortage of self-rescuers.

Shipping large quantities of lignite long distances by rail was difficult, and ways were being sought for transporting energy from the country's massive lignite reserves in the eastern part of the country to the industrialized western part of the country. Methods under development and being tested included coal slurry pipelines, construction of large electric powerplants connected to long-distance electricity networks, and coal liquefaction and gasification projects. In 1988, in the Soviet Far East in the Maritime Kray coalfields, a coal gasification project was launched in one of the field's largest mines, the Amurskaya. The project was projected to yield more than 14 billion cubic feet of gas per year by the end of 1990.

Natural Gas.—Natural gas production continued its rapid rise in 1988, increasing by 6% to 27.2 trillion cubic feet, moving the Soviet Union further to the fore as the world's largest natural gas producer. The increase in natural gas production occurred primarily from the Yamburg deposit, which was under development in West Siberia to the north of the massive Urengoy field, the country's largest producing field. Also, data began appearing on associated gas recovery. Reportedly, the U.S.S.R. was recovering about 1.5 trillion cubic feet per year of associated gas equaling more than 70% of the associated gas extracted. The largest source of associated gas production was West Siberia, which accounted for two-thirds of the national output. Still, large amounts of associated gas were being flared in West Siberia, and a program was underway to expand gas-processing facilities there.

A major success achieved was the completion of the Yamburg "Progress" gas pipeline to the Soviet western border in June. Natural gas deliveries through this pipeline to the Western regions of the U.S.S.R. commenced in July. Exports of gas to East Europe through the pipeline were scheduled to commence in 1989 and could eventually result in a one-third increase in gas exports to East Europe.

In the RSFSR, containing the Yamburg and Urengoy fields, natural gas production increased by 8% above the 1987 level. Within the RSFSR, development was also underway at the Astrakhan sour gas deposit north of the Caspian Sea. Reportedly, in May, at Astrakhan, the first stage for processing 105 billion cubic feet per year of sour gas reached design capacity.[124]

Despite the reported success in achieving design capacity production at the first stage at Astrakhan, numerous problems were reported in the development of Astrakhan including serious environmental problems. Criticisms were raised concerning unfinished work, defective equipment, and improper installation of equipment. These factors were considered partially to blame for serious environmental problems, and emissions of about 1 million tons per year of hydrogen sulfide at Astrakhan far exceeded safety norms. Reportedly, in a 12-kilometer zone surrounding the gas-condensate complex in which 30,000 people lived, the level of harmful substances in the atmosphere was more than five times the permissible level.[125] Also, the Astrakhan plant was faulted for greatly increasing the level of pollutants in the Volga River.

On May 5, in another environmental mishap at the Orenburg gas processing complex in the Urals, an accident occurred which released a discharge of harmful substances into the atmosphere, and caused injuries to many people in the village of Muzhichya Pavlovka.[126] There were 27 persons hospitalized, 16 of whom were described as in moderately serious condition.[127]

In Turkmenistan, the second largest gas-producing republic in the country, natural gas production, reportedly, increased by 0.2% to 3.1 trillion cubic feet, exceeding the plan target by 2%.[128] The area for major new gas development in Turkmenistan was the Sovetabad sour-gas field. In 1988, the first complex of the second structure was commissioned at Sovetabad. It had a capacity for purifying and drying 177 billion cubic feet of sour gas as well as for removing paraffin.

Natural gas production was targeted to increase to 850 billion cubic meters in 1990. Approximately 50% of the country's natural gas was consumed in industry, 30% by electric powerplants, 14% by the household sector, and the remainder in other uses.[129] Natural gas as a fuel played a dominant role in the production of many metallurgical products, accounting for the production of 93% of pig iron and open-hearth steel, 44% of rolled steel, 99% of steel pipes, 82% of ammonia, 100% of refractories, 70% of cement, and 70% of stampings and forgings.[130]

A major issue was the more efficient use of natural gas. Natural gas consumption per unit of output had decreased by 2% to 3% in the past decade, while in advanced industrialized market economy countries, it had decreased by 30% to 40%. For example, in the U.S.S.R., gas consumption in the production of forgings was 6 times greater than abroad and for the production of rolled steel 2.5 times greater.[131] Efficiency problems also occurred in natural gas production and transmission. At compressor stations, losses of 10% and higher of the total gas transported and distributed occurred, and losses during transmission through major gas mains exceeded 13%.

Plans for the period to the year 2000 called for development of the gas processing industry in order to provide for the demand for ethane, liquified petroleum gases (LPG), helium, condensate, and sulfur. Eventually, 60% of the country's sulfur output was to be derived from gas processing.

The U.S.S.R. occupied third place in the world in the volume of gas processing, following the United States and Canada, but only 15% of the gas produced in the country underwent complex processing. The volume of gas processing was planned to increase based on the development of the sulfur-rich deposit at Astrakhan north of the Caspian Sea and the Karachaganak and Sovetabad sour-gas deposits in Soviet Central Asia. Also, plans called for constructing large gas-processing plants in Tyumen' Oblast', West Siberia, the country's main gas-producing region. In 1988, the new Krasnoleniskaya and Noyarb'sk gas-processing plants were reported in operation in West Siberia. Reportedly, however, the second stage of the Noyarb'sk plant failed to come on-stream as planned. Plans also called for construction of new gas-processing plants in the Soviet Far East and in Irkutsk Oblast' in East Siberia. With the cooperation of the FRG's Lurgi and France's Litwin, two new oil and sour-gas processing plants were to be built at the Tengiz field in Kazakhstan, with work scheduled for completion in 1990.

In an effort to take advantage of the country's large increasing gas production, plans were underway to use compressed natural gas (CNG) as a motor fuel; plans called for 1 million vehicles to be converted to CNG by 1990. Plans also called for converting natural gas to methanol in the eastern part of the country to help alleviate the gasoline supply situation there. In 1988, there was practically no use of natural gas as a motor fuel.[132]

Efforts were underway to use Soviet natural gas as a feedstock to expand petrochemical production. In West Siberia, a consortium involving Combustion Engineering and McDermott International from the United States and Japan's Mitsubishi and Mitsui set a goal by 1995 to construct more than 20 petrochemical plants based on natural gas, near the towns of Surgut and Tobol'sk.

In 1988, Iran and the U.S.S.R. signed a protocol whereby Iran would deliver to the U.S.S.R. 70.6 to 105.9 billion cubic feet of natural gas annually through the existing pipeline network, renewing deliveries which had been suspended in 1980. Also, Greece signed a contract to import natural gas from the U.S.S.R. beginning in 1992 with shipments of 35.3 billion cubic feet and increasing to more than 84.8 billion cubic feet by the year 2000.

Nuclear Power.—Reportedly, in 1988, in the U.S.S.R., 16 nuclear powerplants with 45 reactors were operating. In 1988, they produced 215 billion kilowatt hours of electricity equaling 12.6% of the country's total electric-power production. A group of measures was being undertaken to ensure greater safety for those plants in operation and for those plants being built or planned to be built. Siting requirements had become stricter with new restrictions established on construction in areas of high seismicity. In addition, new construction standards had been established for the industry.

Plans for Soviet nuclear power development formulated in 1983 called for a national capacity of 30,000 megawatts by 1985 with a fivefold to sevenfold increase to between 150,000 to 200,000 megawatts by the year 2000. However, the accident at Chernobyl' caused these plans to change. Plans now called for nuclear powerplant capacity to total 100,000 megawatts by the year 2000. To achieve this goal, it would be necessary to build four to six new nuclear powerplants as well as to expand existing plants.

Construction had halted at a number of nuclear powerplants because of seismic conditions or changes in construction standards. In one of the potentially most dangerous situations, the nuclear powerplant in Armenia was jolted by the earthquake, but was not damaged.

Publicly expressed concerns over nuclear-power safety was instrumental in the closing or abandonment of plans for constructing nuclear power, heat and power, and heat plants. For example, in Armenia, the nuclear powerplant was to be closed in 1989, and a halt was ordered to the construction of a nuclear powerplant 90 kilometers from Baku in neighboring Azerbaidzhan. In Byelorussia, construction was abandoned of a new nuclear heat and power station close to Minsk because of a public outcry from the citizenry, who were among the most severely affected by the Chernobyl' disaster. Protests were occurring in the Ukraine concerning the operation of the Chernobyl' nuclear powerplant as well as the construction and expansion of other nuclear plants in the Ukraine. Also, in other regions, including the Crimea, the North Caucasus, Georgia, the Tatar ASSR, the European Central and Volga regions, and the Soviet Far East, opposition had been aroused concerning construction of nuclear plants. The halting of construction at nuclear powerplants would result in a shortfall of 28,000 megawatts by 1990, and immediate shortfalls would be made up by thermal-powered or hydroelectric plants.[133]

There were still problems in 1988 regarding operational safety at nuclear powerplants. At the Ignalina nuclear powerplant in Lithuania, at least four separate fires occurred during the year. No injuries or radiation leaks were reported. The fires did result in shutting down Ignalina's two reactors. A controversy surrounded the planned construction of a third reactor at Ignalina, and at yearend, the future of the third reactor was still under debate. The Ignalina reactors were more powerful versions of the type at Chernobyl'.

In November, a fire occurred at the South Ukrainian nuclear powerplant, but the fire was put out with extinguishers before the fire department arrived. An initial description of the incident was published in Izvestiya, November 17, and a fuller explanation of the emergency situation at the powerplant was published in Pravda Ukrainy, Nov. 19, in order to address the concerns of worried local inhabitants.[134]

Also revealed was the fact that in 1978 a fire had occurred at the Byeloyarsk nuclear powerplant and that more than 1,200 persons were involved in putting out the fire. Tragic consequences were averted although it was uncertain at times that the fire could be kept under control, and preparations were made to evacuate the inhabitants of the region.[135] It was also revealed that in 1957 there was a serious nuclear accident at the Kyshtym military complex in the Urals not far from Chelyabinsk.[136] Rumors and unconfirmed reports concerning this accident had been circulating for years.

A memorandum on cooperation between the Soviet Union and the United States regarding safety at civilian nuclear powerplants was signed in April in Washington by the chairman of the U.S.S.R. State Committee for the Utilization of Atomic Energy and by the U.S. Chairman of the Nuclear Regulatory Commission. The agreement envisaged a broad exchange of information on research, design, and construction of nuclear powerplants, on technologies in use at nuclear powerplants, and experience in maintaining safe operating procedures.

In addition to nuclear powerplants, there were 36 research reactors operating in the U.S.S.R. Four of the reactors had more than 20 megawatts of power. In addition, 18 research reactors had been built in other countries with the assistance of the U.S.S.R.[137]

An accord was signed with the FRG consortium of Siemens AG and Asea Brown Boveri AG that could lead to construction of a large-scale high-temperature test reactor at a Soviet research center about 500 miles east of Moscow. The 200-megawatt reactor would use 10% enriched uranium, providing higher efficiency and improved safety compared with standard light-water reactors. The plant would serve as a pilot project to enable the Soviets to perfect this technology. Elements of this arrangement would have to be approved by Cocom, the 16 Western nation organization established to control the export of sensitive technology for military purposes.

Beginning in 1973, the All-Union association Tekhsnabeksport concluded its first long-term contract to provide uranium processing and enrichment services with the Atomic Energy Commission of France, and many other members of the International Energy Agency (IEA) began contracting with Tekhsnabeksport. Orders for uranium reprocessing and enrichment peaked in volume in the late 1970's and early 1980's and dropped with the decrease in demand from the fall in nuclear powerplant usage. To maintain its competitiveness, in 1986, Tekhsnabeksport substantially modified its policy governing uranium reprocessing and enrichment services including more flexible terms regarding delivery dates, volume, etc. Tekhsnabeksport was now also considering accepting regenerated uranium obtained from spent fuel, originally enriched in the U.S.S.R., for use as secondary uranium in the enrichment process.

Oil.—National oil production remained at about its 1987 level, which was the peak amount produced in the country's history. In 1988, crude-oil exports increased by more than 5.5%, and there was also a slight increase in petroleum-product exports. Crude-oil production was stabilizing near its 1988 production level with no major production increases planned. A major problem preventing increasing production was lower productivity at some of the main oilfields in West Siberia, the country's leading oil-producing region.

Although future plans did not call for a significant increase in crude-oil extraction, a difference of opinion was apparent between the U.S.S.R. Ministry of Geology and the Ministry of the Petroleum Industry regarding the rate of petroleum development. The Ministry of the Petroleum Industry contended that the size of proved and probable reserves did not permit increased crude production without squandering resources needed for the future. The position of the Ministry of Geology, on the other hand, was that proved and probable reserves were large enough to permit more than a 15% increase in oil production by 1995 over the 1988 level. The Ministry of Geology faulted the Ministry of the Petroleum Industry for placing the emphasis on finding new large fields rather than properly developing fields already being exploited. They also faulted the Petroleum Ministry for underestimating reserves in order to more easily fulfill its plan and achieve bonuses.[138]

As part of an effort to increase production through greater efficiency rather than by merely increasing expenditures, a different path for petroleum development was being discussed. An article in Izvestiya stated that "Colossal resources are being invested in the sector. . . . and extraction is extremely small in relation to both the proven reserves and the budget appropriations." Instead of opening new deposits, the article recommended significantly improving recovery as "scientifically based exploitation of each petroleum deposit will make it possible to obtain hundreds of millions of tons of additional petroleum from them without significant capital investment."[139] The article contended that improper development of wells resulted in premature drops in reservoir pressure and water encroachment in wells, reducing production by 15% or more, and much of this lost oil could never be recovered.

. Consumption was another major area where more efficient utilization would greatly expand petroleum supplies. Oil consumption in the U.S.S.R. was considered excessive in comparison with advanced market economy countries as "fuel consumption by motor vehicles, tractors, and other motorized equipment is double if not more than that of foreign equipment."[140]

The inefficient processing, distribution, and utilization of oil also resulted in gasoline shortages in many parts of the country. A long-standing problem, which the Soviets were working to resolve, was to increase the proportion of higher fractions produced at refineries and decrease the proportion of fuel oil (mazout), which still accounted for about 40% of Soviet refinery output. Progress in this direction in the past decade has been slow, and the share of automobile gasoline and diesel fuel of total refined products was about 35% compared to 65% in the United States.[141]

As part of an effort to better utilize hydrocarbon reserves, plans called for expanding production of heavy crude from the Yarega oil mine in the Komi, ASSR. Construction of four new shafts and renovation of two old ones was expected to increase production at Yarega from 1,360 tons per day in 1987 to, eventually, more than 4,000 tons per day. Previous plans to increase production at Yarega were delayed because of a serious fire and methane explosion at the mine in 1986. Success at Yarega with methods such as steam injection could lead to attempts to use similar extraction techniques in older petroleum-production areas of the country where recovery of the remaining crude oil by conventional means was almost impossible.

As part of its program to replace oil as a fuel with less costly fuel sources and, instead, to use more oil for producing petrochemicals for domestic use and for export, the U.S.S.R. was seeking joint ventures with Western firms to develop its petrochemical industry. Soviet levels of petrochemical production were far behind those of advanced industrialized market economy countries.

However, based on levels of oil and gas production, the country had enough raw materials to potentially become one of the world's largest petrochemical producers. Joint ventures for petrochemical production were underway at the Tengiz deposit with the participation of Occidental Petroleum Corp. from the United States, the Italian firms Montedison S.p.A and Enichem S.p.A., and Japan's Marubeni Corp.

In November, a consortium headed by Japan's Mitsubishi Corp. signed a preliminary agreement to construct a large petrochemical complex in West Siberia in the area of Nizhnevartovsk. The complex, which could produce up to 1 million tons of petrochemicals annually, would consist of up to 15 plants and would require 10 to 15 years to complete. The first output was scheduled for as early as 1992. Also, in November, the French firm Technip signed an agreement for the development and modernization of oil-refining and petrochemical facilities in the U.S.S.R.

In arrangements to assist other countries, the U.S.S.R. signed an agreement to aid Cuba in constructing its first oil pipeline, which would be about 200 kilometers long. The project was scheduled to require 2 years, and part of the project's value would be in training Cuban engineers in future pipeline construction techniques. In South Yemen, the Soviets announced the discovery of three oil deposits of commercial significance, and Soviet specialists were to participate in their development.

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[1] This publication is based on a review of sources published in the U.S.S.R.

[2] Foreign mineral specialist, Division of International Minerals. Joseph Placy, Division of International Minerals, assisted in preparation of tables 2, 3, 6, and 7.

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[33] ———. No. 10, Oct. 1988, pp. 23-36.

[34] ———. No. 8, Aug. 1985, pp. 30-34.

[35] Pravda (Moscow). Sept. 18, 1988, p. 2.

[36] Sotsialisticheskaya industriya (Socialist Industry) (Moscow). Jan. 26, 1989, p. 2.

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[47] Work cited in footnote 46.

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THE MINERAL INDUSTRIES OF

THE UNITED KINGDOM AND IRELAND

By Harold R. Newman[1]

UNITED KINGDOM

The United Kingdom, although small in area, is well endowed with mineral resources. The development, exploitation, and processing of these minerals was the basis of a large and economically important industry. The area was the center of an extensive and interconnected web of mineral activities and serves as a base for major international oil and metal mining companies. Significant resources of industrial minerals have provided a base for expanding both domestic and foreign extractive industries. United Kingdom companies had substantial and increasing foreign interest in production of industrial minerals such as aggregates, ball clay, china clay, and gypsum. The trend toward overseas acquisitions was particularly notable in 1988.

At yearend, Rio Tinto Zinc Corp. PLC (RTZ) announced it had agreed in principal to acquire the worldwide interests of BP Minerals International for \$4.3 billion.[2] This acquisition would represent a major restructuring of the United Kingdom mineral industry and could make RTZ the largest mining company in the world. It would take RTZ into the production of heavy-mineral sands and titanium slag. Also, the company's interest in copper and precious metals would be increased significantly.

A hostile takeover bid by Minorco SA for Consolidated Gold Fields PLC (CGF) in the latter part of 1988 was referred to the Monopolies and Mergers Commission. It concluded that the proposed merger was not against the public interest. However, the U.S. Securities and Exchange Commission took exception to this position. CGF, through legal intervention in a U.S. court in the form of a restraining injunction, succeeded in blocking the proposed acquisition. The injunction prevented Minorco from raising its stake in CGF above 30%. Litigation was continuing at yearend.

The United Kingdom had the third fastest growing economy, after Japan and Canada, in the Organization for Economic Cooperation and Development. Real gross domestic product grew by more than 4%. Consumption was up by more than 5%, investment by more than 10%, and total trade by more than 8% in 1988. Unemployment was less than 8%. However, the price for the higher than average growth rate has been higher inflation, which was approaching 7% at yearend. The major problem remained the trade deficit, which was caused mainly by high consumer spending.

Production and Trade

Following a very successful year in 1987, in which British Steel Corp.'s (BSC) crude steel output rose by 20% to 13.5 million tons, there was a further gain of about 9% giving a total production of about 14.7 million tons in 1988. This gain was achieved because of a high level of operating capacity of 90%. Privatization of British Steel PLC, formerly BSC, was accomplished in November 1988 as a result of a share flotation on the London Stock Market. More than 400 million shares were available in the initial offering, and individual ownership of shareholding in the company was restricted to 15%. The Government retained a special or "golden share" for a period of 5 years to prevent an unwelcome takeover bid. Other privatization considerations, which included the electrical generating and distribution industry, and the coal industry, were underway. However, the coal industry was not expected to be privatized until after the Parliament elections.

On January 1, 1990, the monopoly of the Central Electricity Generating Board (CEGB) for generating electrical power in the United Kingdom is scheduled to end. CEGB will be replaced by two power-generating companies, National Power and Power Gen. Once privatized, these two companies would compete with each other and any other private power-generating company that wishes to produce electricity, the aim being to bring down overall generating costs. The privatization issue was of significant concern to the British coal industry. CEGB was the largest single consumer of coal in the United Kingdom in 1988. It purchased 80 million tons of coal, and only 1 million tons was sourced from locations outside the United Kingdom. This could change significantly when the industry becomes privatized. If the private electric companies move into the world coal market, there would be a definite impact on the British coal industry and possible further mine closings. In mid-1988, the number of collieries operated by British Coal Corp. was 94. As a comparison, the number of collieries operating in 1985 was 169. Fifteen collieries, which represented an annual capacity loss of about 7 million tons, ceased production in 1988. Further closures of deep-mining capacity appear to be inevitable, through reserve exhaustion and financial pressures. However, the extent of the closures would depend on the rate of decline in operating costs and the level of coal imports. The United Kingdom's coal mines still maintained eighth position among world coal producers in hard coal output.

The Government announced in July 1988 that the Northern Ireland electricity service was being prepared for privatization as a single unit. Also, the Government shelved plans to use the Province's lignite resources for power generation. The low cost of oil and coal made the proposal to build a lignite-fired generating station nonviable.

At yearend, the United Kingdom's petroleum production capacity was further reduced when a tanker used as a floating collection system broke loose from its moorings. Production from the Auk, Clyde, and Fulmar Fields was suspended. These suspensions, combined with the earlier loss of production because of Occidental Petroleum Corp.'s Piper Alpha incident in July 1988, resulted in a 30% loss of total capacity. Consequently, there was a significant decline in crude petroleum output in 1988. The surplus on trade in oil shrank

TABLE 1

UNITED KINGDOM: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987[p]	1988[e]
METALS						
Aluminum:						
Alumina from imported bauxite		105,000	109,700	109,940	109,800	110,000
Metal:						
Primary		287,874	275,373	275,876	294,382	[2]300,166
Secondary		143,949	127,595	116,406	116,744	[2]105,764
Cadmium: Metal including secondary		390	370	379	498	[2]399
Copper:						
Ore and concentrate, Cu content		[r]657	[r]592	602	750	[2]732
Metal, refined:						
Primary		69,458	63,851	62,368	54,023	49,258
Secondary		67,376	61,575	63,206	68,264	74,700
Total		**136,834**	**125,426**	**125,574**	**122,287**	**[2]123,958**
Iron and steel:						
Iron ore:						
Gross weight		379,300	274,400	289,000	262,700	[2]224,100
Fe content		82,000	60,400	61,000	58,000	49,300
Metal:						
Pig iron	thousand tons	9,487	10,381	9,686	12,017	[2]13,056
Ferroalloys, blast-furnace: Ferromanganese	do.	75	77	100	92	[2]107
Steel, crude	do.	15,121	15,722	14,725	17,414	[2]18,950
Rolled products	do.	12,634	12,818	11,594	18,606	20,909
Lead:						
Mine output, Pb content		2,431	3,994	648	691	[2]600
Metal:						
Smelter:						
Bullion from imported concentrate		36,071	35,994	37,798	35,200	34,900
Secondary (refined)[3]		191,252	179,064	172,537	201,100	201,600
Total		**227,323**	**215,058**	**210,335**	**236,300**	**236,500**
Refined:						
Primary[4]		147,122	148,133	156,093	145,823	[2]172,220
Secondary[3]		191,252	179,064	172,537	201,131	[2]201,625
Total		**338,374**	**327,197**	**328,630**	**346,954**	**373,845**
Magnesium metal, secondary including alloys[e]		1,000	900	1,000	1,000	1,200
Nickel metal, refined		22,300	17,800	30,900	29,500	27,700
Silver: mine ouptut, Ag content	troy ounces	82,241	55,299	57,003	65,266	[2]67,516
Tin:						
Mine output, Sn content		5,216	5,204	4,276	4,003	[2]3,454
Metal:						
Primary		7,105	7,548	9,227	[2]12,135	[2]9,014
Secondary (refined)		6,743	7,265	5,676	[e]4,600	[2]7,757
Zinc:						
Ore and concentrate, Zn content		[r]7,159	[r]5,043	5,605	6,522	[2]5,502
Metal, smelter		85,604	74,278	85,902	81,360	[2]76,028

See footnotes at end of table.

TABLE 1—Continued

UNITED KINGDOM: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987[p]	1988[e]
INDUSTRIAL MINERALS						
Barite[5]		63,000	107,344	86,754	77,000	76,250
Bromine		[r]28,532	[r]29,851	26,000	26,184	26,000
Cement, hydraulic	thousand tons	13,481	13,339	13,413	[e]14,000	14,500
Clays:						
Fire clay	do.	757	831	940	[e]900	1,060
Fuller's earth[6] [e]	do.	202	216	202	[r]213	210
Kaolin (china clay)	do.	2,810	2,870	2,913	3,059	[2]3,149
Ball clay and pottery clay	do.	629	587	611	679	716
Other including shale	do.	17,817	18,909	17,565	18,300	18,500
Diatomite[e]		200	200	300	350	320
Feldspar (china stone)		5,901	[r]5,934	7,304	5,692	[2]6,267
Fluorspar, all grades[7]		136,700	167,390	133,420	120,400	103,300
Gypsum and anhydrite	thousand tons	3,138	3,189	3,416	[e]3,500	3,700
Lime: Quicklime and hydrated[e]	do.	2,500	2,500	2,600	2,800	2,800
Nitrogen: N content of ammonia	do.	1,836	1,767	1,388	[2]1,415	1,105
Potash, K_2O equivalent		[r]335,440	354,496	416,965	[2]429	767
Salt:						
Rock	do.	1,569	2,030	2,040	1,855	[2]877
From brine	do.	1,423	1,552	1,510	1,554	[2]1,426
In brine, sold or used as such	do.	4,134	3,563	3,305	3,672	[2]3,827
Sand and gravel:						
Common sand and gravel	do.	105,990	107,727	112,043	117,827	[2]136,404
Industrial sand	do.	4,329	4,178	4,108	3,265	4,300
Sodium compounds, n.e.s.: Carbonate synthetics[e]	do.	1,000	1,000	1,000	[2]765	1,000
Stone:						
Crushed:						
Calcite	do.	7	6	10	[e]10	12
Chalk	do.	12,022	12,023	12,511	13,444	13,500
Chert and flint	do.	17	22	14	[e]15	11
Dolomite	do.	14,228	14,953	15,851	17,000	19,900
Igneous rock	do.	36,825	[r]31,720	34,038	39,529	51,956
Limestone	do.	79,239	[r]93,517	97,056	110,641	105,816
Sandstone including ganister	do.	15,116	[r]10,870	11,337	13,824	18,900
Slate including fill	do.	121	124	242	322	708
Total	**do.**	**157,575**	**163,111**	**171,059**	**193,341**	**190,751**
Dimension:						
Igneous	do.	55	67	[e]100	[e]100	128
Limestone	do.	225	[e]175	127	244	233
Sandstone	do.	117	130	120	142	183
Slate	do.	36	34	[e]35	[e]35	40
Strontium minerals		16,100	23,000	14,700	22,655	[2]25,553

See footnotes at end of table.

TABLE 1—Continued

UNITED KINGDOM: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987[p]	1988[e]
INDUSTRIAL MINERALS—Continued						
Sulfur, byproduct:						
Of metallurgy		[r]56,869	[r]53,766	[r]58,319	51,398	55,000
Of petroleum refining		75,000	80,000	105,000	119,000	[2]129,000
Total		**[r]133,169**	**133,766**	**163,319**	**170,398**	**184,000**
Talc, soapstone, pyrophyllite		19,413	20,000	12,352	12,529	[2]14,182
Titania[8]		206,000	219,100	229,900	225,600	230,000
MINERAL FUELS AND RELATED MATERIALS						
Coal:						
Anthracite	thousand tons	1,217	2,142	1,985	2,091	[2]1,827
Bituminous including slurries, fines, etc.	do.	49,965	91,905	106,107	102,344	[2]101,964
Lignite	do.	2	5	7	6	18
Total		**51,184**	**94,052**	**108,099**	**104,441**	**103,809**
Coke:						
Metallurgical	do.	5,866	7,838	7,795	[2]7,585	7,610
Breeze, all types	do.	[r]220	[r]337	[r]344	[2]273	277
Fuel briquets, all grades	do.	1,067	1,763	1,599	[2]1,637	1,464
Gas, natural:						
Marketable[9]	billion cubic feet	1,361	1,517	1,594	1,590	1,713
Marketed[10]	do.	1,263	1,403	1,474	1,470	1,299
Natural gas liquids[11]	thousand 42-gallon barrels	[r]55,204	[r]59,740	67,442	66,039	[2]58,035
Petroleum:						
Crude[12]	do.	[r]905,678	[r]914,204	905,162	878,099	[2]816,795
Refinery products:						
Liquefied petroleum gases	do.	[r]19,210	[r]17,354	[r]16,484	17,110	19,129
Naphtha including white spirit	do.	[r]27,251	[r]24,506	[r]22,542	18,123	[2]16,728
Gasoline	do.	[r]189,014	[r]189,159	[r]198,560	209,780	[2]224,477
Jet fuel	do.	[r]42,816	[r]42,056	[r]46,504	48,504	[2]53,800
Kerosene	do.	[r]16,012	[r]17,879	[r]16,639	17,592	[2]17,740
Distillate fuel oil	do.	[r]160,741	[r]161,897	[r]167,171	159,828	[2]178,480
Residual fuel oil	do.	[r]87,053	[r]85,887	[r]83,403	85,228	[2]83,217
Lubricants	do.	[r]7,756	[r]8,316	[r]6,363	6,202	[2]6,790
Bitumen		[r]10,878	[r]10,690	[r]11,435	12,459	[2]13,908
Petroleum coke	do.	[r]2,783	[r]2,844	[r]2,827	2,844	2,976
Petroleum wax	do.	[r]630	[r]559	[r]456	449	496
Unspecified	do.	[r]2,954	[r]2,982	[r]2,051	2,100	[2]3,563
Refinery fuel and losses	do.	[r]47,619	[r]46,632	[r]49,321	44,889	[2]47,626
Total	**do.**	**[r]614,717**	**[r]610,761**	**[r]623,756**	**625,107**	**668,930**

[e] Estimated. [p] Preliminary. [r] Revised.
[1] Includes data available through Sept. 1, 1989.
[2] Reported figure.
[3] Includes a small quantity of primary lead from domestic concentrate.
[4] Produced entirely from imported bullion and includes the lead content of alloys.
[5] Includes witherite.
[6] Salable product.
[7] Proportions of grades not available; probably about two-thirds acid grade.
[8] Sales.
[9] Methane excluding gas flared or reinjected.
[10] Marketable methane excluding that used for drilling, production, and pumping operations.
[11] Includes ethane, propane, butane, and condensates.
[12] Excludes gases and condensates.

TABLE 2

UNITED KINGDOM: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
METALS				
Alkali and alkaline-earth metals:				
Alkali metals	14	11	—	France 10.
Alkaline-earth metals	(2)	9	—	Norway 8; Ireland 1.
Aluminum:				
Ore and concentrate	576	1,042	7	Italy 766; Republic of South Africa 120.
Oxides and hydroxides	46,732	42,366	1,781	Norway 4,465; Sweden 4,086; Portugal 3,555.
Ash and residue containing aluminum	1,301	1,823	—	Republic of South Africa 1,268; India 334.
Metal including alloys:				
Scrap	89,885	87,372	307	West Germany 25,063; Japan 22,587; Italy 9,182.
Unwrought	116,751	133,555	632	West Germany 59,372; Belgium-Luxembourg 17,753.
Semimanufactures	134,739	141,561	9,047	West Germany 25,964; Ireland 17,763; France 14,442.
Antimony: Metal including alloys, all forms	98	59	22	Canada 10; Ireland 6.
Arsenic: Oxides and acid	3,216	2,372	1,378	Finland 278; France 246.
Beryllium:				
Oxides and hydroxides	4	2	(2)	West Germany 1.
Metal including alloys, all forms	(2)	30	23	West Germany 5.
Bismuth: Metal including alloys, all forms	73	40	—	France 9; Italy 8; West Germany 7.
Cadmium: Metal including alloys, all forms	85	62	1	West Germany 12; Israel 11; Taiwan 10.
Chromium:				
Ore and concentrate	406	217	(2)	Norway 107; Nigeria 102.
Oxides and hydroxides	17,188	9,479	19,958	France 3,150; Hong Kong 367.
Metal including alloys, all forms	3,829	3,282	1,681	Japan 387.
Cobalt:				
Oxides and hydroxides	603	780	64	Belgium-Luxembourg 344; France 99.
Metal including alloys, all forms	711	928	153	Netherlands 116; Japan 91.
Columbium and tantalum:				
Ore and concentrate	14	—		
Metals including alloys, all forms:				
Columbium (niobium)	6	16	(2)	Libya 10; Belgium-Luxembourg 4; West Germany 1.
Tantalum	10	18	6	West Germany 8; Italy 1.
Copper:				
Ore and concentrate	6,374	2,990	—	Sweden 2,950.
Matte and speiss including cement copper	(2)	—		
Oxides and hydroxides	464	409	2	Netherlands 113; Singapore 54; Poland 40.
Sulfate	1,487	2,487	36	Nigeria 1,744; Hong Kong 144; Cuba 128.

See footnotes at end of table.

TABLE 2—Continued

UNITED KINGDOM: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
METALS—Continued				
Copper—Continued				
Ash and residue containing copper	2,893	2,583	—	Spain 1,275; India 888; Belgium-Luxembourg 215.
Metal including alloys:				
Scrap	125,323	123,013	355	West Germany 49,487; Belgium-Luxembourg 27,006; Italy 22,151.
Unwrought	29,906	34,266	38	West Germany 9,904; Italy 6,090; Sweden 5,254.
Semimanufactures	114,649	95,109	1,729	Switzerland 14,950; West Germany 9,531; Ireland 7,750.
Germanium: Metal including alloys, all forms	5	6	2	France 2; West Germany 2.
Gold:				
Waste and sweepings value, thousands	$5,336	$15,309	$480	Switzerland $13,759; West Germany $376.
Metal including alloys, unwrought and partly wrought troy ounces	6,647,445	1,119,666	1,841	Oman 30,800; Ireland 23,799; unspecified 981,932.
Iron and steel:				
Ore and concentrate excluding roasted pyrite	1,008	1,225	—	West Germany 485; Cuba 174; Netherlands 141.
Metal:				
Scrap thousand tons	3,837	3,306	45	Spain 1,551; Sweden 229; India 227.
Pig iron, cast iron, related materials	64,897	74,616	1,033	Belgium-Luxembourg 23,598; West Germany 12,240; France 10,744.
Ferroalloys:				
Ferrochromium	525	953	33	Belgium-Luxembourg 291; Pakistan 128; Spain 118.
Ferromanganese	12,750	13,990	—	Belgium-Luxembourg 9,627; West Germany 2,999.
Ferromolybdenum	5,172	4,298	218	Netherlands 1,248; West Germany 1,013.
Ferronickel	11	([2])	—	All to France.
Ferrosilicochromium	—	14	—	Egypt 10; Denmark 4.
Ferrosilicomanganese	147	419	—	Mozambique 293; Ireland 98.
Ferrosilicon	1,073	2,548	52	Ireland 394; West Germany 381; Sweden 300.
Silicon metal	3,223	1,505	185	Belgium-Luxembourg 458; West Germany 343.
Unspecified	12,984	15,902	963	West Germany 2,545; France 978; unspecified 7,208.
Steel, primary forms thousand tons	1,313	1,954	327	Canada 272; Republic of Korea 269.
Semimanufactures:				
Bars, rods, angles, shapes, sections do.	1,831	1,941	280	West Germany 197; Singapore 136.
Universals, plates, sheets do.	1,388	1,645	62	West Germany 183; India 113; U.S.S.R. 110.

See footnotes at end of table.

TABLE 2—Continued

UNITED KINGDOM: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
METALS—Continued					
Iron and steel—Continued					
Metal—Continued					
Semimanufactures—Continued					
Hoop and strip	do.	136	161	9	France 21; U.S.S.R. 16; Ireland 15.
Rails and accessories	do.	126	184	5	India 79; Singapore 16; France 14.
Wire	do.	109	126	20	France 10; Ireland 9.
Tubes, pipes, fittings	do.	461	534	25	West Germany 50; Sweden 40; Netherlands 37.
Castings and forgings, rough	do.	41	35	3	France 10; Sweden 8.
Lead:					
Ore and concentrate		3,191	1,658	17	France 1,600.
Oxides		6,940	8,387	62	Ireland 2,522; West Germany 2,184; Sweden 1,127.
Ash and residue containing lead		2,590	3,628	—	West Germany 1,467; Belgium-Luxembourg 797; East Germany 424.
Metal including alloys:					
Scrap		14,781	21,394	—	West Germany 7,125; Ireland 6,371; Sweden 2,569.
Unwrought		119,700	112,671	822	West Germany 42,065; France 20,576; Belgium-Luxembourg 12,878.
Semimanufactures		6,971	8,280	507	Belgium-Luxembourg 2,757; West Germany 1,187.
Lithium: Oxides and hydroxides		—	62	1	Italy 19; Tunisia 13; West Germany 7.
Magnesium: Metal including alloys:					
Scrap		440	844	612	Italy 90; West Germany 60.
Unwrought		838	790	291	Canada 146; West Germany 91.
Semimanufactures		641	812	29	France 115; Italy 102; Ireland 90.
Manganese:					
Ore and concentrate, metallurgical-grade		235	323	2	Ireland 130; Sweden 100; West Germany 35.
Oxides		1,083	939	—	Nigeria 414; Mozambique 200; Ireland 100.
Metal including alloys, all forms		265	165	—	Kenya 100; Sierra Leone 19; Netherlands 16.
Mercury	76-pound flasks	551	1,857	29	Republic of South Africa 754; Spain 261; New Zealand 232.
Molybdenum:					
Ore and concentrate		2,893	2,269	—	Netherlands 838; Sweden 243; Republic of South Africa 239.
Oxides and hydroxides		1,109	1,298	307	Austria 378; Netherlands 210.
Metal including alloys:					
Scrap		12	17	2	Sweden 11; Norway 2.
Unwrought		465	643	—	Netherlands 434; Belgium-Luxembourg 84.
Semimanufactures		150	103	11	Netherlands 25; France 21; West Germany 7.

See footnotes at end of table.

TABLE 2—Continued

UNITED KINGDOM: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987 United States	Destinations, 1987 Other (principal)
METALS—Continued				
Nickel:				
Ore and concentrate	—	(2)	—	Mainly to Japan.
Matte and speiss	683	1,285	—	Sweden 1,015; Canada 190.
Oxides and hydroxides	79	98	1	Netherlands 83; Egypt 6.
Ash and residue containing nickel	9,563	6,359	—	Canada 5,160; Japan 654.
Metal including alloys:				
Scrap	4,628	5,030	469	Sweden 1,877; Canada 1,157.
Unwrought	17,450	18,565	412	Belgium-Luxembourg 4,953; West Germany 4,422; Sweden 3,022.
Semimanufactures	9,556	9,707	122	Japan 2,817; West Germany 1,667; France 1,321.
Platinum-group metals:				
Waste and sweepings value, thousands	$1,319	$22,875	$48	Republic of South Africa $10,520; Italy $9,497.
Metals including alloys, unwrought and partly wrought thousand troy ounces	r2,085	1,567	413	Netherlands 289; West Germany 225.
Rare-earth metals including alloys, all forms	41	64	5	Malaysia 40; West Germany 13.
Rhenium: Metal including alloys, all forms	1	1	(2)	NA.
Selenium, elemental	120	225	1	Philippines 53; West Germany 26; Spain 24.
Silicon, high-purity	14	20	(2)	West Germany 7; Japan 6; Spain 5.
Silver:				
Ore and concentrate value, thousands	$5	—		
Waste and sweepings do.	$12,208	$13,307	$12	France $6,784; Sweden $1,960; West Germany $1,825.
Metal including alloys, unwrought and partly wrought thousand troy ounces	r64,516	48,644	17	Switzerland 25,342; West Germany 11,137; Italy 2,296.
Tellurium and arsenic, elemental	202	87	3	Netherlands 31; West Germany 28; Ireland 9.
Tin:				
Ore and concentrate	5,085	3,840	—	Netherlands 3,331; Malaysia 214.
Oxides	631	—		
Ash and residue containing tin	297	829	—	West Germany 776; Belgium-Luxembourg 28.
Metal including alloys:				
Scrap	689	529	2	West Germany 245; Belgium-Luxembourg 147.
Unwrought	16,610	17,581	253	Netherlands 9,210; U.S.S.R. 3,891.
Semimanufactures	863	1,299	7	West Germany 586; France 91.
Titanium:				
Ore and concentrate	—	16,187	NA	NA.
Oxides	23,696	27,348	7,646	West Germany 2,374; Netherlands 1,913.

See footnotes at end of table.

TABLE 2—Continued

UNITED KINGDOM: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
METALS—Continued				
Titanium—Continued				
Metal including alloys:				
Scrap	1,065	970	427	Canada 324; France 72.
Unwrought	191	152	4	West Germany 27; Spain 27; Netherlands 19.
Semimanufactures	840	915	116	West Germany 228; France 217.
Tungsten:				
Ore and concentrate	155	597	471	Netherlands 61.
Oxides and hydroxides	5	25	—	Austria 19; France 6.
Ash and residue containing tungsten	21	42	21	Israel 21.
Metal including alloys:				
Scrap	248	297	66	West Germany 81; Belgium-Luxembourg 64.
Unwrought	104	83	1	West Germany 45; Italy 9; Brazil 6.
Semimanufactures	143	104	7	Spain 15; France 14; Italy 12.
Uranium and thorium: Metals including alloys, all forms:				
Uranium	1	1	(2)	Mainly to Iran.
Thorium	19	1	—	Mainly to West Germany.
Vanadium:				
Oxides and hydroxides	28	18	(2)	France 10; Austria 4; Belgium-Luxembourg 2.
Ash and residue containing vanadium	—	58	58	
Metal including alloys:				
Scrap	3	99	99	
Unwrought	2	(2)	—	All to West Germany.
Semimanufactures	10	43	1	Belgium-Luxembourg 41; West Germany 1.
Zinc:				
Ore and concentrate	5,224	8,852	(2)	Netherlands 8,713.
Oxides	5,663	5,203	146	Ireland 745; West Germany 659; France 582.
Blue powder	1,986	2,060	210	France 197; Chile 170.
Matte	70	21	—	All to France.
Ash and residue containing zinc	6,390	4,647	—	Sweden 2,569; France 1,073; West Germany 300.
Metal including alloys:				
Scrap	17,287	22,461	—	West Germany 7,729; Taiwan 3,709; Sweden 3,032.
Unwrought	22,127	13,637	673	France 3,941; Belgium-Luxembourg 2,037; Portugal 2,026.
Semimanufactures	5,229	2,783	76	France 540; Nigeria 462; Belgium-Luxembourg 353.

See footnotes at end of table.

TABLE 2—Continued

UNITED KINGDOM: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
METALS—Continued				
Zirconium:				
Ore and concentrate	315	376	18	China 150; France 55; Portugal 38.
Metal including alloys:				
Scrap	50	19	12	Sweden 3; Netherlands 2.
Unwrought	52	54	—	Japan 36; Sweden 2.
Semimanufactures	21	20	1	Ireland 6; West Germany 2; Venezuela 2.
Other:				
Ores and concentrates	(2)	637	—	Spain 192; Israel 181; Switzerland 114.
Oxides and hydroxides	878	1,828	354	West Germany 592; Japan 383.
Ashes and residues	14,930	12,497	948	Belgium-Luxembourg 8,596; France 1,425.
Base metals including alloys, all forms	16	9	4	France 2; West Germany 1.
INDUSTRIAL MINERALS				
Abrasives:				
Natural: Corundum, emery, pumice, etc.	2,742	2,966	233	Ireland 518; Kuwait 407; West Germany 274.
Artificial:				
Corundum	7,535	7,706	312	West Germany 3,099; Australia 1,490; Sweden 676.
Silicon carbide	625	751	16	West Germany 322; Greece 234; Canada 54.
Dust and powder of precious and semiprecious stones including diamond kilograms	1,428	1,694	147	India 360; Ireland 360.
Grinding and polishing wheels and stones	4,057	3,974	257	West Germany 521; France 418; Iran 329.
Asbestos, crude	430	462	—	Netherlands 100; Belgium-Luxembourg 78; Italy 62.
Barite and witherite	6,722	8,214	—	Ireland 2,427; West Germany 1,490; Republic of Korea 621.
Boron materials:				
Crude natural borates	1,598	1,446	—	France 988; Venezuela 403.
Elemental	28	35	(2)	France 22; Ireland 4; Netherlands 4.
Bromine	2,307	2,556	—	France 1,066; West Germany 576; Netherlands 382.
Cement	107,490	95,961	(2)	Ireland 48,466; Nigeria 5,533.
Chalk	44,178	38,138	916	Finland 4,081; West Germany 4,003; Australia 3,982.
Clays, crude:				
Bentonite thousand tons	34	36	(2)	Sweden 11; Belgium-Luxembourg 4; West Germany 4.
Chamotte earth do.	(2)	—		
Fuller's earth do.	23	25	(2)	West Germany 7; Sweden 7; Finland 2.
Kaolin do.	2,524	2,600	14	Finland 600; West Germany 446; Sweden 362.
Unspecified do.	363	401	NA	NA.

See footnotes at end of table.

TABLE 2—Continued

UNITED KINGDOM: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
INDUSTRIAL MINERALS—Continued				
Cryolite and chiolite	1	8	—	Egypt 5; Ireland 2; Australia 1.
Diamond:				
Gem, not set or strung thousand carats	36,113	41,441	2,453	Belgium-Luxembourg 22,718; India 12,188.
Industrial stones do.	7,836	9,812	1,560	Ireland 6,356; Belgium-Luxembourg 534.
Unsorted stones do.	1,075	2,076	1,363	Belgium-Luxembourg 375; Republic of South Africa 117.
Diatomite and other infusorial earth	522	484	4	France 159; Denmark 108; Belgium-Luxembourg 63.
Feldspar, fluorspar, related materials:				
Feldspar	357	450	—	Indonesia 163; Ireland 93; Greece 62.
Fluorspar	5,137	4,732	18	Sweden 1,014; Netherlands 989; West Germany 699.
Unspecified	691	641	—	Ireland 617; Malaysia 20.
Fertilizer materials:				
Crude, n.e.s.	2,922	1,202	81	Ireland 741.
Manufactured:				
Ammonia	70,849	31,922	(2)	Morocco 9,700; Belgium-Luxembourg 8,203; Spain 4,303.
Nitrogenous	(3)	130,778	48	France 33,311; Ireland 24,617; Spain 15,625.
Phosphatic	613	332	—	Ireland 247.
Potassic	95,829	339,374	11,172	France 244,061; Finland 33,206.
Unspecified and mixed	327,324	344,106	10	Ireland 232,029; Sweden 23,754.
Graphite, natural	3,741	3,184	2	West Germany 1,480; Republic of South Africa 525.
Gypsum and plaster	17,421	12,146	21	Ireland 4,011; Hong Kong 1,572.
Iodine	197	145	(2)	France 23; Iraq 20; West Germany 19.
Kyanite and related materials	4,631	4,362	131	West Germany 2,428; Italy 399; Republic of South Africa 276.
Lime	26,034	35,950	(2)	Sudan 6,928; Ivory Coast 5,869; France 5,429.
Magnesium compounds:				
Magnesite, crude	105	50	—	Sweden 24; France 20; Portugal 5.
Oxides and hydroxides	82,611	84,685	NA	NA.
Sulfate	—	1,371	—	Ireland 541; Czechoslovakia 319; West Germany 73.
Mica:				
Crude including splittings and waste	3,137	4,310	24	West Germany 1,942.
Worked including agglomerated splittings	106	175	1	West Germany 80; Finland 19; Ireland 14.
Nitrates, crude	223	167	—	Ireland 66; France 59; Ghana 18.
Phosphates, crude	3,406	326	—	Ireland 137; West Germany 90.

See footnotes at end of table.

TABLE 2—Continued

UNITED KINGDOM: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
INDUSTRIAL MINERALS—Continued				
Phosphorus, elemental	1	1	—	All to United Kingdom.
Pigments, mineral: Natural, crude	663	1,110	70	Philippines 486; Kenya 79.
Potassium salts, crude	—	3	—	All to Ireland.
Precious and semiprecious stones other than diamond:				
Natural value, thousands	$65,376	$99,592	$11,202	Switzerland $60,456; France $8,005.
Synthetic do.	$555	$210	$17	Republic of South Africa $74; India $49.
Pyrite, unroasted	82	171	—	France 54; Belgium-Luxembourg 48; Portugal 47.
Salt and brine	368,716	404,587	20,555	Sweden 149,769; Nigeria 102,521; Norway 41,759.
Sodium compounds, n.e.s.: Sulfate including cadmium sulfate, manufactured	38,918	45,431	18	Canada 17,299; Sweden 9,459; Italy 8,724.
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked	4,634	5,944	25	Ireland 2,705; West Germany 1,587; Netherlands 1,070.
Worked	6,172	10,322	2,373	Ireland 1,903; France 1,635.
Dolomite, chiefly refractory-grade	41,825	79,892	—	Sweden 25,229; Belgium-Luxembourg 24,235.
Gravel and crushed rock	1,495,360	1,658,917	346,143	France 443,866; West Germany 306,705.
Limestone other than dimension	591,617	609,540	—	West Germany 149,731; Belgium-Luxembourg 138,759; Norway 121,676.
Quartz and quartzite	r478	270	(2)	Ireland 118; Netherlands 43; West Germany 40.
Sand other than metal-bearing	43,684	60,449	—	Canada 17,299; Sweden 9,459; Italy 8,724.
Sulfur:				
Elemental:				
Crude including native and byproduct	1,584	2,857	—	West Germany 990; Netherlands 860; France 264.
Colloidal, precipitated, sublimed	601	169	(2)	Republic of South Africa 42; Belgium-Luxembourg 40; France 20.
Dioxide	93	11	—	Mauritius 3; West Germany 2; Ireland 2.
Sulfuric acid	92,340	68,884	4	France 27,066; Ireland 18,558; Spain 10,827.
Talc, steatite, soapstone, pyrophyllite	2,541	2,354	25	Nigeria 420; Belgium-Luxembourg 276.
Vermiculite, perlite, chlorite	1,604	1,206	2	Finland 273; Netherlands 226; Sweden 225.
Other:				
Crude	26,747	36,132	21	West Germany 16,055; Venezuela 3,238; Ireland 2,919.
Slag and dross, not metal-bearing	72,643	77,561	2,394	West Germany 56,212; Belgium-Luxembourg 6,679.

See footnotes at end of table.

TABLE 2—Continued

UNITED KINGDOM: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
MINERAL FUELS AND RELATED MATERIALS					
Asphalt and bitumen, natural		7,716	5,897	20	Ireland 3,481; Tanzania 629.
Carbon:					
Carbon black		44,431	12,813	263	Nigeria 2,700; West Germany 2,351; France 1,966.
Gas carbon		14	34	—	Netherlands 9; France 7; West Germany 6.
Coal:					
Anthracite	thousand tons	352	201	—	France 157; Norway 20.
Bituminous	do.	2,396	2,141	(2)	Denmark 1,022; Ireland 319; Portugal 225.
Briquets of anthracite and bituminous coal	do.	155	114	—	Norway 77; Venezuela 27.
Lignite including briquets	do.	1	3	—	Mainly to Ireland.
Coke and semicoke	do.	1,163	352	(2)	Norway 154; Finland 52; Sweden 49.
Gas, natural: Gaseous	million cubic feet	3,366	2,873	—	Netherlands 1,209; Belgium-Luxembourg 714; Norway 677.
Peat including briquets and litter		16,617	21,760	26	Sweden 9,263; France 7,633.
Petroleum:					
Crude	thousand 42-gallon barrels	r622,267	612,051	123,036	Netherlands 118,423; France 99,746.
Refinery products:					
Liquefied petroleum gas	do.	38,188	29,602	1,632	Netherlands 9,278; France 4,921.
Gasoline, motor	do.	41,115	30,014	6,196	West Germany 9,387; Netherlands 8,360.
Mineral jelly and wax	do.	364	317	25	West Germany 39.
Kerosene and jet fuel	do.	7,641	8,852	643	Ireland 2,508; Sweden 1,074; Denmark 964.
Distillate fuel oil	do.	47,165	33,905	1,817	France 10,773; West Germany 8,207; Ireland 6,097.
Lubricants	do.	5,150	4,600	17	Belgium-Luxembourg 703; West Germany 642; Netherlands 633.
Residual fuel oil	do.	22,713	30,286	5,435	Italy 6,665; Ireland 3,690.
Bitumen and other residues	do.	522	274	(2)	Ireland 271.
Bituminous mixtures	do.	205	202	2	Turkey 27; Norway 18; Ireland 16.
Petroleum coke	do.	2,670	2,416	NA	NA.

r Revised. NA Not available.
[1] Table prepared by P. J. Roetzel.
[2] Less than 1/2 unit.
[3] Unreported quantity valued at $9,329,000.

from more than $500 million in early 1988 to about $100 million in late 1988.

Commodity Review

Metals.—**Copper.**—All of the copper concentrate produced in 1988 was a byproduct of Carnon Consolidated Ltd.'s Wheal Jane tin mine in Cornwall. However, this situation was expected to change because, in mid-1988, Anglesey Mining PLC was given permission to develop a mine at Parys Mountain, Anglesey. Reserves were estimated at 4.8 million tons of ore grading 1.5% copper, 3% lead, 6% zinc, 1.8 troy ounces per ton silver and 0.01 troy ounce of gold per ton. Plans were to operate the mine at 400,000 tons per year for an estimated 14 years. Production was expected to begin by 1992. The

TABLE 3

UNITED KINGDOM: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987 United States	Sources, 1987 Other (principal)
METALS				
Alkali and alkaline-earth metals:				
Alkali metals	2,268	1,540	—	West Germany 971; France 513.
Alkaline-earth metals	73	85	NA	NA.
Aluminum:				
Ore and concentrate	270,767	325,436	65	Ghana 219,542; Sierra Leone 32,678; Brazil 24,356.
Oxides and hydroxides	559,045	629,179	2,954	Ireland 191,334; Jamaica 153,505; Italy 98,628.
Ash and residue containing aluminum	539	698	29	West Germany 643.
Metal including alloys:				
Scrap	7,811	12,621	896	Ireland 5,664; West Germany 2,494; France 1,379.
Unwrought	182,165	175,823	103	Norway 109,018; Netherlands 13,940; West Germany 12,295.
Semimanufactures	251,763	298,650	3,984	West Germany 87,266; France 48,386; Belgium-Luxembourg 38,809.
Antimony:				
Oxides	1,325	1,416	11	France 944; China 238.
Metal including alloys, all forms	454	389	(2)	China 243; France 76; Hong Kong 26.
Arsenic: Oxides and acid	4,354	4,059	—	Sweden 1,212; France 1,011; Republic of South Africa 746.
Beryllium:				
Oxides and hydroxides	11	7	7	
Metal including alloys, all forms	1	7	3	Switzerland 1.
Bismuth: Metal including alloys, all forms	370	550	1	Australia 265; West Germany 91; China 72.
Cadmium: Metal including alloys, all forms	1,086	1,099	15	Finland 335; Netherlands 317; Canada 209.
Cesium and rubidium: Metals including alloys, all forms	1	(2)	(2)	
Chromium:				
Ore and concentrate	138,573	124,318	—	Republic of South Africa 111,655; Netherlands 7,995.
Oxides and hydroxides	712	541	NA	NA.
Metal including alloys, all forms	378	504	77	Japan 223; France 54.
Cobalt:				
Oxides and hydroxides	526	636	6	Canada 428; Belgium-Luxembourg 111; Finland 77.
Metal including alloys, all forms	2,433	2,014	111	Netherlands 431; Zaire 349.
Columbium and tantalum:				
Ore and concentrate	6	65	—	Canada 37; Nigeria 24.
Metals including alloys, all forms:				
Columbium (niobium)	17	20	2	West Germany 15; Switzerland 2.
Tantalum	42	64	20	West Germany 28; France 11.

See footnotes at end of table.

TABLE 3—Continued

UNITED KINGDOM: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS—Continued				
Copper:				
Ore and concentrate	10	68	23	Italy 26; Austria 12.
Oxides and hydroxides	1,794	2,166	188	Australia 728; Norway 574; West Germany 502.
Sulfate	8,111	10,579	321	France 5,756; Israel 1,159; Italy 988.
Ash and residue containing copper	63,831	34,071	774	Republic of South Africa 22,173; West Germany 5,913; Netherlands 2,815.
Metal including alloys:				
Scrap	10,539	14,344	3,661	West Germany 1,872; Ireland 1,655.
Unwrought	344,119	313,187	4,792	Peru 64,251; Chile 48,810; Canada 39,633.
Semimanufactures	103,106	119,448	1,595	West Germany 43,119; France 16,012; Italy 11,426.
Germanium: Metal including alloys, all forms	17	8	(2)	France 4; West Germany 4.
Gold:				
Waste and sweepings value, thousands	$110,349	$92,094	$9,915	Singapore $16,430; Chile $16,140;
Metal including alloys, unwrought and partly wrought troy ounces	r1,808,887	2,068,506	39,945	Switzerland 195,851; West Germany 52,897; unspecified 1,750,097.
Hafnium: Metal including alloys, all forms	5	2	2	
Iron and steel:				
Ore and concentrate:				
Excluding roasted pyrite thousand tons	14,558	18,028	—	Canada 6,417; Australia 3,524; Brazil 3,313.
Pyrite, roasted do.	249	168	(2)	Sweden 155; Norway 10.
Metal:				
Scrap	46,517	72,635	36,128	Canada 9,503; Ireland 5,894.
Pig iron, cast iron, related materials	133,421	125,707	213	Netherlands 29,048; Brazil 19,339; Canada 15,270.
Ferroalloys:				
Ferrochromium	94,767	109,992	NA	NA.
Ferromanganese	53,396	36,954	39	Norway 18,467; France 5,710; Republic of South Africa 4,800.
Ferromolybdenum	276	724	123	Austria 281; Belgium-Luxembourg 257.
Ferronickel	21,545	22,307	—	Greece 10,761; Dominican Republic 3,737; Indonesia 2,952.
Ferrosilicochromium	21	4	—	All from Austria.
Ferrosilicomanganese	27,821	21,524	—	Norway 10,339; Republic of South Africa 9,304; Czechoslovakia 1,842.
Ferrosilicon	65,641	76,352	NA	NA.
Silicon metal	37,476	40,911	5	France 15,963; Norway 10,582; Republic of South Africa 9,840.
Unspecified	12,551	15,285	645	Norway 5,249; France 2,871; Japan 2,008.

See footnotes at end of table.

TABLE 3—Continued

UNITED KINGDOM: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987	
				United States	Other (principal)
METALS—Continued					
Iron and steel—Continued					
Metal—Continued					
Steel, primary forms	thousand tons	1,127	1,128	(2)	West Germany 465; Netherlands 157; Belgium-Luxembourg 114.
Semimanufactures:					
Bars, rods, angles, shapes, sections	do.	889	962	3	Spain 162; Belgium-Luxembourg 112; Sweden 94.
Universals, plates, sheets	do.	1,594	1,710	4	West Germany 348; Belgium-Luxembourg 317; Netherlands 233.
Hoop and strip	do.	170	190	1	West Germany 78; France 27.
Rails and accessories	do.	12	29	(2)	Belgium-Luxembourg 12.
Wire	do.	60	69	1	Belgium-Luxembourg 21; France 16; West Germany 7.
Tubes, pipes, fittings	do.	387	326	1	West Germany 55; Netherlands 46; Italy 33.
Castings and forgings, rough	do.	24	25	(2)	France 5; West Germany 5; Netherlands 3.
Lead:					
Ore and concentrate		36,301	25,382	5,320	Spain 10,196; Honduras 5,500.
Oxides		1,175	1,484	6	Netherlands 879; West Germany 497.
Ash and residue containing lead		16,144	14,504	8,080	Norway 1,526; Ireland 806.
Metal including alloys:					
Scrap		3,817	10,456	516	Belgium-Luxembourg 3,655; Netherlands 1,220.
Unwrought		183,032	186,634	68	Australia 160,643; Canada 17,775.
Semimanufactures		12,115	14,051	9	Ireland 6,485; Belgium-Luxembourg 5,327.
Lithium:					
Oxides and hydroxides		—	883	177	West Germany 78; China 15.
Metal including alloys, all forms		—	51	NA	NA.
Magnesium: Metal including alloys:					
Scrap		1,205	479	29	Sweden 158; West Germany 121; Netherlands 71.
Unwrought		5,893	4,426	(2)	Norway 1,653; Canada1,203; Netherlands 1,124.
Semimanufactures		863	2,954	125	Belgium-Luxembourg 1,210; Norway 506; Yugoslavia 429.
Manganese:					
Ore and concentrate, metallurgical-grade		159,501	120,550	11	Republic of South Africa 65,078; Brazil 39,635; Morocco 4,545.
Oxides		5,463	5,199	187	Ireland 2,740; Norway 779; Belgium-Luxembourg 623.
Metal including alloys, all forms		4,916	2,484	161	Republic of South Africa 1,486; China 507; France 248.
Mercury	76-pound flasks	12,093	12,648	1,914	Netherlands 5,367; Spain 3,365.

See footnotes at end of table.

TABLE 3—Continued

UNITED KINGDOM: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS—Continued				
Molybdenum:				
Ore and concentrate	19,917	15,756	8,202	Peru 1,764; Netherlands 1,355.
Oxides and hydroxides	237	135	—	Netherlands 92; Belgium-Luxembourg 43.
Metal including alloys:				
Scrap	53	117	2	Austria 73; Netherlands 18; West Germany 9.
Unwrought	78	52	16	France 24; Ireland 4.
Semimanufactures	144	146	38	Austria 57; Netherlands 21.
Nickel:				
Ore and concentrate	8	159	—	All from Netherlands.
Matte and speiss	38,008	39,958	—	Canada 39,476.
Oxides and hydroxides	598	2,709	169	Australia 2,419.
Ash and residue containing nickel	424	1,230	210	Netherlands 629; Denmark 176.
Metal including alloys:				
Scrap	3,195	4,503	907	Netherlands 398; Canada 317.
Unwrought	16,081	18,157	165	Netherlands 7,863; Australia 2,849; Republic of South Africa 2,080.
Semimanufactures	4,503	4,922	2,124	West Germany 1,675; France 393.
Platinum-group metals:				
Waste and sweepings value, thousands	$71,052	$79,723	$19,441	Finland $6,812; Netherlands $6,137.
Metals including alloys, unwrought and partly wrought troy ounces	867,700	767,462	153,361	Canada 135,701; Republic of South Africa 111,929.
Rare-earth metals including alloys, all forms	61	57	1	Austria 29; France 19; West Germany 4.
Rhenium: Metal including alloys, all forms	2	13	6	Republic of South Africa 6; West Germany 1.
Selenium, elemental	394	462	39	Canada 131; Japan 64; Belgium-Luxembourg 55.
Silicon, high-purity	29	27	(2)	Japan 17; West Germany 8; France 1.
Silver:				
Ore and concentrate[3] value, thousands	$220,193	$213,939	$8,046	Canada $100,525; Republic of South Africa $88,844.
Waste and sweepings[3] do.	$28,359	$21,997	$3,310	Denmark $5,144; Sweden $2,830.
Metal including alloys, unwrought and partly wrought thousand troy ounces	r56,836	42,668	4,981	France 8,355; East Germany 6,966; Mexico 4,440.
Tellurium and arsenic, elemental	149	152	11	Sweden 43; Belgium-Luxembourg 28; Netherlands 23.
Tin:				
Ore and concentrate	30,166	26,280	35	Bolivia 11,518; Peru 7,117; Canada 5,911.
Oxides	29	38	(2)	Italy 6; unspecified 32.
Ash and residue containing tin	8,176	9,369	2,926	West Germany 2,109; Japan 852.

See footnotes at end of table.

TABLE 3—Continued

UNITED KINGDOM: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS—Continued				
Tin—Continued				
Metal including alloys:				
Scrap	302	446	214	Italy 49; Finland 41.
Unwrought	7,691	5,232	243	Singapore 1,970; Malaysia 651; Netherlands 622.
Semimanufactures	1,672	468	10	West Germany 125; Italy 120; Malaysia 88.
Titanium:				
Ore and concentrate	373,654	416,209	—	Norway 95,081; Sierra Leone 51,247; India 24,900.
Oxides	4,062	3,450	237	West Germany 1,387; Czechoslovakia 544; Italy 324.
Metal including alloys:				
Scrap	7,114	9,435	5,125	U.S.S.R. 2,792.
Unwrought	500	2,024	183	Japan 1,659.
Semimanufactures	1,243	1,179	826	Japan 99.
Tungsten:				
Ore and concentrate	549	311	—	Portugal 100; Netherlands 74; West Germany 46.
Oxides and hydroxides	—	2	(2)	West Germany 1.
Ash and residue containing tungsten	133	142	71	Sweden 36; Netherlands 35.
Metal including alloys:				
Scrap	265	229	14	West Germany 89; Austria 56; Denmark 32.
Unwrought	160	114	5	Republic of Korea 55; France 22; Belgium-Luxembourg 15.
Semimanufactures	134	81	11	Austria 22; West Germany 16; China 10.
Uranium and thorium: Metals including alloys, all forms:				
Uranium	1	4	4	
Thorium	—	2	(2)	Austria 1; West Germany 1.
Vanadium:				
Ore and concentrate	1	—		
Oxides and hydroxides	373	255	23	China 97; Finland 72; West Germany 27.
Ash and residue containing vanadium	43	67	67	
Metal including alloys:				
Scrap	3	(2)	—	All from West Germany.
Unwrought	119	202	5	West Germany 197.
Semimanufactures	33	37	16	West Germany 20.
Zinc:				
Ore and concentrate	201,098	177,233	—	Australia 57,767; Canada 34,215; Peru 28,229.

See footnotes at end of table.

TABLE 3—Continued

UNITED KINGDOM: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987	
			United States	Other (principal)
METALS—Continued				
Zinc—Continued				
Oxides	5,857	6,915	90	Mexico 1,994; West Germany 1,991; France 635.
Blue powder	1,237	1,718	33	West Germany 1,196.
Matte	24	137	—	West Germany 92; Morocco 34; Spain 11.
Ash and residue containing zinc	18,631	26,808	874	Australia 11,650; West Germany 6,172; Spain 5,143.
Metal including alloys:				
Scrap	2,651	4,601	144	France 1,436; West Germany 1,139; Canada 630.
Unwrought	105,781	121,491	2	Netherlands 38,138; Finland 26,944; Canada 26,466.
Semimanufactures	2,999	3,724	11	West Germany 1,292; France 880; Netherlands 824.
Zirconium:				
Ore and concentrate	33,275	37,308	137	Australia 25,119; Republic of South Africa 11,609.
Metal including alloys:				
Scrap	74	81	44	Canada 32.
Unwrought	70	185	60	Norway 55; Sweden 42.
Semimanufactures	35	48	33	Switzerland 9; Sweden 4.
Other:				
Ores and concentrates	34	429	3	France 241; Bolivia 183.
Oxides and hydroxides	1,143	883	516	Canada 163; Spain 93.
Ashes and residues	8,035	58,778	2,645	Canada 46,919; Sweden 3,133; West Germany 1,798.
Base metals including alloys, all forms	20	141	78	West Germany 17; Belgium-Luxembourg 16.
INDUSTRIAL MINERALS				
Abrasives:				
Natural: Corundum, emery, pumice, etc.	174,863	169,676	119	Greece 69,122; Italy 61,602; Iceland 25,416.
Artificial:				
Corundum	16,339	18,775	254	Canada 12,202; West Germany 3,623; France 1,297.
Silicon carbide	17,779	24,838	98	Norway 14,133; West Germany 4,127; Spain 2,323.
Dust and powder of precious and semiprecious stones including diamond value, thousands	$13,609	$14,335	NA	NA.
Grinding and polishing wheels and stones	6,042	6,601	169	Netherlands 1,267; West Germany 1,164; France 1,137.
Asbestos, crude	26,765	23,865	250	Canada 17,338; Republic of South Africa 3,294; Italy 2,706.

See footnotes at end of table.

TABLE 3—Continued

UNITED KINGDOM: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
INDUSTRIAL MINERALS—Continued					
Barite and witherite		90,386	112,042	20	Ireland 36,478; Morocco 31,819; Norway 14,239.
Boron materials:					
Crude natural borates		68,194	72,507	—	Turkey 71,875.
Elemental		1	34	22	Japan 7; Austria 3.
Oxides and acid		4,731	5,609	—	France 5,536.
Bromine		8,454	8,968	762	Israel 8,176.
Cement		650,224	978,267	169	Ireland 267,194; Greece 176,661; East Germany 159,790.
Chalk		7,727	18,038	—	France 8,599.
Clays, crude:					
Bentonite		102,572	98,133	21,740	Greece 37,651; Cyprus 25,362.
Chamotte earth		26,371	38,437	6,045	France 27,390; Republic of South Africa 1,974.
Fuller's earth		1,430	1,284	898	West Germany 242.
Kaolin		4,678	7,658	1,003	Spain 2,324; Belgium-Luxembourg 2,020.
Unspecified		36,364	59,582	11,881	France 20,577; Senegal 18,468.
Cryolite and chiolite		1,033	864	—	Denmark 758; West Germany 104.
Diamond:					
Gem, not set or strung	value, thousands	$2,470,074	$2,629,894	NA	NA.
Industrial stones	do.	$39,367	$33,119	NA	NA.
Diatomite and other infusorial earth		26,413	25,689	1,711	Denmark 18,186; France 2,953; Iceland 2,195.
Feldspar, fluorspar, related materials:					
Feldspar		59,377	53,985	—	Norway 25,859; Finland 15,009; Sweden 10,893.
Fluorspar		4,314	4,295	—	Mexico 4,003; France 280.
Unspecified		79,158	—		
Fertilizer materials:					
Crude, n.e.s.		2,835	1,029	—	France 760; Ireland 149; Sweden 108.
Manufactured:					
Nitrogenous	thousand tons	1,082	915	29	Netherlands 371; Belgium-Luxembourg 264.
Phosphatic	do.	275	287	—	Netherlands 104; Tunisia 38; Morocco 32.
Potassic	do.	479	759	([2])	East Germany 256; West Germany 170; Netherlands 139.
Unspecified and mixed	do.	534	640	16	Netherlands 196; Belgium-Luxembourg 89; Sweden 71.
Graphite, natural		32,104	19,728	258	China 8,656; Madagascar 3,703; Sri Lanka 2,978.
Gypsum and plaster		86,171	144,106	400	Spain 45,361; Ireland 32,775; France 18,933.

See footnotes at end of table.

TABLE 3—Continued

UNITED KINGDOM: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
INDUSTRIAL MINERALS—Continued					
Iodine		1,546	1,633	6	Japan 1,162; Chile 398.
Kyanite and related materials		44,639	48,717	10,408	Republic of South Africa 24,677; France 10,304.
Lime		7,289	6,442	—	Ireland 5,484; France 747.
Magnesium compounds:					
Magnesite, crude		9,241	7,778	58	Greece 4,557; Turkey 3,150.
Oxides and hydroxides		115,292	121,752	279	Greece 26,155; Spain 21,090; Netherlands 17,515.
Sulfate		18,564	19,494	—	East Germany 11,158; West Germany 8,336.
Mica:					
Crude including splittings and waste		20,015	19,942	189	China 10,045; Netherlands 2,548; France 2,082.
Worked including agglomerated splittings		513	474	6	Belgium-Luxembourg 154; France 143; West Germany 52.
Nitrates, crude		6,677	5,060	—	Chile 3,637; West Germany 1,330.
Phosphates, crude		936,153	758,084	—	Morocco 424,384; Tunisia 228,785.
Pigments, mineral:					
Natural, crude		2,687	5,313	29	India 2,040; Cyprus 1,333; Austria 1,284.
Iron oxides and hydroxides, processed		33,323	36,291	420	West Germany 28,015; Spain 1,242; Italy 1,012.
Potassium salts, crude		32,144	25,912	—	West Germany 15,967; East Germany 9,865.
Precious and semiprecious stones other than diamond:					
Natural	value, thousands	$70,482	$86,769	$125	Switzerland $1,872; unspecified $82,666.
Synthetic	do.	$1,953	$3,003	$193	Republic of South Africa $1,318; Belgium-Luxembourg $445; West Germany $411.
Pyrite, unroasted		15,540	12,830	NA	NA.
Salt and brine		358,514	222,668	439	Morocco 52,580; Italy 44,984; France 29,886.
Sodium compounds, n.e.s.: Sulfate including cadmium sulfate, manufactured		149,072	120,062	37	Belgium-Luxembourg 39,374; Sweden 38,364; Spain 19,982.
Stone, sand and gravel:					
Dimension stone:					
Crude and partly worked		200,454	214,672	375	Norway 176,489.
Worked		92,239	112,071	303	Italy 33,711; Spain 23,731; Portugal 22,959.
Dolomite, chiefly refractory-grade		168,168	171,329	114	Spain 114,787; Norway 43,403.
Gravel and crushed rock		859,569	785,714	2,030	Ireland 350,317; France 103,860; Netherlands 94,045.
Limestone other than dimension		2,155	433	—	France 193; Ireland 161; Italy 57.

See footnotes at end of table.

TABLE 3—Continued

UNITED KINGDOM: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
INDUSTRIAL MINERALS—Continued				
Stone, sand and gravel—Continued				
Quartz and quartzite	9,204	4,057	457	Italy 597; Portugal 592.
Sand other than metal-bearing	58,042	87,149	1,731	Belgium-Luxembourg 63,281; Netherlands 10,181; West Germany 7,017.
Sulfur:				
Elemental:				
Crude including native and byproduct	684,569	618,984	NA	NA.
Colloidal, precipitated, sublimed	564	379	4	France 259; West Germany 45; Belgium-Luxembourg 42.
Dioxide	1,198	837	—	All from Sweden.
Talc, steatite, soapstone, pyrophyllite	68,409	70,675	NA	France 6,000; unspecified 63,761.
Vermiculite, perlite, chlorite	138,363	115,705	4,477	Republic of South Africa 44,730; Italy 35,177; Greece 16,723.
Other:				
Crude	2,754	267,341	4,620	Norway 155,535; Spain 34,097; France 17,396.
Slag and dross, not metal-bearing	534,417	704,392	1,811	Belgium-Luxembourg 269,395; France 259,876; Netherlands 118,364.
MINERAL FUELS AND RELATED MATERIALS				
Asphalt and bitumen, natural	9,339	11,390	2,559	Trinidad and Tobago 4,253; France 3,910.
Carbon:				
Carbon black	104,477	39,096	1,998	France 16,786; West Germany 9,494; Netherlands 6,385.
Gas carbon	1,483	2,253	51	East Germany 643; West Germany 474; Mexico 419.
Coal:				
Anthracite thousand tons	595	573	10	West Germany 225; Netherlands 145; China 89.
Bituminous do.	9,959	9,208	2,649	Australia 2,698; Netherlands 1,530.
Briquets of anthracite and bituminous coal do.	89	129	—	West Germany 96; Netherlands 15; France 12.
Lignite including briquets do.	21	19	([2])	East Germany 12; West Germany 5; Netherlands 1.
Coke and semicoke	216,169	248,399	24,046	East Germany 85,597; Netherlands 59,316; Belgium-Luxembourg 31,019.
Gas, natural: Gaseous million cubic feet	497,340	458,647	([2])	Mainly from Norway.
Peat including briquets and litter	235,203	241,861	4	Ireland 211,497; U.S.S.R. 12,034.
Petroleum:				
Crude thousand 42-gallon barrels	r237,312	223,612	1,606	Norway 109,932; Turkey 23,368; Mexico 16,977.

See footnotes at end of table.

TABLE 3—Continued

UNITED KINGDOM: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
MINERAL FUELS AND RELATED MATERIALS—Continued					
Petroleum—Continued					
Refinery products:					
Liquefied petroleum gas	thousand 42-gallon barrels	6,253	9,343	283	Algeria 3,166; Netherlands 983; Kuwait 947.
Gasoline, motor	do.	50,297	8,439	1,144	Netherlands 5,476; Belgium-Luxembourg 1,098.
Mineral jelly and wax	do.	134	184	4	Netherlands 98; West Germany 16; Republic of South Africa 16.
Kerosene and jet fuel	do.	4,372	6,910	160	Netherlands 2,665; Italy 984; Spain 756.
Distillate fuel oil	do.	14,521	12,716	61	U.S.S.R. 3,992; Netherlands 3,730; Belgium-Luxembourg 1,434.
Lubricants	do.	12,920	14,050	173	Netherlands 6,663; Belgium-Luxembourg 1,419; France 967.
Residual fuel oil	do.	75,811	64,070	37	U.S.S.R. 14,744; Netherlands 10,807; Libya 9,465.
Bitumen and other residues	do.	428	799	(2)	France 559; Belgium-Luxembourg 148; Netherlands 85.
Bituminous mixtures	do.	29	38	4	France 15; West Germany 6.
Petroleum coke	do.	3,141	2,987	450	Netherlands 1,663; Belgium-Luxembourg 787.

r Revised. NA Not available.
1 Table prepared by P. J. Roetzel.
2 Less than 1/2 unit.
3 May include other precious metals.

mine could produce 25,600 tons of zinc, 5,840 tons of copper, 25 tons of silver and a small amount of gold per year. Development of the project was planned to be two phases. Phase 1 would involve the sinking of a 540-meter-deep, 4.75-meter-diameter shaft, which was expected to be finished by June 1990, and the development of two levels for bulk sampling and diamond drilling. If the project proved successful, phase 2 would commence and would encompass the development and commissioning of the mine and the mineral processing plant. Production costs at the proposed mine were estimated at about $31 per ton of ore milled with revenues of $65 per ton based on May 1988 metal prices.

Gold.—There was a considerable increase in gold exploration in the United Kingdom in 1988 in line with the level of exploration activity worldwide. Also, it was reported that as of March 31, 1988, about 13 companies held prospecting licenses in Northern Ireland, and 10 of these companies held concurrent licenses for exploration of precious metals in the same area.

Ennex International PLC continued development of its Curraghinalt gold deposit in the Sperrin Mountains, County Tyrone, Northern Ireland. The company had completed a 400-meter development and exploration adit at yearend 1988. Lateral drilling on the main ore vein was underway. The company also announced that it had doubled its estimate of ore reserves at the Cononish gold property near Tyndrum in Scotland. At yearend, the reserves were estimated to be 925,000 tons with grades averaging 0.28 ounce of gold per ton and 1 ounce of silver per ton. Ennex had received planning permission for an 850-meter exploration adit. Drilling at the nearby Beinn Udlaidh project located erratic gold and silver mineralization. The best intersection from a series of drill holes graded 0.08

ounce of gold per ton and 3.5 ounces of silver per ton over a length of 3 meters.

Iron and Steel.—Iron ore production in the United Kingdom supplied less than 2% of total requirements. The remainder was imported from various countries, mainly Canada, Australia, Brazil, and Sweden. Egremont Mining Co.'s Florence Mine in Cumbria continued to produce a small amount of hematite for specialized applications.

Raw steel production continued to increase owing to continued strong demand. BSC's steel plants were producing at about 100% of capacity, and the ironmaking facilities at 103% of capacity. In the United Kingdom, BSC's sales of finished steel were up 18% in fiscal year 1987-88 and commanded 52% of the United Kingdom market. After the privatization of BSC in late 1988, all steel firms in the United Kingdom were under private ownership. This was the first time since 1932 that there was an absence of Government regulation or control of the steel industry.

BSC closed one of its three tin-plate plants in late 1988. The Velindre facility in Wales had produced about 20% of BSC's tinplate. The company has made about 1 million tons of tinplate annually and was the United Kingdom's only tinplate producer. The two remaining facilities planned to increase output to compensate for the shutdown.

BSC announced in late 1988 that it would install a second continuous slab caster at its Port Talbot plant. It was expected that the new caster would enable Port Talbot to operate on a 100% continuous cast basis. The new casters would cost $135 million and were expected to be operational in 1991. Port Talbot was capable of producing 3 million tons of raw steel per year, but was restricted to the capacity of its continuous caster, which could only handle 2 million tons per year.

BSC's steel export terminal at the Teesside Works handled more than 1 million tons of steel for the second year in a row. The 1-millionth ton, composed of slabs and structurals, was bound for the United States. The terminal has been in operation for 14 years and handles one-fourth of the company's exports.

Tin.—The only base metal mined in significant amounts in the United Kingdom is tin. The tin industry continued to be influenced by the prolonged depression in tin prices. In early 1988, RTZ sold its subsidiary, Carnon Consolidated Ltd., to interests representing the local management and work force. Carnon was the last company mining tin in the United Kingdom and operated the Wheal Jane and South Crofty Mines in Cornwall. RTZ was providing $180 million of aid as an interest-free loan repayable if profits reached a certain level. The Department of Trade and Industry improved its existing aid package up to $450 million of interest-free credit as an additional help. Carnon continued with its modernization and development plans. At South Crofty, the plans included deepening of workings from 768 meters to 860 meters, installing new pumping equipment, and improving shaft access.

The new management at Carnon announced plans to produce tungsten and fluorspar concentrates in addition to the existing output of tin.

RTZ was also considering the sale of its Capper Pass tin smelter at North Ferriby. In late 1988, the company announced a major reorganization plan in order to make the operation viable. The plan involved a major reduction in output of electrolytic tin and the loss of 328 jobs. In the future, the company planned to produce 10,000 tons per year of electrolytic tin compared with an existing capacity of 22,000 tons per year.

Other Metals.—Deeside Aluminum PLC was expanding its production of aluminum billets over the next 2 years to 50,000 tons per year. The first stage was operational in September 1988 and raised capacity to 35,000 tons per year. The second phase was scheduled for completion in 1989.

Inco Ltd. was investing $20 million to modernize and expand operations at the Inco Alloys Ltd. nickel-alloy rolling mill at Hereford. The plans included a new tube reducer, modernization of the extrusion press and melting furnaces, and a new coil cutting lime.

Almost all of the zinc produced in 1988 was a byproduct of the Wheal Jane tin mine in Cornwall. A small amount was produced as a byproduct of barite operations at Strontian, Scotland. Lead was primarily a byproduct of fluorspar operations in Derbyshire. Canada Tungsten Mining Corp. Ltd. extended its option on the Hermerdon tungsten property near Plymouth. However, plans to develop the property were deferred owing to the depressed tungsten market.

***Industrial Minerals.*—Aggregates.**—Aided by a continuing construction boom, the aggregate industry had an outstanding performance in 1988. Production of aggregates was about 290 million tons, which exceeded the previous alltime high of 256 million tons in 1976. The acquisition of U.S. crushed stone operations continued by United Kingdom firms. About 10 U.S. operations have been purchased by 6 firms from the United Kingdom in the last 5 years.

Beazers PLC, a building company, acquired Koppers Co. of the United Kingdom. Koppers is the second largest producer of aggregates, after Vulcan Materials Co., in the United States. The $1.7 billion acquisition cost covers 80 quarries, 24 sand and gravel plants, and Kopper's chemical division throughout a 13-state area. Tarmac PLC bought out the remaining 40% of its U.S. subsidiary, Tarmac-Lone Star, which is based in Virginia and North and South Carolina. Cost for the total operation, which consists of seven crushed stone plants and several ready-mixed and concrete-products plants, was estimated at more than $400 million. English China Clays

PLC also entered the U.S. aggregate industry in early 1988 when it purchased J. L. Shiely Co. for $73 million. The company also announced its proposed purchase of the calcium carbonate business of Cyprus Minerals Co.

On the domestic scene, Evered Holdings PLC took over the quarrying interest of London and Northern Group and further expanded its activities by acquiring Aberdeen Construction Group PLC. RTZ disposed of its interests in aggregate and cement production with the sale of Thomas W. Ward Ltd. and Tunnel Holdings to the RMC Group for $59 million. This purchase increased RMC's annual output by 2.5 million tons per year and made the company a significant producer of dimension stone.

Cement.—Castle Cement, the United Kingdom's second largest cement producer, after Blue Circle Industries PLC, was sold by the parent company RTZ to Aber Norcem A/S of Norway and Industries AB Euroc of Sweden, with each to own 50%. The cost was about $410 million. The acquisition was part of an expressed strategy by both groups to establish a firmer foothold in the European Community (EC). Castle Cement, with plants in Kelton, Padeswood, Pitstone, and Ribblesdale, has about 400 million tons per year of production capacity. All of this is sold in the United Kingdom and represents about 25% of the total domestic market. The company has a network of depots providing good nationwide coverage.

Construction activity continued on a high level throughout the year. Demand exceeded the supply, and manufacturers were supplementing their own production with imports. The price of cement, after having been stable for several years, was raised about 6% in late 1988.

Clays.—The United Kingdom was the leading world producer and the largest exporter of ball clay. Also, it was the world's second largest producer of kaolin (china clay), after the United States, and was the largest exporter. The industry has been experiencing strong demand in recent years, and output has been rising steadily since 1982. Production in 1988 was at an alltime high.

The significant rises in production of clays in 1988 were due in part to English China Clays opening of a new quarry, the Old Pound pit near Cornwall, and the reopening of the Lower Ninestones pit. These operations produced both paper coating and filler-grade clays. The ball clay industry experienced strong demand from the ceramic and wall tile industries. Watts, Blake, Bearne & Co. PLC, the largest producer with about 13 mines in Devon, was producing about 400,000 tons annually in order to meet demands from its customers. Laporte Industries Ltd. was continuing its exploration and development activities for bentonite. The company was planning to develop a bentonite deposit near Redhill, south of London.

Other Industrial Minerals.—The United Kingdom remained a net importer of barite. The main producer was M. I. Great Britain Ltd. with operations at Aberfeldy, Scotland. Both Strontian Minerals Ltd., at Strontian, Scotland, and Ashover Consolidated Mining, at Eaglesham, Strathclyde, ceased operations in 1988. Laporte Minerals produced byproduct barite and limestone aggregate from its fluorspar operation in Derbyshire. The fluorspar operation consisted of both underground and open pit operations near Stoney Middleton. Laporte produces about 75,000 tons per year of acid grade fluorspar.

British Gypsum Ltd. continued as the sole producer of gypsum in the United Kingdom. Approximately three-quarters of the gypsum mined was calcined for plaster and plasterboard. Most of the remaining uncalcined material was used by the cement industry. A small amount of 99% purity gypsum was furnished to the dental and pharmaceutical sectors. Mining was carried out by underground and open pit operation in the northwest, northern Midlands, and the southeastern part of the country. Redland Plasterboard, a joint venture between Redland PLC (51%) and CSR Ltd. (49%), began construction of a plaster and plasterboard plant in Bristol, Avon, in 1988. The plant was scheduled to become operational in 1990 and planned to utilize imported gypsum from Spain.

Anglo European Minerals Ltd. applied for permission to operate two quarries in Scotland. One quarry would exploit talc, the other white marble. The talc project would involve a 50% joint venture with Palraida Mineral Ventures to exploit a deposit on the Isle of Shetland near the Village of Cunnigsburgh. Reserves of 4 million tons have been delineated, and the intended production would be about 300,000 tons per year. The only significant source of talc has been on the island of Unst in the Shetlands, produced by Alexander Sandison and Sons Ltd. Production has been approximately 15,000 tons per year. Anglo European's other project, operated by Leadmere Marble, was a white marble operation near Ullapool. The ore was of a high whiteness of 89% to 90%, and some products were graded at 93% to 94% whiteness. The major market would be the paper industry, which uses such material as a filler and pigment coating, depending on the grade.

Mineral Fuels.—The Government continued with plans to privatize the Central Electricity Generating Board, the principal customer for coal in the United Kingdom. More than 75% of British Coal's sales was to the electricity industry in 1988. The coal industry was intent on retaining this share through long-term contracts in order to avoid being displaced by imported coal. The Government also confirmed its intention to privatize British Coal, although not until the next Parliament.

Coal.—The withdrawal of underground mining capacity continued during 1988 when 15 collieries ceased production. Among the collieries was the Cynheidre colliery near Llanelli, which was one of the two remaining large anthracite coal producers in the United Kingdom. The closures represented a loss of about 7 million tons of annual capacity. Further closures were expected through exhaustion of reserves, difficult geologic conditions, and financial pressures. The extent of closures would depend on how well the industry can increase efficiency and operating costs and on the level of coal imports.

In 1988, eight collieries were merged into four single units, and three new collieries within the Selby Complex commenced operation. Also, Europe's longest underground conveyor became operational at the Gascoigne Wood Mine within the Selby Complex. Dirt contamination of coal continued to be a problem at the Selby Complex. British Coal was blending Selby coal with clean coal brought in from other areas in order to bring the product up to specifications. No coal preparation plant was planned for Selby at the time of construction because it was considered that coal, with an average ash content of only 15%, could be mined.

British Coal announced that Thoresby Colliery near Mansfield, Nottingham, had become the first Midlands mine to top 2 million tons per year. The colliery was one of the most efficient mines in Europe. Productivity, measured in output per worker per shift, was 7.43 tons, nearly twice the national average.

Covendish Coal Ltd. completed its management buy in of the Viaduct Mine near Murkirk, Ayrshire. The mine was being developed to produce 50,000 tons per year of high-quality domestic and industrial coal making it the largest private underground coal mine in the United Kingdom. A dense-medium coal processing plant was to be built on-site.

British Coal awarded its largest long-term contract in 20 years to Crouch (Mining) Ltd., the opencast mining division of Ryan International. The contract, worth about $270 million, was to extract 15 million tons of coal from the Dalguhandy site in Scotland. This coal would provide a substantial proportion of the requirements of the Kilroot power station in Northern Ireland for the next 20 years. In line with this, an order was placed by the Government for the construction of storage and shiploading facilities capable of handling 1,200 tons per hour at Point of Ayr, North Wales. These facilities would be used for shipping coal to the Kilroot power station. Crouch also started mining on a 2.5-million-ton site at Chalmerston, Ayrshire. Along with other mines, this site brings the company's contracted reserves to more than 24 million tons. Because its production rate approached 3 million tons a year, Crouch was the largest opencast coal mining company in the United Kingdom.

Natural Gas.—The United Kingdom sector of the North Sea experienced an upsurge in activity in 1988. Nine new gas projects, all in the southern basin, were approved by the Department of Energy. Sixteen more projects were considered likely to be contracted by the Government over the next 2 years. The concern by British Gas PLC that the Frigg Field would be depleted by 1992–93 has stimulated efforts to develop additional reserves.

The company had originally planned to replace the Frigg output with gas imports from the Norway sector of the North Sea, until the Government vetoed that option. Norway was the obvious choice as there would be spare capacity in the Frigg gas lines; however, Government permission was required to import natural gas.

The largest natural gas deposits were in the southern areas of the North Sea. The gas in the southern basin was sweet gas, whereas gas in the northern area of the North Sea was sour gas. Total gas production from the United Kingdom Continental Shelf continued to rise. This was encouraging because the United Kingdom could face a gas shortage by the early 1990's.

Conoco (UK) Ltd.'s "V" fields gas development was officially inaugurated in 1988. The "V" fields consisted of the North and South Valiant, Vulcan, and Vanguard Fields and a 75-mile-long, 36-inch-diameter pipeline to Conoco's gas terminal at Theddlethorpe, Lincolnshire. The $1.6 billion production complex and the Lincolnshire Offshores Gas Gathering System (Loggs) could handle 2 billion cubic feet per day of gas, slightly more than 20% of consumption. The "V" fields had combined reserves of 1.9 trillion cubic feet.

More developments in the southern basin included British Petroleum Co. PLC and Britoil PLC's approval for the $465 million development of the East and West Amethyst Fields, which had recoverable gas reserves of 850 billion cubic feet. Phillips Petroleum Co. (UK) Ltd. was given Government approval to develop the Della Field, which contained 41 billion cubic feet of recoverable gas.

There were 27 drilling rigs working in the Southern Basin in 1988, up from 19 at yearend 1987. It was expected activity would have been higher if not for the shortage of available rigs.

Peat.—It was reported that Amercoeur Energy opened a peatlog factory in Northern Ireland at an estimated cost of $535 million. The company planned to harvest peat from its 540-hectare peat bogs at Dungiven and process it into peatlogs. This is a clean, convenient, and prepackaged solid fuel for the domestic market, which can be substituted for coal. Peat production was about 10,000 tons per year, and production was planned to be doubled in 1989. Proven reserves of high quality peat suitable for fuel were estimated to be in excess of 1.5 million tons.

Petrochemicals.—Shell Chemicals, a subsidiary of the Royal Dutch/Shell Group announced plans for a pipeline to transport ethylene to two of its chemical facilities, in Carrington, Manchester, and Stanlow, Cheshire. Both plants made plastics such as polyethylene and other materials used in motor oils and detergents.

The transmission facility was expected to ease supply shortages, which have caused both plants to work below capacity in recent years. The pipeline would connect with an existing ethylene transmission network on the west coast and ensure that Shell could increase production at the Carrington and Stanlow plants.

Petroleum.—North Sea accidents have curtailed the United Kingdom petroleum output by nearly 25%, which seriously damaged the trade surplus on petroleum. In July 1988, Occidental Petroleum's Piper Alpha platform was destroyed by fire and explosions. The five oilfields linked to this platform ceased production. In December 1988, the Fulmer Field storage tanker used for collection broke loose from its permanent moorings. Production from three fields was suspended. A gas leak on Shell's Brent Delta platform in early 1988 resulted in a mishap causing shutdown of the platform. These three accidents caused a loss of 580,000 barrels per day of petroleum output.

However, the medium term outlook was optimistic. A study released in late 1988 states that North Sea petroleum reserves increased significantly in 1988. These reserve additions, both new discoveries and upward revisions in already discovered fields, led to an improved outlook on North Sea petroleum production. More than 1 billion barrels, representing nearly 20% greater production, was discovered in 1988.

There were several discoveries of considerable size such as the Nelson discovery by Enterprise Oil, which was estimated to contain 300 million barrels; the Amerada Hess and Amoco's Waverly/Brunel discovery, which was estimated to contain 420 million barrels; and confirmation by BP that the onshore Wytch Farm Oilfield in Dorset extends offshore under Poole Bay. This added another 100 million barrels to onshore reserves and made the field comparable in size to some of the major oilfields in the North Sea.

It was expected that, by improving recovery techniques and extending the life of existing reservoirs, a production level of 2.1 million barrels per day could be maintained until 1995.

IRELAND

Ireland continued to be a significant producer of alumina, barite, lead, peat, and zinc. Exploration activity showed a marked increase with continuing emphasis on gold. A number of companies reported good results from gold prospects in different geographic areas.

The Government has identified as its priority objective the stabilization of the national debt, which has escalated to the equivalent of 150% of the gross national product (GNP). The austerity program, which was started in 1987 to reduce public spending and borrowing and to improve the financial condition of private industry, continued through 1988. The Government was taking steps to prepare the country for 1992 when the internal trade barriers of the EC member nations will be eliminated.

Despite a high unemployment rate of about 18%, the program appeared to be working. Public expenditures were reduced from 13.2% of GNP in 1986 to 7% of GNP in 1988. The budget deficit was narrowed from 8.6% of GNP in 1986 to 5% of GNP in 1988. The prime interest rate was 8%, and the inflation rate was 1.8% in 1988. The average rate of inflation in the EC was 2.8% in 1988.

Production and Trade

Tara Mines Ltd., at Navan, continued to be the only metals mine operating in 1988. The company produced an estimated 180,000 tons of zinc concentrate and 36,000 tons of lead concentrate from the Navan ore body. Bula Mines Ltd., which holds an adjacent part of the ore body remained in receivership at yearend, as did Avoca Mines Ltd. in County Wicklow.

Ireland is a significant base metal producer and currently produces about 18% of the total mine production and approximately 10% of total lead production in Western Europe.

Base metal exploration continued to be encouraged by positive results from Conroy Petroleum and Natural Resources at its Galmoy lead-zinc prospect. Two mineralized zones have been identified with assays averaging 12.5% combined lead-zinc. Ennex International and Chevron Mineral Corp. continued exploration on nearby prospects.

Gold exploration continued with Burmin Exploration and Development PLC prospects in County Mayo. Gold-bearing horizons were identified, and sampling produced material assaying 2 ounces of gold per ton. Ennex and Ovoca Gold Exploration PLC continued assessment of their gold prospects in the Dooros area of Connemara.

The Geologic Survey of Ireland published a study of the gold potential of the country. The study, which listed 130 known gold localities in Ireland, provided assistance in gold exploration.

The construction industry reflected the perceptible improvement in the economy with interest in industrial minerals increasing. Several companies were pursuing exploration and evaluation efforts on various minerals including gypsum, heavy-minerals sands, and talc.

Mineral fuels also drew its share of attention with exploration concentrated mostly on anthracite coal deposits. Most coal exploration efforts were in the Leinster Coalfield. Ireland's production was mainly high-ash subbituminous coal from the Connacht Coalfield. Very little anthracite coal was being produced.

Irish exports and imports of goods and services rose about 15% and 5%, respectively. The balance of payments on current accounts remained in the

TABLE 4

IRELAND: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987	1988[p]
METALS						
Alumina	thousand tons	653	555	686	784	843
Iron and steel: Steel, crude	do.	166	203	208	220	271
Lead:						
Mine output, Pb content		37,200	34,600	36,400	33,800	32,500
Metal, refined, secondary		9,100	9,000	10,200	9,600	[e]10,000
Silver, mine output, Ag content	thousand troy ounces	279	276	262	231	180
Zinc, mine output, Zn content		205,900	191,600	181,700	177,000	173,200
INDUSTRIAL MINERALS[2]						
Barite	thousand tons	220	214	128	70	83
Cement, hydraulic	do.	1,377	1,457	1,398	1,448	1,685
Gypsum	do.	325	304	289	284	326
Lime		67,900	84,800	87,600	77,000	96,800
Magnesia[e 3]	thousand tons	75	75	65	70	—
Nitrogen: N content of ammonia	do.	371	338	355	399	[e]414
Sand and gravel[4]	do.	6,714	6,749	6,550	5,564	6,163
Stone and other quarry products:						
Limestone[4]	do.	10,598	9,337	7,865	6,970	9,680
Other[4 5]	do.	2,665	2,411	2,041	1,953	1,615
MINERAL FUELS AND RELATED MINERALS						
Coal, anthracite and bituminous	do.	70	57	54	45	42
Gas, natural: Marketed	million cubic feet	82,200	85,200	59,300	58,900	71,230
Peat:						
For agricultural use	thousand tons	96	96	97	81	[e]85
For fuel use:						
Sod peat[6]	do.	[r]963	[r]786	[r]782	336	1,147
Milled peat[7]	do.	[r]6,787	[r]1,884	[r]3,928	5,278	3,230
Total	**do.**	**[r]7,750**	**[r]2,670**	**[r]4,710**	**5,614**	**4,377**
Peat briquets	do.	[r]418	[r]492	[r]460	505	378
Petroleum refinery products:						
Liquefied petroleum gas	thousand 42-gallon barrels	162	186	302	255	210
Naphtha	do.	99	126	378	387	245
Gasoline, motor	do.	2,610	2,694	2,762	2,528	1,850
Distillate fuel oil	do.	3,120	3,255	3,788	3,945	3,160
Residual fuel oil	do.	2,886	3,166	3,744	3,556	3,075
Refinery fuel and losses	do.	659	365	685	390	400
Total	**do.**	**9,536**	**9,792**	**11,659**	**11,061**	**8,940**

[e] Estimated. [p] Preliminary. [r] Revised.
[1] Table includes data available through June 30, 1989.
[2] Ireland also produces significant quantities of synthetic diamond and is the major overseas supplier of this material to the United States. However, output is not quantitatively reported, and available general information is inadequate to make reliable estimates of output levels.
[3] Based on exports.
[4] Excludes output by local authorities and road contractors.
[5] Includes clays for cement production, fire clay, granite, marble, rock sand, silica rock, and slate.
[6] Includes production by farmers and by Bord Na Mona.
[7] Includes milled peat used for briquet production.

TABLE 5

IRELAND: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
METALS				
Alkali and alkaline-earth metals	22	5	(2)	Mainly to United Kingdom.
Aluminum:				
Oxides and hydroxides	669,362	741,487	25,207	Norway 207,748; United Kingdom 188,591; Canada 135,218.
Metal including alloys:				
Scrap	8,093	8,468	—	United Kingdom 4,958; France 1,253; Japan 1,239.
Unwrought	1,478	1,475	—	United Kingdom 1,441; Italy 24.
Semimanufactures	2,070	2,389	1	United Kingdom 1,307; France 64.
Arsenic: Oxides and acid	—	1	—	All to United Kingdom.
Beryllium: Metal including alloys, all forms	(2)	—		
Bismuth: Metal including alloys, all forms	—	(2)	—	Do.
Chromium:				
Oxides and hydroxides	20	—		
Metal including alloys, all forms	(2)	—		
Cobalt:				
Oxides and hydroxides	—	21	—	Finland 6; United Kingdom 5.
Metal including alloys, all forms	73	95	79	United Kingdom 13; West Germany 3.
Columbium and tantalum: Metal including alloys, all forms: Columbium (niobium)	3	(2)	—	All to United Kingdom.
Copper:				
Matte and speiss including cement copper	17	—		
Oxides and hydroxides	5	—		
Sulfate	24	16	—	Do.
Ash and residue containing copper	172	209	—	All to West Germany.
Metal including alloys:				
Scrap	6,312	9,783	—	Belgium-Luxembourg 2,861; West Germany 2,308; United Kingdom 1,557.
Unwrought	825	209	—	West Germany 81; United Kingdom 69; Belgium-Luxembourg 41.
Semimanufactures	1,862	3,375	653	West Germany 1,100; United Kingdom 569.
Gold:				
Waste and sweepings value, thousands	$991	$1,714	$4	United Kingdom $1,474; West Germany $233.
Metal including alloys, unwrought and partly wrought troy ounces	26,338	110	—	All to Japan.
Iron and steel: Metal:				
Scrap	40,751	26,249	—	United Kingdom 25,073; Belgium-Luxembourg 842.
Pig iron, cast iron, related materials	81	97	15	United Kingdom 71; Switzerland 5.

See footnotes at end of table.

TABLE 5—Continued

IRELAND: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
METALS—Continued				
Iron and steel: Metal—Continued				
Ferroalloys:				
Ferrochromium	(2)	—		
Ferromanganese	29	9	1	Belgium-Luxembourg 8.
Ferromolybdenum	2	—		
Silicon metal	7	21	—	All to United Kingdom.
Unspecified	—	16	—	Belgium-Luxembourg 10; United Kingdom 6.
Steel, primary forms	20	290	17	Netherlands 106; United Kingdom 76.
Semimanufactures:				
Bars, rods, angles, shapes, sections	179,847	198,955	252	United Kingdom 77,010; West Germany 34,425; France 23,787.
Universals, plates, sheets	5,280	6,720	—	United Kingdom 6,353; Belgium-Luxembourg 74.
Hoop and strip	579	510	(2)	United Kingdom 414; Italy 71.
Rails and accessories	228	130	—	United Kingdom 123; Belgium-Luxembourg 7.
Wire	1,187	1,000	3	United Kingdom 952; Belgium-Luxembourg 15.
Tubes, pipes, fittings	3,957	5,167	3	United Kingdom 4,567; West Germany 160.
Castings and forgings, rough	207	118	—	United Kingdom 64; Netherlands 27; France 17.
Lead:				
Ore and concentrate	60,400	56,218	3,057	West Germany 22,222; France 15,255; Republic of South Africa 5,000.
Ash and residue containing lead	58	62	—	India 57; United Kingdom 6.
Metal including alloys:				
Scrap	2,062	3,761	—	Belgium-Luxembourg 1,244; United Kingdom 1,131; Netherlands 1,024.
Unwrought	14	83	—	All to United Kingdom.
Semimanufactures	5,303	6,850	1	United Kingdom 6,699; Hong Kong 37.
Lithium: Metal including alloys, all forms	(2)	—		
Magnesium: Metal including alloys:				
Scrap	10	6	—	Mainly to West Germany.
Unwrought	4	(2)	—	All to United Kingdom.
Semimanufactures	4	2	—	Do.
Manganese: Oxides	46	42	—	West Germany 40; United Kingdom 2.
Mercury 76-pound flasks	(2)	—		
Molybdenum: Metal including alloys:				
Unwrought	3	6	—	United Kingdom 4; Republic of South Africa 2.
Semimanufactures	(2)	—		

See footnotes at end of table.

TABLE 5—Continued

IRELAND: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
METALS—Continued				
Nickel: Metal including alloys:				
Scrap	161	208	25	United Kingdom 152; West Germany 31.
Unwrought	35	7	3	United Kingdom 4.
Semimanufactures	244	228	—	United Kingdom 86; Switzerland 57; West Germany 51.
Platinum-group metals:				
Waste and sweepings value, thousands	$14	$192	—	United Kingdom $163; West Germany $30.
Metals including alloys, unwrought and partly wrought:				
Platinum troy ounces	53	59	32	United Kingdom 27.
Unspecified do.	13,728	20,139	—	All to United Kingdom.
Silver:				
Waste and sweepings value, thousands	$1,022	$1,636	—	United Kingdom $753; West Germany $646; Switzerland $228.
Metal including alloys, unwrought and partly wrought troy ounces	r4,533	17,265	289	West Germany 8,263; United Kingdom 6,141; Sweden 2,154.
Tin:				
Oxides	795	480	—	All to United Kingdom.
Ash and residue containing tin	—	88	—	Do.
Metal including alloys:				
Scrap	1,416	2,132	—	United Kingdom 2,068; Belgium-Luxembourg 40.
Unwrought	64	129	—	United Kingdom 86; Belgium-Luxembourg 44.
Semimanufactures	117	102	—	All to United Kingdom.
Titanium:				
Oxides	7	1	—	Do.
Metal including alloys:				
Scrap	—	19	—	Do.
Semimanufactures	12	6	1	United Kingdom 5.
Tungsten: Metal including alloys:				
Scrap	—	5	—	All to United Kingdom.
Unwrought	3	3	—	Do.
Semimanufactures	1	(2)	(2)	Singapore (2).
Uranium and thorium: Metal including alloys, all forms: Thorium	—	(2)	—	Mainly to United Kingdom.
Zinc:				
Ore and concentrate	368,974	352,778	—	Belgium-Luxembourg 158,181; Italy 89,346; Spain 25,799.
Oxides	88	40	(2)	Mainly to United Kingdom.
Blue powder	53	176	—	India 108; United Kingdom 68.

See footnotes at end of table.

TABLE 5—Continued

IRELAND: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
METALS—Continued				
Zinc—Continued				
Ash and residue containing zinc	142	179	—	All to West Germany.
Metal including alloys:				
Scrap	168	88	—	United Kingdom 49; France 21; India 18.
Unwrought	123	73	—	Mainly to United Kingdom.
Semimanufactures	37	5	—	Austria 1; Belgium-Luxembourg 1.
Zirconium: Metal including alloys, semimanufactures	—	1	—	All to United Kingdom.
Other:				
Oxides and hydroxides	46	19	—	United Kingdom 17; West Germany 2.
Ashes and residues	—	54	—	All to United Kingdom.
INDUSTRIAL MINERALS				
Abrasives:				
Natural: Corundum, emery, pumice, etc.	11	31	—	Do.
Artificial:				
Corundum	1	—		
Silicon carbide	r3	1	—	Do.
Dust and powder of precious and semiprecious stones kilograms	19,982	8,243	3,285	Japan 1,842; Republic of Korea 1,043.
Grinding and polishing wheels and stones	72	43	16	Singapore 11; United Kingdom 8.
Asbestos, crude	179	42	—	All to United Kingdom.
Barite and witherite	121,585	77,707	—	United Kingdom 39,509; Norway 19,740; Republic of South Africa 9,000.
Boron materials: Elemental	2	—		
Bromine	15	—		
Cement	254,898	270,873	21,896	United Kingdom 239,207; Norway 9,073.
Chalk	—	48	—	All to United Kingdom.
Clays, crude:				
Bentonite	102	209	NA	United Kingdom 53; unspecified 157.
Kaolin	1	—		
Unspecified	46	109	—	All to United Kingdom.
Diamond: Gem, not set or strung carats	—	208	—	Switzerland 206; United Kingdom 2.
Feldspar, fluorspar, related materials	72	—		
Fertilizer materials:				
Crude, n.e.s.	r2,460	280	—	All to United Kingdom.
Manufactured:				
Ammonia	100,992	103,626	—	United Kingdom 64,857; Spain 30,736; Netherlands 8,033.
Nitrogenous	r271,552	318,106	—	United Kingdom 119,288; France 66,700; West Germany 57,515.
Phosphatic	10	48	—	All to United Kingdom.

See footnotes at end of table.

TABLE 5—Continued

IRELAND: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
INDUSTRIAL MINERALS—Continued					
Fertilizer materials—Continued					
Manufactured—Continued					
Potassic		2,419	560	—	United Kingdom 229; unspecified 331.
Unspecified		57,969	39,490	—	United Kingdom 39,453; France 38.
Graphite, natural		19	38	—	All to United Kingdom.
Gypsum and plaster		56,196	51,916	—	United Kingdom 51,908; France 8.
Iodine		15	10	—	United Kingdom 8; Denmark 2.
Kyanite and related materials		—	4	—	All to United Kingdom.
Lime		6,884	5,245	—	Do.
Magnesium compounds: Oxides and hydroxides		1,200	8,514	2,560	United Kingdom 2,850; Belgium-Luxembourg 2,350.
Mica: Worked including agglomerated splittings		—	(2)	(2)	
Nitrates, crude		24	24	—	All to United Kingdom.
Phosphates, crude		992	1,126	—	United Kingdom 702; France 423.
Phosphorus, elemental		1	1	—	All to United Kingdom.
Pigments, mineral: Iron oxides and hydroxides, processed		21	—		
Potassium slats, crude		—	28	—	Do.
Precious and semiprecious stones other than diamond:					
Natural	value, thousands	$199	$192	$3	Austria $85; Greece $65; Italy $13.
Synthetic	do.	$4	$2	—	All to Greece.
Salt and brine		1,556	1,234	—	United Kingdom 1,233.
Sodium compounds, n.e.s.:					
Carbonate, manufactured		(2)	—		
Sulfate, manufactured	kilograms	300	200	—	All to United Kingdom.
Stone, sand and gravel:					
Dimension stone:					
Crude and partly worked		1,396	1,023	75	United Kingdom 684; Netherlands 176.
Worked		4,287	8,859	3,041	United Kingdom 4,284; Australia 1,018.
Gravel and crushed rock		388,510	457,982	—	United Kingdom 357,301; West Germany 96,148.
Limestone other than dimension		103	238	—	All to United Kingdom.
Quartz and quartzite		926	604	(2)	United Kingdom 542; Switzerland 39.
Sand other than metal-bearing		1,574	339	—	United Kingdom 211; unspecified 129.
Sulfur:					
Elemental: Crude including native and byproduct		—	4	—	All to United Kingdom.
Sulfuric acid		505	283	—	United Kingdom 282.
Talc, steatite, soapstone, pyrophyllite		134	—		
Vermiculite, perlite, chlorite		—	3	—	All to United Kingdom.

See footnotes at end of table.

TABLE 5—Continued

IRELAND: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Destinations, 1987	
				United States	Other (principal)
INDUSTRIAL MINERALS—Continued					
Other:					
Crude		277	58	—	Do.
Slag and dross, not metal-bearing		779	168	—	United Kingdom 149; Canada 19.
MINERAL FUELS AND RELATED MATERIALS					
Asphalt and bitumen, natural		19	—		
Carbon black		548	252	—	Netherlands 167; United Kingdom 61.
Coal:					
Anthracite		1,543	1,799	—	All to United Kingdom.
Bituminous		10,817	48,323	—	Do.
Lignite including briquets		55	971	—	Do.
Gas, natural: Gaseous	million cubic feet	1	—		
Peat including briquets and litter		243,658	273,046	18	United Kingdom 232,766; France 32,812; Netherlands 2,084.
Petroleum:					
Crude	42-gallon barrels	—	147,644	—	All to Belgium-Luxembourg.
Refinery products:					
Liquefied petroleum gas	do.	101,361	97,602	—	All to United Kingdom.
Gasoline, motor	do.	475,966	572,347	34	Netherlands 246,219; United Kingdom 189,371; West Germany 135,549.
Mineral jelly and wax	do.	999	1,125	(2)	Netherlands 543; Australia 197.
Kerosene and jet fuel	do.	20,499	96	NA	United Kingdom 80.
Distillate fuel oil	do.	306,710	3,588	—	United Kingdom 3,514; Spain 75.
Lubricants	do.	24,087	36,610	—	United Kingdom 32,585; West Germany 1,435.
Residual fuel oil	do.	3,979,370	3,506,310	232,780	United Kingdom 1,537,581; Netherlands 647,405; France 512,527.
Bitumen and other residues	do.	5,812	103	NA	Netherlands 6; unspecified 97.
Bituminous mixtures	do.	509	739	—	All to United Kingdom.
Petroleum coke	do.	—	27	—	Do.

[r] Revised. NA Not available.
[1] Table prepared by P. J. Roetzel.
[2] Less than 1/2 unit.

black for the second consecutive year. The trade surplus was over $2 billion dollars.

Commodity Review

Metals.—Aughinish Alumina Ltd. (AAL) continued to increase production at its alumina refinery. AAL plans to increase the capacity of its plant from the current 800,000 tons per year to 1 million tons per year by 1991 and has undertaken a $10 million expansion program. The refinery has been operating at about 110% of its rated capacity since 1987. The refinery was designed to allow for expansion to three times its original capacity.

Connary Minerals Ltd. was evaluating recovering gold from the waste dumps at the Avoca Copper Mine, County Wicklow, which was no longer operating. Connary's sampling program indicated ore in sufficient grade

TABLE 6

IRELAND: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS				
Alkali and alkaline-earth metals:				
Alkali metals	6	26	—	United Kingdom 25; West Germany 1.
Alkaline-earth metals	—	9	8	United Kingdom 1.
Aluminum:				
Ore and concentrate thousand tons	1,080	1,440	—	Guinea 1,371; Malaysia 65; China 4.
Oxides and hydroxides	4,415	4,234	725	United Kingdom 2,995; Netherlands 289.
Ash and residue containing aluminum	12	—		
Metal including alloys:				
Scrap	513	395	—	United Kingdom 178; Belgium-Luxembourg 113; Hungary 97.
Unwrought	3,789	2,252	—	United Kingdom 1,143; Norway 805; Italy 156.
Semimanufactures	36,202	39,518	2,145	United Kingdom 19,376; West Germany 5,710.
Antimony:				
Ore and concentrate	76	—		
Oxides	51	63	7	United Kingdom 53; West Germany 3.
Metal including alloys, all forms	2	([2])	—	All from United Kingdom.
Arsenic: Oxides and acids	15	37	—	Do.
Beryllium: Metal including alloys, all forms	([2])	([2])	([2])	
Bismuth: Metal including alloys, all forms	—	([2])	—	Do.
Cadmium: Metal including alloys, all forms	—	2	—	France 1.
Chromium:				
Ore and concentrate	29	3,010	—	China 2,998; Netherlands 10.
Oxides and hydroxides	129	236	—	United Kingdom 183; West Germany 38.
Metal including alloys, all forms	19	10	2	Japan 5; United Kingdom 3.
Cobalt:				
Ore and concentrate	—	1	—	All from United Kingdom.
Oxides and hydroxides	9	7	3	Finland 2; United Kingdom 2.
Metal including alloys, all forms	117	132	129	West Germany 3.
Columbium and tantalum: Metal including alloys, all forms: Tantalum	1	3	3	
Copper:				
Ore and concentrate	([2])	—		
Oxides and hydroxides	([2])	1	—	All from United Kingdom.
Sulfate	1,130	1,162	1	U.S.S.R. 450; Belgium-Luxembourg 228; United Kingdom 153.
Ash and residue containing copper	215	22	—	All from Belgium-Luxembourg.
Metal including alloys:				
Scrap	152	86	—	All from United Kingdom.
Unwrought	179	186	—	United Kingdom 185; Sweden 1.
Semimanufactures	23,589	19,872	131	United Kingdom 7,983; Belgium-Luxembourg 3,719; Sweden 2,216.

See footnotes at end of table.

TABLE 6—Continued

IRELAND: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS—Continued				
Germanium: Metal including alloys, all forms	1	—		
Gold:				
Waste and sweepings value, thousands	$1	$16	—	All from United Kingdom.
Metal including alloys, unwrought and partly wrought troy ounces	171,051	50,700	64	United Kingdom 42,086; Japan 4,278; Sweden 4,083.
Hafnium: Metal including alloys, all forms	—	([2])	—	All from West Germany.
Iron and steel:				
Ore and concentrate:				
Excluding roasted pyrite	80	40	—	All from United Kingdom.
Pyrite, roasted	629	1,418	—	All from Belgium-Luxembourg.
Metal:				
Scrap	121,979	148,594	([2])	United Kingdom 148,524.
Pig iron, cast iron, related materials	1,716	1,118	3	United Kingdom 1,051; Sweden 42.
Ferroalloys:				
Ferroaluminum	—	2	—	All from United Kingdom.
Ferrochromium	9	10	—	Sweden 5; United Kingdom 5.
Ferromanganese	286	187	—	France 80; West Germany 78; United Kingdom 29.
Ferromolybdenum	2	3	—	All from Sweden.
Ferrosilicochromium	—	21	16	West Germany 3; Sweden 2.
Ferrosilicomanganese	1,587	838	—	France 700; United Kingdom 138.
Ferrosilicon	1,049	2,406	—	Norway 2,030; United Kingdom 376.
Silicon metal	265	277	—	United Kingdom 138; France 90; China 20.
Unspecified	51	2	—	All from United Kingdom.
Steel, primary forms	2,265	8,767	3	Sweden 6,321; United Kingdom 1,884.
Semimanufactures:				
Bars, rods, angles, shapes, sections	106,198	126,910	190	United Kingdom 82,209; Spain 22,411; Norway 3,986.
Universals, plates, sheets	125,483	134,871	234	United Kingdom 84,732; Finland 9,505; France 9,450.
Hoop and strip	20,073	20,485	1	United Kingdom 16,815; West Germany 2,187; Spain 1,003.
Rails and accessories	6,519	4,385	22	United Kingdom 4,177; West Germany 132.
Wire	18,711	20,549	30	United Kingdom 8,348; France 4,130; Belgium-Luxembourg 2,722.
Tubes, pipes, fittings	50,548	42,986	153	United Kingdom 24,831; Netherlands 4,511; Finland 3,129.
Castings and forgings, rough	2,803	2,538	37	France 697; United Kingdom 690; West Germany 429.
Lead:				
Ore and concentrate	—	([2])	—	All from United Kingdom.

See footnotes at end of table.

TABLE 6—Continued

IRELAND: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS—Continued				
Lead—Continued				
Oxides	95,143	2,597	—	United Kingdom 2,577; Netherlands 20.
Metal including alloys:				
Scrap	7,359	8,473	—	United Kingdom 6,397; France 879; Belgium-Luxembourg 607.
Unwrought	1,251	1,297	—	United Kingdom 1,142; France 144.
Semimanufactures	411	999	3	Belgium-Luxembourg 609; United Kingdom 317.
Lithium:				
Oxides and hydroxides	20	—		
Metal including alloys, all forms	(2)	(2)	—	All from United Kingdom.
Magnesium: Metal including alloys:				
Unwrought	75	91	74	Norway 15; West Germany 2.
Semimanufactures	186	140	48	United Kingdom 49; Canada 25.
Manganese:				
Ore and concentrate, metallurgical-grade	34,758	26,343	—	Ghana 25,827; Brazil 383.
Oxides	219	218	3	United Kingdom 104; Belgium-Luxembourg 90.
Metal including alloys, all forms	—	18	—	All from United Kingdom.
Mercury 76-pound flasks	537	41	—	United Kingdom 29.
Molybdenum:				
Oxides and hydroxides	—	(2)	(2)	
Metal including alloys:				
Unwrought	1	—		
Semimanufactures	1	3	3	
Nickel:				
Ore and concentrate	5	—		
Matte and speiss	—	2	—	All from United Kingdom.
Oxides and hydroxides	3	3	3	
Metal including alloys:				
Scrap	13	1	—	All from France.
Unwrought	585	398	(2)	United Kingdom 264; U.S.S.R. 126.
Semimanufactures	458	613	291	West Germany 166; United Kingdom 87.
Platinum-group metals: Metals including alloys, unwrought and partly wrought:				
Platinum troy ounces	10,280	10,192	4,524	United Kingdom 5,259; Netherlands 289.
Unspecified do.	8,991	26,737	—	All from United Kingdom.
Rare-earth metals including alloys, all forms	18	2	—	Do.
Silicon, high-purity	16	(2)	—	All from Spain.

See footnotes at end of table.

TABLE 6—Continued

IRELAND: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS—Continued				
Silver:				
Ore and concentrate value, thousands	$1	—		
Waste and sweepings do.	—	$16	—	All from United Kingdom.
Metal including alloys, unwrought and partly wrought troy ounces	r479,335	652,016	127,670	United Kingdom 518,334; West Germany 5,112.
Tellurium and arsenic, elemental	10	2	—	All from United Kingdom.
Tin:				
Oxides	22	20	—	Do.
Ash and residue containing tin	—	2	—	Do.
Metal including alloys:				
Scrap	(2)	(2)	NA	NA.
Unwrought	60	95	—	All from United Kingdom.
Semimanufactures	504	873	(2)	United Kingdom 844; Italy 19.
Titanium:				
Ore and concentrate	196	58	58	
Oxides	3,300	1,791	3	United Kingdom 743; West Germany 468; Norway 352.
Metal including alloys, semimanufactures	74	43	34	United Kingdom 9.
Tungsten:				
Ore and concentrate	—	38	—	Italy 32; United Kingdom 6.
Ash and residue containing tungsten	—	(2)	—	All from United Kingdom.
Metal including alloys:				
Unwrought	3	2	—	Do.
Semimanufactures	13	5	3	United Kingdom 2.
Uranium and thorium: Metal including alloys, all forms: Thorium	(2)	—		
Vanadium: Oxides and hydroxides	3	1	—	All from United Kingdom.
Zinc:				
Ore and concentrate	1	42	—	Do.
Oxides	1,248	1,008	185	United Kingdom 741; Netherlands 38.
Blue powder	r186	90	—	United Kingdom 54; Italy 31.
Ash and residue containing zinc	18	36	—	All from West Germany.
Metal including alloys:				
Scrap	57	393	19	United Kingdom 278; Canada 95.
Unwrought	1,359	1,603	—	United Kingdom 613; Netherlands 568; Belgium-Luxembourg 229.
Semimanufactures	r1,645	444	—	United Kingdom 319; Netherlands 71; West Germany 18.
Zirconium:				
Ore and concentrate	42	58	54	Netherlands 3.

See footnotes at end of table.

TABLE 6—Continued

IRELAND: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS—Continued				
Zirconium—Continued				
Oxides and hydroxides	15	70	—	All from United Kingdom.
Metal including alloys, semimanufactures	3	12	8	United Kingdom 4.
Other:				
Ores and concentrates	3,042	20	20	
Oxides and hydroxides	r79	248	13	United Kingdom 192; West Germany 34.
Ashes and residues	22	(2)	—	All from United Kingdom.
Base metals including alloys, all forms	—	1	—	Mainly from United Kingdom.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	299	601	1	United Kingdom 453; West Germany 62; Iceland 61.
Artificial:				
Corundum	77	152	—	United Kingdom 114; West Germany 38.
Silicon carbide	24	26	(2)	West Germany 17; United Kingdom 7; Norway 2.
Dust and powder of precious and semiprecious stones including diamond kilograms	1,739	1,363	1,311	United Kingdom 40; Sweden 6.
Grinding and polishing wheels and stones	1,172	577	21	United Kingdom 197; West Germany 145; Italy 89.
Asbestos, crude	5,546	5,045	—	Canada 3,862; Zimbabwe 734; Cyprus 300.
Barite and witherite	875	2,652	NA	United Kingdom 2,531; West Germany 105.
Boron materials:				
Crude natural borates	503	98	—	Belgium-Luxembourg 40; Netherlands 40; Turkey 18.
Elemental	—	7	—	All from United Kingdom.
Oxides and acids	151	180	(2)	France 144; Belgium-Luxembourg 20.
Bromine	49	112	—	United Kingdom 69; Belgium-Luxembourg 43.
Cement	81,285	93,867	1	United Kingdom 55,417; Spain 23,567; East Germany 10,891.
Chalk	4,579	3,721	—	United Kingdom 3,142; France 387.
Clays, crude:				
Bentonite	1,281	997	2	United Kingdom 994.
Chamotte earth	4,380	1,562	—	Spain 1,552; United Kingdom 10.
Fuller's earth	233	228	—	All from United Kingdom.
Kaolin	8,546	4,206	37	United Kingdom 3,846; Italy 323.
Unspecified	12,007	7,369	54	United Kingdom 5,605; Spain 1,386.
Cryolite and chiolite	2	2	—	All from United Kingdom.

See footnotes at end of table.

TABLE 6—Continued

IRELAND: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
INDUSTRIAL MINERALS—Continued					
Diamond:					
Gem, not set or strung	carats	630,959	7,900	1	United Kingdom 6,904; Belgium-Luxembourg 875.
Industrial stones	do.	10,030	15,858	—	All from United Kingdom.
Diatomite and other infusorial earth		146	224	162	United Kingdom 47; Belgium-Luxembourg 8.
Feldspar, fluorspar, related materials:					
Feldspar		52	80	—	All from United Kingdom.
Fluorspar		43	19	—	Do.
Unspecified		8,024	3,569	—	Norway 2,830; United Kingdom 721.
Fertilizer materials:					
Crude, n.e.s.		3,573	1,584	—	All from United Kingdom.
Manufactured:					
Ammonia		265	663	(2)	United Kingdom 597; West Germany 60.
Nitrogenous		r365,209	333,361	(2)	Netherlands 106,796; West Germany 61,091; Belgium-Luxembourg 58,071.
Phosphatic		109,297	127,282	2,315	Netherlands 43,643; Tunisia 31,079; Sweden 19,827.
Potassic		239,780	301,828	8,515	West Germany 190,704; Israel 33,112; East Germany 31,952.
Unspecified and mixed		r579,458	656,796	42,488	United Kingdom 279,560; Netherlands 113,441; Belgium-Luxembourg 55,544.
Graphite, natural		7	29	(2)	United Kingdom 23; West Germany 5.
Gypsum and plaster		10,956	8,244	6	United Kingdom 4,899; Sweden 3,120.
Iodine		24	61	—	Japan 39; United Kingdom 12; Netherlands 10.
Kyanite and related materials		144	293	229	Belgium-Luxembourg 65.
Lime		2,512	1,577	—	United Kingdom 1,572.
Magnesium compounds:					
Magnesite, crude		258	—		
Oxides and hydroxides		41,993	18,842	—	China 6,102; United Kingdom 4,726; Spain 3,005.
Sulfate		243	123	—	West Germany 72; Belgium-Luxembourg 36.
Mica:					
Crude including splittings and waste		222	127	24	United Kingdom 97.
Worked including agglomerated splittings		6	42	(2)	United Kingdom 40.
Nitrates, crude		76	51	—	All from United Kingdom.
Phosphates, crude		5,105	2,813	—	Morocco 1,100; France 819; East Germany 796.
Phosphorus, elemental		1	19	—	All from United Kingdom.

See footnotes at end of table.

TABLE 6—Continued

IRELAND: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
INDUSTRIAL MINERALS—Continued				
Pigments, mineral:				
Natural, crude	26	86	—	Do.
Iron oxides and hydroxides, processed	2,199	2,373	58	West Germany 1,966; United Kingdom 246.
Precious and semiprecious stones other than diamond:				
Natural value, thousands	$288	$288	—	United Kingdom $188; West Germany $70; Thailand $12.
Synthetic do.	$56	$103	$92	Switzerland $6; Belgium-Luxembourg $3.
Pyrite, unroasted	25	6	—	All from United Kingdom.
Salt and brine	107,907	105,570	7	United Kingdom 55,417; Spain 19,823; West Germany 17,960.
Sodium compounds, n.e.s.:				
Carbonate, manufactured	14,805	18,492	2	United Kingdom 14,522; Netherlands 3,436; Poland 473.
Sulfate including cadmium, manufactured	853	1,312	—	United Kingdom 685; West Germany 409; Netherlands 191.
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked	7,441	8,077	—	United Kingdom 3,068; Italy 1,382; Republic of South Africa 1,355.
Worked	5,718	7,622	—	Italy 3,322; United Kingdom 2,334; Spain 1,058.
Dolomite, chiefly refractory-grade	1,178	1,317	—	United Kingdom 919; Norway 254; Netherlands 102.
Gravel and crushed rock	280,744	223,088	24	United Kingdom 222,374; France 505.
Limestone other than dimension	24,093	23,686	—	All from United Kingdom.
Quartz and quartzite	305	278	—	United Kingdom 114; Portugal 100; Belgium-Luxembourg 57.
Sand other than metal-bearing	98,045	128,097	37	United Kingdom 85,044; Belgium-Luxembourg 40,280.
Sulfur:				
Elemental:				
Crude including native and byproduct	391	318	32	United Kingdom 131; Netherlands 118.
Colloidal, precipitated, sublimed	98	39	—	United Kingdom 24; Sweden 10; West Germany 5.
Dioxide	750	NA		
Sulfuric acid	74,473	80,930	—	Norway 43,191; United Kingdom 19,337; Spain 12,149.
Talc, steatite, soapstone, pyrophyllite	1,643	1,654	5	Belgium-Luxembourg 496; United Kingdom 308.
Vermiculite, perlite, chlorite	2,513	2,695	—	United Kingdom 1,494; Netherlands 1,200.

See footnotes at end of table.

TABLE 6—Continued

IRELAND: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987	
				United States	Other (principal)
INDUSTRIAL MINERALS—Continued					
Other:					
Crude		4,129	4,911	10	United Kingdom 2,999; France 1,089; Belgium-Luxembourg 562.
Slag and dross, not metal-bearing		2,454	3,475	120	Belgium-Luxembourg 2,963; Netherlands 269.
MINERAL FUELS AND RELATED MATERIALS					
Asphalt and bitumen, natural		2,871	1,217	—	United Kingdom 904; Trinidad and Tobago 246.
Carbon:					
Carbon black		6,109	4,758	3	United Kingdom 4,144; Netherlands 224; Italy 202.
Gas carbon		190	22	—	All from United Kingdom.
Coal:					
Anthracite	thousand tons	60	74	1	Netherlands 23; Republic of South Africa 16; China 2.
Bituminous	do.	2,562	2,861	1,366	Poland 746; United Kingdom 323.
Lignite including briquets	do.	37	13	—	United Kingdom 5; West Germany 4; East Germany 2.
Coke and semicoke		5,368	7,079	—	United Kingdom 4,127; Spain 2,008; Norway 716.
Peat including briquets and litter		8,106	4,722	—	United Kingdom 2,495; Finland 2,196.
Petroleum:					
Crude	thousand 42-gallon barrels	10,197	11,149	—	United Kingdom 10,670; Libya 479.
Refinery products:					
Liquefied petroleum gas	do.	1,483	1,445	—	United Kingdom 1,276; Netherlands 111.
Gasoline, motor	do.	5,158	5,139	3	United Kingdom 4,593; France 300.
Mineral jelly and wax	do.	33	30	2	United Kingdom 22; West Germany 4.
Kerosene and jet fuel	do.	2,871	3,188	1	United Kingdom 2,489; U.S.S.R. 517.
Distillate fuel oil	do.	8,458	7,064	(2)	United Kingdom 5,873; U.S.S.R. 639; France 550.
Lubricants	do.	353	360	12	United Kingdom 291; Greece 17; Spain 14.
Residual fuel oil	do.	12,209	8,685	218	United Kingdom 3,623; Spain 1,636; Netherlands 441.
Bitumen and other residues	do.	531	521	—	United Kingdom 301; Belgium-Luxembourg 184.
Bituminous mixtures	do.	27	21	(2)	United Kingdom 19; Italy 1.
Petroleum coke	do.	350	379	371	West Germany 7.

[r] Revised. NA Not available.
[1] Table prepared by P. J. Roetzel.
[2] Less than 1/2 unit.

and quantity to justify constructing a 100-ton-per-day leaching plant to recover the gold. The company expected to start operation in 1989.

Industrial Minerals.—Magobar Ltd., a subsidiary of Dresser Minerals Inc., United States, increased production at its open pit barite mine at Silvermines, County Tipperary. Limited reserves continued to be a constraint on the company. Discovery of a high-grade dolomite deposit was reported by Moy Insulation, a subsidiary of Irish Gypsum Ltd. Reserves were estimated to be 15 million tons of dolomite grading 21.3% MgO and less than 0.15% Fe_2O_3. The dolomite would be used primarily for fiberglass manufacture.

Irish Gypsum continued development of its new open pit gypsum mine at Knocknacran, County Monaghan. The company was expecting to start operations in late 1989 with an annual production of 250,000 tons per year. The new open pit operation was expected to eventually replace the company's underground mines.

Premier Periclase completed converting its plant to use natural gas as a fuel. The company produces magnesia from seawater.

Mineral Fuels.—In late 1988, Ireland and the United Kingdom reached an agreement regarding the line of delimitation of the Continental Shelf in the Irish and Celtic Seas and in the northwest area. The agreement does not cover the waters off northern Ireland. Subsequently, the Government of Ireland and Marathon Petroleum Ireland Ltd. signed an agreement whereby Marathon would conduct a 3-year exploration program on their leases in the Celtic Sea. The program consists of seismic work and the drilling of up to 10 exploration wells.

The Government reported that three exploration wells were drilled offshore with disappointing results. All three were plugged and declared dry holes. One onshore well was drilled and also abandoned.

[1] Physical scientist, Division of International Minerals.

[2] Where necessary, values have been converted from pounds sterling (£) to U.S. dollars at the rate of (£)1.00=US$1.78, the average rate during 1988.

THE MINERAL INDUSTRIES OF

THE ARABIAN PENINSULA AND PERSIAN GULF COUNTRIES

By Bernadette Michalski, Lloyd E. Antonides, and George A. Morgan

BAHRAIN[1]

Although hydrocarbons accounted for more than 60% of Bahrain's income and more than 80% of export earnings, this island nation sustained one of the more diversified economies in the Gulf Region. The availability of low-cost natural gas for electric power has fostered the development of a significant aluminum refining and manufacturing industry with emphasis on vertical integration. The Bahraini iron pelletization plant, closed since 1986 due to financial problems, was scheduled to reopen by early 1989.

Commodity Review

Metals.—**Aluminum.**—Aluminium Bahrain Bsc (Alba) attained record high production levels in 1988 taking advantage of favorable aluminum prices, which averaged over $2,000 per ton as compared with less than $1,500 per ton in 1987. Net aluminum production was nearly 13,000 tons over design capacity. Fewer standard ingots (52,081 tons as compared with 79,685 in 1987) were produced as Alba concentrated on higher value added products such as rolling ingots (42,324 tons as compared with 32,125 tons) and extrusion billets (60,934 tons as compared with 46,618 tons).

Expansion plans that would eventually double aluminum smelter capacity to nearly 400,000 tons per year have been announced. One of the programs would augment Alba's power supply by the installation of a 60-megawatt steam turbine to recover heat from 5 of the plant's 24 gas turbines. Aluminum production capacity would be increased by 25,000 tons with the addition of 76 pots raising the total to 684 pots with a total capacity of 195,000 tons per year. A second project involving modernization of four of the six potrooms by computerizing operations and installing hoods to take off gas from the molten metal should result in a rise in production of 20,000 tons per year, raising total capacity to about 215,000 tons per year. Alba also announced plans to install a completely new potline with the capacity to produce an additional 180,000 tons per year. Kaiser Aluminum (United States) was preparing a feasibility study for this additional production capacity.

The Bahrain-Saudi Aluminium Marketing Co. (Balco) sold the Bahraini, 57.9%, and the Saudi Arabians, 20%, shares of Alba's aluminum production or 142,400 tons of aluminum

TABLE 1

BAHRAIN: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Country and commodity		1984	1985	1986	1987[p]	1988[e]
Aluminum metal: Primary, smelter		177,300	176,371	178,188	180,344	[2]182,804
Gas, natural:						
Gross	million cubic feet	145,152	224,475	256,230	[e]257,000	260,000
Marketed	do.	130,000	177,755	200,020	[e]200,600	200,000
Natural gas liquids:						
Butane	thousand 42-gallon barrels	864	772	894	775	[2]897
Propane	do.	1,010	976	889	1,133	[2]880
Naphtha	do.	1,251	1,206	1,169	1,361	[2]1,349
Petroleum:						
Crude	do.	15,289	15,301	15,484	15,377	[2]15,671
Refinery products:						
Gasoline	do.	5,653	6,892	7,520	6,157	[2]5,449
Jet fuel	do.	12,520	11,434	9,613	10,818	[2]10,081
Kerosene	do.	2,372	2,446	7,023	5,200	[2]6,286
Distillate fuel oil	do.	22,738	19,734	26,693	28,071	[2]27,562
Residual fuel oil	do.	17,196	15,378	22,611	22,225	[2]22,268
Other	do.	13,644	11,862	16,100	16,500	[2]17,200
Total	**do.**	**74,123**	**67,746**	**89,560**	**88,971**	**88,846**
Sulfur, byproduct of petroleum		47,300	42,300	46,000	47,500	48,000

[e]Estimated. [p]Preliminary.
[1]Table includes data available through Nov. 29, 1989.
[2]Reported figure.

in 1988. Other equity holders were Kaiser-Tech Ltd. (United States), 17%, and Breton Investments (Federal Republic of Germany), 5.1%. Local markets included the Gulf Aluminium Rolling Mill Co., which consumed about 55,000 tons of Balco aluminum; Midal Cables Co., which consumed about 25,000 tons; and Bahrain Aluminum Extrusion Co., which consumed about 6,000 tons in 1988. More than 70% of Balco's sales were in the Gulf region, 20% in the Far East, 8% in the Indian subcontinent, and about 1% each in the United States and in Europe. Planned production increases will eventually require additional markets outside of the region. Bahrain was seeking an exemption on the 6.1% tariff which is now levied on Gulf aluminum by the European Community (EC).

Iron and Steel.—The Arab Iron and Steel Co., closed since mid-1986 and in voluntary liquidation since August 1987, was purchased in March by the Kuwaiti-owned Gulf Industrial Investment Co. Production was scheduled to resume in early 1989. Raw material for the pelletizing plant would be obtained from the Kudremukh Iron Ore Co. Ltd. (India), Companhia Vale Do Rio Doce (Brazil), and Mineraco Brasileira Reunidas (Brazil). By yearend, the Gulf Industrial Investment Co. had obtained a contract to supply Iraq with 4.5 million tons of iron pellets over a 5-year period.

Mineral Fuels.—**Natural Gas.**—Natural gas production was about 260 billion cubic feet. About 25% of gross production was reinjected into the Awali onshore field to maintain pressure, and the remainder was processed for the extraction of natural gas liquids (propane, butane, and naphtha) and marketed as dry natural gas. Principal consumers were the Alba aluminum refinery, powerplants, and desalination plants. Naphtha recovered as a natural gas liquid was delivered as feedstock to the Bapco refinery, while the propane and butane were exported.

The Bahrain National Gas Co. (Banagas) awarded an $80 million expansion contract to the JGC Corp. (Japan), which would increase capacity at the Jebel al-Dukham natural gas liquids plant from 170 million cubic feet per day to 250 million cubic feet per day. Under the proposed expansion program, propane, butane, and naphtha output would increase from the current level of 3.2 million barrels to 5.5 million barrels. The expansion of Banagas' existing terminal facilities was also planned.

Petroleum.—Bahrain produced an average of nearly 43,000 barrels per day (bbl/d) of 33°API gravity crude oil from the Awali Field. Refinery throughput averaged 243,000 bbl/d with about 200,000 bbl/d of refinery feedstock supplied by Saudi Arabia. The Bahrain Petroleum Co. (Bapco) had engaged Bechtel Corp. (United States) as a consultant to develop a modernization plan in the framework of future refinery product requirements. Demand for heavier oils was expected to be reduced as more power stations convert to natural gas.

IRAN[2]

Introduction

The mineral industry and the economy were dependent upon the crude petroleum, liquid, and gaseous fuels sectors. Output of the products was relatively stable as the country continued its reconstruction efforts following the cease-fire with Iraq.

Its primary efforts have been to push expansion of the natural gas and petroleum industry for production of chemicals, plastics, and fertilizers. A second priority is the training and education of a professional cadre to implement similar rehabilitation and expansion of the metals and industrial minerals sectors.

Commodity Review

Mineral Fuels.—**Natural Gas.**—A natural gas field was discovered near Assaluyeh, about 70 kilometers southeast of Kangan on the Persian Gulf coast. Estimated production potential from the field was 12 million cubic meters per day from the lower area of the reservoir and 14 million cubic meters per day from the upper portion of the reservoir. Output may be shipped to the nearby Nar-Kangan refinery, which is being expanded from a capacity of 34 million cubic meters per day to 80 million cubic meters per day. The refinery was damaged in an air raid in July, but work was resumed in September, and completion was scheduled for yearend 1989.

The increase in capacity at the Nar-Kangan refinery is planned to be in excess of domestic consumption. The remainder would be available for export to the U.S.S.R. Agreement has been reached with the U.S.S.R. on recommencing exports of natural gas to that country, the first such planned since 1980. The initial agreement provided for exports of 3 billion cubic meters per year via the IGAT-1 pipeline. Currently used to supply domestic needs, the pipeline has a reported capacity of 10 billion cubic meters per day. A contract was also awarded to Saipem S.p.A. of Italy to complete the IGAT-2 pipeline, which would export natural gas to the U.S.S.R. and Europe. The design capacity of IGAT-2 was 27 billion cubic meters per year, of which about 17 billion cubic meters would be available for export.

Petroleum.—Exploration.—Following 10 years of inactivity in petroleum exploration owing to the war with Iraq, two crude oil discoveries were announced. The field discovered south of Bushire was reported to have 10 billion barrels of heavy crude oil, and the discovery east of Belbahan had 200 million barrels of light crude oil in three zones. One zone was estimated to be capable of producing 40,000 bbl/d.

TABLE 2

IRAN: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1984	1985	1986	1987[p]	1988[e]
METALS						
Aluminum metal, primary ingot[e]		[3]42,400	43,000	40,000	39,800	40,000
Chromium: Chromite, mine output, gross weight[e]		59,000	56,000	56,000	56,000	56,000
Copper:						
Mine output, Cu content[e]		[3]43,300	50,000	[r]60,000	[r]60,000	70,000
Metal:						
Smelter output, primary blister[e]		[3]47,900	60,000	60,000	60,000	50,000
Refinery output, primary refined[e]		5,000	12,000	12,000	12,000	12,000
Iron and Steel:						
Iron ore, mine output:						
Gross weight[e]	thousand tons	2,700	2,800	2,800	2,800	2,800
Fe content[e]	do.	1,550	1,600	1,600	1,600	1,600
Metal:						
Pig iron[e]	do.	250	250	250	250	250
Steel, crude[e]	do.	1,200	900	900	900	900
Lead, mine output, Pb content[e]		[3]19,000	[3]21,600	21,600	21,600	21,600
Manganese, mine output, gross weight[e]		66,000	55,000	55,000	55,000	5,000
Molybdenum, mine output, Mo content[e]		500	500	500	500	500
Zinc, mine output, Zn content[e]		47,100	50,000	36,000	40,000	42,000
INDUSTRIAL MINERALS						
Asbestos, marketable fiber[e]		2,500	2,500	3,000	3,300	3,000
Barite[e]		90,000	90,000	90,000	90,000	90,000
Boron: Borax[e]		700	1,200	1,200	1,200	1,200
Cement, hydraulic	thousand tons	11,803	12,464	12,273	12,729	12,500
Clays:						
Bentonite[e]		[3]35,000	[3]27,000	27,000	27,000	27,000
Kaolin and Fire clay[e]		[3]622,000	[3]429,000	430,000	430,000	430,000
Feldspar[e]		33,000	32,000	32,000	32,000	32,000
Fluorspar: Fluorite[e]		3,300	3,300	3,300	3,300	3,300
Gem stones: Turquoise	kilograms	37,073	34,671	[e]35,000	[e]35,000	35,000
Gypsum[e]	thousand tons	[3]9,666	[3]8,384	8,400	8,400	8,400
Lime	do.	650	650	650	650	650
Magnesium compounds: Magnesite[e]		[3]830	[3]2,240	2,240	2,240	2,240
Mica[e]		[3]565	[3]820	820	820	820
Nitrogen: Ammonia, N content[e]		21,400	[3]27,100	65,900	119,200	110,100
Pigments, mineral, natural iron oxide[e]		[3]9,100	[3]4,300	4,300	4,300	4,300
Salt, rock	thousand tons	[3]691	[3]703	700	700	700
Sodium compound: Caustic soda[e]		12,000	12,000	12,000	12,000	12,000
Stone, sand and gravel:[e]						
Crushed: Limestone	thousand tons	[3]11,574	[3]15,430	16,000	16,000	16,000
Dimension: Marble, granite, and travertine	do.	[3]3,072	[3]3,291	3,300	3,300	3,300
Strontium: Celestite		23,000	20,000	22,000	22,000	22,000

See footnotes at end of table.

TABLE 2—Continued

IRAN: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1984	1985	1986	1987[p]	1988[e]
INDUSTRIAL MINERALS—Continued						
Sulfates, natural:[e]						
Aluminum potassium sulfate (alum)		12,000	12,000	12,000	12,000	12,000
Sodium sulfate		12,000	12,000	12,000	12,000	12,000
Sulfur:[e]						
Native		30,000	30,000	30,000	30,000	30,800
Byproduct of petroleum and natural gas		130,000	150,000	250,000	300,000	300,000
Total		**160,000**	**180,000**	**280,000**	**330,000**	**330,000**
Sulfuric acid		200,000	200,000	200,000	200,000	200,000
Talc		[3]35,400	[3]30,800	31,000	31,000	31,000
MINERAL FUELS AND RELATED MATERIALS						
Coal	thousand tons	[r]1,241	[r]1,252	1,262	1,240	1,240
Coke[e]	do.	349	399	349	400	400
Gas, natural:						
Gross	million cubic feet	1,077,000	1,257,000	1,165,000	1,246,000	1,275,000
Dry[4]	do.	[r]476,000	[r]600,000	536,000	565,000	520,000
Natural gas plant liquids, unspecified	thousand 42-gallon barrels	3,600	3,600	5,500	7,300	8,784
Petroleum:						
Crude	do.	793,510	821,250	742,775	838,770	826,794
Refinery products:						
Liquified petroleum gas	do.	6,230	6,830	6,250	6,570	5,000
Gasoline	do.	34,675	24,820	25,915	33,215	20,000
Jet fuel	do.	3,985	2,920	2,555	2,555	2,000
Kerosene	do.	38,720	23,963	22,630	22,630	22,630
Distillate fuel oil	do.	57,305	75,555	80,300	58,400	45,000
Residual fuel oil	do.	86,870	68,985	74,095	67,525	55,000
Other	do.	24,795	26,512	28,835	18,980	15,000
Total	**do.**	**252,580**	**229,585**	**240,535**	**209,875**	**162,000**

[e]Estimated. [p]Preliminary. [r]Revised.
[1]Data are for fiscal years beginning Mar. 21 of that stated, except those for natural gas and petroleum, which are for regular calendar years. Table includes data available through Dec. 30, 1989.
[2]In addition to the commodities listed, other types of crude construction materials, such as common clays, sand and gravel, and other varieties of stone, are produced, but output is not reported, and available information is inadequate to make reliable estimates of output levels.
[3]Reported figure.
[4]Excludes natural gas used for reinjection, flaring, venting, or consumed in the extraction of liquids.

Cooperation with China in power-plant construction, shipbuilding, and petroleum refining has expanded to petroleum exploration following discussion between the two countries in October.

Production.—The Government planned to invite bids for reconstruction of the Salman offshore oil station, which supplied crude petroleum to the Lavan Island terminal via pipeline. The Salman oilfield had reserves of about 800 million barrels. The station's output was restored to about one-third of its design capacity of 140,000 bbl/d after repair of damage incurred during the war with Iraq.

Transportation.—A 40-kilometer pipeline from Anzali to Rashi was placed into operation in September. It can transport refinery products to Rashi or crude petroleum to the U.S.S.R.

A decision was made by the Government to proceed with the Mohaman pipeline and export terminal, at an estimated cost of $2 billion. The 320-

TABLE 3

IRAN: APPARENT EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
METALS				
Aluminum:				
Oxides and hydroxides	NA	696	—	All to Ireland.
Metal including alloys, semimanufactures	8	175	85	Turkey 90.
Arsenic: Oxides and acids	NA	242	242	
Copper:				
Matte and speiss including cement copper	492	259	—	All to Greece.
Metal including alloys:				
Scrap	267	NA		
Unwrought	25,492	7,965	—	United Kingdom 4,950; Italy 2,995.
Iron and steel: Metal:				
Scrap	2,360	NA		
Pig iron, cast iron, related materials	NA	1,050	—	All to Taiwan.
Semimanufactures: Tubes, pipes, fittings	—	20	—	All to United Kingdom.
Lead:				
Ore and concentrate	5,698	3,814	—	All to Greece.
Metal including alloys, semimanufactures	—	33	—	All to Belgium-Luxembourg.
Manganese: Oxides	—	18	18	
Molybdenum: Ore and concentrate	152	578	—	Belgium-Luxembourg 552; United Kingdom 26.
Platinum-group metals: Waste and sweepings value, thousands	NA	$275	—	All to Netherlands.
Silver:				
Ore and concentrate do.	$126	NA		
Waste and sweepings[2] do.	$391	$275	—	Do.
Tin: Metal including alloys:				
Unwrought	60	4	—	All to Belgium-Luxembourg.
Semimanufactures	—	5	—	Do.
Zinc:				
Ore and concentrate	2,280	NA		
Ash and residue containing zinc	1,009	NA		
Metal including alloys, unwrought	NA	1,041	—	Do.
Zirconium:				
Ore and concentrate	NA	9,186	—	All to Finland.
Metal including alloys, unwrought	20	—		
Other: Oxides and hydroxides	—	2	—	All to Belgium-Luxembourg.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.: Natural: Corundum, emery, pumice, etc.	1	—		
Cement	590	NA		

See footnotes at end of table.

TABLE 3—Continued

IRAN: APPARENT EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
INDUSTRIAL MINERALS—Continued				
Clays, crude:				
Bentonite	NA	20	—	All to Italy.
Unspecified	1	—		
Diamond:				
Gem, not set or strung carats	253,037	106,127	106,127	
Dust and powder, synthetic value, thousands	$173	NA		
Magnesium compounds, unspecified	1	—		
Precious and semiprecious stones other than diamond: Natural value, thousands	$49	$120	$45	Taiwan $75.
Salt and brine	100	175	—	All to Turkey.
Stone, sand and gravel: Dimension stone:				
Crude and partly worked	2,569	37	—	All to Switzerland.
Worked	36	5,409	18	Turkey 5,327; Italy 45.
Sulfur:				
Elemental: Crude including native and byproduct	11,545	72,506	—	Tunisia 56,756; Italy 15,750.
Sulfuric acid	3,300	NA		
Other: Crude	100	20	—	All to United Kingdom.
MINERAL FUELS AND RELATED MATERIALS				
Peat including briquets and litter	63	NA		
Petroleum:				
Crude thousand 42-gallon barrels	r348,114	348,000	89,662	Netherlands 53,329; Italy 50,892.
Refinery products:				
Gasoline do.	144	NA		
Distillate fuel oil do.	90	NA		
Lubricants do.	—	(3)	—	All to Italy.
Residual fuel oil do.	r278	598	—	All to Belgium-Luxembourg.

r Revised. NA Not available.

[1] Table prepared by Virginia A. Woodson. Owing to a lack of official trade data published by Iran, this table should not be taken as a complete presentation of Iran's mineral exports. Unless otherwise specified, these data have been compiled from trade statistics of individual trading partners.

[2] May include platiunum-group metals.

[3] Less than 1/2 unit.

kilometer section from the Gurreh pumping station north of Kharg Island to Taheri near Kangan was scheduled for completion by March 1989 by Saipem S.p.A. The second section to Bandar Abbas was planned for March 1990. Throughput capacity would be 1 million bbl/d.

Refining.—Funding of $500 million was to be provided by a Japanese group for the Bander Abbas refinery.[3] Bids for equipment for the 230,000-bbl/d refinery were being prepared, and final cost of the facility was expected to be about $1.75 billion.

The Abadan refinery, with a prewar capacity of 628,000 bbl/d, was to be rebuilt in three stages. The first two stages would provide 140,000 bbl/d and 380,000 bbl/d, respectively.

The Baktaran refinery was also being rebuilt owing to damage suffered in the war. It was originally supplied by the Naftshahr Field until the occupation by Iraq; however, it will be supplied in the future via pipeline from southern oilfields. Capacity of the refinery is being increased by 5,000 bbl/d to 30,000 bbl/d.

TABLE 4

IRAN: APPARENT IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS				
Aluminum:				
Ore and concentrate	—	3	—	All from Switzerland.
Oxides and hydroxides	14,397	18,917	—	Greece 18,000; Netherlands 730.
Metal including alloys:				
Scrap	—	20	—	All from United Kingdom.
Unwrought	26	—		
Semimanufactures	7,673	4,296	—	Switzerland 3,271; Belgium-Luxembourg 505.
Arsenic: Oxides and acids	—	1	—	All from United Kingdom.
Cadmium: Metal incuding alloys, all forms	—	1	—	Do.
Chromium: Oxides and hydroxides	219	NA		
Cobalt: Metal including alloys, all forms	5	—		
Copper:				
Oxides and hydroxides	1	—		
Metal including alloys:				
Scrap	—	20	—	All from United Kingdom.
Unwrought	—	46	—	Italy 36; Belgium-Luxembourg 10.
Semimanufactures	16,180	1,823	2	Argentina 484; Italy 435; Turkey 337.
Gold: Metal including alloys, unwrought and partly wrought troy ounces	NA	729,821	—	All from United Kingdom.
Iron and steel:				
Iron ore and concentrate excluding roasted pyrite	—	20	—	All from Netherlands.
Metal:				
Pig iron, cast iron, related materials	1,999	13,325	—	Canada 12,000; United Kingdom 1,189.
Ferroalloys:				
Ferrochromium	66	NA		
Ferromanganese	768	NA		
Ferromolybdenum	—	1	—	All from United Kingdom.
Ferrosilicon	460	1	—	Do.
Unspecified	2,064	1,180	—	Turkey 1,055; Italy 104.
Steel, primary forms	156,783	396,828	—	Turkey 336,808; Australia 59,997.
Semimanufactures:				
Bars, rods, angles, shapes, sections	90,744	495,801	—	Turkey 491,043; Italy 2,707.
Universals, plates, sheets	390,164	64,036	—	Turkey 44,739; Netherlands 8,079; Belgium-Luxembourg 8,074.
Hoop and strip	23,591	213	—	Turkey 151; Belgium-Luxembourg 40.
Rails and accessories	4,613	3,924	—	Netherlands 3,748; Italy 102.
Wire	11,041	4,414	—	Spain 2,086; Turkey 1,161.
Tubes, pipes, fittings	132,052	27,819	—	Italy 10,106; Turkey 8,639; United Kingdom 3,358.
Castings and forgings, rough	930	307	—	Australia 301.

See footnotes at end of table.

TABLE 4—Continued

IRAN: APPARENT IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987	
				United States	Other (principal)
METALS—Continued					
Lead:					
Oxides		23	—		
Metal including alloys:					
Unwrought		5,708	12,130	—	Australia 11,330; Turkey 500.
Semimanufactures		31	7	—	All from United Kingdom.
Magnesium: Metal including alloys:					
Semimanufactures		17	17	—	Do.
Unspecified		—	2	—	Do.
Mercury	76-pound flasks	64	29	—	All from Italy.
Molybdenum: Metal including alloys:					
Semimanufactures		—	1	—	All from Netherlands.
Unspecified		1	2	—	Do.
Nickel: Metal including alloys:					
Scrap		—	2	—	Do.
Unwrought		1	363	—	All from United Kingdom.
Semimanufactures		15	10	—	United Kingdom 6; Italy 3.
Platinum-group metals:					
Waste and sweepings	value, thousands	NA	$5	—	All from United Kingdom.
Metals including alloys, unwrought and partly wrought:					
Platinum	do.	NA	$56	—	All from Switzerland.
Unspecified	do.	$201	$80	—	Switzerland $56; United Kingdom $24.
Selenium, elemental		5	—		
Silver: Metal including alloys, unwrought and partly unwrought	thousand troy ounces	75	1,268	—	Spain 739; West Germany 352.
Tin: Metal including alloys:					
Unwrought		28	19	—	All from United Kingdom.
Semimanufactures		26	—		
Titanium:					
Ore and concentrate		131	1,000	—	All from Netherlands.
Oxides		348	83	—	Spain 47; United Kingdom 21.
Metal including alloys, all forms		2	—		
Tungsten: Metal including alloys:					
Semimanufactures		—	3	—	All from Netherlands.
All forms		—	3	—	Do.
Zinc:					
Oxides		284	1,269	—	Belgium-Luxembourg 520; Turkey 421.
Blue powder		—	2	—	All from Denmark.
Metal including alloys:					
Unwrought		3,665	4,840	—	Spain 3,279; Turkey 1,056.
Semimanufactures		7	593	—	Spain 514; Turkey 72.

See footnotes at end of table.

TABLE 4—Continued

IRAN: APPARENT IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS—Continued				
Zirconium: Ore and concentrate	36	423	—	Italy 400; Netherlands 23.
Other:				
Ores and concentrates	NA	250	—	All from Spain.
Oxides and hydroxides	1	—		
Base metals including alloys, all forms	6	4	—	All from United Kingdom.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	89	42	—	All from Turkey.
Artificial:				
Corundum	25	16	—	All from United Kingdom.
Silicon carbide	NA	118	—	Italy 117; United Kingdom 1.
Dust and powder of precious and semiprecious stones including diamond value, thousands	$7	$339	—	Switzerland $190; Belgium-Luxembourg $143.
Grinding and polishing wheels and stones	860	788	—	United Kingdom 329; Switzerland 209; Italy 187.
Asbestos, crude	20	2,300	—	Canada 2,250; Netherlands 50.
Boron materials: Oxides and acids	20	3,068	—	All from Turkey.
Cement	2,668	645	—	Netherlands 500; Italy 102.
Chalk	—	17	—	All from Belgium-Luxembourg.
Clays, crude:				
Bentonite	425	1	—	All from Italy.
Chamotte earth	98	NA		
Kaolin	860	2,929	—	United Kingdom 2,679; Spain 250.
Unspecified	500	2,730	—	Greece 1,500; Turkey 1,200.
Diamond: Industrial stones value, thousands	$637	$101	—	All from Switzerland.
Diatomite and other infusorial earth	41	NA		
Fertilizer materials: Manufactured:				
Ammonia	16	3	—	All from United Kingdom.
Nitrogenous	465	11,931	—	All from Turkey.
Phosphatic	176,299	126,768	—	Tunisia 78,518; Philippines 47,250.
Potassic	36	22	—	All from Italy.
Unspecified and mixed	1,804	214,854	—	Turkey 199,008; Philippines 15,750.
Graphite, natural	95	NA		
Gypsum and plaster	178	NA		
Iodine	2	—		
Magnesium compounds:				
Magnesite, crude	2,082	612	—	Turkey 459; Netherlands 153.
Other	20	—		
Pigments, mineral: Iron oxides and hydroxides, processed	—	2	—	All from Switzerland.

See footnotes at end of table.

TABLE 4—Continued

IRAN: APPARENT IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
INDUSTRIAL MINERALS—Continued				
Precious and semiprecious stones other than diamond: Natural value, thousands	$35	NA		
Salt and brine	364	NA		
Sodium compounds, n.e.s.:				
Carbonate, manufactured	5	36,942	—	All from Turkey.
Sulfate, manufactured	NA	2,590	—	Turkey 2,208; Spain 382.
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked	24	3	—	All from Belgium-Luxembourg.
Worked	39	299	—	Italy 235; Belgium-Luxembourg 40.
Gravel and crushed rock	9,367	NA		
Limestone other than dimension	17	—		
Quartz and quartzite	21	—		
Sand other than metal-bearing	20	81	—	All from Turkey.
Sulfur:				
Elemental: Crude including native and byproduct	—	3	—	Do.
Dioxide	12	—		
Sulfuric acid	—	3	—	All from United Kingdom.
Other:				
Crude	NA	59	—	United Kingdom 37; Netherlands 22.
Slag and dross, not metal-bearing	9,300	NA		
MINERAL FUELS AND RELATED MATERIALS				
Asphalt and bitumen, natural	—	2	—	All from United Kingdom.
Carbon:				
Carbon black	26,850	5	—	Switzerland 4; United Kingdom 1.
Gas carbon	—	16	—	All from United Kingdom.
Coal:				
Anthracite and bituminous	418,133	149	—	Do.
Briquets of anthracite and bituminous coal	81	NA		
Coke and semicoke	13	—		
Petroleum refinery products:				
Liquefied petroleum gas thousand 42-gallon barrels	1	([2])	—	All from United Kingdom.
Gasoline do.	401	468	—	Italy 467.
Mineral jelly and wax do.	3	3	—	Mainly from Netherlands.
Kerosene and jet fuel do.	10,084	1,422	—	Italy 734; United Kingdom 637.
Distillate fuel oil do.	3,709	2,037	—	Italy 2,019.
Lubricants do.	323	489	—	Netherlands 207; Italy 151; Spain 72.
Residual fuel oil do.	—	11	—	Argentina 6; Belgium-Luxembourg 5.
Bitumen and other residues do.	—	([2])	—	All from Italy.
Bituminous mixtures do.	2	([2])	—	All from United Kingdom.
Petroleum coke do.	32	NA		

[r] Revised. NA Not available.

[1] Table prepared by Virginia A. Woodson. Owing to a lack of official trade data published by Iran, this table should not be taken as a complete presentation of Iran's mineral imports. Unless otherwise specified, these data have been compiled from trade statistics of individual trading partners.

[2] Less than 1/2 unit.

A coal tar refinery was to be constructed near the Esfahan steel mill, and will provide for production of numerous chemicals, including 8,500 tons per year of naphthalene. Total output of coal tar was reported at about 400,000 tons per year.

Petrochemicals.—Annual investment in the petrochemical industry was estimated at $2 billion. Expansion of domestic facilities could reduce imports of petrochemicals by $1 billion annually.

Snamprogetti of Italy was awarded the task of managing contractor for the $1.5 billion Arak complex. Infrastructure construction has begun at the site, southwest of Tehran.

Technipetrol of Italy was selected to construct the olefins unit at the Tabriz petrochemical plant. Valued at $120 million, the contract provides for design, equipment, and supervision of construction of the 136,000-ton-per-year unit. Construction was to start in 1990.

Uranium.—The Atomic Energy Organization of Iran reported that uranium exploration was planned for five separate areas of the country. No location or time frame was given regarding the areas to be studied.

IRAQ[4]

A cease-fire in the 8-year war between Iraq and Iran was declared on August 20. Much economic information that formerly was considered classified by the Iraqi Government because of the war has become available. According to the Minister of Planning, the gross domestic product (GDP) in 1987, the latest year available, was $76.8 billion.[5] Agricultural production was $6.4 billion, and industrial production was $8.96 billion. National income was $43.8 billion, and per capita income was $2,600 in 1987.

A number of mineral-industry-related projects were part of a $14.2 billion allocation for industrial development following the war. Projects included a 2-million-ton-per-year increase in steel capacity, a 200,000-ton-per-year aluminum smelter, a 4.5-million-ton-per-year increase in fertilizer capacity, and an additional 400,000 tons per year of salt output.

The scarcity of hard currency was expected to last for several years, and companies seeking business contracts in Iraq would be given preference if they could supply credit, either directly or through their governments. The United States renewed a $1 billion agricultural commodity credit; the United Kingdom offered $598 million and Ireland $150 million in credit extensions. Iraq was the ninth largest market for U.S. agricultural products in 1988. U.S. imports from Iraq for the first 8 months of 1988 were $977 million, mainly crude petroleum. Barter was encouraged by the Government because it avoided complicated banking procedures, with most trading being done directly by the manufacturer or the exporter. Not all payments have been in oil, however; Iraq ended its arrears with New Zealand by the payment of $30 million in April.

Crude petroleum exports reported for 1988 averaged 323,000 bbl/d to the United States, 199,300 bbl/d to Turkey, 152,000 bbl/d to the Netherlands, 120,000 bbl/d to France, and 105,200 bbl/d to Yugoslavia. The Indian Government-owned Indian Oil Corp. finalized a 9-month contract to buy 70,000 bbl/d of crude petroleum in 1989.

Government Policies and Programs

The Government reorganized many state organizations into the Industry and Minerals Ministry. Agencies included were: the State Enterprise for Construction Industries (SECI), the State Enterprise for Cement, the State Enterprise for Geological Survey and Investigation, the State Enterprise for Fertilizers Industries, the State Enterprise for Extraction Industries, the State Enterprise for Phosphate, the Mishraq Sulphur State Enterprise (MSSE), and the State Enterprise for Petrochemical Industries.

Foreign investment and joint ventures were not allowed through 1988, although there was some indication that the Government would soon reverse itself.

Production and Trade

Exports were dominated by crude petroleum. Iraq indicated that it would comply with an Organization of Petroleum Exporting Countries (OPEC) production quota of 2.64 million bbl/d and would stop truck exports of 65,000 bbl/d through Aqabah, Jordan, and 25,000 bbl/d through Turkey. Non-oil exports in 1988 were $191 million, consisting mainly of cement, fertilizers, phosphates, and sulfur. A 22% increase in import spending was announced for 1989, with the Government being allocated 70% of the total, primarily for food imports.

SECI reported that $17.8 million was saved by using domestic products in lieu of imports. About $3 million was saved by using local bentonite.

Iraq may bypass the Shatt al-Arab waterway as its link to the Persian Gulf by expanding the ship canal built by the Japanese in the late 1970's. The canal is 60 kilometers long, 200 meters wide, and 13 meters deep, and links Khor al-Zubair with Umm Qasr and the gulf. In the north, it links with Lake Hammar. The first vessel to transit the Persian Gulf after 8 years of war did so on September 11, delivering about 120,000 barrels of crude oil to the Aden refinery.

Trade with the U.S.S.R. was estimated at almost $2 billion in 1988. In 1987, trade was $1.75 billion, of which U.S.S.R. imports were $1.24 billion, mainly crude petroleum, and U.S.S.R. exports to Iraq were $511 million, mainly machinery, equipment, and services. Credits from the government-to-government cooperation agreement with the U.S.S.R. from 1984 amounted to $2 billion, repayable in 8 to 10 years in oil and hard currency. Bilateral trade with China was $130 million, and 10 Chinese companies were in Iraq, employing 9,000 Chinese.

Companies from the Republic of Korea were being given priority on new projects because of their presence in Iraq during the war. Projects mentioned included expansion of the Khor al-Zubair steel complex and the Al-Qaim phosphate fertilizer complex. Payment was expected to be partly in crude oil owing to the lack of foreign currency.

French Government claims on unpaid debt by Iraq were reported at $4 billion, the highest of any member of the Organization for Economic Cooperation and Development. French commercial creditors were reported to have equivalent claims.

India reported that over 60 projects valued at $3.5 billion had been completed and rendered to Iraq by Indian companies. Owing to the war, cash contracts were converted into deferred payments with the assistance of the Export-Import Bank of India. An average of $330 million was received annually by India in repayment of the earlier debt, the highest paid to any creditor.

A new railroad maintenance plant was scheduled for opening in Abu-Ghurayyib, west of Baghdad, in late 1989. An instrumentation laboratory, a locomotive inspection unit, and a spare parts manufacturing unit were under construction.

Exports through the ports of Umm Qasr and Faw were restarted following the clearing of an 8-meter-deep navigation channel. Traffic included several 8,000-to-15,000-deadweight ton (dwt) vessels carrying urea to China and Hong Kong. Cement was also exported, and fertilizer exports could increase to 50,000 tons per month. Imports of 300,000 tons of iron ore pellets per year for use at the Khor al-Zubayr plant were planned through the port. At yearend, 10 jetties were near completion at Umm Qasr, adding 3 million tons to the port's capacity. Ivan Milutinovic of Yugoslavia was attempting to close a $500 million contract to build 13 more berths at Umm Qasr, adding 4 million tons in the port's capacity. Included in the contract were 250,000 square feet of warehouse space, 45 kilometers of railroad, and 13 prefabricated concrete berths. Work was to be completed in 42 months.

The two offshore terminals, Mina al-Bakr, with a prewar capacity of 2.7 million bbl/d and Khor al-Amaya, with a prewar capacity of 1.8 million bbl/d, were heavily damaged during the war and would require 9 to 12 months of rehabilitation prior to restart of crude oil loadings.

Commodity Review

***Metals.*—Aluminum.**—An aluminum products plant built before the war by Creusot Loire of France had the capacity to produce 10,000 tons per year of rolled wire and 15,000 tons per year of other rolled products. A new 200,000-ton-per-year aluminum smelter was proposed for Nasiriya, near the products plant, and may be built by Pechiney of France.

Iron Ore.—Contracts recently signed to supply raw materials to the iron and steel works at Khor al-Zubair include 4.5 million tons per year of iron ore pellets from Bahrain's Gulf Industrial Investment Co. and 300,000 tons per year of pellets from the Kundremukh Iron Ore Co. of India. The Kundremukh pellets were valued at $12 million and were scheduled for delivery between April and December 1989. Prior to the Iraq-Iran war, Brazil supplied iron ore. Local iron ore resources are being studied by Kloeckner Industrie-Anlagenbau of the Federal Republic of Germany.

Low-grade iron ore was mined in significant quantity for the production of resistant cement, according to the General Establishment for Geological Survey and Mineral Discovery. Location and grade were not given. About 24.7 million tons of goethite and hematitic ore averaging about 24% iron and 0.03% phosphorus and occurring in lenses averaging 2.4 meters thick were known in the vicinity of Wadi Husainiya in northwestern Iraq.

Iron and Steel.—The existing iron and steel works at Khor al-Zubair, built mainly by Creusot Loire prior to the war, consists of two direct reduction units of 440,000- and 750,000-ton-per-year capacity for production of sponge iron and a steel mill with a 400,000-ton-per-year capacity. The smaller direct-reduction unit was to supply the steel plant, and the larger was to supply the export market. Planned investment consists of expansion of the HYL steel works by an additional 400,000 or 500,000 tons per year. Following expansions of the current facilities, a second iron and steel complex costing $1 billion may be proposed. Output would include 590,000 tons per year of hot-rolled flat products, 210,000 tons per year of cold-rolled sheet steel, and 210,000 tons per year of galvanized sheet steel. Sponge iron from the Khor al-Zubair complex would be feed for three electric arc furances for output of 1.3 million tons per year of steel. A 45,000-ton-per-year galvanizing plant was commissioned for coating steel parts and structures.

The Industry and Military Installations Ministry awarded a contract to Danieli of Italy for a 300,000-ton-per-year specialty steel plant, primarily to supply local demand. Steel billets from a plant being built by Kloeckner in the Taji area would be used for engineering, stainless, and tool steels at the specialty steel plant. Also being considered were a $100 million plant to produce 100,000 tons per year of seamless pipe and a $75 million plant to produce 150,000 tons per year of welded pipe, both at Ramadi.

***Industrial Minerals.*—Cement.**—Production, according to the Northern State Establishment for Cement, was 10.5 million tons of cement, and exports were

TABLE 5

IRAQ: PRODUCTION OF MINERAL COMMODITIES[1]

Commodity[2]		1984	1985	1986	1987[p]	1988[e]
INDUSTRIAL MINERALS						
Cement, hydraulic[e]	thousand metric tons	8,000	8,000	8,000	10,000	10,500
Gypsum[e]	do.	300	300	300	350	350
Nitrogen:[e]						
N content of ammonia	do.	80	60	60	60	70
N content of urea	do.	[r]50	60	60	60	70
Phosphate rock[e]	do.	1,000	1,000	1,000	1,000	1,015
Salt[e]	do.	80	70	70	70	70
Sulfur, elemental:[e]						
Native, Frasch	do.	500	500	600	[r]707	700
Byproduct	do.	70	70	200	250	350
Total	**do.**	**570**	**570**	**800**	**[3]957**	**1,050**
MINERAL FUELS AND RELATED MATERIALS						
Gas, natural:[e]						
Gross	million cubic feet	400,000	450,000	450,000	500,000	500,000
Marketed[4]	do.	60,000	80,000	80,000	100,000	100,000
Natural gas liquids:[e]						
Natural gasoline	thousand 42-gallon barrels	400	400	400	400	400
Propane and butane	do.	1,000	1,000	1,000	1,000	1,000
Petroleum:						
Crude	do.	437,800	520,900	617,000	792,050	[3]981,000
Refinery products[e]	do.	110,000	110,000	110,000	110,000	120,000

[e]Estimated. [r]Revised. [p]Preliminary.
[1] Includes data available through June 9, 1989.
[2] In addition to the commodities listed, lime and a variety of crude construction materials (clays, sand and gravel, and stone) were also produced, but output was not reported, and available information is anadequate to make reliable estimates of output levels.
[3] Reported figure.
[4] Includes reinjected, if any.

$20 million. Capacity was 14 million tons per year, expandable to 17 million tons per year. Products include clinker, standard-grade cement, white cement, salt-resistant cement, and cement for oil wells, the latter originally imported at $700 per ton. About 5.2 million tons of cement was contracted for shipment to Egypt, Kuwait, and Turkey out of a total of 5.5 million planned for export in 1989, with Egypt to receive about 800,000 tons. The Iraq State Enterprise for Cement commenced filling orders for 1 million tons of clinker for Kuwait. The Yemen Arab Republic was to receive 75,000 tons and Kuwait 20,000 tons of white cement.

The Upper Euphrates cement works in Kubaisa commissioned its $17.7 million bulk-handling system for bagged and bulk cement, as well as fuel oil, in April. Capacity of the system was 400,000 tons per year for shipment on the Akashat-Baghdad railroad. Output could be doubled with the addition of a second work shift. Two Indian firms, Associated Cement Co. and Tata Exports, had their operations and maintenance contracts for the Upper Euphrates plant renewed for 2 years. The two firms also have an operations-and-maintenance contract at the Al-Qaim cement plant.

Clays.—Reserves, as reported by the Iraq General Establishment for Geological Survey and Mineral Discovery, were 180 million tons of colored clays and 21 million tons of white clay.

Fertilizers.—Output of mixed fertilizers by the State Establishment for Fertilizers was 641,000 tons, and exports were $31 million. The rescheduled startup of Complex 4, near Baiji, in 1989, would make Iraq self-sufficient in production of all types of fertilizers. Annual output would be 360,000 tons per year of ammonia and 600,000 tons per year of urea. Shipments to Al-Qaim would consist of 100,000 tons of urea. The $350 million complex had technical problems with a compressor, waste heat boiler, and water pump, which prevented startup in August 1988. The facility has a storage capacity of 35,000 tons of urea, or about 20 days of production, and underground storage tanks for 3,000 tons of ammonia. Natural gas and naphtha feedstocks were brought in from the Baiji refinery, 18 kilometers distant. The Government canceled plans for a fifth fertilizer complex in Mosul and planned instead to double capacity of the Baiji complex, where site preparation was underway. Planned capacity was 1,700 tons per day of urea using the Stamicarbon process and 1,000 tons per day of ammonia using M. W. Kellogg Co's technology. Kellogg was the project engineer and startup of Complex 5 was scheduled for 1992. Kellogg also bid on a contract to double the capacity of Complex 3 at Khor al-Zubair. The original plant commenced output in 1978 with annual capacities of 360,000 tons of ammonia and 600,000 tons of urea prior to shutdown in September 1980 due to the war. About 50% of the plant was reported damaged in the war.

Davy McKee of the United Kingdom was selected as overall project engineer for expanding the Al-Qaim fertilizer complex by processing an additional 1.64 million tons of phosphate annually. The expansion includes a 2-million-ton-per-year sulfuric acid plant with three production lines; a 640,000-ton-per-year phosphoric acid plant; a granulation plant producing 540,000 tons per year triple superphosphate, 520,000 tons per year diammonium phosphate, and 370,000 tons per year of compound fertilizer; and an ammonia plant with an output of 730,000 tons per year of ammonia and 640,000 tons per year of urea. Calcined phosphate is shipped by rail from the Akashat Mine, which had a capacity of 7 million tons per year. The current plant includes two facilities yielding 5,700 tons per day of concentrate grading 30% phosphorus pentoxide. The existing triple superphosphate plant has a capacity of 600,000 tons per year.

A sodium tripolyphosphate plant with a capacity of 50,000 tons per year was contracted for construction by Abay and Sie-Batignolles, a joint Belgian-French venture, for the Arab Co. for Detergent Chemicals (Aradet). Feasibility and site preparation for the plant was done by the Arab Petroleum Investments Corp. (Apicorp), which held 32% of Aradet. Location of the plant was not reported.

Gypsum.—The Government indicated that it was selling off two state-run gypsum quarries in Arbil and Anbar. No capacity or value for the enterprises was reported.

Kaolin.—Kaolin reserves were estimated at 40 million tons.

Phosphate Rock.—Production was 1.5 million tons of phosphate rock, and exports were valued at $65 million. Reserves were 10 billion tons, according to the Iraq General Establishment for Geological Survey and Mineral Discovery.

Potash.—A $500,000 loan was negotiated with the Islamic Development Bank to finance imports of potash.

Pyrite.—Production was 209,000 tons in 1988, and output in 1989 was targeted at 450,000 tons. Proved reserves were 64 million tons.

Salt.—The Heavy Industries Ministry commenced output of salt from 10 pans at a lake 180 kilometers south of Baghdad. Cost of the project was $32 million, and first stage production was 200,000 tons per year, about one-half the design capacity.

Sand.—SECI reported production of 143,000 tons of glass sand, and output in 1989 was to be about 164,000 tons. A $1 million contract for the export of glass sand to Kuwait was signed.

Sulfur.—Output was reported at 957,000 tons, exports were $74.1 million, and reserves were 515 million tons. About one-half of total production was exported. Exports in 1988 were to Egypt, India, Italy, Jordan, and Romania, with Egypt receiving 175,000 tons of sulfur valued at $18 million. Sulfur exports in 1987 were 470,000 tons, compared with 500,000 tons in 1986. Jordan and Egypt were the main markets in 1987, receiving 170,000 tons and 150,000 tons, respectively. In 1986, purchases by the two countries amounted to 120,000 tons and 180,000 tons, respectively. Domestic sulfur consumption was about 500,000 tons for fertilizer production and about 170,000 tons for the chemical, oil, and the iron and steel industries. Plant capacity at Mishraq was to increase by 50%. A British company won a $9.6 million order from the MSSE to supply equipment for the Mishraq Mine.

Minerals & Metals Trading Corp. of India agreed to purchase 200,000 tons of sulfur in 1989 in a countertrade deal with MSSE. MSSE was to buy products and services valued at 25% of the first 100,000 tons of sulfur delivered in the first 6 months of 1989. Between 35% and 50% of the balance of goods and services from India would be bought in the second half of 1989. Total value was about $20 million, with prices of $101 per ton f.o.b. Shuaiba in Kuwait, or $96 per ton f.o.b. Umm Qasr.

The sulfuric acid plant at Al-Qaim has a capacity of 4,500 tons per day. It is to be supplemented by a new plant with two production lines totaling 1.25 million tons per year.

Mineral Fuels.—Six power stations were commissioned in 1987, and both thermal and hydroelectric plants were planned. Sales of electricity to Turkey were planned, connection with the Turkish power grid was completed. A similar project has been studied with Kuwait.

Iraq was processing with large-scale development of its hydroelectric potential. About 17 plants could be built on the Tigris River with a total output of 4,859 megawatts; 7 on the Euphrates

River with 1,493 megawatts; 26 on the Greater Zab River totaling 4,118 megawatts; 9 on the Diyala River totaling 1,190 megawatts, and 12 on the Lesser Zab River totaling 1,951 megawatts.

Hyundai Engineering & Construction Co. of the Republic of Korea was negotiating a $350 million extension to the Musayyib power station, where two 300-megawatt units would increase the existing 1,200 megawatts.

Three powerplants were being built, each having six 300-megawatt oil and gas units. The Al-Anbar plant is to be built on the north bank of the Euphrates, 140 kilometers northwest of Baghdad. The two other plants were at Al-Shamal and Yusufiya. The Al-Shamal plant would be a 1,400-megawatt station, for which Yugoslavian companies have won $150 million in contracts. Technopromexport of the U.S.S.R. signed a $777 million contract for construction of the plant at Yusufiya, about 40 kilometers southeast of Baghdad on the Euphrates River. Total capacity of the plant would be 1,260 megawatts, based on six 210-megawatt units, the first of which was to be operational in about 4 years. The project was part of a $2 billion line of credit from the U.S.S.R. to Iraq.

Natural Gas.—Proved reserves were 1 trillion cubic meters, of which 750 billion cubic meters was associated gas and the remainder was nonassociated. About 90 cubic meters of natural gas was associated with 7 barrels of crude petroleum.

Natural Gas Liquids.—A contract was reportedly signed with Chiyoda Chemical Engineering and Construction Co. to conduct additional work at the $137 million natural gas liquids plant in the southern gas-collection complex to provide for gas reinjection. A 7,000-bbl/d liquified petroleum gas (LPG) unit at the Basra refinery was expected to be reactivated in January 1989. LPG output was 5 million barrels in 1983, 7.3 million barrels in 1984, and 8.7 million barrels in 1985.

Petroleum.—Crude petroleum capacity was 4.5 million bbl/d, 500,000 bbl/d above prewar levels, with actual output about 2.64 million bbl/d. Domestic consumption was 300,000 bbl/d, mainly for military purposes. Trial output from the Balad Field commenced in June, to be followed by the West Tikrit Field in early 1989. The East Baghdad Field began the first phase of a development program of 20,000 bbl/d of crude and 0.5 million cubic meters per day of natural gas. The State Co. for Oil Projects (SCOP) was the main contractor. Crude was to be refined at the Daura refinery, and also was to be used as feedstock for the Daura power station. Proved and estimated reserves of the East Baghdad Field were 28.6 billion barrels.

Mannesmann Anlagenbau of the Federal Republic of Germany signed a $225 million contract with the Northern Oil Co. (NOC) to develop the Saddam Field. Reserves were 2 billion barrels of light crude, and production was to be 45,000 bbl/d of crude oil and 11 million cubic meters per day of gas. The contract includes installation of collection and gas separation plants, oil and gas treatment units, and 500 kilometers of collection and distribution pipelines. Payment would be in crude petroleum. The NOC also awarded a $70 million contract to Technip Group of France to commence development of the Khabbaz Field. A subcontract was agreed to between Italy and the U.S.S.R. to develop the West Qurna Field. Development of the Khormal Field was under consideration. Initial output was estimated at 60,000 to 70,000 bbl/d, rising to 100,000 bbl/d at full capacity.

SCOP neared final determination of the construction project for a 140,000-bbl/d refinery to be built 60 kilometers south of Baghdad. Startup for the $1 billion refinery was planned for 1991, and it would produce gasoline, kerosene, fuel oil, and LPG. The LPG was for use in a petrochemical complex to be built nearby.

Surveys were under way on the subsea pipeline linking the mainland with the Khor al-Amaya terminal to decide its reactivation following cessation of hostilites with Iran. Restoration of the terminal would depend upon the line's serviceability. Rehabilitation of the onshore terminal at Fao, destroyed in the war, had yet to be decided. A contract was let to Bechtel Corp. of the United States for the proposed $2 billion petrochemical complex to be built in central Iraq, south of Baghdad.

Mitsubishi Corp. of Japan agreed to finance part of the $1.5 billion Iraq Pipeline Trans Saudi Arabia (IPSA-2); repayment would be in crude petroleum. Construction of IPSA-2 involves a consortium of seven companies, including Mitsubishi. Mitsubishi was the largest Japanese buyer of crude oil from Iraq, averaging about 200,000 bbl/d in 1987. A carefully monitored system of payments by Iraq to the consortium will permit Mitsubishi to deduct unpaid balances from the price of oil shipments not yet paid for. Conventional oil shipments may be paid for 60 to 90 days after delivery.

GTS Industrie, a subsidiary of Usinor-Sacilor of France, had a $150 million contract to supply about 140,000 tons of 42-inch-diameter pipe for delivery in 1989, primarily for installation along the 570-kilometer north-south pipeline route. Designed as the second strategic oil pipeline, with a construction time of 33 months, it would allow greater flexibility in moving various qualities and quantities of crude oil for export from Rumaila in the south to Haditha.

The State Co. for Oil Marketing (SOMO) announced that the Basra refinery would make available for export naphtha, kerosene, diesel fuel, and fuel oil. Throughput at Basra was 140,000 bbl/d of crude oil. Port of loading would probably be Khor al-Zubair, and primarily fuel oil would be for export to Persian Gulf and Far East countries. Snamprogetti S.p.A. of Italy started repair work on the $138 million lubrication unit at Basra, where production capacity was 100,000 tons per year of lube oil and 200,000 tons per year of asphalt. Refined products from Basra were also being exported by truck to Jordan's port of Aqaba. Current tank-truck shipments of 65,000 bbl/d of crude through Jordan and 25,000 bbl/d through Turkey were to cease in 1989 owing to cost and to remain within export quotas agreed to with the OPEC.

The Basra petrochemical complex, built in the late 1970's for $1 billion and never commissioned because of the war, was to start production in 1989. Capacity units include 140,000 tons per year of ethylene gas, 270,000 tons per year of liquid ethylene, 9,000 tons per year of butane, 43,000 tons per year of chlorine, 1,000 tons per year of liquid soda, 1,200 tons per year of hydrogen, 60,000 tons per year of hard plastic, 60,000 tons per year of low-density polyethylene, and 30,000 tons per year of high-density polyethylene. All output would be for local consumption.

KUWAIT[6]

Astute planning and exemplary management of petroleum revenues has brought Kuwait economic maturity. With most of the basic modern infrastructure now completed, investment capital was being diverted to overseas operations. By 1988, income from foreign investments was estimated to be nearly equal to income derived from petroleum exports, affording Kuwait a buffer in the event of any sharp decline in crude oil prices, a unique position among members of OPEC. Petroleum revenues for the fiscal year ending on June 30, 1988, totaled $7 billion, representing nearly 90% of Kuwait's domestic revenues.[7] Foreign assets were estimated at more than $90 billion, including at least $30 billion held in the United States.

One of the Kuwaiti Government's goals was to expand further into overseas refining and marketing. Toward that end, the Kuwait Investment Office (KIO) acquired an interest in British Petroleum Co. PLC (BP) after the United Kingdom Government floated its remaining equity shares in the company in November 1987. Initially, KIO acquired 10.06% of BP. By March 1988, it had raised its holdings to 21.6%. The British Monopolies and Mergers Commission advised that foreign ownership of 10% or more would not be in the public interest, resulting in a controversial ruling in October requiring that Kuwait reduce its BP holdings to 9.9%. The divestiture was to occur over a 3-year period to minimize possible Kuwaiti financial losses that might result from a forced sale. By yearend, BP offered to buy back 790 million shares from KIO for $4.32 billion, subject to approval of stockholders at the January 1989 meeting. The offer would reduce KIO holdings to 9.9% and earn Kuwait a profit of $684 million.

Other interests in overseas refining and marketing operations included ownership of a refinery in the Netherlands with a crude distillation capacity of 75,500 bbl/d, a 57,000 bbl/d refinery in Denmark, and a partial interest in an 80,000 bbl/d refinery owned by Union Explosive Rio Tinto near Huelva on the southern Atlantic coast of Spain. Kuwait Petroleum International, the European subsidiary of the Kuwait Petroleum Corp. (KPC), operated 5,000 gasoline retail outlets under the Q8 logo throughout Belgium, Luxembourg, Italy, United Kingdom, Denmark, and Sweden. Government-owned KPC was rated as the 13th largest oil company in the world in 1988.

Production and Trade

Kuwait production of crude oil, less restrained in 1988, exceeded by 40%, on average, the OPEC production quota of 996,000 bbl/d. Other OPEC members also ignored quotas, bringing additional supplies of crude oil to the market and weakening prices. OPEC's combined production quota for 1988 was to average 16.6 million bbl/d but production actually averaged 19.7 million bbl/d. The largest over quota excesses were posted by Saudi Arabia, Iraq, and Kuwait, creating downward pressure on prices throughout the year. The Kuwaiti 31°API blend price was $16.67 per barrel as the year began. It fell to $13.36 per barrel in March, rebounded to $15.70 in April, dipped to $9.68 per barrel in October, and ended the year at $9.86.

A surge in demand in response to lower prices, particularly in North America where consumption rose by 600,000 bbl/d to 19 million bbl/d, prevented a more serious price collapse from occurring in 1988. The Iran-Iraq war was the catalyst for quota violations. Iraq produced at capacity to acquire revenue to finance the war, and this prompted other OPEC members with large excess capacity to increase production as well. In August, Iran accepted United Nations Resolution 598 calling for a cease-fire. This not only improved the security of Kuwaiti shipping in the Persian Gulf, particularly of crude oil, but also afforded a more amicable atmosphere at the November OPEC meeting that established quotas for 1989 production. Quotas for Iran and Iraq were set at 2.6 million bbl/d each, and the quota for Kuwait was increased to slightly more than 1 million bbl/d but well below Kuwait's average production levels of 1.7 million bbl/d in the last quarter and the average of 1.4 million bbl/d for the year. The combined production quotas for all OPEC members in 1989 was raised 11% to 18.5 million bbl/d.

Revenues obtained from crude oil production averaging 315,000 bbl/d in the Neutral Zone were diverted by Kuwait and Saudi Arabia to Iraq to assist in financing the war effort. Iraq relinquished further use of these funds at the November OPEC meeting, and production from the Neutral Zone returned to the shared status between

Kuwait and Saudi Arabia.

With the cessation of hostilities between Iran and Iraq in August, shipping activities in the Persian Gulf increased; however, Kuwaiti ports had not yet reached capacity levels by yearend. Of the 11 Kuwaiti petroleum tankers that had been registered in the United States to legally permit U.S. Naval protection, 6 had reverted to the Kuwaiti flag by yearend with the remaining 5 to follow in early 1989.

While petroleum was Kuwait's principal mineral export—averaging nearly 1.4 million barrels of crude oil and products daily in 1988, shipments of ammonia, urea, and fertilizers from Kuwait made a significant impact in African, Middle Eastern, and Far Eastern markets. In 1986, exports of urea totaled 715,000 tons and exports of ammonia totaled 170,000 tons. When hostilities in the Gulf escalated in 1987, Kuwait stopped exporting ammonia until a cease-fire went into effect. In spite of high-war-risk-insurance premiums, 430,000 tons of fertilizer was exported to China and an estimated 300,000 tons was exported to India in 1987. Ammonia exports were resumed after the August 1988 cease-fire, and exports for 1989 were expected to be between 350,000 and 400,000 tons.

In 1988, 11% by value of all Kuwaiti imports were derived from the United States. Petroleum exports to the United States averaged 92,000 bbl/d of which 89,000 bbl/d was crude and unfinished oils, and the remainder was liquefied

TABLE 6

KUWAIT: PRODUCTION OF MINERAL COMMODITIES[1]

Commodity		1984	1985	1986	1987[p]	1988[e]
Cement	thousand metric tons	1,184	1,193	1,014	1,000	[2]888
Clay products, nonrefractory: Sand lime bricks	cubic meters	[e]450,000	336,200	336,000	336,000	[2]300,100
Gas, natural:[3]						
Gross	million cubic feet	250,000	190,000	235,000	[2]182,000	300,000
Marketed	do.	173,000	172,000	210,000	[2]165,000	270,000
Lime: Hydrated and quicklime	metric tons	15,000	52,400	57,198	[2]62,700	[e]65,000
Natural gas liquids[4]	thousand 42-gallon barrels	[r]24,455	19,710	27,375	[2]29,200	[e]30,000
Nitrogen: N content of ammonia	metric tons	289,800	322,700	450,600	[2]577,500	[e]550,000
Petroleum:						
Crude[3]	thousand 42-gallon barrels	424,200	374,000	518,600	[2]496,770	[e]590,000
Refinery products:						
Gasoline, motor	do.	8,760	[r e]10,000	[e]11,300	[e]11,500	12,000
Jet fuel	do.	5,110	[r e]6,000	[e]9,800	[e]9,500	10,000
Kerosene	do.	8,030	[e]10,000	[e]13,100	[e]13,000	13,000
Distillate fuel oil	do.	37,960	[r e]45,000	[e]45,600	[e]45,000	45,000
Residual fuel oil	do.	66,430	[e]79,000	[e]95,000	[e]90,000	88,000
Refinery fuel and loss	do.	5,840	[e]7,000	[e]8,400	[e]8,000	8,000
Other	do.	41,975	[e]50,000	[e]46,000	[e]45,000	45,000
Total	**do.**	**174,105**	**[r e]207,000**	**[e]229,000**	**[e]222,300**	**221,000**
Salt	metric tons	21,000	21,000	21,000	21,000	21,000
Sodium and potassium compounds:						
Caustic soda	do.	9,500	9,800	10,000	12,000	[2]16,100
Sulfur:						
Elemental, petroleum byproduct	do.	[e]237,000	[e]250,000	260,000	310,000	[2]360,000
Sulfuric acid	do.	[e]4,495	4,600	4,600	4,600	[2]4,500

[e] Estimated. [p] Preliminary. [r] Revised.
[1] Table includes data available through June 17, 1989.
[2] Reported figure.
[3] Includes Kuwait's share of production in the Kuwait-Saudi Arabia Neutral Zone.
[4] Gas plant liquids.

petroleum gas, residual fuel oil, and jet fuel. The United States also imported 9,000 bbl/d of Khafji 28°AP1 crude oil from the Neutral Zone.

Commodity Review

Industrial Minerals.–**Fertilizer Materials.**—Ammonia production installed capacity was 998,000 tons nitrogen (N) content from four plants at the Shuaiba industrial complex operated by the Petrochemical Industries Co. Feedstock for the plants was associated gas from domestic petroleum fields supplanted by gas from Iraq via a 200-million-cubic-feet-per-day capacity pipeline completed in 1986. Plant 1 was closed in July 1988 with no indication of reopening, and plant 2 was undergoing refurbishing to improve energy efficiency and was scheduled to be operational by 1989.

KIO acquired a 15% interest in SA Cros, Spain's leading fertilizer producer. This acquisition was part of Kuwait's plan to invest $500 million in Spain.

Mineral Fuels.—**Natural Gas and Petroleum.**—Exploration.—Domestic exploration focused on the search for nonassociated natural gas deposits but with no success. The Kuwait Foreign Exploration Co. (Kufpec), a KPC subsidiary, signed an agreement in November 1988 with China to develop and market the oil and gas resources in the Ying-ge-Hai concession of Hainan Province. Kufpec also considered an exploration agreement for the East Maturh concession in the Western Desert sharing a 612-square-kilometer block with Norsk Hydro A/S of Norway. Kufpec had ongoing projects in Australia, Congo, Egypt, Indonesia, Ireland, Italy, Pakistan, South Yemen, Sudan, and Tunisia.

Production.—Crude oil production ranged from 1.1 million to 1.7 million bbl/d for an average of 1.4 million bbl/d in 1988. Actual capacity was estimated at 2 million bbl/d. Production from the Neutral Zone ranged between 200,000 and 425,000 bbl/d, with an average of 315,000 bbl/d.

Gross natural gas output was estimated at 300 billion cubic feet. Of that quantity, an estimated 25 billion cubic feet was vented or flared and 3 billion cubic feet was reinjected to maintain pressure in petroleum reservoirs.

Refining.—The Kuwait National Petroleum Co. (KNPC), a KPC subsidiary, completed modernization of its domestic refinery complex consisting of the 370,000 bbl/d Mina al-Ahmadi refinery, the 190,000 bbl/d Mina Abdullah refinery, and the 187,000 bbl/d Shuaiba refinery. Catalytic hydrocracking and desulfurizing units were added to both the Mina al-Ahmadi and Mina Abdullah. The latter was also equipped with two coking units with a combined capacity of 1,900 tons of coke per day. Existing units at all refineries were being upgraded, with the work scheduled for completion by 1989. A pipeline network linking all refineries for product exchanges was constructed to facilitate delivery of gas oil from Mina Abdullah as feedstock for the fluid catalytic cracking unit at Mina al-Ahmadi. The pipeline network would also facilitate blending of fuel oil at Mina al-Ahmadi for delivery to Shuaibia and Mina Abdullah as well as for delivering fuel oil from Mina al-Ahmadi to the vacuum distillation and coking plants at Mina Abdollah. This network enabled KNPC to make optimum use of refinery facilities. In 1988, the Shuaiba refinery received an average of about 80,000 bbl/d of products from the other two refineries and transferred about an average of 40,000 bbl/d to them.

Of the two Kuwaiti refineries in Europe, the KPC Europort refinery at Rotterdam in the Netherlands had a crude distillation capacity of 75,500 bbl/d and a catalytic reforming capacity of 8,200 bbl/d while the smaller KPC refinery at Gulfhavn in Denmark had a crude distillation capacity of 57,000 bbl/d and a catalytic reforming capacity of 110,500 bbl/d. Kuwait's marketing distribution network, Q8 retail outlets, absorbed about 250,000 bbl/d of petroleum products from Kuwait's domestic and European refineries.

OMAN[8]

Hydrocarbons dominated the Omani mineral industry, accounting for more than 80% of Government revenues and more than 90% of export earnings. Other commercial mineral industries included copper mining and refining, cement manufacture, as well as dimension and crushed stone operations. The development of a chromite mining industry could result from the reserve assessment now underway in the Farfar-Hilti and Rajmi-Fizh areas in northern Oman.

Oman's economy continued to recover from the recession caused by the collapse of crude oil prices. A rebound of prices in 1987 substantially aided economic growth; this elevated the GDP from $7.2 to $7.8 billion. While prices remained favorable in the first half of 1988, lower prices at yearend limited the GDP to less than $8 billion. Export earnings were reported at $3.3 billion while imports were reported at $2.1 billion.

Commodity Review

Metals.—**Chromite.**—The Robertson Group (United Kingdom) inaugurated a feasibility study as to the commercial viability of chromite-bearing ophiolite deposits in the Rajmi-Fizh area. Study conclusions were anticipated by mid-1990. Initial surveys indicate the area could yield as much as 1.6 million tons of ore. Chromite deposits in the Ghashabi area, with an estimated reserve of 180,000 tons of ore, were being developed for export. The Government was considering the construction of a ferrochromium plant with an annual capacity range of 25,000 to 50,000 tons of refined product if the Robertson Group survey results support the proposed plant.

Copper.—Copper, the only metal commercially extracted in 1988, was mined in an area 16 kilometers west of Suhar from the al-Asil, Arja, and Bayda Mines. The mines were operated by the Government-owned Oman Mining Co. and will be exhausted in 5 years at the present production rate. Additional deposits have been discovered at al-Rakkah and Hayl al-Safil in the State of Yanqul, which has an estimated 8 to 12 million tons of ore. An exploitation feasibility study was awarded to Bishimetal Exploration Co. Ltd. (Japan). If the results are positive and the mining of the deposit is viable, a more advanced study to prepare for exploitation will follow.

Mine output totaled 1.14 million tons of ore averaging 1.5% copper. Copper concentrate was pelletized and processed in an electric furnace. The copper matte was upgraded to blister copper quality in a Peirce-Smith converter. The Suhar smelter-refinery complex produced more than 16,000 tons of electrolytic copper cathode for export principally to Amalgamated Metals Corp. (United Kingdom).

TABLE 7

OMAN: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Country and commodity		1984	1985	1986	1987[p]	1988[e]
Cement, hydraulic		477,000	648,501	[e]700,000	839,796	[2]788,561
Chromite, gross weight		7,000	—	4,820	—	—
Copper:						
Metal:						
Mine output, Cu content		16,200	17,700	18,200	18,121	[2]17,065
Smelter		21,300	18,800	19,601	[e]19,500	16,500
Refinery		15,100	14,300	14,561	15,490	[2]16,473
Gas, natural:						
Gross	million cubic feet	137,000	140,000	162,060	164,000	165,000
Marketed	do.	66,300	78,000	76,000	80,000	80,000
Natural gas liquids: Butane and propane	thousand 42-gallon barrels	[r]1,000	1,200	1,460	2,120	2,130
Petroleum:						
Crude	do.	152,400	181,800	204,100	212,430	225,800
Refinery products:						
Gasoline	do.	2,996	3,243	3,585	2,864	2,900
Jet fuel	do.	1,431	1,462	1,476	928	1,000
Kerosene	do.	78	85	70	77	80
Distillate fuel oil	do.	3,517	3,930	3,880	3,565	3,600
Residual fuel oil	do.	7,695	8,570	9,363	7,373	7,400
Other	do.	772	809	938	900	1,000
Total	**do.**	**16,489**	**18,099**	**19,312**	**15,707**	**15,980**
Sand and gravel	thousand tons	6,420	[e]6,642	7,514	7,590	[2]4,719
Stone:						
Marble	do.	37	[e]37	44	39	[2]41
Other	do.	4,224	[e]4,000	2,875	248	[2]1,335
Sulfur, pyrites, S content		31,000	31,000	31,000	[r]30,000	30,000

[e]Estimated. [p]Preliminary. [r]Revised.
[1]Table includes data available through Nov. 29, 1989.
[2]Reported figure.

Mineral Fuels.—**Natural Gas.**—Natural gas reserves were estimated at 9.3 trillion cubic feet, including 6.8 trillion cubic feet of nonassociated natural gas. Production averaged 469 million cubic feet per day with most of the output derived from the operations of Petroleum Development Oman. Two-thirds of the natural gas production was recovered in association with crude oil. Seven wells in the Yibal Field accounted for 252 million cubic feet per day of natural gas, while the Fahud and Saih Niyada Fields each provided about 25 million cubic feet per day. Field operations, including reinjection, utilized 43% of Oman's natural gas production in 1988. The Government Gas System absorbed 32% of the output for its distribution network. Natural gas liquids extraction accounted for 10%. Only 15% of total natural gas production was flared, a major improvement when only 5 years earlier as much as 44% was flared.

Petroleum.—Unlike the large reservoirs of easily recovered crude oil discovered in much of the Gulf area, Oman's hydrocarbon production was derived from small scattered fields. During 1988, more than 250 million barrels were added to crude oil reserves through new discoveries and reevaluations of existing fields. Total recoverable reserves were increased to 4.2 billion barrels. During 1988, 45 exploratory wells and 107 development wells were drilled. Petroleum Development Oman drilled 78 development wells. In 1988, the company brought into production fields at Rajaa, Ramlat Rawl, and Zumurrud. Discoveries were reported at al-Aroos, al-Husain, Huwaisah, Lekhwair, Yibal, in northern Oman; at Mafraq and Qarat al-Milh in central Oman; at Naseem Safwan and Sadad in Southern Oman; and at Burj, Bayinah, Ihsan, Jaraad, Murshid, and Thamoud in Dhofar.

Because of depressed prices, capital and operating expenses have been trimmed by postponing all the new enhanced recovery projects until mid-1990. Ongoing recovery projects, however, continued unabated. In 1988, about 70 billion cubic feet of natural gas was reinjected to maintain pressure in oilfields.

Occidental of Oman Inc. drilled 28 development wells in the Safah Field where reserves were estimated at 60 to 80 million barrels by primary depletion. After treatment at the Safah production facilities, the 43°API gravity crude was exported via Occidental's pipeline to Lekhwair. Here, it joins the Petroleum Development Oman pipeline system for transportation to the storage and export facilities at Mina al-Fahal. Storage capacity at the export terminal was augmented by a 920,000-barrel tank, which was installed in 1988 to elevate total storage capacity to 3.6 million barrels.

Amoco Oman Oil Co. continued to explore its northern concession area without much success. In May 1988, the company was awarded a block in Southern Oman at Afar, which was previously held by Japan Petroleum Development Co. The concession agreement required that the company drill at least six exploratory wells in a 3-year period. Exploration acreage totaling 27,000 square kilometers in the Saiwan area of Southern Oman was awarded to Wintershall AG, with drilling requirements similar to the Amoco concession.

International Petroleum Corp. drilled three test wells in the Bukha Field in the Musandam Peninsula. Production was expected to commence in 1990 at 10,000 bbl/d of condensate and 100 million cubic feet per day of natural gas. Natural gas from the Bukha Field was being considered as feedstock for a reassembled methanol plant to be installed on a tanker moored off the coast of Oman near al-Khasab. The 500,000-ton-per-year-capacity plant was purchased from Hoescht Celanese Chemical Corp. by Offshore Gas Developments Ltd. (Grand Cayman).

Most of the nation's crude oil was produced by Petroleum Development Oman, with Government equity at 60%, Royal/Dutch Shell Oil Co. at 34%, Compagnie Française des Pétroles (Total) at 4%, and Partex at 2%. Production was about 600,000 bbl/d from 58 fields. Other producers were Occidental Oil of Oman, 12,500 bbl/d, and Elf Aquitaine Oman, 5,600 bbl/d. Crude oil exports were estimated at 568,000 bbl/d. About three-quarters of all crude oil exports were destined for Far Eastern markets. More than 40% of the crude oil exports were shipped to Japan alone.

The Government-owned Oman Refinery Co., managed by Ashland Oil Co. (United States), was designed to meet domestic requirements for gasoline (90 and 97 octane). The facility also produced jet fuel, diesel, kerosene, and bunker fuel. Products in excess of domestic consumption requirements were sold to Shell Markets (Middle East) Ltd. Refinery throughput averaged 51,000 bbl/d in 1988. The refinery installed five 2.5-megawatt gas turbines utilizing natural gas, which was heretofore flared. The turbines not only brought electrical self-sufficiency to the refinery but placed the refinery in position to sell excess power to the Mina al-Fahal industrial and residential complex.

QATAR[9]

The nation's economy was largely sustained by revenues obtained from the sale of crude oil and refined products, which was estimated at nearly $2 billion in 1988. Other mineral commodity exports were fertilizers, petrochemicals, and steel, all of which were heavily dependent upon the nation's natural gas output, principally from the Khuff reservoir, as fuel and feedstock. The availability of abundant inexpensive natural gas from the North Field deposit, now under development, has prompted several spinoff projects. One project was the construction of an aluminum smelter requiring 100 to 115 million cubic feet of natural gas per day. Other projects under consideration were the expansion of the fertilizer and petrochemical plants at Umm Said.

Commodity Review

Metals.—**Aluminum.**—By late November, a memorandum of agreement was signed establishing the Doha Aluminium Co. Ltd., a consortium of International Engineering Consultants Ltd. and Amari Plc.(United Kingdom), United Aluminum Fabricators (United States), the National Metals and Minerals Import and Export Corp. (China), and private Arab interest. The consortium plans to operate a 240,000-ton-per-year-capacity aluminum smelter. It was proposed for construction at Umm Said near Doha where a natural deep port would facilitate delivery and shipping of about three quarters of a million tons of alumina and aluminum per year. Product output would be absorbed by the partners and suppliers. The latter were undetermined by year-end. Total cost of the complex, which included a 500-megawatt power station and a 25-million-gallon-per-day desalination plant, was estimated at $1.2 billion. The proposed smelter would use technology licensed by the Aluminum Co. of America to produce standard grades of aluminum at 99.7% purity.

Iron and Steel.—The management of the Qatar Iron and Steel Co.'s integrated steel complex at Umm Said was transferred to Qatar at the close of 1988 with the expiration of the Kobe Steel Co.'s (Japan) management contract. In the decade since its commissioning, the plant has produced 4.5 million tons of steel. However, 1988 marked the company's first profitable year, largely as a result of a 15% to 20% increase in the price of steel bars and the fall of sales to the Gulf region by Brazilian, Japanese, and Korean producers. The production of steel bars increased by 6% to 533,000 tons in 1988, well above the original annual design capacity of 350,000 tons, as the company contin-

TABLE 8

QATAR: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Country and commodity		1984	1985	1986	1987[p]	1988[e]
Cement, hydraulic		326,000	318,000	308,000	303,000	300,000
Gas, natural:						
Gross	million cubic feet	215,905	214,480	229,100	227,395	[2]261,504
Marketed	do.	197,800	187,300	[e]199,300	[e]198,000	227,000
Iron and steel:						
Metal:						
Crude steel	thousand tons	478	533	507	492	527
Semimanufactures	do.	488	510	493	503	505
Natural gas liquids	thousand 42-gallon barrels	16,594	12,789	[e]13,600	13,500	15,000
Nitrogen: N content of ammonia		519,300	524,800	544,100	560,800	605,665
Petroleum:						
Crude	do.	147,100	111,800	102,000	106,945	124,445
Refinery products:						
Gasoline	do.	1,700	2,169	2,130	2,125	2,150
Jet fuel	do.	880	723	710	608	625
Kerosene	do.	30	27	32	35	35
Distillate fuel oil	do.	[r]1,395	[r]1,678	3,148	2,685	2,700
Residual fuel oil	do.	1,015	[r]3,668	4,162	3,929	4,000
Other	do.	72	558	696	[e]800	900
Total	**do.**	**[r]5,092**	**[r]8,823**	**10,878**	**[e]10,182**	**10,410**
Stone: Limestone	thousand tons	1,500	1,100	900	900	900
Sulfur		33,264	36,500	48,500	53,300	55,000

[e]Estimated. [p]Preliminary. [r]Revised. NA Not available.
[1]Table includes data available through Nov. 29, 1989.
[2]Reported figure.

ued to update its production technology by replacing equipment and machinery. About 40% of production was delivered to Saudi Arabia; Kuwait and the United Arab Emirates each accounted for 20%; about 10% was absorbed by other Middle East markets; and the remaining 10% was absorbed by the domestic market.

Mineral Fuels.—**Natural Gas.**—Qatar enjoyed a significant world position in natural gas reserves, which totaled approximately 160 trillion cubic feet or more than 4% of the world's total recoverable reserves. Only the Soviet Union, Iran, the United Arab Emirates, Saudi Arabia, and the United States enjoyed larger reserves. Most of the natural gas reserves were contained in the 6,000-square-kilometer North Field reservoir in the shallow waters northeast of the Qatar Peninsula. Natural gas dependent industries, powerplants, and desalination plants were supplied by offshore associated gas from the Khuff reservoir under the Dukhan Oilfield. While the Khuff reservoir supplied about 98% of Qatar's natural gas production in 1988, this source is expected to be depleted in the early 1990's necessitating urgent development of the North Field.

Consultancy contracts for the development of the North Field were awarded jointly to the Bechtel Corp. (United States), 60%, and to Technip (France), 40%. By mid-August, drilling commenced on the first well in the North Field. The initial development phase was expected to eventually produce 800 million cubic feet of gas per day. This production level would provide the domestic market with the necessary fuel for energy and raw material for local industries as well as provide about 40,000 bbl/d of natural gas liquids for export. The second development phase anticipates the production of an additional 800 million cubic feet per day for processing and pipeline distribution to nearby Gulf states such as Bahrain, Kuwait, and the United Arab Emirates. The third development phase envisages the construction of a liquefied natural gas plant to process 800,000 million cubic feet per day for export.

Petroleum.—Crude oil production averaged 340,000 bbl/d. About one-half of the output was produced from the onshore Dukhan Field. Qatar's refined-product consumption requirement was 12,000 bbl/d, which was wholly satisfied by the 50,000-bbl/d Umm Said refinery. Two petroleum product pipelines linking the Umm Said refinery to the export terminal were commissioned in January 1988 inaugurating the export of motor gasoline and aviation fuel. A 42-kilometer pipeline to connect the refinery with the storage and distribution center at Abu Hamur in Doha was near completion.

The Universal Oil Products Co. (United States) completed the design study for expansion of the refinery to 62,000 bbl/d. The design study covered the modernization of the distillation unit, the naphtha and kerosene hydrotreating plant, the platforming unit, the fuel gas treating plant, and the liquefied petroleum gas plant.

In mid-July, an administrative reorganization of the Qatar hydrocarbons industry was effected. The Qatar General Petroleum Corp. was given authority over all negotiations and contract awards involving hydrocarbon exploration and development. The corporation was also made responsible for the management of hydrocarbon exploration and drilling activities, which was formerly under the auspices of the Ministry of Finance and Petroleum.

SAUDI ARABIA[10]

Although Saudi Arabia had diversified its economic base significantly, the petroleum industry continued to fuel the Saudi Arabian economy in 1988. Petroleum revenues accounted for approximately one-fourth of the GDP, two-thirds of Government revenues, and about 85% of the Kingdom's export earnings. The GDP grew by 3.2% over the 1987 figure, to $72 billion.[11] Saudi Arabia was the third-ranking world producer of crude oil; Saudi crude accounted for nearly one-fourth of total crude oil output by OPEC.

Massive adjustments took place in the Kingdom's petroleum industry during the year. Foremost among these was the incorporation of the Saudi Arabian Oil Co., which absorbed the remaining functions of the Arabian American Oil Co. (ARAMCO). This development followed the acquisition of beneficial ownership of ARAMCO's assets by the Saudi Arabian Government between 1973 and 1980, after which period Aramco carried out the managerial and operational responsibilities of oil production on behalf of the Government. With the November 1988 approval of the charter of the new national oil firm, managerial and operational responsibilities were assumed by the Saudi Arabian Oil Co. During the year, Saudi Arabia entered into its first major overseas investment in downstream petroleum operations by purchasing a 50% interest in Texaco's United States east and gulf coast refining, distributing, and marketing system. This afforded the Kingdom a solid downstream base in a major world market, providing a secure outlet for about 15% of crude oil production permitted under current OPEC quotas. To improve the efficiency and accountability of the domestic petroleum refineries, international marketing operations, and domestic distribution activities, the Saudi Arabian Government formed a new company, known as the Saudi Arabian Marketing and Refining Co. (SAMAREC).

The net result of these changes was to create a public oil industry largely organized along product lines. Under the new arrangements, crude oil and natural gas remained under the auspices of the newly incorporated Saudi Arabian Oil Co., which also retained responsibility for the operation of all pipelines in Saudi Arabia and for the management of the Kingdom's overseas downstream investments. Refined product output and distribution were under the auspices of SAMAREC. One exception was the Ras Tanura refinery, which remained with the Saudi Arabian Oil Co. but which was to be operated in accordance with a product output dictated by SAMAREC. Additionally, the refining and blending of lubricating oils remained in the domain of the General Petroleum and Mineral Organization (PETROMIN) in joint ventures with Mobil and with private investors.

Saudi Arabia made a major adjustment in its estimate of recoverable crude oil and natural gas reserves. It increased estimates from the previous year by about 50% and 25%, respectively, to 255 billion barrels of crude oil and 183 trillion cubic feet of natural gas. This represents more than a quarter of all crude oil recoverable reserves in the world. The Government approved expansion of the 1,200-kilometer-long pipeline, Petroline, which links the Eastern Province to the Red Sea terminal at Yanbu, by 1.2 million bbl/d. Eventually, planners expected to raise total capacity to 4.5 million bbl/d. Petroline's expanded capacity was expected to provide greater access to United States and European markets, as well as to increase export capacity independent of the Strait of Hormuz. Several diversification programs launched by the Government in recent years relied on abundant associated natural gas as feedstock and fuel. With the availability of associated gas limited by petroleum production quotas, Saudi Arabia developed the capacity to tap nonassociated gas deposits to nearly 2 billion cubic feet per day, thus supplementing the requirements of the Master Gas System that serves the Kingdom's industrial and petrochemical facilities.

The Government continued to encourage private-sector investment in the minerals industry. Sectors attracting limited private investment included aluminum, gold exploration, and lubricant manufacturing.

Production

The production of crude oil, Saudi Arabia's principal mineral commodity, was contained by OPEC quotas to levels of about 4.5 million bbl/d for the first half of 1988. As the quota levels were disregarded by several OPEC members, Saudi Arabia increased its output by mid-1988 to ensure a market share. By yearend, output of 7 million bbl/d approached estimated current capacity levels.

Production of other mineral commodities reflected the success of the Kingdom's diversification program. These commodities included aluminum, cement, copper, fertilizer materials, gold, iron and steel, silver, zinc, and various types of ornamental stone.

Production of gold, silver, copper, and zinc commenced in 1988 with the commissioning of the Mahad al-Dhahab gold mine.

The production of petrochemicals in 1988 doubled over the 1987 output as new plants came on-stream just as world market demand rose. The production of natural gas liquids was curtailed by the reduction in associated natural gas output as a consequence of quota limitations on crude oil output. In the last half of 1988, increased crude oil output resulted in increased natural gas liquids production.

Trade

Crude oil, natural gas liquids, and other petroleum products accounted for 85% of all exports in 1988, or more than $21 billion; Saudi Arabia's second leading export commodity, petrochemicals, earned $1.25 billion. Crude oil export earnings remained stable as higher volume exports largely offset lower world prices. Saudi Arabia exported approximately 4.2 million bbl/d of crude oil and products in 1988, an increase of 23% from the 3.4 million bbl/d exported in the previous year. In 1988, about 35% of all Saudi Arabia's petroleum exports was delivered to North America, about 30% was delivered to the Far East, and 25% was destined for Europe. Saudi Arabia emerged as the principal supplier of petroleum to the United States, providing more than 1 million bbl/d in 1988, exceeding 1987 levels by nearly 300,000 bbl/d.

Iron and steel exports earned an estimated $55 million, while other metals exports earned an estimated $27 million.

Commodity Review

***Metals.*—Aluminum.**—Plans for the construction of a 240,000-ton-per-year-capacity aluminum smelter at Yanbu were revived by Saudi Arabian private investment interests. Together they formed the Alujain Corp. Saudi Arabia (ALUSA). Shareholders included the Saudi Cable Co., a subsidiary of Xenel Industries. Saudi Arabian nationals were to retain 60% of ALUSA, with the remaining equity offered to nationals of the other Gulf Cooperation Council member countries—Bahrain, Kuwait, Oman, Qatar, and the United Arab Emirates. The Yanbu smelter was expected to utilize natural gas piped from the Khuff reserves off the eastern coast. The Ministry of Industry and Electricity was expected to approve construction and issue a license in early 1989. Technology and management services for the smelter were to be provided by Aluminium Pechiney (France). Bechtel (United States) was named as project manager for the $700 million operation.

Discussions focusing on obtaining long-term alumina supply agreements and refined product offtake agreements were conducted with Australian, European, Japanese, and United States companies. Plant completion was scheduled for early 1992 raising total aluminum production capacity in the Gulf, including the Bahrain, Dubai, and proposed Qatar plants, to 740,000 tons annually.

Copper.—The Mahad al-Dhahab precious metals mine entered production in early 1988, yielding an estimated 300 tons of copper as a coprod-

TABLE 9

SAUDI ARABIA: PRODUCTION OF MINERAL COMMODITIES[1]

Commodity		1984	1985	1986	1987[p]	1988[e]
Copper: Cu content of concentrate and bullion[e 2]	metric tons	—	—	—	—	300
Cement, hydraulic	thousand metric tons	[r]7,850	[r]8,221	9,332	8,595	8,500
Gold:[e]						
Mine output:						
Ore, gross weight	metric tons	—	—	—	—	40,000
Concentrate, gross weight[2]	do.	—	—	—	—	2,800
Bullion, crude, gross weight	thousand troy ounces	—	—	—	—	61
Au content of concentrate and bullion	do.	—	—	—	—	32
Gas, natural:[3]						
Gross	million cubic feet	1,025,900	1,133,000	1,430,000	1,380,000	1,450,000
Dry	do.	252,500	716,000	[4]847,600	708,000	800,000
Gypsum	thousand metric tons	369	410	373	373	375
Iron and steel: Metal, steel, crude	do.	842	1,106	[e]1,100	1,100	[4]1,365
Lime[e]	do.	[4]12	12	12	12	12
Natural gas liquids, all forms[3]	thousand 42-gallon barrels	124,100	123,370	149,650	125,896	[4]149,145
Nitrogen: N content of ammonia	thousand metric tons	415	436	467	637	800
Petroleum:[3]						
Crude	thousand 42-gallon barrels	1,701,995	1,236,620	1,841,425	1,535,555	1,850,000
Refinery products:[e]						
Gasoline	do.	37,000	49,000	[r]70,000	[r]73,700	80,000
Jet fuel	do.	17,000	4,100	[r]11,600	[r]11,600	12,000
Kerosene	do.	12,000	10,300	[r]7,300	[r]7,300	8,000
Distillate fuel oil	do.	68,700	86,900	[r]108,000	[r]109,000	115,000
Residual fuel oil	do.	92,600	87,200	[r]135,000	[r]138,000	140,000
Unspecified	do.	83,200	111,300	[r]144,500	[r]144,500	146,000
Refinery fuel and losses	do.	10,000	14,000	[r]19,000	[r]19,000	19,000
Total	**do.**	**320,500**	**362,800**	**495,400**	**503,100**	**520,000**
Silver: Ag content of concentrate and bullion[e 2]	thousand troy ounces	—	—	—	—	116
Sulfur: Byproduct, all sources	thousand metric tons	833	1,068	1,446	1,432	[4]1,378
Zinc: Zn content of concentrate[e 2]	metric tons	—	—	—	—	700

[e]Estimated. [p]Preliminary. [r]Revised.
[1]Table includes data available through Sept. 1, 1989.
[2]Mahad Al-Dhahab final products include a bulk flotation concentrate containing gold, silver, copper, zinc and crude bullion containing gold, silver, and copper.
[3]Includes Saudi Arabian one-half share of production in the Kuwait-Saudi Arabia Neutral Zone.
[4]Reported figure.

uct, which was combined with base and precious metals in a flotation concentrate and crude bullion. Output was stockpiled, pending outcome of contract negotiations with foreign smelting and refining companies.

Gold.—The Mahad al-Dhahab underground gold mine entered production in early 1988. The mine was designed to produce 120,000 tons of ore per year, yielding 95,000 troy ounces of gold and 350,000 of silver annually for an estimated mine life of 11 years. A total of 4,800 meters of development work was undertaken to ready the mine for production. Cut-and-fill mining was planned for ore zones greater than 3 meters wide and shrinkage stoping for

TABLE 10

SAUDI ARABIA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS				
Alkali and alkaline-earth metals	1,802	97	—	All from Switzerland.
Aluminum:				
Ore and concentrate	162,821	77,590	—	India 45,059; Australia 32,531.
Oxides and hydroxides	565	528	273	West Germany 254.
Metal including alloys:				
Scrap	615	198	—	All from France.
Unwrought	14,295	18,165	—	Bahrain 15,772; West Germany 910.
Semimanufactures	44,974	48,751	3,114	West Germany 8,612; United Kingdom 5,167; Egypt 4,916.
Cobalt: Oxides and hydroxides	63	387	387	
Columbium and tantalum: Metal including alloys, all forms: Tantalum	([2])	230	230	
Copper:				
Matte and speiss including cement copper	972	556	—	All from Turkey.
Metal including alloys:				
Scrap	133	—		
Unwrought	14,379	17,406	—	Zambia 11,340; United Kingdom 2,501; Chile 1,997.
Semimanufactures	13,270	16,232	823	West Germany 2,237; Japan 2,142; Republic of Korea 2,019.
Iron and steel:				
Iron ore and concentrate excluding roasted pyrite thousand tons	1,385	1,487	—	Brazil 1,188; Sweden 268.
Pyrite, roasted	—	8,000	—	All from India.
Metal:				
Scrap	980	33,814	33,814	
Pig iron, cast iron, related materials	281,017	4,912	—	Turkey 2,359; Brazil 1,986; France 567.
Steel, primary forms	148,940	111,270	246	West Germany 39,443; Japan 27,240; Republic of Korea 17,403.
Semimanufactures:				
Bars, rods, angles, shapes, sections	737,312	485,777	319	Qatar 163,292; Republic of Korea 156,115; Japan 102,959.
Universals, plates, sheets	371,801	422,405	1,632	Japan 231,384; West Germany 81,670; Republic of Korea 54,106.
Hoop and strip	5,917	4,753	—	United Kingdom 1,679; Republic of Korea 1,233; Japan 1,099.
Rails and accessories	849	—		
Wire	38,207	27,063	—	Japan 8,568; China 5,122; United Kingdom 4,619.
Tubes, pipes, fittings	311,332	251,384	12,565	Japan 63,083; West Germany 40,275; Republic of Korea 28,530.

See footnotes at end of table.

TABLE 10—Continued

SAUDI ARABIA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS—Continued				
Lead:				
Ore and concentrate	140	—		
Oxides	112	—		
Metal including alloys:				
Unwrought	158	—		
Semimanufactures	1,261	—		
Magnesium: Metal including alloys:				
Unwrought	31	—		
Semimanufactures	14	—		
Manganese: Ore and concentrate, metallurgical-grade	27,926	26,124	—	France 15,195; Austria 3,400; Belgium-Luxembourg 3,120.
Mercury 76-pound flasks	15,026	—		
Nickel: Metal including alloys, semimanufactures	278	126	—	All from Italy.
Platinum-group metals: Metals including alloys, unwrought and partly wrought value, thousands	$29	—		
Silver: Metal including alloys, unwrought and partly wrought do.	$161	—		
Tin: Metal including alloys:				
Unwrought	68	—		
Semimanufactures	546	265	—	All from Netherlands.
Titanium: Oxides	4,242	5,426	1,595	United Kingdom 1,547; West Germany 881.
Zinc:				
Ore and concentrate	48	—		
Oxides	811	183	183	
Metal including alloys:				
Scrap	389	—		
Unwrought	8,756	5,999	—	Belgium-Luxembourg 3,196; Australia 1,445; China 558.
Semimanufactures	4,785	4,784	—	West Germany 2,244; Japan 2,202.
Other:				
Ores and concentrates	2,060	666	291	West Germany 375; Belgium-Luxembourg 70.
Oxides and hydroxides	633	850	242	West Germany 307; United Kingdom 182.
Ashes and residues	371	5,199	—	All from Belgium-Luxembourg.
Base metals including alloys, all forms	158	—		
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	1,380	3,408	—	All from Netherlands.
Artificial: Corundum	59	—		
Grinding and polishing wheels and stones	1,495	1,992	—	All from Italy.

See footnotes at end of table.

TABLE 10—Continued

SAUDI ARABIA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
INDUSTRIAL MINERALS—Continued					
Asbestos, crude		4,379	—		
Barite and witherite		407	—		
Boron materials:					
Crude natural borates		41	—		
Oxides and acids		113	500	—	All from Turkey.
Cement	thousand tons	2,676	1,889	—	Japan 584; Republic of Korea 419; United Arab Emirates 297.
Chalk		3,916	—		
Clays, crude		7,165	10,784	—	Bulgaria 5,425; West Germany 4,550; United Kingdom 808.
Diamond:					
Gem, not set or strung	value, thousands	$1,808	$1,683	—	Belgium-Luxemborg $522; Switzerland $429; India $393.
Industrial stones	do.	$372	$846	—	India $466; Belgium-Luxembourg $380.
Diatomite and other infusorial earth		2,493	—		
Feldspar, fluorspar, related materials		275	—		
Fertilizer materials:					
Crude, n.e.s.		12,851	9,671	814	West Germany 8,857.
Manufactured:					
Ammonia		193	—		
Nitrogenous		153,216	75,807	1,552	Belgium-Luxembourg 15,220; Italy 13,760; Netherlands 13,673.
Phosphatic		263,154	312,779	70,499	Iraq 94,862; Finland 44,015.
Potassic		35,068	45,630	4,727	Finland 15,000; West Germany 7,428; Netherlands 7,304.
Unspecified and mixed		11,507	10,929	—	Jordan 9,071; West Germany 1,031.
Gypsum and plaster		65,809	5,994	—	West Germany 3,041; France 2,953.
Lime		1,472	—		
Mica: Worked including agglomerated splittings		15	—		
Nitrates, crude		1,982	13,063	—	Iraq 11,742; West Germany 1,321.
Phosphates, crude		17,175	3,234	—	Netherlands 1,630; Jordan 1,604.
Pigments, mineral: Iron oxides and hydroxides, processed		12,636	779	661	Belgium-Luxembourg 117.
Potassium salts, crude		21	—		
Precious and semiprecious stones other than diamond:					
Natural	value, thousands	$483	$349	—	All from Italy.
Synthetic	do.	$485	$373	—	All from India.
Pyrite, unroasted		30	—		
Salt and brine		13,677	8,443	6,846	Netherlands 1,597.

See footnotes at end of table.

TABLE 10—Continued

SAUDI ARABIA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
INDUSTRIAL MINERALS—Continued				
Sodium compounds, n.e.s.: Carbonate, natural and manufactured	17,711	6,506	—	Kenya 4,371; Belgium-Luxembourg 1,675.
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked	27,999	17,115	—	Italy 13,233; Greece 3,882.
Worked	371,448	336,049	353	Italy 233,699; Greece 61,873.
Dolomite, chiefly refractory-grade	3,431	—		
Gravel and crushed rock	35,699	20,627	—	Italy 20,076; Japan 551.
Quartz and quartzite	364	—		
Sand other than metal-bearing	4,619	3,823	—	All from Netherlands.
Sulfur:				
Elemental:				
Crude including native and byproduct	81	—		
Colloidal, precipitated, sublimed	77	—		
Sulfuric acid	441	—		
Talc, steatite, soapstone, pyrophyllite	2,455	1,145	—	All from Finland.
Other:				
Crude	3,540	532	532	
Slag and dross, not metal-bearing	1,135	—		
MINERAL FUELS AND RELATED MATERIALS				
Asphalt and bitumen, natural	17	—		
Carbon black	50	—		
Coal:				
Anthracite and bituminous	463	109	—	All from Japan.
Briquets of anthracite and bituminous coal	4,230	10,503	—	West Germany 9,132; United Kingdom 1,371.
Coke and semicoke	869	—		
Peat including briquets and litter	339	—		
Refinery products:				
Liquefied petroleum gas thousand 42-gallon barrels	1	—		
Mineral jelly and wax do.	4	1	—	All from United Kingdom.
Kerosene and jet fuel do.	56	37	9	United Arab Emirates 11; Singapore 6.
Distillate fuel oil do.	(3)	—		
Lubricants do.	216	512	62	France 194; Netherlands 147.
Residual fuel oil do.	3	10	—	Belgium-Luxembourg 9; France 1.
Bitumen and other residues do.	(3)	—		
Bituminous mixtures do.	5	6	3	United Kingdom 3.
Petroleum coke do.	(3)	—		

[1] Table prepared by P.J. Roetzel. Export data were not available at time of publication.
[2] Unreported quantity valued at $33,000.
[3] Less than 1/2 unit.

areas less than 3 meters wide. Ore was hauled to the surface in 20-ton, low-profile trucks through a 500-meter-long, 3.5-meter-wide, and 3.3-meter-high incline at a gradient of 1:9. The primary ore zone lies between 25 and 150 meters below the surface, negating the need for a shaft, unless the ore body was found to extend to considerably greater depth than had been previously indicated.

Surfaced ore was stockpiled according to grade and fed selectively to the 75-ton-per-hour capacity crushing plant. The concentrator design capacity was 400 dry tons per day in all major sections, including cyanidation, leaching, and carbon absorption. Crushed ore was blended and ground to feed the flotation circuit consisting of roughers, scavengers, and three cleaning stages; a gold, silver, copper, and zinc flotation concentrate was produced for eventual shipment to a foreign smelter, pending pilot testing and contract negotiations. Tailings from this process were leached with cyanide and passed through carbon-absorption tanks. Gold and silver were pressure stripped from the carbon using a hot, caustic cyanide solution. Gold was recovered from the strip solution by electrowinning on stainless steel cathodes. The resulting crude bullion was also stockpiled for eventual shipment to a foreign refinery.

In late 1988, a mining lease was issued to the Saudi Co. for Precious Metals, an operating company for the Boliden AB (Sweden) and PETROMIN (Saudi Arabia) joint partnership, to develop the Sukhaybarat deposit located between Medina and Al-Quasim Province. Reserves were estimated at 7.2 million tons of ore, containing an estimated 650,000 troy ounces of gold. Mine capacity was planned at 600,000 tons yielding about 50,000 troy ounces of gold annually. Mine development and construction of the ore-dressing plant and infrastructure was expected to be completed by early 1991.

The Al-Amar deposit located 350 kilometers southwest of Riyadh covers a 10,000-square-meter area with an estimated reserve of 1 million tons of ore, containing 0.6 to 1.1 troy ounces of gold per ton. A number of companies registered interest in developing Al-Amar, including Utah International, a subsidiary of Broken Hill Properties, Australia. The Petroleum and Minerals Ministry was expected to reach a final decision by mid-1989 on the issuance of a mining license for the deposit.

Iron and Steel.—The Saudi Iron and Steel Co. (Hadeed) operated a 1.1-million-ton annual capacity direct-reduction plant utilizing two 400-series Midrex lines and a steel plant with a 135-ton-tap-weight electric arc furnace with an annual liquid steel capacity of 1.4 million tons. A steel shredder plant was commissioned in early 1988, with the capacity to produce 500 tons of scrap daily from automobiles. Finished steel capacity at Hadeed was 1.2 million tons of reinforcing bars and wire rods. The steelworks also supplied billets to the Jeddah Rolling Mill Co., producing reinforcing bars of 6- to 28-millimeters in diameter at near-capacity levels of 90,000 tons annually.

The industry enjoyed a 20% tariff protection in 1988 and supplied nearly 90% of the nation's steel product demand.

The installation of an additional direct-reduction line, as well as the expansion of the liquid steel capacity to 2 million tons annually, was under consideration.

***Industrial Minerals.*—Cement.**—Low cement prices and an over capacity in the domestic industry contributed to serious operating losses for cement producers. Plants operated at about 65% of their combined annual capacity of nearly 14 million tons, while imports reached 4 million tons annually. Producers were successful in obtaining an 8% increase in tariffs, raising the import duty to 20% in the 1987-88 budget, with a further increase to 30% anticipated. Prices, although low, were fairly stable in 1988, averaging from $34.70 to $36.00 per ton for portland cement and from $37.30 to $40.00 per ton for sulfur-resistant cement; however, producers reported that prices ranging from $45.00 to $48.00 per ton would be necessary to provide a profit margin.

Fertilizer.—Technipetrol (Italy) was selected to provide all designs, procurement services, and construction supervision for the construction of the National Chemical Fertilizer Co. (Ibn al-Baytar) complex at Al-Jubail, scheduled to come on-stream in 1990. The complex included a 500,000-ton-annual-capacity mixed fertilizer plant under license provided by Cros (Spain); a 200,000-ton-annual-capacity granulated triple-superphosphate plant licensed by Jacobs Engineering (United States); a 100,000-ton-annual-capacity diammonium phosphate plant licensed by Cros; a 500,000-ton-annual-capacity granulated urea plant licensed by Snamprogetti (Italy); and a 10,000-ton-annual-capacity liquid nitrogen and phosphate fertilizer plant. When completed, the new facilities were to be supplied with ammonia feedstock from the Ibn al-Baytar's 500,000-ton-annual-capacity anhydrous liquid ammonia works, which began operating in August 1987. Its entire output was directed to the export market until the fertilizer complex was completed and ready to consume two-thirds of its product. Other raw materials, including phosphates, were to be imported. Construction of the Ibn al-Baytar complex was to be financed by loans from the Saudi Industrial Development Bank and the Arab National Bank.

***Mineral Fuels.*—Natural Gas.**—Recoverable reserves were reported at 177.3 trillion cubic feet (cu. ft.) at the end of 1988, as compared with 141.8 trillion cubic feet reported the previous year. Adding Saudi Arabia's share of natural gas reserves from the Neutral

TABLE 11

SAUDI ARABIA: FERTILIZER INDUSTRIES

Company	Location	Feedstock	Product	Annual capacity (thousand metric tons)	Operation date
National Chemical Fertilizer Co. (Ibn al-Baytar)	Al-Jubail	Methane	Ammonia	500	1987
			Compound and phosphate fertilizers	800	1990
			Urea	500	1990
			Liquid fertilizer	10	1990
Saudi Arabian Fertilizer Co. (SAFCO)	Dammam	Methane	Urea	330	1969
			Sulfuric acid	100	1969
			Melamine	20	1985
Al-Jubail Fertilizer Co. (SAMAD)	Al-Jubail	Methane	Urea	620	1983

Source: Saudi Basic Industries Corporation.

Zone raised the total to 183.4 trillion cubic feet. This reserve assessment was the result of an intensive, 6-year study that included analysis supported by an exploration and petroleum-engineering data base and reservoir-simulation models from the Dhahran Computer Center.

To fully utilize the natural gas produced in association with crude oil, a processing and distribution system was designed and constructed in the early 1980's. The Master Gas System consists of 60 gas-oil separation plants in the Khurais, Safaniyah, Ghawar, and Zuluf Fields; three gas-processing plants at Berri Shedgum and Uthmaniyah; the east-west natural gas liquids pipeline designed to transport natural gas liquids from Shedgum to Yanbu; and two gas-fractionation plants at Yanbu and Ju'Aymah. Altogether, the system has the capacity to gather 6 billion cubic feet per day of raw gas. However, in compliance with OPEC quota allocations, crude oil production and consequently associated natural gas output were reduced to about one-half of Saudi Arabia's peak production level.

Development of nonassociated gas resources became necessary to sustain the system. Nonassociated natural gas from the deep Permian Khuff formation was included in the Master Gas System to help meet peak demand levels. By the end of 1988, the flow lines to six Khuff formation wells brought nonassociated natural gas production capacity to nearly 2 billion cubic feet per day. Plants at Shedgum and Uthmaniyah had a combined capacity to process 1.6 billion cubic feet per day of nonassociated raw gas for feed into the Master Gas System. A proposed new high-pressure plant was expected to add another 0.4 billion cubic feet per day of nonassociated raw gas processing capacity to the Shedgum facility by late 1990.

Bids were invited for design, engineering, and procurement assistance contracts on a fourth offshore gas-oil separation plant for the Safoniyah-Khafji Field. The plant, 50 kilometers northeast of Safoniyah, was expected to have the capacity to separate 250,000 bbl/d of crude oil and 100 million cubic feet per day of natural gas. Two United States firms, Fluor Daniel and Lummus Crest, were invited to submit bids for the engineering contract on the separation plant and final design for four tie-in platforms.

Petroleum.—Exploration and Development.—As a result of a massive reassessment of hydrocarbon resources over the last 6-year period, estimates of recoverable crude oil reserves were elevated by more than 85 billion barrels to 252.4 billion barrels at the end of 1988. When the Saudi Arabian share of reserves in the Neutral Zone was considered, the Kingdom's recoverable reserve total increased to 255 billion barrels, or one-quarter of total world recoverable reserves.

Seismic exploration activities heightened after the 1986 Government action granting ARAMCO the right to survey the entire country, thus opening those areas outside the retained concession to exploration. By 1987, ARAMCO had placed three seismic teams in the field and added a fourth in 1988.

A total of 20 wells were completed in onshore and offshore drilling operations, including 17 development wells and 3 exploratory wells.

Production.—The production of crude oil supported the Kingdom's goals, which included preserving long-term market prospects for petroleum while generating sufficient income for domestic economic needs. Crude oil production ranged from a monthly average of 4.2 to 4.6 million bbl/d during the first half of the year; however, production steadily increased in the second half of 1988 as the Kingdom responded to the threat to its market position by the promise of large new supplies from Iran and Iraq, and to the over-quota production by several other OPEC members. Production approached 7 million bbl/d in late 1988, raising average production for the year to 5.1 million bbl/d, or about 0.5 million bbl/d above quota. By yearend, most Saudi Arabian crude oil was sold under formula pricing arrangements. For example, sales to the Far East were linked to the average price of Oman and Dubai crudes, sales to Europe were linked to the price of Brent crude, and sales to North America were linked to the price of Alaskan crude. These flexible pricing arrangements when combined with generous allowances for transport cost, created a wider distribution pattern for crude oil exports.

Refining.—Saudi Arabia finalized its first major overseas refining and marketing investment with the purchase of 50% of Texaco's distribution and marketing system in the United States' east and Gulf coast area. The system includes 3 refineries with a combined capacity of 615,000 bbl/d in Delaware, Texas, and Louisiana; 49 terminals; 1,450 service stations owned and leased by Texaco; as well as a distribution network covering 10,000 more stations bearing the Texaco name.

Domestic refining and marketing operations were restructured. SAMAREC was created in December 1988 to undertake all petroleum refining and marketing activities that previously were the responsibility of PETROMIN. SAMAREC's Refining Div. took over the management of the three refineries operating at Riyadh, Jeddah, and Yanbu with a combined annual capacity of 420,000 bbl/d. In addition, SAMAREC's Refining Div. absorbed Petromin's 50% interest in two joint-venture export refineries, each with a 250,000 bbl/d capacity; the first was at Al-Jubail with the Shell Refining Co. and the second at Yanbu with Mobil Refining Co. The Rabigh refinery with its 350,000 bbl/d capacity was to be included in the SAMAREC Refining Div. when it was commissioned in 1990.

SAMAREC's International Marketing, Marine, and Supply Division undertook the responsibility for international sales, marketing functions, marine transportation and domestic supply. This task included distribution of the entire output of the 530,000-bbl/d capacity Ras Tanura refinery that was owned and managed by Saudi Aramco but which now operates at levels determined by SAMAREC. This refinery traditionally functioned as a swing producer, meeting the balance of domestic consumption requirements and exporting the remainder.

The lubricant refining, blending, and marketing industry was not included under the SAMAREC Group. The domestic market for lubricants absorbed about 2 million barrels annually. Because this industry was largely covered by private-sector investment, Government involvement was limited to majority ownership of two joint ventures with Mobil, the Lubricating Oil Refining Co. (LUBEREF), and the Petromin Lubricating Oil Co. (PETROLUBE). The Kingdom's sole lubricant oil refinery was operated by LUBEREF at Jeddah, with an annual capacity of 1.7 million barrels. Expansion to 2.1 million barrels annually was considered as an alternative when plans for a second lubricant refinery were abandoned in 1988 when it became apparent that the demand growth for lubricating oils was slowing rapidly. PETROLUBE operated three blending plants with a combined capacity of 2.5 million barrels annually and marketed over 60% of all lubricants sold in Saudi Arabia in 1988. Three other lube plants were in operation. Of these, two plants were owned and operated by Royal Dutch/Shell as a joint venture with two private Saudi Arabian companies, and the third was operated by the Gulf Oil Trading Co.

Transportation.—Saudi Arabia continued to increase its west coast exporting capacity through expansion of the cross-country crude oil pipeline, Petroline, and through the crude oil terminal at Yanbu on the Red Sea coast. Petroline's original capacity was 1.8 million bbl/d when it was commissioned in 1981; by 1987, a 56-inch-in-diameter parallel line was operational, raising capacity to 3.3 million bbl/d. Plans were announced to increase capacity to 4.5 million bbl/d by installing 22 additional pumps and turbines. Other adjustments were expected to be implemented to facilitate shipment of two grades of crude oil by 1992. Once completed, Petroline was foreseen to have the capacity to transport 2.93 million bbl/d of Arabian Light and 1.57 million bbl/d of Arabian Heavy crude oil.

In 1988, Petroline also serviced Iraqi crude oil exports via a pipeline extending from Al-Zubayr in southern Iraq to Petroline at a pump station east of Riyadh. The Iraq pipeline was expected to eventually parallel Petroline, crossing Saudi Arabia to an export terminal being constructed at Ras al-Mu'ajjis on the Red Sea coast. Upon completion of the pipeline and terminal, Iraq was expected to have the capacity to ship and export 1.65 million bbl/d of crude oil via Saudi Arabia.

Expansion of port facilities at Yanbu was planned to increase loading capacity from 2.6 million bbl/d to 3.9 million bbl/d. Three offshore crude oil berths, the largest of which is capable of servicing tankers up to 550,000 dwt, were in operation, with a fourth berth under construction. The port storage capacity was reported at 6 million barrels.

Port facilities under construction at Rabigh to service the new export refinery included nine berths capable of handling tankers up to 312,000 dwt in size.

A total of 2,199 vessels called at Saudi Arabian ports at Ras Tanura, Ju'Aymah, and Yanbu during 1988. The average turnaround time for all vessels was 30 hours.

Petrochemicals.—Saudi Arabia produced over 8 million tons of liquid petrochemicals and plastic resins during 1988. Retirement of aging capacity in Europe and the United States enabled the Kingdom to benefit from the market upswing. Plants operated 20% above rated capacity to meet the demand. Saudi Arabian petrochemicals and plastic resins were confronted with a 13% tariff in the EC. In November, the EC announced the eventual abolition of duty-free access for limited volumes of seven of the Kingdom's petrochemical products. During the year, petrochemicals were exported to 65 countries. About 50% of the export volume was shipped to the Far East.

Products introduced in 1988 were fortunately timed to meet a rising market. The Arabian Petrochemical Co. (PETROKEMYA), a wholly owned subsidiary of Saudi Basic Industries Corp. (SABIC), began producing polystyrene at the Al-Jubail plant. The plant was designed to produce annually 50,000 tons of high-impact polystyrene, 30,000 tons of general-purpose polystyrene, and 20,000 tons of expandable polystyrene. By mid-1988, the Saudi European Petrochemical Co. (IBN ZAHR), another SABIC affiliate, began producing methyl tertiary butyl ether (MTBE) at its 500,000-ton-annual-capacity plant at Al-Jubail. MTBE is a substitute for lead as an octane enhancer for gasoline.

UNITED ARAB EMIRATES[12]

The United Arab Emirates was a major world producer of petroleum and natural gas. It also had the capacity to produce over 70 million barrels annually of petroleum refinery products. Of the seven principalities making up the United Arab Emirates, Abu Dhabi had the most diverse mineral industry, and was also the largest contributor to the nation's total sales of mineral based products.

The only significant metal production was the output of aluminum by Dubai. The ready availability of natural gas has made possible the construction of such energy-intensive industries. However, revenues from the petroleum and natural gas sector remained the most significant contributor to the economy, accounting for about 85% of total Government receipts.

Commodity Review

Mineral Fuels.—**Natural Gas.**—The United Arab Emirates host the largest natural gas reserve among the Arab States with a total of 5,706 billion cubic meters accounting for nearly one-fifth of the Arab nations' reserves and about 5% of the total world's natural gas reserve. The Abu Dhabi Gas Liquefaction Co. remained the only liquefied natural gas producer in the Persian Gulf region. The company's entire output of more than 100 billion cubic feet was delivered to Japan.

The Abu Dhabi Co. for Onshore Operations (ADCO) has proposed upgrading the Thamama C gas processing plant to increase condensate production and provide more facilities for downstream processing. ADCO operated the wells and gathering lines of the Thamama F and Thamama C associated gas treatment plants, which supply fuel gas to the Umm al-Nar and Abu Dhabi power stations as well as provide feedstock to the Ruwais refinery.

The Dubai Natural Gas Co. produced over 6.9 million barrels of natural gas liquids at the Jebel Ali gas processing plant in 1988. The company was awaiting Government approval for obtaining additional supplies of raw gas. At yearend, the company signed an agreement with C Itoh & Co., replacing the existing 5-year agreement due to expire in 1990. The company is supplied natural gas from Sharjah at the rate of 220 million cubic feet per day. The Dubai Petroleum Corp. is also a large supplier. A 13-million-cubic-meter-per-day-capacity pipeline was under construction, connecting the Margham Gasfield with the Jebel Ali plant. Completion of the 59-kilometer pipeline was anticipated by April 1990. Upon completion, the pipeline will permit the gas company to broaden its customer base beyond the aluminum smelter operations and the Dubai Electric Co.

The Government of Sharjah purchased 60% of the Sajaa condensate and natural gasfield from Amoco in January. The field produced about 45,000 bbl/d of condensate entirely for export and nearly 500 million cubic feet per day of natural gas, all for delivery to the Dubai Gas Co. and the Emirates General Petroleum Co.

Petroleum.—Production of crude oil averaged nearly 60% above the OPEC production quota of 948,000 bbl/d for the Emirates with actual output averaging over 1.5 million bbl/d in 1988. Most petroleum production from the United Arab Emirates was derived from Abu Dhabi, which had an average output for the year of well over 1 million bbl/d. A total of 400,000 bbl/d was produced from the Margham, Fateh, Falah, and Rashid Fields in Dubai, and about 65,000 bbl/d was produced in Sharjah. Crude oil exports to Japan were reported at 822,000 bbl/d, and exports to Western Europe were reported at 348,000 bbl/d.

In June 1988, a major reorganization of the Abu Dhabi petroleum industry was effected with the objective of unifying the Government's planning and supervisory activities in the interest of cost and administrative efficiency. The Department of Petroleum was abolished in favor of a Higher Council for Petroleum. The new 11-member petroleum council replaced the board of the Abu Dhabi National Oil Co. (ADNOC). The council assumed the responsibility of the Emirates' policy and objectives in all sectors of the petroleum industry. Creation of the council concentrated authority in the Crown Prince and president of the national executive council.

ADNOC prepared the Umm al-Anbar offshore field to commence production of 8,000 bbl/d of 36° to 37°API crude oil by yearend. Field development was undertaken by the Mubarrez Oil Co., a consortium including the Japan National Oil, Cosmo Oil Co., Nippon Mining Co., and ADNOC. Reserves at Umm al-Anbar were estimated at 40 million barrels.

The Abu Dhabi based International Petroleum Investment Co. (IPIC) purchased a 10% equity share in Compania Espanola de Petroleos (Cepsa) for $124 million. This purchase entitled Abu Dhabi to supply the Spanish refiner with 60,000 bbl/d of crude oil or about one-third of Cepsa's require-

TABLE 12

UNITED ARAB EMIRATES: PRODUCTION OF MINERAL COMMODITIES[1]

Emirate[2] and Commodity[3]		1984	1985	1986	1987[p]	1988[e]
ABU DHABI						
Cement, hydraulic[e]	thousand metric tons	800	800	800	[4]700	[4]750
Gas, natural:						
Gross	million cubic feet	[r]562,200	[r]446,370	566,400	566,000	[4]465,000
Dry, marketed	do.	355,000	358,000	359,900	400,000	380,000
Natural gas liquids	thousand 42-gallon barrels	[r]24,249	[r]22,400	10,245	10,248	[4]4,745
Nitrogen, N content of ammonia[e]	metric tons	226,000	282,300	290,800	311,000	296,700
Petroleum:						
Crude	thousand 42-gallon barrels	256,047	287,700	348,555	386,230	370,612
Refinery products:						
Liquefied petroleum gas	do.	1,700	2,300	2,300	2,920	3,000
Gasoline	do.	8,500	[r]8,330	8,370	9,855	9,900
Jet fuel	do.	8,320	8,325	8,350	8,395	8,400
Kerosene	do.	230	310	270	4,015	4,025
Distillate fuel oil	do.	15,400	[r]15,516	15,666	17,895	17,900
Residual fuel oil	do.	14,700	[r]15,975	16,083	16,425	16,500
Naphtha	do.	[r]11,100	[r]10,753	12,836	9,855	10,300
Total	**do.**	**[r]60,400**	**[r]61,509**	**63,875**	**69,350**	**70,025**
Sulfur, byproduct:[e]						
From petroleum refining	metric tons	NA	1,000	11,000	8,000	10,000
From natural gas processing	do.	35,000	104,000	104,000	97,000	100,000
Total	**do.**	**35,000**	**105,000**	**115,000**	**105,000**	**110,000**
AJMAN						
Cement, hydraulic[e]	thousand metric tons	200	200	250	[4]356	[4]380
DUBAI						
Aluminum, metal, primary ingot	metric tons	155,333	153,186	154,838	154,832	[r]162,000
Cement, hydraulic	thousand metric tons	[e]800	[e]800	500	500	[4]500
Gas, natural:						
Gross	million cubic feet	[e]107,000	185,500	[e]200,300	225,000	230,000
Dry, marketed	do.	[e]43,400	75,220	81,220	90,000	93,000
Natural gas plant liquids, unspecified;	thousand 42-gallon barrels	17,000	10,220	8,833	7,125	6,710
Petroleum, crude	do.	116,400	128,200	127,400	137,810	130,040
FUJAIRAH						
Cement, hydraulic	thousand metric tons	550	550	500	380	[4]465
RAS AL-KHAIMAH						
Cement, hydraulic	do.	1,200	1,200	360	890	950
Gas, natural: Marketed	million cubic feet	NA	4,590	[4]4,600	7,000	8,000
Lime[e]	thousand metric tons	45	45	45	45	45
Natural gas condensate	thousand 42-gallon barrels	2,120	3,640	4,680	4,700	3,650

See footnotes at end of table.

TABLE 12—Continued

UNITED ARAB EMIRATES: PRODUCTION OF MINERAL COMMODITIES[1]

Emirate[2] and Commodity[3]		1984	1985	1986	1987[p]	1988[e]
SHARJAH						
Cement, hydraulic	thousand metric tons	[e]700	[e]700	330	280	[4]240
Gas, natural:						
Gross[e]	million cubic feet	[r]186,800	[r]211,500	219,000	355,000	370,000
Dry marketed	do.	31,800	45,900	40,000	100,000	100,000
Natural gas plant liquids	thousand 42-gallon barrels	11,435	21,170	21,900	21,170	15,755
Petroleum, crude and condensate	do.	18,793	23,400	23,700	23,725	23,790

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

[1]Table includes data available through Jan. 12, 1990.

[2]In addition to the emirates listed, Umm al-Qaiwain reports no mineral production, but presumably produces small quantities of crude construction materials.

[3]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 to make reliable estimates of output levels.

[4]Reported figure.

ments. IPIC expressed interest in pursuing other overseas downstream holding as well as possibly doubling the equity holding in Cepsa.

Production from Sharjah's Mubarak Field was interrupted for a 2-month period to allow for essential repairs after a platform was damaged by an Iranian gunboat attack in April. Output ranged from 6,000 to 8,000 bbl/d. Prior to the attack, the field had underway a development program to increase production.

PEOPLE'S DEMOCRATIC REPUBLIC OF YEMEN[13]

Until the discovery of commercial quantities of crude oil in 1987, the mineral industry of the People's Democratic Republic of Yemen was limited to the production of salt at Khawi Maksar from the evaporation of seawater. The 160,000 bbl/d capacity refinery at Aden processed imported crudes for domestic consumption and for crude oil producers such as Iraq, Kuwait, and the Soviet Union. With the flow from the exploration wells in the Eastern Ayyad, Western Ayyad, and the Amal Fields, production totaled well over 2 million barrels or an average of 6,000 bbl/d of 36°API gravity crude oil. Crude oil was trucked to the Aden refinery for processing; however, completion of a 230-kilometer pipeline connecting the fields to the coast at Bir Ali was anticipated by 1990. The Gulf of

TABLE 13

PEOPLE'S DEMOCRATIC REPUBLIC OF YEMEN: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Country and commodity		1984	1985	1986	1987[p]	1988[e]
Petroleum refinery products:						
Gasoline	thousand 42-gallon barrels	[r]1,750	1,785	1,445	1,530	1,600
Kerosene	do.	[r]1,162	1,356	1,240	1,240	1,250
Distillate fuel oil	do.	[r]9,220	8,205	8,653	8,355	8,400
Residual fuel oil	do.	[r]9,310	9,325	7,990	8,985	9,000
Other	do.	230	[e]230	[e]900	1,000	1,000
Total	**do.**	**[r]21,672**	**20,901**	**20,228**	**21,110**	**21,250**
Salt[e]	thousand tons	75,000	75,000	75,000	75,000	75,000

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

[1]Table includes data available through Nov. 29, 1989.

Aden terminal will serve to load tankers for crude oil delivery to the domestic refinery at Aden or for delivery to international markets. The pipeline will have a capacity of 120,000 bbl/d. Output from the fields in the Shabwa region was estimated to eventually attain levels of 50,000 to 70,000 bbl/d. With domestic consumption at 15,000 bbl/d, the nation will enter the ranks of net exporters early in the coming decade.

The Soviet Union has extended credit of $500 million for field development and pipeline construction to be repaid from future production. By yearend, about 15 Soviet drilling rigs were in operation exploring, delineating, and developing the Shabwa area.

Western oil companies have also engaged in exploration activities. Foremost of which was Total Compagnie Francaise des Petroles (France) in partnership with Kufpec (Kuwait) and Union Oil Co. (United States). This consortium neared completion of its seismic survey analysis and expected to drill its first exploration well by mid-1989 in the east Shabwa region. Société Nationale Elf Aquitaine (France) and British Petroleum Co. and London and Scottish Marine Oil (United Kingdom) were surveying a concession in the Aden region. Société Nationale Elf Aquitaine was awarded a 46,630-square-kilometer concession in the northern Sirr Hazar region in November 1988. The Western companies have concluded production-sharing agreements, although the title to the Shabwa concession, under development by the Soviet Union, remained with the nation's petroleum exploration department.

The Yemen Co. for Investment in Oil and Mineral Resources was formed in 1988. Headquartered in Sanaa, Yemen Arab Republic, the joint company was formed to award concessions in the 2,200-square-kilometer corridor between the oil-bearing zones of Marib al-Jawf in the Yemen Arab Republic and Shabwa in the People's Democratic Republic of Yemen.

YEMEN ARAB REPUBLIC[14]

Basically an agrarian economy, mineral industry activity had been confined to the production of gypsum, dimension stone, and rock salt until the Alif Field was discovered to contain commercial quantities of crude oil in November 1985.

The Yemen Arab Republic experienced its first full year of crude oil exports in 1988, generating revenues estimated at about $500 million from taxes and the sales of the Government's share of production. Total exports were valued at $55 million in 1987 compared with $486 million in 1988. Crude oil export revenues were reported at $432 million and accounted for 89% of total export revenues in 1988.

Total production averaged 165,000 bbl/d, but production levels of 190,000 bbl/d were attained by the close of 1988. Production for the year was below expectations due to delays in attaining production targets for the Alif and Azal Fields and delays in the construction of the 430-kilometer pipeline network linking the production facilities to the export terminal at Salif on the Red Sea. The terminal consists of a 9-kilometer offshore pipeline linked to a 400 dwt storage tanker. The tanker will feed offtake vessels via a Single Point Mooring.

The Yemen Exploration and Production Co., a joint venture between Hunt Oil Co. at 51% equity (United States)

TABLE 14

YEMEN ARAB REPUBLIC: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Country and commodity		1984	1985	1986	1987[p]	1988[e]
Cement	thousand tons	1,390	1,400	1,160	760	[2]646
Gypsum		24,295	25,000	53,000	150,000	[2]160,000
Petroleum:						
Crude	thousand 42-gallon barrels	—	—	2,700	7,800	60,390
Refinery products:						
Gasoline	do.	—	—	811	1,103	1,125
Diesel fuel	do.	—	—	870	1,123	1,130
Fuel oil	do.	—	—	929	1,128	1,135
Total	**do.**	**—**	**—**	**2,610**	**3,354**	**3,390**
Salt		[e]148,000	150,000	300,000	163,000	[2]150,000

[e] Estimated. [p] Preliminary.
[1] Table includes data available through Nov. 29, 1989.
[2] Reported figure.

and the Exxon Corp. at 49% equity (United States), declared the Asaad al-Kamil Field as commercially viable. The field covers about 40 square kilometers and contains an estimated 133 million barrels of crude and condensate as well as 2.7 trillion cubic feet of associated gas in place. This represents the company's fifth commercial field. The others were the Alif, the Azal, and two smaller fields that were declared commercial in September. Recoverable reserves in the Marib Basin were reported at 500 million barrels of crude oil and condensate and 4 trillion cubic feet of gas. Under the concession terms, the Yemen Exploration and Production Co. shares production with the state on a sliding scale. The company enjoys 30% of the production up to the first 100,000 bbl/d level and drops by 5% for each additional 100,000 bbl/d to just 10% should output exceed 400,000 bbl/d.

The Yemen Co. for Investment in Oil and Mineral Resources was formed in 1988. Headquartered in Sanaa, the joint company was mandated to award concessions in the formerly disputed 2,200-square-kilometer corridor between the oil-bearing zones of the Shabwa in the People's Democratic Republic of Yemen and of the Marib al-Jawf area.

The French State Corp. for Earth Sciences completed a comprehensive review of Yemen's mineral potential and identified a commercially minable but heavily oxidized lead-zinc deposit at Jabali.

A cement plant was planned for construction at Mafraq with a 500,000-ton-per-year capacity. This will elevate the nation's total annual cement production capacity to 1.25 million tons. Existing plants, the Japanese built 500,000-ton-per-year capacity Amran plant and the 250,000-ton-per-year capacity Bajil plant constructed by the Soviet Union, were being considered for modernization and expansion.

[1] Prepared by Bernadette Michalski, minerals specialist, Division of International Minerals.

[2] Prepared by Lloyd E. Antonides, physical scientist, Division of International Minerals.

[3] Values are quoted by sources of information, unless otherwise indicated. Where necessary, values were converted from Iranian rials (Rls) to U.S. dollars at the rate of Rls71.460 = US$1.00.

[4] Prepared by George A. Morgan, physical scientist, Division of International Minerals.

[5] Where necessary, values have been converted from Iraqi dinars (ID) to U.S. dollars at the rate of ID0.31 = US$1.00.

[6] Prepared by Bernadette Michalski, minerals specialist, Division of International Minerals.

[7] Where necessary, values have been converted from Kuwaiti dinars (KD) to U.S. dollars at the rate of KD0.30085 = US$1.00 (1985), KD0.29054 = US$1.00 (1986), KD0.2825 = US$1.00 (1987), KD0.2748 = US$1.00 (1988).

[8] Prepared by Bernadette Michalski, minerals specialist, Division of International Minerals.

[9] Prepared by Bernadette Michalski, minerals specialist, Division of International Minerals.

[10] Prepared by Bernadette Michalski, minerals specialist, Division of International Minerals.

[11] Where necessary, values have been converted from Saudi riyals (SRL) to U.S. dollars at the rate of SRLs3.75 = US$1.00.

[12] Prepared by Lloyd E. Antonides, physical scientist, Division of International Minerals.

[13] Prepared by Bernadette Michalski, minerals specialist, Division of International Minerals.

[14] Prepared by Bernadette Michalski, minerals specialist, Division of International Minerals.

THE MINERAL INDUSTRIES OF

THE EASTERN MEDITERRANEAN COUNTRIES

By Bernadette Michalski, Hendrik G. van Oss, Thomas P. Dolley, and Jozef Plachy

CYPRUS[1]

The overall output of Cyprus' mineral industry in 1988 showed only a slight increase in volume. The only notable gains were in pyrite and petroleum refinery production. The increase in volume of pyrite and corresponding sulfur content was nearly 24%. The increase of petroleum refinery production from imported crude oil was somewhat smaller at 19% but noteworthy.

A metallic sulfides exploration program was carried out in the areas of Avia Marina, Mosphiloti-Pyrga, and Troulli. At the same time, in cooperation with foreign institutions and universities, the Economic Geology Section of the Geological Survey Department of Cyprus continued its research on the origin and distribution patterns of sulfide and chromite mineralization. Chromite mining, last carried out in 1982, remained suspended. In industrial minerals, limited exploration focused on adding reserves of construction materials. Possibilities for oil sparked some interest in offshore exploration on the Limassoil area.

A more significant expansion of the mineral industry was hindered by the continued political division of Cyprus. After a separate meeting with the United Nation's Secretary General in August 1988, both northern and southern leaders called for peace within a year. Only the southern sector was considered in this chapter because there was very little, if any, mineral production in the northern sector.

The overall economy of Cyprus had continued rapid growth in 1988. The gross national product (GNP) increased by 14% based on current market prices. The growth in real gross domestic product (GDP) decreased slightly to 6.9% from 7% in 1987. The high growth of the GNP resulted in essentially full employment, with only 2.8% of the economically active people being unemployed. However, because of increased prices for imports, inflation rose nominally from 2.8% in 1987 to 3.4% in 1988.

Production

In addition to the pyrite and refinery products already mentioned, the biggest increase was in the production of cement copper. However, the nearly threefold increase over that of 1987 may be misleading when compared with previous years. The industry continued to suffer from the effects of depletion of the richer copper ore bodies and its inability to discover new ones. All the other changes in 1988 production reflected the changing economic conditions of domestic and foreign commodity markets.

Trade

On January 1, 1988, the customs union agreement with the European Community (EC) became effective. According to this agreement, all trade barriers-customs duties and quotas are to be dismantled during the next 10 years. Under this customs union, the already dominant position of the EC as Cyprus' main trading partner will be further strengthened. In 1987, the latest data available, 48% of the value of trade in mineral commodities was with the EC. This represented 32% of known export destinations and 51% of imports. In Cyprus' total 1987 trade, the shares of the EC were 45% of exports and 62% of imports. The corresponding shares of U.S. trade in mineral commodities with Cyprus were 6% of exports and less than 1% of total imports. Table 1 summarizes the role of mineral commodities in total Cypriot trade for the latest years for which comprehensive data were available.

TABLE 1

CYPRUS: VALUE OF MINERAL COMMODITIES TRADE

(Thousand dollars)

	1986	1987
Mineral commodities:		
Exports	49,332	58,460
Imports	284,452	289,659
All commodities:		
Exports	506,355	621,190
Imports	1,263,434	1,463,327

Clearly, mineral commodity exports made only a modest contribution to export earnings, and mineral commodity imports represented only about one-fifth of total commodity imports, a figure similar to the world as a whole.

For 1988, the total trade deficit of Cyprus increased by 30% to $1.1 billion[2], of which $69 million was with the United States. Compared with the previous year, the value of 1988 exports of minerals decreased by $2 million and the value of industrial products of mineral origin decreased by $150,000.

Commodity Review

Metals.—**Copper.**—Until 1979, when reserves were depleted, Cyprus was a significant cement copper producer and exporter. In 1988, cement copper was produced only by the Hellenic Mining Co. Ltd. from tailings at the Skouriotissa Mine by an in situ leaching process. During the year, the company continued its research on the cyanidation of auriferous ores. The results were encouraging, and Hellenic Mining carried out a pilot plant test on auriferous minerals from Skouriotissa and other prospects.

Iron Pyrites.—Out of three opencast mines, the Mathiatis and Mani Mines were owned by Hellenic Mining. The third mine was operated by Maconda Ltd. The 1988 production of iron pyrites exceeded the prior year's production by 17%. The value of exports, however, plummeted from $617,300 in 1987 to $19,300 in 1988.

Industrial Minerals.—**Asbestos.**—Despite reported financial difficulties, the Cyprus Asbestos Mines Ltd. continued operations at its only mine. The opencast operation was located at Amiandos. During 1988, 936,838 tons of ore was mined, representing a 26% decrease compared with that of 1987.

TABLE 2

CYPRUS: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
METALS				
Aluminum: Metal including alloys:				
Scrap	881	1,314	—	Greece 566; Netherlands 386; West Germany 85.
Unwrought	—	11	—	All to Denmark.
Semimanufactures	35	288	—	United Kingdom 120; Italy 54; West Germany 26.
Copper:				
Matte and speiss including cement copper	1,148	304	—	West Germany 264; Denmark 20.
Metal including alloys:				
Scrap	365	756	—	Belgium-Luxembourg 220; United Kingdom 144; West Germany 131.
Semimanufactures	—	10	—	United Kingdom 9.
Iron and steel: Metal:				
Scrap	13,309	4,543	—	Greece 4,057.
Steel, primary forms	—	12	—	All to United Kingdom.
Semimanufactures:				
Bars, rods, angles, shapes, sections	60	1,584	—	Algeria 1,534.
Universals, plates, sheets	57	201	—	United Kingdom 159; Algeria 18.
Hoop and strip	—	381	—	All to Syria.
Wire	1	64	—	Israel 36; Kuwait 21.
Tubes, pipes, fittings	289	1,578	1,315	Greece 106; Saudi Arabia 41.
Lead: Metal including alloys, scrap	—	20	—	All to Denmark.
Silver:				
Waste and sweepings value, thousands	—	$30	—	All to West Germany.
Metal including alloys, unwrought and partly wrought do.	—	$2	—	All to United Kingdom.
Titanium: Oxides	—	5	—	All to Saudi Arabia.
Zinc: Metal including alloys, scrap	22	20	—	All to France.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	—	2	—	All to Algeria.
Grinding and polishing wheels and stones value, thousands	—	$3	—	Algeria $2; United Kingdom $1.
Asbestos, crude	11,781	22,340	—	Thailand 5,127; Belgium-Luxembourg 3,301; Indonesia 2,842.
Cement	349,994	495,729	—	Egypt 189,593; Cameroon 169,365; Lebanon 70,162.
Clays, crude	18,164	15,682	—	All to United Kingdom.
Diamond, natural: Gem, not set or strung value, thousands	$218	$259	—	Belgium-Luxembourg $103; Austria $61.
Fertilizer materials: Manufactured, unspecified and mixed	—	136	—	United Arab Emirates 129.

See footnotes at end of table.

TABLE 2—Continued

CYPRUS: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Destinations, 1987	
				United States	Other (principal)
INDUSTRIAL MINERALS—Continued					
Gypsum and plaster		12,224	15,907	—	Cameroon 10,031; Lebanon 5,000.
Lime		—	213	—	Kuwait 158; Syria 55.
Pigments, mineral: Natural, crude		6,741	—		
Precious and semiprecious stones other than diamond: Natural	value, thousands	—	$8	—	Australia $2; Greece $2; Saudi Arabia $2.
Pyrite, unroasted		65,938	21,905	—	All to Italy.
Salt and brine		27	19	—	Oman 15.
Sodium compounds, n.e.s.:					
Carbonate, manufactured		—	34	—	All to Syria.
Sulfate, manufactured		—	188	—	Do.
Stone, sand and gravel:					
Dimension stone:					
Crude and partly worked		1,025	1,142	—	Israel 902; Saudi Arabia 240.
Worked	value, thousands	$293	$218	—	Bahrain $124; Yemen (Aden) $40; Yemen (Sanaa) $33.
Gravel and crushed rock		—	43	—	All to Israel.
Limestone other than dimension		—	12,212	—	All to Cameroon.
Sulfur: Sulfuric acid		—	16,249	—	Switzerland 11,249; Italy 5,000.
Other: Crude		—	15,195	6,237	West Germany 6,489; United Kingdom 1,306.
MINERAL FUELS AND RELATED MATERIALS					
Peat including briquets and litter		—	2	—	All to Qatar.
Petroleum refinery products:					
Gasoline, motor	42-gallon barrels	r22,491	323	—	All to Algeria.
Mineral jelly and wax	do.	1,227	1,991	—	Saudi Arabia 1,928.
Kerosene and jet fuel	do.	r711,450	828,398	NA	NA.
Distillate fuel oil	do.	r77,711	86,148	NA	NA.
Lubricants	do.	5,589	7,035	—	Greece 2,387; Algeria 525; unspecified 3,885.
Residual fuel oil	do.	116,996	279,588	NA	NA.
Bituminous mixtures	do.	394	630	—	All to Jordan.

r Revised. NA Not available.

[1] Table prepared by Virginia A. Woodson.

The quality and quantity of fiber produced from this ore was as follows: 1,513 tons of long grade, 7,458 tons of medium grade, and 5,614 tons of short grade. The total of 14,585 tons of fiber was 19% higher than in 1987. During the year, 15,771 tons of fiber, valued at $4.1 million, was exported.

Cement.—Two cement plants at Vassilikos—one operated by Cyprus Cement Co. Ltd. and the other by Vassiliko Cement Works Ltd.—produced a total of 868,000 tons of cement, showing a slight increase over that of 1987. The value of cement per ton and the total value of production for 1988 remained approximately the same.

Clays.—There were only four companies producing bentonite: Bentex

TABLE 3

CYPRUS: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS				
Aluminum:				
Oxides and hydroxides	—	4	—	Netherlands 3.
Metal including alloys:				
Scrap	40	—		
Unwrought	2,000	4,737	—	Greece 3,384; Canada 843.
Semimanufactures	2,477	1,290	66	Greece 434; United Kingdom 206; Italy 186.
Cobalt: Oxides and hydroxides	(2)	—		
Copper:				
Matte and speiss including cement copper	10	21	—	All from United Kingdom.
Metal including alloys:				
Scrap	75	3	—	All from Japan.
Unwrought	43	43	(2)	United Kingdom 42.
Semimanufactures	1,140	1,101	39	Greece 278; United Kingdom 228; Finland 152.
Iron and steel: Metal:				
Scrap	—	384	—	United Kingdom 348; West Germany 36.
Pig iron, cast iron, related materials	1,519	529	—	Poland 500; Sweden 21.
Ferroalloys:				
Ferromanganese	—	21	—	All from France.
Unspecified	—	2	—	Do.
Steel, primary forms	—	12,416	—	Italy 7,432; Mozambique 4,978.
Semimanufactures:				
Bars, rods, angles, shapes, sections	93,866	104,605	3	Poland 30,723; Greece 27,639; Spain 19,972.
Universals, plates, sheets	23,306	21,766	—	Greece 5,901; West Germany 3,896; United Kingdom 2,268.
Hoop and strip	5,680	2,394	(2)	Greece 1,556; Belgium-Luxembourg 239.
Rails and accessories	88	7	—	Mainly from Belgium-Luxembourg.
Wire	2,578	2,707	—	United Kingdom 769; Hungary 660; Greece 429.
Tubes, pipes, fittings	22,408	15,670	3	France 4,805; Greece 4,261; Hungary 1,810.
Castings and forgings, rough	3	7	—	East Germany 3; United Kingdom 3.
Lead:				
Oxides	206	263	—	United Kingdom 262.
Metal including alloys:				
Scrap	2	—		
Unwrought	151	851	—	Belgium-Luxembourg 307; United Kingdom 276; Italy 184.
Semimanufactures	716	185	—	United Kingdom 153; Lebanon 25.
Maganese: Oxides	—	21	—	All from Belgium-Luxembourg.

See footnotes at end of table.

TABLE 3—Continued

CYPRUS: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS—Continued				
Mercury value, thousands	$4	$1	NA	NA.
Nickel:				
Matte and speiss	1	2	—	Israel 1; Spain 1.
Metal including alloys, semimanufactures	—	12	—	Austria 9; West Germany 2.
Platinum-group metals: Metal including alloys, unwrought and partly wrought value, thousands	$108	$169	$6	West Germany $150; United Kingdom $7.
Silver:				
Ore and concentrate do.	—	$1	—	All from United Kingdom.
Metal including alloys, unwrought and partly wrought do.	$1,706	$2,085	$21	United Kingdom $1,042; West Germany $625.
Tin: Metal including alloys, semimanufactures	—	9	—	United Kingdom 8; Sweden 1.
Titanium: Oxides	335	279	—	Finland 122; United Kingdom 119.
Uranium and thorium: Metal including alloys, all forms value, thousands	—	$1	—	All from West Germany.
Zinc:				
Oxides	53	25	—	West Germany 22.
Metal including alloys:				
Unwrought	78	69	—	Belgium-Luxembourg 60; United Kingdom 9.
Semimanufactures value, thousands	$121	$75	—	Spain $67; United Kingdom $6.
Other:				
Ores and concentrates	72	91	—	Australia 90.
Oxides and hydroxides	—	20	—	Mainly from United Kingdom.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	129	534	—	Greece 500; Yugoslavia 23.
Dust and powder of precious and semiprecious stones including diamond value, thousands	$1	$1	—	All from Belgium-Luxembourg.
Grinding and polishing wheels and stones do.	$345	$439	$3	Italy $217; West Germany $70; Austria $30.
Asbestos, crude	224	3	—	All from United Kingdom.
Barite and witherite	2	13	—	West Germany 9; United Kingdom 4.
Boron materials: Oxides and acids	2	1	—	All from West Germany.
Cement	16,099	9,530	28	Greece 6,195; Italy 2,140.
Chalk	438	1,463	—	Greece 930; United Kingdom 322.
Clays, crude	7,626	9,787	2	Greece 9,337; United Kingdom 269.
Diamond, natural: Gem, not set or strung value, thousands	$1,199	$1,730	$32	Belgium-Luxembourg $910; United Kingdom $316; Israel $281.
Diatomite and other infusorial earth	203	186	152	West Germany 27.
Feldspar, fluorspar, related materials	20	—		
Fertilizer materials: Manufactured:	—	22	—	France 20; Greece 2.
Ammonia	25	8,516	—	U.S.S.R. 4,000; United Kingdom 2,496; Italy 2,000.

See footnotes at end of table.

TABLE 3—Continued

CYPRUS: IMPORTS OF MINERAL COMMODITIES [1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
INDUSTRIAL MINERALS—Continued				
Fertilizer materials: Manufactured—Continued				
Nitrogenous	17,050	24,900	—	Bulgaria 10,496; Romania 6,800; Hungary 6,421.
Phosphatic	50	2,301	—	Lebanon 1,801; Romania 500.
Potassic	1,020	1,239	—	Israel 1,220.
Unspecified and mixed	29,456	6,481	62	Hungary 3,664; Romania 1,650; Israel 479.
Graphite, natural	8	1	—	All from United Kingdom.
Gypsum and plaster	25	48	12	United Kingdom 21; West Germany 15.
Magnesium compounds: Magnesite, crude	77	48	—	All from Netherlands.
Mica:				
Crude including splittings and waste	9	36	—	India 17; Norway 14.
Worked including agglomerated splittings value, thousands	—	$8	—	United Kingdom $5; Austria $2.
Phosphates, crude	—	16,254	—	Togo 16,250.
Pigments, mineral:				
Natural, crude value, thousands	$730	—		
Iron oxides and hydroxides, processed	34	25	—	United Kingdom 12; West Germany 8.
Precious and semiprecious stones other than diamond:				
Natural value, thousands	$760	$798	—	West Germany $345; Hong Kong $108; United Kingdom $75.
Synthetic do.	$131	$158	—	Switzerland $73; France $29; West Germany $24.
Salt and brine	1,221	5,616	—	Israel 1,228; France 1,200; Tunisia 1,100.
Sodium compounds, n.e.s.:				
Carbonate, manufactured	872	1,318	—	United Kingdom 392; Bulgaria 319; France 303.
Sulfate, manufactured	783	1,132	—	West Germany 427; United Kingdom 259; Netherlands 138.
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked	9,636	9,990	—	Italy 5,062; Greece 4,864.
Worked value, thousands	$654	$1,643	$1	Italy $1,018; Greece $513.
Dolomite, chiefly refractory-grade	49	59	—	Norway 43; Greece 8.
Gravel and crushed rock	1,033	1,960	—	Italy 1,390; United Kingdom 458.
Limestone other than dimension	11,515	12,141	—	Greece 12,140.
Quartz and quartzite	23	1,017	—	Greece 1,000.
Sand other than metal-bearing	569	704	—	Netherlands 264; Egypt 225; United Kingdom 125.

See footnotes at end of table.

TABLE 3—Continued

CYPRUS: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
INDUSTRIAL MINERALS—Continued					
Sulfur:					
Elemental:					
Crude including native and byproduct		2,823	2,384	—	Yugoslavia 1,807; Greece 305.
Colloidal, precipitated, sublimed		1	—		
Sulfuric acid		342	304	—	Greece 303.
Talc, steatite, soapstone, pyrophyllite		380	595	—	Greece 374; Norway 101; China 35.
Other:					
Crude		—	2,762	—	Greece 2,690.
Slag and dross, not metal-bearing		72,709	18,657	—	All from France.
MINERAL FUELS AND RELATED MATERIALS					
Asphalt and bitumen, natural		106	136	—	Greece 126; United Kingdom 10.
Carbon black		4	7	2	West Germany 3.
Coal:					
Anthracite and bituminous		54,638	151,423	16,541	U.S.S.R. 90,511; Australia 41,398.
Briquets of anthracite and bituminous coal		68	—		
Coke and semicoke		328	397	—	United Kingdom 147; Belgium-Luxembourg 101; Italy 101.
Peat including briquets and litter		2,614	3,127	—	West Germany 2,464; Ireland 310.
Petroleum:					
Crude	thousand 42-gallon barrels	4,155	4,434	—	Iraq 3,416; U.S.S.R. 708; Algeria 309.
Refinery products:					
Liquefied petroleum gas	do.	278	243	—	Greece 53; Bulgaria 47; Iraq 41.
Gasoline	do.	120	104	—	Italy 87; Belgium-Luxembourg 2.
Mineral jelly and wax	do.	2	4	—	Hungary 2; Greece 1.
Kerosene and jet fuel	do.	966	1,172	—	Italy 557; Greece 520.
Distillate fuel oil	do.	461	494	—	Greece 173; Italy 146.
Lubricants	do.	67	66	1	Belgium-Luxembourg 18; United Kingdom 16; Italy 12.
Residual fuel oil	do.	2,841	2,358	—	Romania 638; Italy 553; Spain 385.
Bituminous mixtures	do.	5	4	([2])	Greece 2; United Kingdom 1.

NA Not available.
[1] Table prepared by Virginia A. Woodson.
[2] Less than 1/2 unit.

Minerals Co. Ltd.; Egek Ltd.; Drapia Mining; and the largest of all four, Peletico Plasters Ltd. Together they produced 90,300 tons of bentonite, a 13% increase over that of 1987. In the only activation plant, operated by Peletico, several grades of bentonite were produced, mainly for export.

Fertilizers.—After a 3-year closure for maintenance and overhaul, production resumed in August 1988 at Cyprus' sole fertilizer plant, which was owned by the Hellenic Chemical Industries and leased by the Cyprus Chemical and Fertilizer Co. Production is expected to be between 135,000 and 180,000 tons annually, mainly for export.

Gypsum.—The 1988 production of crude gypsum was 32,710 tons and

3,975 tons of calcined gypsum. The amounts represent declines of 28% and 20%, respectively, compared with that of 1987. Although 17,500 tons of crude gypsum was exported, all of the 1988 production of calcined gypsum was used domestically.

Sand and Gravel.—The production of sand and gravel amounted to 4.4 million tons, showing a 5% increase over that of 1987. After cement, sand and gravel was the second highest valued mineral product in Cyprus during 1988.

Strontium.—Concentrates grading 93% strontium sulfate were produced from celestite ore mined and concentrated with the flotation method at the Psematismenos quarry. Known reserves at yearend amounted to 80,000 tons with an average strontium sulfate content of 45%. Although no expansion was planned, Hellenic Mining continued its exploration of new reserves and intensified its efforts to improve the concentration process.

Mineral Fuels.—As in previous years, Cyprus continued to import all its primary energy sources. Most of the imported coal was used for production of electric energy, since all power stations were coal fired. The total capacity of power stations in 1987, the latest year for which data was available, was 393,000 kilowatts, producing 1.5 billion kilowatt hours. Expenditures on electricity development during 1989–97 were estimated to reach $650 million. A coal-fired power station, with a final capacity of 360 megawatts, was proposed to be built at Vassiliko. Firms in the United Kingdom were preparing a feasibility study and an environmental impact assessment.

All the crude oil refined in the country's only refinery at Larnaca was imported. About one-half of total petroleum demand was met by locally refined products made from imported crude oil, and the other one-half was met by direct imports of products.

ISRAEL[3]

Mineral production was limited to the extraction of chemicals from the Dead Sea brines, the mining of phosphate rock in the Negev Desert, and the production of minor quantities of crude oil and natural gas. Indigenous mineral fuel production represented less than 1% of the nation's energy requirements. Imported crude oil and petroleum products accounted for nearly 74%, and imported coal accounted for more than 23% of total energy requirements. Mineral processing, based on imported raw materials, included the cutting and polishing of gemstones, the refining of crude oil, and the production of crude steel.

In the first few years following the introduction of the 1985 Economic Stabilization Program, the Israeli economy experienced firm economic growth. By the latter half of 1987, the pace of economic activity slackened, and the slowdown continued and deepened in 1988. The GDP expanded by only 1.6%, against 5.2% in 1987. Industrial production declined by 3% over 1987. The metal products sector of industry showed a 5% decline in sales from the previous year. Crude metal sales declined by 10%.

The Government continued to encourage privatization of a number of Government corporations. In 1988, the Government sold its 75% controlling interest in the Paz Petroleum Company to a private investor, Jack Lieberman, for $95 million. Paz Petroleum controls 45% of the Israeli petroleum market. The sale of Israel Chemicals Ltd. (ICL) was under consideration. The most successful companies under the ICL group were the Dead Sea Works and Dead Sea Bromine, both of which benefited from the increased demand for phosphates and bromide compounds in 1988. The Negev Phosphates Ltd., also part of the ICL group, was expected to return to profitability by 1989. ICL reported total assets of $1.4 billion and a working capital of $490 million. Terms of the contract for the sale of 50.1% of the Government ownership have been agreed upon by the First Boston Bank of the United States and France's La Compagnie Financiere. An additional 20% will be sold to the public through Israeli and foreign stock exchanges.

Haifa Chemicals completed a $2.2 million, 54-meter-high absorption tower. As a result, pollutants in the Haifa area have been reduced below the legal maximum set by environmental authorities.

Production and Trade

Overall mineral production remained relatively stable. However, the production of elemental bromine and bromine compounds attained record levels for the Dead Sea Bromine Group.

Israel's balance of trade improved somewhat in 1988. The increased level of exports was mainly caused by increased prices for Israel's export commodities on the international market. For example, the price of potash increased by 25% in early 1988. By contrast, crude oil, a major mineral import for Israel, was reduced in price during the last half of 1988. Taking advantage of favorable prices, oil imports increased to 52 million barrels valued at $676 million or about $13 per barrel as compared to a little more than 48 million barrels valued at $823 million or $17 per barrel in 1987.

Total imports were valued at $12.3 billion[4] in 1988, and mineral industry commodities accounted for more than a third of all imports. Diamond imports were reported at $2.8 billion, and fuel imports, mostly crude oil, were reported at more than $1 billion. Exports totaled $9.4 billion, including more than $2.8 billion from the export of cut and polished diamonds, many of which were shipped to the expanded Far Eastern markets of Japan, Taiwan, South Korea, and Hong Kong. In 1988, more diamonds were shipped to these combined markets than to the United States, Israel's traditional leading diamond export market.

TABLE 4

CYPRUS, ISRAEL, JORDAN, LEBANON, SYRIA: PRODUCTION OF MINERAL COMMODITIES

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987[p]	1988[p]
		CYPRUS[1 2]				
METALS						
Copper: Cement copper:						
Gross Weight		2,290	2,130	1,188	193	765
Cu content		1,260	1,065	606	80	315
INDUSTRIAL MINERALS						
Asbestos, fiber produced		7,429	16,360	13,011	18,070	14,585
Cement, hydraulic	thousand tons	853	659	864	854	868
Clays, crude:						
Bentonite		32,400	52,000	55,000	79,600	90,300
Other:						
For brick and tile manufacture	thousand tons	220	212	220	300	357
For cement manufacture[e]	do.	250	250	250	250	250
Total	**do.**	**470**	**462**	**470**	**550**	**607**
Gypsum:						
Crude		22,100	16,000	30,000	45,700	32,710
Calcined		11,900	8,500	5,500	4,960	3,975
Lime, hydrated		7,380	7,730	7,452	6,890	6,810
Pigments, mineral: Umber		13,100	12,200	10,000	12,500	[e]13,000
Salt, marine		7,399	10,013	6,051	—	—
Stone, sand, and gravel:						
Limestone, crushed (Havara)	thousand tons	3,560	2,800	2,500	2,360	2,450
Marble	do.	88	80	75	80	78
Marl, for cement production	do.	567	541	568	567	[e]565
Sand and gravel	do.	4,075	4,450	4,370	4,200	4,400
Unspecifed building stone	do.	450	343	280	285	300
Strontium: Celestite concentrate		—	1,400	7,365	6,300	5,000
Sulfur:						
Pyrite, gross weight		23,322	69,600	56,672	91,380	113,145
S content		10,494	30,972	24,936	41,121	50,916
MINERAL FUELS AND RELATED MATERIALS						
Petroleum refinery products:						
Liquefied petroleum gas	thousand 42-gallon barrels	218	172	239	250	342
Gasoline	do.	856	789	993	1,088	1,224
Kerosene and jet fuel	do.	463	248	272	281	375
Distillate fuel oil	do.	1,160	990	1,220	1,299	1,489
Residual fuel oil	do.	1,148	924	1,069	1,288	1,506
Asphalt	do.	174	145	165	191	246
Refinery fuel and losses	do.	201	145	152	158	222
Total	**do.**	**4,220**	**3,413**	**4,110**	**4,555**	**5,504**

See footnotes at end of table.

TABLE 4—Continued

CYPRUS, ISRAEL, JORDAN, LEBANON, SYRIA: PRODUCTION OF MINERAL COMMODITIES

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987[p]	1988[p]
ISRAEL[3]						
METALS						
Copper, oxide (80%-90% Cu):[e]						
Gross weight		3,500	—	—	—	—
Cu content		2,900	—	—	—	—
Iron and steel: Steel, crude		92,000	100,000	110,000	116,000	95,000
INDUSTRIAL MINERALS						
Bromine:[e]						
Elemental		90,700	100,000	105,000	110,000	120,000
Compounds		65,300	70,000	73,000	78,000	87,000
Cement, hydraulic (from domestic clinker)	thousand tons	2,064	2,020	2,059	2,226	[4]2,326
Clays:						
Bentonite		5,898	[e]6,000	5,000	4,500	3,000
Flint clays[e]		[r]6,000	[r]6,000	[r]6,000	[r]6,000	6,020
Kaolin[e]		[4]26,844	27,000	[r]28,000	[r]29,000	30,600
Other[e]		[4]18,274	[r]16,000	[r]14,000	[r]12,000	11,739
Gypsum		46,000	[e]45,000	45,999	35,000	[4]31,181
Lime[e]		50,000	50,000	[r]75,000	[r]100,000	[4]130,000
Nitrogen: N content of ammonia		57,500	57,500	[r e]60,000	[r e]60,000	[4]60,000
Phosphate rock, beneficiated	thousand tons	3,312	4,076	3,673	3,798	3,479
Potash, K_2O equivalent	do.	1,100	1,200	1,253	1,244	[4]1,240
Salt, marketed (mainly marine)[e]		145,000	150,000	150,000	150,000	150,000
Sand:						
Glass sand		61,000	[e]61,000	60,000	60,000	[4]59,520
Other (for building industry)	thousand tons	4,300	[e]4,300	4,300	4,500	4,500
Sodium and potassium compounds: Caustic soda		28,501	31,248	27,000	29,717	[4]29,727
Stone:						
Crushed	thousand cubic meters	6,000	[e]6,000	6,000	6,000	6,000
Dimension, marble		13,000	[e]13,000	13,000	10,000	10,000
Sulfur:						
Byproduct from petroleum[e]	thousand tons	10	10	15	15	15
Sulfuric acid	do.	189	178	182	142	[4]163
MINERAL FUELS AND RELATED MATERIALS						
Gas, natural, marketed	million cubic feet	[r]1,883	[r]1,866	1,390	1,594	[4]1,463
Peat[e]	thousand tons	20	20	20	20	20
Petroleum:						
Crude	thousand 42-gallon barrels	[r]53	[r]52	74	85	[4]107
Refinery products:						
Gasoline	do.	8,830	9,855	10,700	11,400	11,500
Kerosene and jet fuel	do.	5,256	[r]5,290	5,100	5,450	5,500
Distillate fuel oil	do.	9,640	11,800	11,315	14,650	14,700
Residual fuel oil	do.	19,300	13,300	14,920	13,440	13,500
Other	do.	[r]2,350	6,000	7,900	5,200	5,200

See footnotes at end of table.

TABLE 4—Continued

CYPRUS, ISRAEL, JORDAN, LEBANON, SYRIA: PRODUCTION OF MINERAL COMMODITIES

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987[p]	1988[p]
ISRAEL—Continued						
MINERAL FUELS AND RELATED MATERIALS—Continued						
Petroleum—Continued						
Refinery products—Continued						
Refinery fuel and losses	thousand 42-gallon barrels	2,260	1,800	1,800	1,800	1,800
Total	**do.**	**47,636**	**48,045**	**51,735**	**51,940**	**52,200**
JORDAN[5]						
Cement, hydraulic	metric tons	1,988,424	2,022,952	1,794,679	2,373,078	[4]1,828,189
Clays	do.	26,035	[e]26,000	14,144	14,000	[4]23,452
Gypsum	do.	[r]111,524	91,965	70,083	114,560	[4]84,866
Iron and steel: Steel crude	do.	112,502	136,266	[e]136,000	217,000	[4]17,000
Lime	do.	[6]224,318	[e][6]224,000	4,338	3,906	[4]2,461
Petroleum:						
Crude[e]	thousand 42-gallon barrels	—	([7])	110	153	200
Refinery products:						
Gasoline	do.	3,161	4,900	4,517	2,975	4,500
Jet fuel	do.	1,760	1,474	1,456	1,496	1,600
Kerosene	do.	1,138	1,529	1,793	1,581	1,800
Distillate fuel oil	do.	5,200	10,806	4,602	5,431	4,600
Residual fuel oil	do.	5,900	4,720	4,543	4,735	4,500
Liquefied petroleum gas	do.	900	930	1,012	1,032	1,000
Other	do.	865	890	791	1,158	800
Total	**do.**	**18,924**	**25,249**	**18,714**	**18,408**	**18,800**
Phosphate:						
Mine output:						
Gross weight	thousand metric tons	[r]6,263	6,067	6,250	6,800	[4]6,611
P_2O_5 content[e]	do.	2,069	2,011	2,063	2,260	[4]2,182
Phosphatic fertilizers		568,968	500,650	550,880	565,066	[4]615,000
Potash:						
Crude salts	do.	486,868	908,560	1,103,716	1,200,000	[4]1,309,000
K_2O equivalent	do.	[e]297,000	550,000	660,000	720,000	[4]785,400
Salt	thousand metric tons	22	32	[e]32	[e]18	18
Stone:						
Limestone[e]	metric tons	7,000	7,000	7,000	[r]13,484	[4]3,642
Marble	do.	4,625	4,600	[e]4,600	[e]4,600	[4]322,800
LEBANON[8]						
Cement, hydraulic	thousand tons	1,250	1,000	1,000	1,000	1,000
Gypsum		5,000	3,000	3,000	2,000	2,000
Iron and steel: Metal, semimanufactures		100,000	90,000	NA	80,000	80,000
Lime[e]		20,000	10,000	10	10,000	10,000
Petroleum refinery products:						
Gasoline	thousand 42-gallon barrels	935	[r]1,275	2,566	2,015	2,000
Jet fuel	do.	107	160	218	92	100

See footnotes at end of table.

TABLE 4—Continued

CYPRUS, ISRAEL, JORDAN, LEBANON, SYRIA: PRODUCTION OF MINERAL COMMODITIES

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987[p]	1988[p]
LEBANON—Continued						
MINERAL FUELS AND RELATED MATERIALS—Continued						
Petroleum refinery products—Continued						
Kerosene	thousand 42-gallon barrels	[r]77	[r]120	129	151	150
Distillate fuel oil	do.	1,417	[r]1,566	2,234	1,723	1,725
Residual fuel oil	do.	2,664	[r]1,232	2,264	3,388	3,400
Liquefied petroleum gas	do.	174	[r]230	194	141	140
Other	do.	125	150	153	35	40
Refinery fuel and losses	do.	610	590	735	510	500
Total	**do.**	**[r]6,109**	**5,323**	**8,493**	**8,055**	**8,055**
Salt[e]	thousand tons	5	5	3	3	3
SYRIA[8]						
Cement, hydraulic	thousand tons	4,279	4,296	4,200	3,870	3,330
Gas, natural:[e]						
Gross	million cubic feet	17,922	18,000	18,000	19,000	20,000
Marketed	do.	4,556	5,400	5,400	5,600	6,000
Gypsum		[r]79,580	160,250	160,000	248,000	179,000
Iron and steel: Metal: Steel, crude		69,000	[e]69,000	[e]69,000	[e]69,000	70,000
Nitrogen: N content of ammonia		11,584	132,450	136,984	92,533	93,000
Petroleum:						
Crude	thousand 42-gallon barrels	60,400	61,100	68,000	84,570	93,700
Refinery products:						
Naphtha	do.	5,329	5,270	5,355	5,124	5,100
Gasoline	do.	7,190	8,202	8,453	7,242	7,300
Kerosene	do.	1,573	1,271	1,705	1,565	1,600
Jet fuel	do.	1,680	1,968	2,352	4,180	4,200
Distillate fuel oil	do.	[r]21,373	27,602	19,709	21,750	21,800
Residual fuel oil	do.	31,135	31,300	32,514	33,580	33,600
Liquefied petroleum gas	do.	1,606	1,240	2,030	1,763	1,700
Asphalt	do.	2,409	2,855	1,654	1,357	1,400
Other	do.	1,716	1,765	1,880	1,900	1,900
Total	**do.**	**[r]74,011**	**81,473**	**75,652**	**81,085**	**81,300**
Phosphate rock	thousand tons	1,514	1,270	1,606	1,986	2,186
Salt		87,000	[e]87,000	[e]87,000	81,000	127,000
Stone, sand and gravel:						
Stone: Dimension, marble	cubic meters	71,000	[e]71,000	[e]71,000	15,062	17,804
Sand and gravel	thousand tons	5,829	[e]6,000	[e]6,000	[e]6,000	8,000
Sulfur, byproduct of petroleum and natural gas	do.	35,000	35,000	120,000	[e]120,000	120,000

[e]Estimated. [p]Preliminary. [r]Revised.
[1]Table includes data available through Sept. 15, 1989.
[2]In addition to the commodities listed, a variety of other crude construction materials are produced, but available information is inadequate to make reliable estimates of output levels. Statistics on pilot plant gold recovery were not available.
[3]Table includes data available through Nov. 21, 1989.
[4]Reported figure.
[5]Table includes data available through Nov. 28, 1989.
[6]Includes aggregates of unspecified type.
[7]Revised to zero.
[8]Table includes data available through Nov. 29, 1989.

Total imports in 1987 were valued at \$11.5 billion, and exports totaled \$8.2 billion. Imported precious stones were valued at nearly \$2.4 billion, including \$1.4 billion imported from Belgium and \$0.5 billion from Switzerland. Exports of precious stones exceeded \$2.5 billion. Nearly one-half of all precious stone exports or \$1.2 billion in value were exported to the United States. Japan received \$0.4 billion, and the EC received more than \$0.3 billion. Mineral fuel exports, principally gasoline and distillate fuel oil, were valued at \$5.9 million dollars; mineral fuel imports, mostly crude oil, were valued at more than \$1 billion. Industrial minerals, including cement and fertilizer imports, were reported at \$142.7 million; exports brought into the country totaled \$288.3 million. Imports of metallic ores, slag, metal semimanufactures, and worked metals were reported at \$774 million; exports were \$845 million. Minerals, including diamonds, accounted for 37% of all imports by value and 43% of all exports in 1987.

Israel enjoyed several trade advantages; the United States Generalized Schedule of Preferences allows 2,700 tariff items to enter the United States without duties. Israel received a similar Generalized Schedule of Preferences arrangement from the EC, Sweden, Finland, Norway, Austria, Switzerland, Canada, Japan, Australia, and New Zealand. An agreement was made with the EC that will eliminate duties for nonagricultural products by 1989; the Free Trade Agreement with the United States will eliminate duties on all products traded between the two countries by 1995.

Commodity Review

Metals.—**Gold.**—Israel's Geological Survey reported that a significant area of gold mineralization exists in the southern portion of the Arava region. Grade levels ranged from 0.03 grams to 2 grams per metric ton. A more thorough study, planned for 1989, may result in a detailed prospectus for foreign investment.

Industrial Minerals.—**Bromine.**—Production of bromine by The Dead Sea Bromine Ltd. attained a record level at 120,000 tons. Nearly three-quarters of this output was further processed into a wide range of bromine compounds in plants in Israel and the Netherlands. Sales by Israeli plants in 1988 were \$175 million.

The Dead Sea Bromine Group continued to be the world's leading exporter of bromine and bromine compounds; overall sales, including those of Broomchemie BV in the Netherlands, were reported at \$260 million.

Magnesium.—Refractory-grade magnesium oxide and calcined magnesium specialties are derived from the magnesium chloride obtained from the Dead Sea brine. Production of magnesium oxide in 1988 totaled 44,000 tons. The sole producer was the Dead Sea Periclase Ltd., a Division of ICL. Improved sales were reported as a result of increased penetration of the United States, Japanese, and European markets.

Phosphates.—Phosphate rock production was by Negev Phosphates Ltd. from reserves in a triangle defined by Beer Sheva, the Dead Sea, and the Red Sea. The Company operated three phosphate mines: Zin, Arad, and Oron, which had a combined capacity of 3.5 million tons per year. In addition to phosphate rock, the company produced and exported about 30,000 tons annually of technical-grade phosphoric acid. The nation's principal producer of phosphoric acid was Rotem Fertilizers Ltd., producing 175,000 tons in 1988.

Potash.—Construction of a \$5 million, 300,000-ton-per-year capacity potassium sulfate plant was planned by the Dead Sea Works Ltd. with startup expected by 1989. Potash recovered from the Dead Sea and gypsum recovered from the wastes of phosphoric acid production will serve as raw materials. In addition, installation of a new mechanical shiploader at the Dead Sea Works Ltd.'s operations at the Port of Ashdod was under consideration.

Most of Israel's potash production was exported. Nearly one-half was shipped to Europe, about 23% was destined for the Western Hemisphere, 16% was shipped to Asia, and Africa received 8%.

Mineral Fuels.—**Coal.**—The coal terminal to supply the Ruttenberg power station was near completion in the vicinity of Ashdod. The \$33 million investment will enable the National Supply Corp. to deliver 2.5 million tons of steam coal annually to the Ruttenberg powerplant. Completion of the terminal was anticipated by mid-1989. The National Coal Supply Corp. made available about 3.5 million tons of steam coal annually to the Haderal power station. Most of the coal was imported from Australia, Colombia, and the Republic of South Africa; imports from the United States totaled only 0.2 million tons. Coal combustion residue, or coal ash, was used by Israel's cement industry.

Natural Gas.—Natural gas liquids accounted for 0.4% of the nation's energy requirements in 1988.

Oil Shale.—Reserves were reported at 12 billion tons containing 15 to 17 gallons of oil per ton or a total of 4 billion barrels. The Government estimates that oil produced from this source would cost about \$34 per barrel. An alternative to extraction is direct combustion. Israel has placed in construction a \$26 million demonstration facility to generate 4.5 megawatts of electricity by direct combustion of oil shale.

Petroleum.—Exploration drilling was planned near Palmahim Beach in early 1989. Drilling was planned to reach a depth of 5.6 kilometers, and \$12 million was slated for this well; additional funds were to be available should commercial quantities of oil be discovered. If the well site is dry, plans were to drill in at least one other location. The Palmahim well will be the second phase of the Negev Commercial Project for which the total budget, including drilling expenditures, is estimated to be $25.5 million.

Crude oil imports totaled 52 million barrels in 1988. Mexico supplied 25% of this total. Other suppliers included Egypt and Norway. About 60% of crude oil imports were refined at the Haifa refinery, and the remainder refined at Ashdod. Petroleum product consumption, as a percentage of Israel's total energy consumption in 1988, was as follows:

LPG	1.8%
Naphtha	3.4%
Gasoline	12.3%
Kerosene	7.2%
Distillate fuel oil	11.3%
Residual fuel oil	37.8%

JORDAN[5]

In 1988, the Jordan Phosphate Mines Co. (JPMC) maintained a third-place standing in phosphate rock production among market economy countries, after the United States and Morocco. Phosphate and potash were the most important mineral products produced by Jordan's mining industry. Higher world phosphate prices and a decline in the value of the dinar in late 1988 stimulated an increase in phosphate sales by JPMC. Total phosphate sales increased to 6.9 million tons. Potash production and profitability in Jordan increased in 1988 over the previous year.

These events were positive signs for the mineral industry in Jordan during a year that featured a rapidly declining economic picture. Despite the austerity measures that were implemented by the Government during the year, the mineral industry was not initially affected. This was due to the fact that the appropriations for mineral industry development were already in place before major economic changes were implemented.

However, long-term projects in the mineral industry were in greater jeopardy of being underfinanced. The Government's outstanding external debt rose to $8 billion[6] by yearend 1988. The Persian Gulf cease-fire of August 1988 had an immediate negative effect on the volume of trade flowing through Jordan to Iraq. Trade was rerouted through the Persian Gulf, causing a loss of revenue and thus increasing pressures on Jordan's balance of payments. The Government estimated that 300,000 to 350,000 Jordanians were employed overseas, roughly 40% of the Jordanian work force. The recession in the Gulf states precipitated a return of these workers to Jordan, causing a rise in unemployment and a loss in foreign currency flowing into Jordan from workers' wages. Additionally, aid due from other Arab states did not materialize.

The Government of Jordan implemented emergency economic measures in June 1988 that included devaluation of the dinar against the dollar, cutting Government spending, and restricting the monetary policy. The dinar continued to drop in value against the dollar towards the end of 1988. A strict policy of austerity was in effect to increase foreign currency reserves and lower the balance of payments deficit. Additionally, these actions produced a rise in prices of imported raw materials and a consequent rise in the price of construction materials, accompanied by a steel shortage.

Production and Trade

JPMC increased exports of phosphates in 1988 to 5.8 million tons, compared with 5.5 million tons exported in 1987. Hard currency earnings from these exports amounted to $350 million in 1988. Other exported materials from JPMC were 7,500 tons of phosphoric acid, 16,000 tons of aluminum fluoride, and 625 tons of secondary phosphate.

During the Iran-Iraq war, Jordan's Port of Aqaba became an important alternate route and transport hub for Iraqi imports and exports. Additionally, Iraq had become the largest single importer of Jordanian commodities. This trade relationship represented 25% of Jordan's total exports. The Persian Gulf cease-fire diminished trade through Jordan to Iraq beginning in August 1988. The Port of Aqaba handled approximately 20 million tons of commodities in 1988. The Aqaba Ports Authority planned to expand exports of Iraqi products, particularly of sulfur and phosphates. Despite being in a process of reconstruction, Iraq agreed in principle to continue using the port.

According to Jordan's Arab Mining Company (Armico), small iron, copper, and manganese deposits had not been exploited in modern times. Iron and copper had been exploited in ancient times, however. Jordan's Armico had plans in late 1988 to develop Wadi Araba copper deposits; copper (Cu) content averaged 1.4%, with total proven reserves of 36 million tons. Ceramic- and cement-grade kaolin and gypsum were being exploited and predominantly utilized in local industry.

Commodity Review

Metals.—The Natural Resources Authority (NRA) performed preliminary investigations into possible gold and other polymetallic mineral deposits in several areas of Jordan. The results were inconclusive; however, the NRA believed that the information available warranted investigation of the polymetallic mineralization and placers in south Jordan. Such investigation was to include systematic mineralogical, petrographical, and geochemical analysis. The NRA announced a cooperative project for the exploration of precious metals between Jordan and the EC. The project was expected to commence operations in 1989-90.

TABLE 5

JORDAN: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Destinations, 1987
METALS				
Aluminum:				
Oxides and hydroxides		—	5,000	All to Iraq.
Metal including alloys:				
Scrap		3,076	3,133	Japan 2,364; Netherlands 300; United Arab Emirates 140.
Semimanufactures		16	121	Iraq 117.
Copper: Metal including alloys:				
Scrap		603	238	Belgium-Luxembourg 52; Japan 32; unspecified 97.
Semimanufactures		1	—	
Iron and steel: Metal:				
Scrap		1,872	2,059	Syria 1,053; Saudi Arabia 424; Japan 87.
Steel, primary forms		1	—	
Semimanufactures:				
Bars, rods, angles, shapes, sections		160	95	Iraq 34; Syria 31; Kuwait 11.
Universals, plates, sheets		332	158	Saudi Arabia 82; Libya 41.
Hoop and strip		3	3	All to Egypt.
Wire		19	65	Saudi Arabia 61.
Tubes, pipes, fittings	value, thousands	$810	$3,772	Iraq $1,857; Egypt $1,231.
Lead: Metal including alloys, semimanufactures		77	—	
Silver: Metal including alloys, unwrought and partly wrought	value, thousands	—	$2	All to Lebanon.
Titanium: Oxides		19	—	
Zinc: Metal including alloys:				
Scrap		387	271	Syria 136; India 100.
Semimanufactures		4	—	
Other: Ores and concentrates		218	—	
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.		—	22	All to Saudi Arabia.
Grinding and polishing wheels and stones		1	2	Do.
Cement		182,033	739,560	Egypt 647,575; Saudi Arabia 58,475.
Clays, crude		80	—	
Fertilizer materials:				
Crude, n.e.s.	thousand tons	1,205	1,244	India 326; China 302; Brazil 102.
Manufactured:				
Nitrogenous		417,293	422,783	Pakistan 112,500; Italy 88,839; France 31,015.
Phosphatic		982	4,346	Saudi Arabia 3,690; United Arab Emirates 515.
Unspecified and mixed		120	—	
Gypsum and plaster		—	11	All to Saudi Arabia.
Lime		2,775	25	Do.
Phosphate, crude	thousand tons	5,198	5,544	India 1,138; Poland 899; Romania 503.

See footnote at end of table.

TABLE 5—Continued

JORDAN: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Destinations, 1987
INDUSTRIAL MINERALS—Continued				
Salt and brine		187	305	Kuwait 255; Saudi Arabia 24.
Sodium compounds, n.e.s.: Sulfate, manufactured		859	1,265	Iraq 1,039; Saudi Arabia 106.
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked		4,718	3,247	Iraq 2,530; Lebanon 431; Egypt 284.
Worked		103,615	109,745	Kuwait 94,447; United Arab Emirates 9,527.
Gravel and crushed rock		6,837	10,699	Saudi Arabia 6,715; Lebanon 2,337.
Quartz and quartzite		1,472	—	
Sand other than metal-bearing		15,713	12,941	Kuwait 10,582; Saudi Arabia 2,167.
Sulfur: Elemental, crude including native and byproduct		—	125	All to Iraq.
Talc, steatite, soapstone, pyrophyllite		10,993	6,357	Saudi Arabia 5,422; Kuwait 935.
Other: Crude		—	1	All to Saudi Arabia.
MINERAL FUELS AND RELATED MATERIALS				
Asphalt and bitumen, natural		—	30	All to Iraq.
Carbon black		—	60	All to United Arab Emirates.
Coal: Anthracite and bituminous		—	40	All to Yemen (Aden).
Coke and semicoke		—	140	Syria 102; Saudi Arabia 38.
Petroleum refinery products:				
Liquefied petroleum gas	value, thousands	$237	$21	All to United Arab Emirates.
Lubricants	42-gallon barrels	28	4,690	Iraq 4,452; Sudan 210.
Bituminous mixtures	do.	—	212	All to Italy.

[1] Table prepared by Virgina A. Woodson. No exports of mineral commodities to the United States were reported in 1987.

Copper.—Jordan's Armico owned a 32.5% interest in the Akjoujt copper mine in Mauritania that had been closed since 1978 because of technical problems and a prolonged period of low world copper prices. Reopening the mine required an investment estimated at $40 million. Equity ownership of the mine also included the Mauritanian Government, with a 37.4% interest; Iraq, 12.5%; Libya, 10%; and the Arab Investment Company, owning 7.5%.

The NRA embarked on a preliminary survey of geologic and mineral resources, hoping to attract possible foreign investment, particularly in the base and precious metals arena. One of several areas surveyed was Wadi Araba, which has been mined for copper since prehistoric times. This area extends from the Dead Sea to the Gulf of Aqaba. It represents several different depositional environments formed during early Paleozoic time. Copper mineralization of varying concentrations exists here in Precambrian and early Paleozoic igneous rocks and as stratabound deposits in Paleozoic sediments. Jordan's Armico planned in late 1988 to exploit the Wadi Araba area, which contains an estimated 36 million tons of ore grading 1.4% Cu content. Development of the deposits depends on future world copper prices.

Manganese.—Manganese mineralization was known to exist in the Wadi Araba area; however, recovery was not considered economically feasible, because of low manganese concentrations and high concentrations of associated copper and iron.

Uranium.—The NRA and the International Atomic Energy Agency began exploring for uranium in late 1988 in the southern and western parts of Jordan. The 5-year project was expected to determine if sufficient uranium and thorium existed in these areas to warrant mining.

***Industrial Minerals.*—Phosphate Rock.**—Phosphate mining in Jordan was entirely controlled by the parastatal JPMC. Increased phosphate sales generated a fivefold increase in JPMC's

TABLE 6

JORDAN: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS				
Alkali and alkaline-earth metals	—	56	—	All from United Kingdom.
Aluminum:				
Oxides and hydroxides	473	11,548	—	France 11,529.
Metal including alloys:				
Scrap	1,022	745	2	Egypt 738.
Unwrought	4,536	5,319	33	Egypt 2,918; Bahrain 1,008; Canada 497.
Semimanufactures	3,182	2,328	14	Egypt 505; Italy 352; Turkey 343.
Chromium: Oxides and hydroxides	2	6	—	Italy 3; United Kingdom 2.
Cobalt: Oxides and hydroxides	—	5	—	Saudi Arabia 3; Czechoslovakia 2.
Copper:				
Matte and speiss including cement copper value, thousands	—	$1	—	All from West Germany.
Metal including alloys:				
Scrap do.	$76	$60	—	Do.
Unwrought	51	42	—	West Germany 40.
Semimanufactures	1,007	1,211	11	Belgium-Luxembourg 597; Turkey 314; United Kingdom 46.
Iron and steel: Metal:				
Scrap	1,810	3,797	—	Saudi Arabia 1,628; Syria 934; West Germany 360.
Pig iron, cast iron, related materials	21,453	16,755	—	Turkey 11,300; East Germany 5,306.
Ferroalloys:				
Ferromanganese	NA	600	—	All from France.
Unspecified	([2])	222	—	Belgium-Luxembourg 197; Saudi Arabia 25.
Steel, primary forms	173,929	136,796	—	Turkey 78,020; Zambia 43,902; Spain 9,997.
Semimanufactures:				
Bars, rods, angles, shapes, sections	73,701	47,902	—	Brazil 11,602; Hungary 6,553; Czechoslovakia 3,958.
Universals, plates, sheets	58,867	54,435	168	Brazil 12,969; Japan 10,015; West Germany 6,342.
Hoop and strip	422	585	—	Japan 221; Belgium-Luxembourg 175; Hungary 50.
Rails and accessories	156	4,523	—	United Kingdom 2,124; Austria 1,455; West Germany 653.
Wire	7,819	11,735	([3])	Saudi Arabia 3,915; Lebanon 1,483; West Germany 1,177.
Tubes, pipes, fittings value, thousands	$29,821	$42,912	$2,090	Turkey $12,844; Brazil $7,737; France $7,420.
Lead:				
Oxides	65	142	—	United Kingdom 112; Austria 21.

See footnotes at end of table.

TABLE 6—Continued

JORDAN: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS—Continued					
Lead—Continued					
Metal including alloys:					
Unwrought		130	22	—	Saudi Arabia 20.
Semimanufactures		9	14	—	Belgium-Luxembourg 5; West Germany 2; Italy 1.
Magnesium: Metal including alloys, unwrought		680	—		
Manganese:					
Ore and concentrate, metallurgical-grade		—	254	—	All from Italy.
Oxides		—	1	—	All from West Germany.
Mercury	76-pound flasks	87	87	—	All from Belgium-Luxembourg.
Molybdenum: Metal including alloys, all forms	value, thousands	—	$2	—	All from India.
Nickel:					
Matte and speiss		(3)	4	—	All from Saudi Arabia.
Metal including alloys, semimanufactures		12	137	—	France 110; Italy 19.
Platinum-group metals: Metals including alloys, unwrought and partly wrought:					
Platinum	value, thousands	$91	NA		
Unspecified	do.	—	$79	—	All from Switzerland.
Silver: Metal including alloys, unwrought and partly wrought	do.	$102	$81	—	Italy $26; unspecified $44.
Tin: Metal including alloys:					
Unwrought		4	22	—	Sweden 10; Italy 7.
Semimanufactures		15	24	1	United Kingdom 11; Belgium-Luxembourg 10.
Titanium: Oxides		808	1,922	120	United Kingdom 956; France 242.
Tungsten: Metal including alloys, all forms	value, thousands	—	$2	—	All from United Kingdom.
Zinc:					
Oxides		9	73	—	Netherlands 41; West Germany 25.
Metal including alloys:					
Scrap		—	406	—	Poland 300; Belgium-Luxembourg 99.
Unwrought		1,128	981	—	Poland 600; Australia 186; Belgium-Luxembourg 180.
Semimanufactures		53	7	—	West Germany 4; Italy 2.
Other:					
Ores and concentrates		3	—		
Oxides and hydroxides		55	378	2	France 360.
Ashes and residues		3	—		
Base metals including alloys, all forms		—	29	—	China 19; Italy 10.

See footnotes at end of table.

TABLE 6—Continued

JORDAN: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	956	152	—	United Kingdom 62; Italy 24; Belgium-Luxembourg 21.
Artificial: Corundum	22	6	—	Italy 3; United Kingdom 2.
Grinding and polishing wheels and stones	230	315	—	Italy 214; Belgium-Luxembourg 33.
Asbestos, crude	—	1	—	All from United Kingdom.
Barite and witherite	301	2	—	All from Thailand.
Boron materials:				
Crude natural borates	105	—		
Oxides and acids	34	—		
Cement	2,785	2,453	—	Saudi Arabia 2,385; Iraq 37.
Chalk	619	910	—	France 400; Belgium-Luxembourg 315; United Kingdom 189.
Clays, crude	6,187	2,879	—	United Kingdom 1,488; Bulgaria 700; Cyprus 431.
Diamond, natural:				
Gem, not set or strung value, thousands	$55	$308	—	All from Belgium-Luxembourg.
Industrial stones do.	$282	$224	—	Belgium-Luxembourg $199; Ireland $25.
Diatomite and other infusorial earth	24	27	—	All from Spain.
Feldspar, fluorspar, related materials	928	805	—	Finland 450; Turkey 355.
Fertilizer materials:				
Crude, n.e.s.	32	1,045	20	Lebanon 812; Iraq 75.
Manufactured:				
Ammonia	77,134	19,322	—	Kuwait 12,850; Qatar 6,352.
Nitrogenous	([4])	86,528	—	Bahrain 20,074; Saudi Arabia 19,683; Kuwait 18,934.
Phosphatic	8,410	8,383	—	Iraq 5,839; Italy 1,686.
Potassic value, thousands	$2	$2	$2	
Unspecified and mixed	8,025	6,680	176	Belgium-Luxembourg 2,150; Netherlands 1,375; United Kingdom 882.
Graphite, natural value, thousands	$2	—		
Gypsum and plaster	1,259	2,701	5	Iraq 2,271; Lebanon 393.
Lime	1,308	683	—	Iraq 418; Lebanon 240.
Magnesite, crude	467	878	—	Italy 600; Greece 267.
Mica:				
Crude including splittings and waste	33	—		
Worked including agglomerated splittings value, thousands	$2	—		
Phosphates, crude	400	—		
Pigments, mineral: Iron oxides and hydroxides, processed	54	132	—	West Germany 99; Netherlands 15.

See footnotes at end of table.

TABLE 6—Continued

JORDAN: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
INDUSTRIAL MINERALS—Continued				
Precious and semiprecious stones other than diamond:				
Natural value, thousands	$76	$31	—	Belgium-Luxembourg $22; Thailand $6.
Synthetic do.	$385	$3	—	Thailand $2; United Arab Emirates $1.
Pyrite, unroasted	2,620	—		
Salt and brine	621	741	—	Saudi Arabia 304; France 147; West Germany 63.
Sodium compounds, n.e.s.:				
Carbonate, manufactured	6,048	10,539	—	France 7,397; Turkey 2,242.
Sulfate, manufactured	6,736	9,744	—	France 5,949; Kuwait 1,710; Austria 753.
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked	9,245	11,787	—	Italy 8,571; Lebanon 1,309.
Worked	564	390	—	West Germany 166; Italy 118; Syria 100.
Dolomite, chiefly refractory-grade	41	83	—	Norway 64; Belgium-Luxembourg 19.
Gravel and crushed rock	2,715	4,218	—	Lebanon 1,931; Italy 1,370; Laos 682.
Limestone other than dimension	—	228	—	Iraq 183; United Kingdom 45.
Sand other than metal-bearing	863	363	—	Syria 337; United Kingdom 26.
Sulfur:				
Elemental:				
Crude including native and byproduct	127,528	168,387	—	Iraq 119,248; Netherlands 24,637; Poland 23,332.
Colloidal, precipitated, sublimed	35,638	20,719	(3)	Poland 19,231.
Sulfuric acid	487	22,323	—	Kuwait 21,975.
Talc, steatite, soapstone, pyrophyllite	399	471	—	Norway 250; China 180.
Other:				
Crude	336	102	—	Czechoslovakia 39; Belgium-Luxembourg 24; United Kingdom 20.
Slag and dross, not metal-bearing	—	16	—	All from Republic of Korea.
MINERAL FUELS AND RELATED MATERIALS				
Asphalt and bitumen, natural	33	—		
Carbon black	5	26	—	West Germany 16; Netherlands 10.
Coal:				
Anthracite and bituminous	212	24	—	All from West Germany.
Briquets of anthracite and bituminous coal	(3)	107	12	Lebanon 85.
Coke and semicoke	737	476	—	France 202; China 100; Malaysia 96.
Peat including briquets and litter	408	2,065	—	U.S.S.R. 621; West Germany 437; Finland 404.
Petroleum:				
Crude thousand 42-gallon barrels	16,434	18,855	—	Iraq 11,887; Saudi Arabia 6,917.

See footnotes at end of table.

TABLE 6—Continued

JORDAN: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987	
				United States	Other (principal)
MINERAL FUELS AND RELATED MATERIALS—Continued					
Petroleum—Continued					
Refinery products:					
Liquefied petroleum gas	thousand 42-gallon barrels	67	197	—	All from Iraq.
Gasoline, motor	value, thousands	—	$90	—	France $75; United Kingdom $15.
Mineral jelly and wax	thousand 42-gallon barrels	2	3	(3)	Kuwait 2.
Kerosene and jet fuel	value, thousands	$807	$435	$41	Saudi Arabia $163; Belgium-Luxembourg $96.
Distillate fuel oil	thousand 42-gallon barrels	305	483	—	Iraq 438; Kuwait 44.
Lubricants	do.	169	187	13	Kuwait 48; Yemen (Aden) 42; Belgium-Luxembourg 29.
Residual fuel oil	do.	3,707	4,778	—	Iraq 2,799; Kuwait 1,913.
Bitumen and other residues	do.	(3)	5	—	Mainly from Austria.
Bituminous mixtures	do.	2	3	(3)	Italy 1; United Kingdom 1.

NA Not available.
[1] Table prepared by Virginia A. Woodson.
[2] Unreported quantity valued at $245,000.
[3] Less than 1/2 unit.
[4] Unreported quantity valued at $8,664,000.

profits for 1988. Pretax profits reached $42.7 million. Phosphorite-bearing layers of Upper Cretaceous and Tertiary rocks in Jordan occur in a belt extending north of Amman to Ras En Naqb in south Jordan. The principal areas whose development played a significant role in Jordan's economy occur within this belt and were, from north to south, the Ruseifa Phosphate Mine, the Wadi Al Abyad Mine, the El Hasa Mine, and the southernmost Ash Shadiya deposit.

The Ruseifa Mine contains four phosphate seams with thicknesses varying from 1.3 to 3.2 meters; it holds proven reserves of 70 million metric tons of high-grade phosphate. Opencast and underground mining were suspended at Ruseifa because of undesirable mining and transportation conditions. Wadi Al Abyad featured two opencast mines that produced from a phosphate unit 40 meters thick. Total, proven reserves of 100 million tons exist for the two mines. Reserves between this area and the opencast El Hasa Mine were estimated at 1 billion tons. The Wadi Al Abyad Mine had an annual production capacity of 1.5 million tons, and the El Hasa Mine produced at a 3.1-million-metric-ton capacity. The unexploited Ash Shadiya phosphorite deposit had total reserves estimated at 958 million tons of phosphate. The average content of tricalcium-phosphate (TCP) in Jordan for all of the deposits ranged from 25% to 70%.

JPMC planned an integrated phosphate project for 1989. Total cost of the project was expected to be $165 million, of which $115 million would come from foreign exchange. The project included constructing a beneficiation plant and rehabilitating a fertilizer plant to augment first-stage development of the Shidiyah phosphate mine in southeast Jordan. The project awaited additional cofinancing from interested parties. The Shidiyah operations were to begin production in early 1989; however, planners continued to discuss ways to transport the phosphate rock to the port of Aqaba. Rail transport was the favored plan; however, a fleet of 100 to 200 trucks would be needed to fill transportation gaps in the rail system. JPMC planners hoped that possible new water discoveries near Shidiyah would allow the construction of several joint-venture phosphoric acid plants, involving Indian and Soviet partners, by 1995. New plant construction would eliminate further environmental pressure on the port of Aqaba, where phosphate loading and gypsum disposal from an existing plant have caused problems. JPMC's fertilizer plant at Aqaba earned a profit for the first time since production began in 1983, but output was only about 75% of its design capacity.

Potash.—Jordan's Arab Potash Company (APC) recorded its first profit since the company began operating in 1983. World potash prices rose from $61 per metric ton in 1986 to $81 per metric ton in 1988. APC benefited from this price increase; estimated revenues totaled $110 million for 1988, while profits reached $12 million. APC's total production of potash for 1988 was 1.31 million metric tons. Indeed, APC's potash plant exceeded its original design capacity of 1.2 million tons of product. This Dead Sea facility was 178 kilometers from Amman at Safi at an elevation of 400 meters below sea level.

It has been estimated that the Dead Sea contains 43 billion tons of minerals. APC produces potassium chloride from the brine at its Dead Sea refinery. In March 1988, Finland's YIT Corp. completed an extension of the APC refinery at the Dead Sea. The 15-month project included the installation of new process equipment and the modification of the existing facility for carnallite treatment. YIT was responsible for the design, supply, and construction of machinery, piping, large thickener tanks, and all required concrete and steel structures. Additional electrification and instrumentation work were also completed at the refinery.

Salt and carnallite are sequentially precipitated from Dead Sea brines by evaporation in open air pans. The crystallized carnallite is then harvested by computer-assisted, dredge-based machinery that was custom designed for the operation. Afterwards, a slurry is transported via floating lines to the refinery, where dewatering of the carnallite takes place. Dewatering the carnallite and salt slurry produces a sylvinite- and magnesium chloride-rich slurry. The filtered sylvinite is then leached by hot brine in four agitation tanks to separate the potassium and sodium chlorides. A series of five crystallizers treats the potassium chloride, which is dried and separated into coarse, standard, and granular varieties of fertilizer-quality potash. Exportable potash is then transported by truck to the port of Aqaba.

YIT's contract work was expected to increase recovery of potassium chloride to 1.4 million tons per year and to allow more efficient operational control of the system. Additional modifications planned for the facility, including the development of a cold crystallization process, are expected to increase production capacity to 2.2 million tons by 1995.

***Mineral Fuels.*—Natural Gas.**—The NRA reported the discovery of a natural gas field at the Al-Rishah area near the Iraqi border. Initial production was 15 million cubic meters a day of natural gas. Preliminary plans called for the construction of surface facilities to exploit the natural gas and for the delivery of gas turbines for electrical generation, initially of 3-megawatt capacity. The Jordanian Electrical Authority planned a 350-kilometer electrical transmission line from Al-Rishah to Amman, with additional gas turbines to be added to the system if the amount of natural gas warrants development.

Petroleum.—The Government was once again confronted with the need to find domestic sources of hydrocarbons. Over the past several years, the hydrocarbon import bill for Jordan varied from 45% to 90% of export earnings. Jordan's oil import bill was more than $360 million for 1988; most of the petroleum was used for electricity generation. The Hamzah oilfield in Jordan annually produces approximately 600 barrels a day of high-quality crude oil. The Jordan Petroleum Refinery Company (JPRC) operated a refinery at Zerka, earning a $6.7 million profit for the year, unchanged from the 1987 amount. JPRC refined approximately 11.8 million barrels of imported crude from Iraq and 5.2 million barrels from Saudi Arabia for transit to the Mediterranean and other destinations.

Among foreign companies involved in petroleum exploration in 1988 were Hunt Oil Corp. and Amoco of the United States, and Petrofina of Belgium. Their combined exploration concessions totaled 30,000 square kilometers. Additionally, in late 1988, Petro-Canada and the Japan National Oil Co. signed exploration agreements. The Japanese contract called for 18 months of oil exploration on 7,500 square kilometers in Wadi Sirhan in southeastern Jordan. The NRA reported another wildcat well being drilled in Wadi Sirhan on the Jordanian-Saudi Arabian border.

The Jordanian Electrical Authority reported that experimental direct burning of oil shale samples could generate electrical power without harm to the environment. Jordan possesses an estimated 36 to 50 billion tons of oil shale reserves. The deposits occur in various locations and, in general, are close to the surface and thus were considered exploitable. The Jordanian Electrical Authority used a 72-ton oil shale test lot in an experimental process that produced light, medium, and heavy oils and a considerable quantity of sulfur. The NRA reported the discovery of six additional oil shale deposits at Wadi Al-'Asal and Kharazah in the district of Al-Ghawr Al-Safi, south of the Dead Sea. Additionally, exploration uncovered considerable amounts of ground water, which would be required for oil shale exploitation operations utilizing both burning and distillation. The high cost of exploiting oil shale had until this time been prohibitive in Jordan; considering the high cost of petroleum importation, however, the Government remained committed to the experimental program. The estimated quantity of oil extractable from oil shale was 21 billion barrels. Both Romania and China had expressed interest and preliminary support for these projects.

Tar sand deposits exist on the eastern

side of the Dead Sea in Jordan. Rudimentary information exists on the nature of these deposits; an assessment of the tar sands would be necessary to determine if exploitation would prove economical. Current world market prices for oil led analysts to decide that exploiting the tar sands would not be economical even if the deposit possessed reserves greater than 70 million tons and had undergone proven, positive oil-recovery tests.

LEBANON[7]

Lebanon was engaged in its 14th year of civil war, which precluded any major mineral industry development in the country. Much of the industrial sector had been destroyed. However, the petroleum refinery operations continued, although they were severely limited by the inability to offload crude oil from terminals under siege.

Lebanon imported an estimated 4.5 million barrels of residual fuel oil, 3 million barrels of gasoline, 1.5 million barrels of distillate fuel oil, and 0.8 million barrels of liquefied petroleum gas. The United States exported 348,000 barrels of petroleum coke and 8,000 barrels of lubricants to Lebanon in 1988. Petroleum product shortages, particularly gasoline and fuel oil, continued. The Electricite du Liban required fuel oil to operate the Zouk power station in East Lebanon. Tankers carrying fuel oil were unable to unload at the Zouk terminal because of heavy shelling resulting in periodic brownouts.

The Lebanon Chemicals complex attempted to reopen in 1988. Syria made an overland delivery to the complex of 115,000 tons of phosphate rock.

SYRIA[8]

Principally an agrarian economy, Syria enjoyed a record harvest following a higher-than-average rainfall in 1988. Modest discoveries, particularly in the Deir al Zor region, increased crude oil output in 1988 by 12% providing a savings on imported blending crudes. These conditions contributed to a 10.7% growth in the economy. However, Syria continued to be burdened by an $18 billion foreign debt largely attributable to arms purchases from the Soviet Union.

Interest in Syria's hydrocarbon potential has gathered impetus because all recent discoveries have been low-sulfur, light crude oils that command more favorable prices in world markets as compared to Syria's 18° to 25° API gravity crude oils. By yearend, several hydrocarbon exploration agreements were signed. They included the Société Nationale Elf Aquitaine's 4,000-square-kilometer concession in the Deir al Zor region, British Petroleum Development Ltd.'s 3,300-square-kilometer concession in the same area, and the Marathon Oil Co.'s concession in the Palmyra region. The Al-Furat Petroleum Co.'s Omar Field, discovered northeast of Thayyem in early 1988, was under development by a consortium consisting of Technoexport of Czechoslovakia and Salzgitter Lummus of the Federal Republic of Germany. The group undertook the design, the procurement, and the commissioning of field equipment and the commissioning of a 90-kilometer pipeline linking the field to existing export facilities and the refineries at Banias and Homs. Production from the Omar Field was expected to commence in 1989 with initial production at 100,000 barrels per day (bbl/d).

The Thayyem Field supplied about 60,000 bbl/d of 36° API crude oil to the Homs refinery. Production from the neighboring Al Asharah and Al-Ward Fields was an estimated 46,000 bbl/d. Nearly half of the nation's total production of about 275,000 bbl/d was from fields yielding a light crude oil. This enabled Syria to discontinue importing light crude oils for blending with the domestic heavy grades for refinery throughput. At yearend, export customers were restricted to the 24° and 25° API gravity and 2.5% and 3% sulfur crudes from Suwaidiyah. About 85,000 bbl/d was exported, principally to western Europe. When the Omar Field enters production in 1989, small quantities of surplus light crude should be made available for export.

Phosphate mining operations were conducted at Kneifiss and in the Ghadir al Hamal region. Production increased by 18% and exports by 17% in a favorable market where international prices enjoyed a 30% rise over the last 2 years. The state-owned mining company, the General Company for Phosphates and Mines, has enjoyed increased output in recent years with modernized mining equipment made available from the Soviet Union for payment in phosphate rock deliveries. Expansion of port facilities at Tartous to accommodate from 1.3 to 2.4 million tons per year was also assisted by the Soviet Union. Exports from Tartous were reported at 1.8 million tons in 1988.

TURKEY[9]

Turkey produced a wide variety of minerals in 1988, a fact reflecting both the diversity of its geology and a long mining history. The mining industry was characterized by a large number of small mines for most commodities rather than a few large ones. In terms of metallic commodities, Turkey ranked fifth in the world in the production of chromite and was a significant producer of antimony and mercury. Turkey was a major producer of a number of nonmetallic minerals. The country ranked first in the world in emery production, second in the world in the production of boron, strontium (celestite) and pumice, and was a significant producer of perlite, soda ash, barite, and marble. Turkey processed a significant amount of imported ores, particularly those of iron and the base metals. Turkish exports of primary minerals made up about 4% of the country's total exports.

The rapid pace of growth in GNP that characterized the Turkish economy from 1980 to 1987 slowed in 1988 to 3.4%. This was below the targeted growth rate of 5%, which was considered the minimum rate necessary to keep unemployment from increasing. The earlier expansion of the economy was largely due to Government policies aimed at encouraging exports. These policies included expansion of capacity in the public sector mining industry and encouragement of the same in the private sector and massive spending on public construction projects. A major outcome of these policies was a very high rate of inflation that, by 1987, had reached 55% and was beginning to have political repercussions. The Turkish Government adopted austerity measures in 1988 that were aimed at reducing public expenditures by reducing the deficit and slow inflation. The new fiscal policies reduced the rate of growth; but inflation, driven by the country's large foreign debt, remained unacceptably high at an annualized rate of 75% at yearend. However, this was an improvement over conditions earlier in the year; annualized inflation was more than 86% in October. The highest inflation was seen in the mining sector, where prices rose almost 89% for the first 10 months because of continued infrastructural spending, particularly in the steel industry.

In contrast to the high inflation rate, many economic indicators in 1988 were encouraging. Turkey's balance of payments improved during the year because of an increase in exports and lower world prices for certain major Turkish imports such as oil. The trade deficit decreased 44% to $1.8 billion[10]. The current account balance was $1.5 billion, in contrast to a deficit in 1987 of $982 million. The country's GDP increased about 4% to $64.5 billion, and the Government deficit as a fraction of the GDP decreased by one-fifth to 3.8%. Turkey met its substantial foreign debt repayment obligations in 1988 and was expected to do so again in 1989.

Production and Trade

Production of most mineral commodities increased in 1988. Among the metallic commodities, the largest relative increase was of alumina, for which production almost doubled to about 181,700 tons. Aluminum production also increased; however, this was relative to 1987 production that was below normal because of a protracted strike at Etibank's Seydisehir plant. Turkey was the world's fifth largest producer of chromite; ore production increased 40% to 1.2 million tons. Zinc production was up slightly, and byproduct cadmium production doubled. Iron ore production increased 6% to 5.7 million tons. Steel production increased about 14% to 8 million tons. Mercury production fell 52% to about 2,800 flasks, largely as a result of low world demand and prices for mercury.

Production of most industrial minerals also increased. Barite production increased 32% to 388,000 tons, which was almost double the production in 1984. Production of phosphate and most clays increased significantly. Feldspar production increased 84% to almost 55,900 tons. Limestone, marble, and quartzite production showed large increases. Turkey's rapidly expanding pumice mining industry was the second largest in the world in 1988. Production of pumice was an estimated 1.6 million tons, which appears to be about 50% higher than the production in 1987 and apparently represents a fivefold or more increase over 1986 and earlier production. Turkish boron production, which is second only to that of the United States, experienced a modest increase in 1988. In contrast, the production of coal, natural gas, and petroleum all decreased in 1988. Petroleum refinery production increased, however, using imported input.

The value of Turkish exports grew 14.4% in 1988 to $11.7 billion. Turkish exports to the United States totaled $760 million, or 6.5% of the country's total exports. Turkish imports from the United States were $1.52 billion or 10.6% of the country's total. The main mineral exports to the United States were boron, steel, ferrochrome, gasoline, and naphtha. In value, the main mineral products imported from the United States were scrap metal and coal.

Total primary mineral exports were valued at $503.6 million, of which the largest share went to the United States ($95.7 million), followed by Italy ($53.1 million), Japan ($36.8 million), and the Federal Republic of Germany ($23.1 million). Exports of pig iron and steel grew 71% to about $1.46 billion. Borate exports grew 23% to $167.5 million, and chrome ore and concentrate exports increased 79% to $71.4 million. Exports of petroleum and petroleum products were $330.5 million, an almost 43% increase.

Turkish imports of pig iron and steel increased almost 8% to $1.66 billion. Fertilizer imports decreased 19% to $242 million. Turkish imports of petroleum and petroleum products decreased in value by 9% to $2.66 billion, but this reflected lower world petroleum prices; the quantity imported actually increased 10% to 165 million barrels. Similarly, the value increase of Turkish petroleum products exports contrasted with an almost doubling of export volume.

In 1984, Turkey signed an agreement with the Soviet Union for the purchase of large quantities of Soviet natural gas. Pipeline construction commenced soon afterwards. In 1987, the first natural gas deliveries were made to westernmost Turkey and to Istanbul shortly thereafter. In 1988, distribution lines were being laid in Ankara, and it was expected that Soviet natural gas would be available there towards yearend 1989. Turkish goods were to make up 70% of the payment for the gas. Shortfalls in the amount of goods supplied by Turkey in 1988 led toward yearend to

TABLE 7

TURKEY: PRODUCTION OF MINERAL COMMODITES[1]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987[p]	1988[p]
METALS						
Aluminum:						
Bauxite		131,568	213,744	280,400	246,541	269,015
Alumina, gross weight		75,120	113,303	144,396	95,236	181,660
Alumina, Al content		37,900	54,100	60,017	41,685	57,000
Antimony:						
Ore, mine output:						
Gross weight		35,525	34,312	32,943	49,614	42,674
Sb content[e]		1,017	982	[r]2,752	[r]2,344	[2]1,945
Metal, smelter		1,821	2,097	2,117	2,232	[e]2,500
Regulus		42	15	28	412	298
Cadmium		31	32	6	11	22
Chromite:						
Gross weight (34% to 43% Cr_2O_3)		688,917	876,807	861,720	866,997	1,212,081
Salable product		487,405	588,576	543,156	[e]600,000	[e]625,000
Copper:						
Mine output, gross weight		2,466,158	2,228,167	2,374,862	[r e]2,650,000	3,120,442
Cu content		24,500	26,600	21,100	24,000	[e]26,400
Metal:						
Smelter output		32,023	33,884	35,466	19,236	12,910
Refined		51,400	60,600	75,100	75,600	[e]80,000
Iron and steel:						
Iron ore, gross weight	thousand tons	4,037	3,994	5,249	5,336	5,693
Metal:						
Pig iron and ferroalloys:						
Ferrochromium		[r]48,000	[r]50,000	50,000	[r e]53,000	60,000
Ferrosilicon		6,902	6,900	7,000	4,400	5,200
Pig iron and other ferroalloys	thousand tons	2,902	3,193	3,666	4,438	[e]4,916
Steel, crude including castings	do.	4,330	4,961	5,928	7,044	[e]8,000
Lead: Mine output, Pb content		[r]15,000	10,000	10,400	10,000	[e]12,000
Manganese ore, gross weight		42,796	10,750	7,106	[e]7,000	[e]7,000
Mercury	76-pound flasks	5,272	6,552	7,574	5,872	2,814
Silver, mine output, Ag content[e]	thousand troy ounces	220	220	220	[r e]284	[2]735
Tungsten, W content of concentrate[e]		153	100	50	[2]187	[2]142
Zinc:						
Mine output, Zn content		50,400	37,400	41,100	[r e]42,200	[e]43,000
Zn content, smelter, primary		19,900	22,200	15,400	[r e]18,000	[e]23,000
INDUSTRIAL MINERALS						
Abrasives, natural: Emery		21,145	15,648	6,333	10,000	[e]17,000
Asbestos		1,499	932	1,098	360	[e]100
Barite, run of mine		198,031	220,497	287,940	294,481	387,733

See footnotes at end of table.

TABLE 7—Continued

TURKEY: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987[p]	1988[p]
INDUSTRIAL MINERALS—Continued						
Boron compounds	thousand tons	895	954	928	1,000	[e]1,200
Cement, hydraulic	do.	15,738	17,581	20,000	21,980	22,675
Clays:						
Bentonite		28,093	46,855	55,367	85,848	77,527
Kaolin		54,932	69,390	78,430	134,114	209,223
Other		71,777	168,719	187,449	308,092	354,482
Total		**154,802**	**284,964**	**321,246**	**528,054**	**641,232**
Diatomite		2,540	[e]3,000	3,000	[e]3,000	[e]1,000
Feldspar[e]		10,000	20,000	20,000	[2]30,336	[2]55,862
Fluorspar[e]		2,000	2,000	[r]10,000	[r]10,000	10,000
Graphite		5,000	5,000	3,600	11,760	12,833
Gypsum		57,875	78,058	128,051	301,743	249,356
Lime	thousand tons	1,000	1,000	1,100	1,100	[e]1,500
Magnesite, crude ore		770,577	1,128,961	1,313,763	1,185,940	1,161,416
Meerschaum	kilograms	15,000	16,800	9,600	10,095	6,450
Nitrogen: N content of ammonia		290,000	217,100	198,000	330,000	[e]330,000
Perlite		60,452	60,000	60,000	111,423	183,028
Phosphate rock		95,600	37,400	3,000	[e]19,200	74,200
Pumice[e]	thousand tons	150	200	325	1,000	1,620
Pyrites, cuprous, gross weight		—	26,032	10,153	30,909	[e]31,000
Salt, all types	thousand tons	1,290	1,189	1,172	1,218	[e]1,350
Sodium compounds, n.e.s.:						
Carbonate[e]		200,000	300,000	[r]330,000	[r]376,000	379,000
Sulfate		83,026	108,665	145,702	[e]150,000	[e]150,000
Sand and gravel, sand, siliceous[e]		110,000	110,000	110,000	[r]150,000	200,000
Stone, sand and gravel, n.e.s.:						
Limestone	thousand tons	350	350	350	405	3,190
Marble		40,000	40,000	40,000	70,000	76,888
Quartzite		240,000	318,450	429,921	552,462	754,379
Strontium minerals: Celestite[e]		35,000	35,000	[r]40,000	[r]49,000	54,000
Sulfates, natural, n.e.s. Aluminum sulfate (alunite)		13,971	11,578	12,000	9,927	10,439
Sulfur:						
Native, other than Frasch		40,722	43,639	41,275	40,000	33,100
S content of pyrites[e]		—	11,250	4,390	[r]30,000	40,000
Byproduct[e]		78,000	80,000	80,000	80,000	80,000
Total		**118,722**	**134,889**	**125,665**	**150,000**	**153,100**
MINERAL FUELS AND RELATED MATERIALS						
Asphalt, natural		[r]225,252	[r]512,268	607,128	631,152	[2]626,340
Carbon black[e]		20,000	20,000	20,000	[2]33,141	[2]31,955
Coal:						
Anthracite	thousand tons	7,103	8,526	8,500	7,084	6,688

See footnotes at end of table.

TABLE 7—Continued

TURKEY: PRODUCTION OF MINERAL COMMODITES[1]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987^p	1988^p
MINERAL FUELS AND RELATED MATERIALS—Continued						
Coal—Continued						
Bituminous	thousand tons	225	523	500	630	626
Lignite	do.	27,199	35,833	36,000	46,149	38,178
Coke and semicoke:						
Metallurgical	do.	2,401	2,400	2,400	2,912	^e3,035
Gashouse	do.	100	100	100	105	^e109
Breeze	do.	174	170	200	259	^e270
Total	**do.**	**2,675**	**2,670**	**2,700**	**3,276**	**^e3,414**
Gas:						
Natural:^e						
Gross	million cubic feet	27,000	27,000	27,000	^r31,500	10,700
Marketed	do.	3,500	3,500	3,500	^r10,493	[2]3,502
Petroleum:						
Crude	thousand 42-gallon barrels	14,941	15,110	^e17,142	18,830	18,360
Refinery products:						
Asphalt	do.	2,960	3,405	3,679	3,825	4,102
Distillate fuel oil	do.	50,570	50,537	50,000	110,901	118,056
Gasoline	do.	18,380	18,681	19,042	22,074	21,285
Jet fuel	do.	2,472	2,875	3,584	6,119	6,937
Kerosene	do.	2,593	3,585	2,344	3,509	3,902
Liquefied petroleum gas	do.	5,585	5,379	5,883	6,995	8,186
Lubricants	do.	1,486	1,174	^e1,000	^e1,000	1,726
Naphtha	do.	58	205	8,449	10,538	12,738
Refinery fuel and losses	do.	2,248	2,388	^e2,500	^e2,500	^e3,000
Residual fuel oil	do.	38,433	37,962	44,903	54,287	59,894
Unspecified	do.	9,787	8,271	^e8,000	^e8,000	^e8,000
Total	**do.**	**134,572**	**134,462**	**^e149,384**	**^e229,748**	**^e247,826**

^e Estimated. ^p Preliminary. ^r Revised.

[1] Table includes data available through Aug. 14, 1989. Limestone quarried for cement manufacture is substantial; however, information is inadequate to make accurate estimates of output levels.

[2] Reported figure.

a Government offer to extend the Soviet Union $500 million in credit over a 2-year period to make up the difference. It was estimated that Turkish imports of Soviet natural gas in 1988 were less than one-third of the 1.5 billion cubic meters agreed upon, largely because cheap gas was available on the world market. It was expected that gas imports from the Soviet Union would reach 6 billion cubic meters per year by the early 1990's.

Turkey was negotiating with the Soviet Union and Iran for natural gas deliveries to eastern Anatolia. In addition, Turkey was negotiating with alternative suppliers of natural gas, such as Libya, Iran, Algeria, and Qatar. An agreement was signed with Algeria for Turkey to import 2 billion cubic meters per year of liquid natural gas (LNG) beginning in 1992. The LNG would be stored in Marmara Eregli and would be pumped into the pipeline grid that was being constructed. Similarly, a protocol was signed with Libya for the purchase of 1.5 billion cubic meters of LNG per year for a period of 25 years.

In 1988, Turkey imported about 155 million barrels of oil, of which about

82% was from Iraq (55%) and Iran. An agreement was signed with Libya by which Turkey would increase its imports of Libyan petroleum from the 1988 level of 457,000 barrels per month to 610,000 barrels per month. The increased oil imports were payment to Turkey by Libya for work done in Libya by Turkish contractors. The Turkish Government had reimbursed the contractors for certain projects when Libyan payments became erratic.

In recent years, Iran and Iraq have been major purchasers of Turkish steel; however, many of the sales were by virtue of generous credit terms to these countries by the Turkish Government. The Government sought to reduce sales to these countries in 1988 and cut off credit to Iraq entirely because of payment irregularities. The steel industry was aggressively pursuing new markets, particularly in Asia.

Commodity Review

***Metals.*—Chromium.**—Turkish exports of chromite ore were almost 50% higher in volume than those of 1987, largely because of strong international demand and the fact that more of the high grade ore was available for export because of the ability of one major domestic consumer to utilize lower grade ore. The strong demand for chromite led Akdeniz Madencilik to open a new chromite mine at Yahyali, in Kayseri Province.

Etibank planned to have the first of two new 50,000-ton-per-year furnaces on-line at the Elazig ferrochrome plant by early 1989. The second furnace was expected to go on-line by yearend 1989. The new furnaces would triple the plant's ferrochrome production capacity to 150,000 tons per year.

Cobalt.—Istanbul Technical University announced a project to recover 1,000 tons per year of cobalt from about 2.5 million tons of old mine tailings located at the Kure copper mine. It was expected that 20,000 tons of cobalt could be extracted in all, with the possible recovery of another 2,000 tons of cobalt from the tailings at Ergani. Recovery of cobalt was expected to begin around 1992.

Copper.—Copper concentrate and blister copper were produced by two parastatal companies: The Black Sea Copper Works (Karadeniz Bakir Isletmeleri—KBI) and Etibank. KBI accounted for about 75% of the total copper production.

Production of copper concentrate by KBI decreased almost 5% to about 85,000 tons, and blister production decreased 32% to about 7,500 tons. Ore production, however, doubled to 30,500 tons. KBI's new smelter at Samsun was expected to go on-line by April 1989. Its design capacity is 38,000 tons per year blister. Projected 1989 KBI blister production is 20,000 tons, including 10,000 tons from the new smelter; 1990 production is projected at 48,000 tons, including 38,000 tons from Samsun.

Rehabilitation of the sulfuric acid plant at Samsun was completed during the year, and its new capacity was 270,000 tons per year of acid. The entire production was to be used at the neighboring Tusgas fertilizer plant.

The concentrator at Etibank's Küre Mine was completed during the year, during which time it produced at 50% of its 90,000-ton-per-year capacity. The concentrate was smelted at Samsun. Etibank planned to use the concentrator at 75% capacity in 1989 and 100% capacity in 1990. Combined production from KBI and Etibank in 1990 was expected to meet 50% of Turkey's 70,000- to-75,000-ton-per-year copper requirements; only 30% of the country's 1987 copper requirements were met by domestic production.

The Government was planning to put all of its copper production under KBI management, but did not announce a date for this consolidation. At yearend, Etibank and the General Directorate of Mineral Research and Exploration (MTA) signed an agreement whereby MTA would assume responsibility for Etibank's mineral exploration efforts in the Ergani region, and Etibank would take over some of MTA's advanced prospects.

In the last quarter, Phelps-Dodge Corp. (United States) sold its remaining 24.5% share of the Rize-Çayeli copper project to Metallsgesellschaft AG (the Federal Republic of Germany). Phelps Dodge had sold a 49% share in the project to the same company in 1987.

Gold.—No verifiable gold discoveries had been announced in Turkey by yearend, despite the fact that at least seven major exploration companies were conducting exploration programs.

Iron and Steel.—The Turkish steel industry continued the expansion and modernization projects that had characterized the industry throughout the 1980's. The expansion resulted from Government incentives, begun in the 1960's, to encourage investment in the steel industry. The private sector concentrated on minimills because of the very high startup costs involved with the integrated plants that characterized the public sector operations. The private sector experienced the greatest growth in recent years, and emphasis during 1987 and 1988 was on creating capacity for high-quality products. In 1988, expansion of the public sector integrated iron and steel plants was partly curtailed as a result of Government austerity measures; however, certain modernization programs continued. Turkey ranked 22d in the world in steel production in 1988 (about 1% of total) compared with 30th in 1982.

Much of the expansion in the steel industry, especially in the private sector in 1987, was due to heavy domestic demand resulting from construction related to the Government's Mass Housing Fund. Domestic steel sales in 1988 suffered from Government spending cuts, and the steel industry was actively seeking new foreign customers for its excess output, particularly of finished and long products. Demand for semi-

TABLE 8

TURKEY: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
METALS				
Aluminum:				
Ore and concentrate	57,325	104,525	57,630	France 29,645; Canada 17,250.
Oxides and hydroxides	23,900	17,746	—	Iraq 8,266; U.S.S.R. 7,143.
Metal including alloys:				
Scrap	—	13	—	All to Cyprus.
Unwrought	1	320	—	All to Iraq.
Semimanufactures	22,228	25,450	7,809	West Germany 3,229; Syria 2,498.
Antimony:				
Ore and concentrate	2,190	4,084	60	Belgium-Luxembourg 3,306; Austria 581; France 96.
Metal including alloys, all forms	387	665	—	West Germany 300; Iraq 271; Belgium-Luxembourg 54.
Cadmium: Metal including alloys, all forms	NA	9	—	All to Netherlands.
Chromium:				
Ore and concentrate	451,384	569,733	189,680	Romania 70,548; West Germany 65,440.
Oxides and hydroxides	76	—		
Cobalt: Oxides and hydroxides value, thousands	—	$1	—	All to Iran.
Copper:				
Matte and speiss including cement copper	—	14	—	All to Iraq.
Sulfate	60	1	—	Do.
Metal including alloys:				
Unwrought	4,614	6,554	—	Saudi Arabia 2,737; Romania 2,408; Greece 1,400.
Semimanufactures	27,047	25,659	866	Egypt 7,304; Iraq 6,457; Algeria 6,307.
Iron and steel:				
Iron ore and concentrate:				
Excluding roasted pyrite	—	27,933	—	All to Iraq.
Pyrite, roasted	78,168	—		
Metal:				
Scrap	4,797	5,169	—	West Germany 4,018; India 749.
Pig iron, cast iron, related materials	137,348	122,051	—	China 45,327; West Germany 17,955; Iraq 17,047.
Ferroalloys	45,486	407,725	13,770	Netherlands 9,500; Japan 7,000.
Steel, primary forms	864,054	905,119	1,105	Iran 336,808; Japan 176,155; Jordan 110,419.
Semimanufactures:				
Bars, rods, angles, shapes, sections thousand tons	1,311	1,359	155	Iran 491; Iraq 389; China 189.
Universals, plates, sheets	242,235	274,554	54,596	Japan 76,601; Iraq 49,116.
Hoop and strip	15,987	35,708	208	Iraq 11,922; Syria 11,589; China 11,217.
Rails and accessories	649	11	—	Iraq 10.

See footnotes at end of table.

TABLE 8—Continued

TURKEY: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
METALS—Continued				
Iron and steel—Continued				
Metal—Continued				
Semimanufactures—Continued				
Wire	9,421	8,510	—	Iraq 3,338; Libya 2,391; Iran 1,161.
Tubes, pipes, fittings	202,075	228,110	117,774	Jordan 36,719; U.S.S.R. 19,430.
Castings and forgings, rough	273	119	—	Pakistan 36; Cyprus 35; Libya 18.
Lead:				
Oxides	176	188	—	Iraq 186.
Metal including alloys:				
Unwrought	2	629	—	Iran 500; Iraq 81.
Semimanufactures	1	60	—	Libya 38; Cyprus 18.
Magnesium: Metal including alloys, semimanufactures	61	30	—	All to West Germany.
Manganese:				
Ore and concentrate, metallurgical-grade	602	28	—	All to Israel.
Oxides	—	40	—	All to Belgium-Luxembourg.
Mercury 76-pound flasks	5,250	2,930	—	All to Netherlands.
Molybdenum: Metals including alloys, all forms	—	1	—	All to Saudi Arabia.
Nickel: Metal including alloys, semimanufactures	1	—		
Platinum-group metals: Metals including alloys, unwrought and partly wrought troy ounces	1,029	—		
Silver: Metal including alloys, unwrought and partly wrought value, thousands	—	$11	—	All to Iraq.
Tin: Metal including alloys:				
Unwrought	—	16	—	Do.
Semimanufactures	([2])	43	—	Iraq 34; Syria 4.
Titanium: Oxides	2	—		
Tungsten: Ore and concentrate	680	832	772	Austria 60.
Zinc:				
Ore and concentrate	11,207	14,812	—	Bulgaria 9,433; Belgium-Luxembourg 2,300.
Oxides	827	1,988	—	West Germany 1,059; Iran 421.
Ash and residue containing zinc	1,995	268	—	West Germany 248; Belgium-Luxembourg 20.
Metal including alloys:				
Unwrought	7,597	1,174	—	Iran 1,056; Iraq 85.
Semimanufactures	10	753	—	Iraq 681; Iran 72.
Other:				
Ores and concentrates	7,000	9,668	60	Netherlands 5,400; Belgium-Luxembourg 3,306.
Oxides and hydroxides	—	30	—	All to Iraq.

See footnotes at end of table.

TABLE 8—Continued

TURKEY: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
METALS—Continued				
Other—Continued				
Ashes and residues	1,650	201	82	Belgium-Luxembourg 119.
Base metals including alloys, all forms	114	—		
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	12,252	109,876	9,272	Italy 22,836; France 19,344; Netherlands 13,057.
Artificial: Corundum	—	500	—	All to Iraq.
Grinding and polishing wheels and stones	304	342	—	Iraq 262; Libya 36; West Germany 31.
Barite and witherite	193,667	231,026	20	U.S.S.R. 134,823; Egypt 31,245; Italy 15,270.
Boron materials:				
Crude natural borates	([3])	720,231	124,102	Italy 142,305; France 75,930.
Oxides and acids	([4])	17,945	1,000	Belgium-Luxembourg 5,350; Italy 3,700; Iran 3,068.
Cement	1,255,520	315,039	—	Cyprus 89,320; Egypt 76,000; Algeria 73,554.
Chalk	5,154	2,786	—	Iraq 796; Lebanon 480; Algeria 436.
Clays, crude:				
Bentonite	42,199	24,740	—	Iraq 7,656; United Arab Emirates 7,000; Austria 3,247
Chamotte earth	15,666	36,201	—	Romania 28,685; United Kingdom 3,000; Iran 1,200.
Fire clay	48,302	2,000	—	All to Romania.
Kaolin	11,895	25,726	—	United Arab Emirates 13,825; Lebanon 7,550; Tunisia 3,250.
Unspecified	313	1,990	—	Romania 1,900; Egypt 52; Iraq 20.
Diatomite and other infusorial earth	4	2,693	—	Iraq 2,190; France 500.
Feldspar, fluorspar, related materials	17,422	18,174	—	Egypt 7,700; Israel 5,980.
Fertilizer materials:				
Crude, n.e.s.	18	—		
Manufactured:				
Ammonia	7	3	—	Cyprus 2; Libya 1.
Nitrogenous	20,514	225,896	—	China 61,247; West Germany 37,032; Italy 31,208.
Phosphatic	406,148	352,991	—	U.S.S.R. 158,689; Algeria 61,623; Belgium-Luxembourg 27,600.
Potassic	201	4	—	All to Cyprus.
Unspecified and mixed	357,505	342,324	—	Iran 199,008; Ethiopia 58,108; China 22,720.
Graphite, natural	([2])	4	—	All to Netherlands.
Gypsum and plaster	5,539	1,280	—	Egypt 800; Lebanon 300; Cyprus 74.

See footnotes at end of table.

TABLE 8—Continued

TURKEY: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987	
			United States	Other (principal)
INDUSTRIAL MINERALS—Continued				
Lime	7,015	11,692	200	Cyprus 10,547; Greece 630.
Magnesium compounds				
Magnesite, crude	17,833	32,069	—	Greece 12,422; United Kingdom 7,997; Italy 6,105.
Oxides, all forms	116,210	134,025	4,659	U.S.S.R. 41,750; Austria 23,268; Romania 19,290.
Mica:				
Crude including splittings and waste	20	121	—	Egypt 45; United Kingdom 40; Iraq 25.
Worked including agglomerated splittings	5	18	—	Egypt 10; Cyprus 7.
Phosphates, crude	—	22	—	All to United Kingdom.
Pigments, mineral: Iron oxides and hydroxides, processed	107	262	—	Iraq 259.
Precious and semiprecious stones other than diamond: Synthetic value, thousands	—	$1	—	All to Switzerland.
Salt and brine	20,857	17,387	—	Iraq 14,621; Cyprus 1,950.
Sodium compounds, n.e.s.:				
Carbonate, manufactured	128,503	137,564	—	Iran 36,942; Iraq 30,793; Syria 12,146.
Sulfate, natural and manufactured	25,573	21,429	—	Yugoslavia 14,217; Iraq 4,502.
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked	59,216	46,153	13	Italy 26,851; Libya 6,279; West Germany 3,600.
Worked	([5])	22,170	2,315	Netherlands 10,432; West Germany 2,645.
Dolomite, chiefly refractory-grade	30	57	—	Greece 27; Iraq 25.
Gravel and crushed rock	1,897	862	—	Cyprus 305; Libya 284; West Germany 99.
Limestone other than dimension	358	92	—	United Kingdom 66; Iraq 25.
Quartz and quartzite	325	87	—	Egypt 38; Syria 28.
Sand other than metal-bearing	7,252	11,296	—	United Arab Emirates 7,200; Egypt 2,000.
Sulfur:				
Elemental:				
Crude including native and byproduct	200	3	—	All to Iran.
Colloidal, precipitated, sublimed	2	—		
Dioxide	22	31	—	Do.
Sulfuric acid	10	6	—	All to Cyprus.
Talc, steatite, soapstone, pyrophyllite	782	334	—	Iraq 218; Greece 59; Cyprus 42.
Other:				
Crude	112,653	140,817	—	West Germany 63,109; Belgium-Luxembourg 25,760; France 16,880.
Slag and dross, not metal-bearing	1,650	13,415	—	Cyprus 7,115; Iraq 6,300.

See footnotes at end of table.

TABLE 8—Continued

TURKEY: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Destinations, 1987 United States	Destinations, 1987 Other (principal)
MINERAL FUELS AND RELATED MATERIALS					
Asphalt and bitumen, natural		—	499	—	All to Cyprus.
Carbon black		1,003	298	—	All to Iraq.
Coal: Lignite including briquets		1,900	3,350	—	All to Cyprus.
Coke and semicoke		18,042	433	—	All to Syria.
Peat including briquets and litter		3	—		
Petroleum refinery products:					
Gasoline, motor	thousand 42-gallon barrels	4,700	3,047	—	Italy 1,634; Japan 721; France 248.
Mineral jelly and wax	do.	13	13	—	West Germany 9; Iran 2.
Kerosene and jet fuel	do.	1,822	471	—	Italy 303; Japan 138.
Distillate fuel oil	do.	319	830	—	Cyprus 420; Italy 410.
Lubricants	do.	79	10	—	Iran 4; Cyprus 3.
Residual fuel oil	do.	5,308	9,153	—	Italy 7,896; Austria 727.
Bitumen and other residues	do.	106	419	—	Italy 235; Tunisia 117.
Bituminous mixtures	do.	(2)	1	—	Mainly to Libya.
Petroleum coke	do.	1	2	—	All to Libya.

NA Not available.
[1] Table prepared by Virginia A. Woodson.
[2] Less than 1/2 unit.
[3] Unreported quantity valued at $130,268,000.
[4] Unreported quantity valued at $14,263,000.
[5] Unreported quantity valued at $13,072,000.

finished products remained strong throughout the year. Of major concern to the industry was the fact that the Government began phasing out tax rebates on steel exports in April at a rate of rebate reduction of 10% per month with rebates stopping completely in 1989. Also of concern were recent increases in the price of electricity, which accounted for about 14% of the variable costs of the private sector producers. The public sector integrated plants used coal and therefore were relatively unaffected by these costs. The Government indicated that it might provide other subsidies, such as cheaper electricity rates, as partial compensation for the loss of tax rebates; however, the industry remained worried about its ability to compete on the international market.

Production started early in 1988 at the new Umran Spirally Welded Pipe plant at Akcakoca near Eregli. The plant was designed to produce pipe of a variety of diameters and wall thicknesses; much of the output was targeted at markets in the Soviet Union. Pipe sales were expected to form part of the Turkish payment for Soviet natural gas, and Umran further hoped that its pipe would be used to build the gas pipeline. The new mill cost between $10 and $15 million and was expected to raise the company's pipe capacity to 500,000 tons per year.

Izmir Demir Celik Sanayi AS (IDC), one of the largest rerollers in the private sector, announced that the 400,000-ton-per-year melting shop that it brought on stream in 1987 almost reached full capacity in 1988. IDC completed expansion of the Aliaga rebar mill from 150,000- to 350,000-ton-per-year capacity.

Construction by steelmaker Ekinciler of a third plant at Iskenderun continued during the year, with production from the new plant expected in early 1989. The 70-ton furnace for the new plant had been scheduled to be started up in May 1988, but problems with equipment deliveries forced a delay. It was expected that the new plant would produce at least 400,000 tons of steel in 1989 and possibly as much as 600,000 tons in 1990. The company was considering adding yet another furnace by about 1995 in order to increase capacity at the new plant to 1 million tons per year.

Installation work began on Cukurova's new 500,000-ton-per-year bar mill

TABLE 9

TURKEY: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS				
Alkali and alkaline-earth metals	15	22	—	West Germany 20; United Kingdom 2.
Aluminum:				
Ore and concentrate	43,366	40,461	2,929	China 25,995; Republic of South Africa 11,005.
Oxides and hydroxides	1,004	1,499	18	West Germany 854; United Kingdom 170; Italy 130.
Metal including alloys:				
Scrap	90	4,314	19	West Germany 2,046; Canada 999; United Kingdom 914.
Unwrought	38,356	89,638	1,396	Canada 29,183; Romania 12,581; Yugoslavia 7,883.
Semimanufactures	3,949	8,539	23	West Germany 2,034; Romania 1,832; Yugoslavia 1,498.
Antimony: Oxides	78	NA		
Arsenic:				
Oxides and acids	179	NA		
Metal including alloys, all forms kilograms	7	NA		
Cadmium: Oxides and hydroxides	18	NA		
Chromium:				
Ore and concentrate	9,978	2	—	Mainly from United Kingdom.
Oxides and hydroxides	390	368	69	Italy 115; China 45.
Cobalt: Oxides and hydroxides	54	54	—	Finland 21; Belgium-Luxembourg 19.
Columbium and tantalum: Metal including alloys: Tantalum value, thousands	$7	$1	—	All from Japan.
Copper:				
Ore and concentrate	42,614	150	—	All from Cyprus.
Matte and speiss including cement copper	—	947	—	All from Chile.
Oxides and hydroxides	43	NA		
Sulfate	572	NA		
Metal including alloys:				
Scrap	3	223	—	Saudi Arabia 89; Chile 72; United Kingdom 62.
Unwrought	54,356	73,108	1	Republic of South Africa 21,855; Chile 20,497; Zaire 6,881.
Semimanufactures	19,485	25,330	20	West Germany 13,591; Saudi Arabia 2,469; France 2,232.
Gold: Metal including alloys, unwrought and partly wrought troy ounces	129	NA		
Iron and steel:				
Iron ore and concentrate:				
Excluding roasted pyrite thousands tons	2,526	1,521	54	Brazil 715; Republic of South Africa 558; Australia 194.

See footnotes at end of table.

TABLE 9—Continued

TURKEY: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS—Continued				
Iron and steel—Continued				
Iron ore and concentrate—Continued				
Pyrite, roasted	49,224	370,919	—	Republic of South Africa 262,263; Brazil 108,594.
Metal:				
Scrap thousand tons	1,799	2,831	2,032	United Kingdom 266; Netherlands 216.
Pig iron, cast iron, related materials	117,652	152,978	12	Brazil 54,036; U.S.S.R. 44,120; Venezuela 14,287.
Ferroalloys:				
Ferroaluminum kilograms	1	NA		
Ferrochromium	2	NA		
Ferromanganese	21,007	41,707	—	Republic of South Africa 30,213; France 5,460.
Ferromolybdenum	223	NA		
Ferrosilicomanganese	25,502	NA		
Ferrosilicon	14,487	NA		
Silicon metal	464	NA		
Unspecified	1,443	56,374	7	Yugoslavia 21,225; Republic of South Africa 15,518; Brazil 4,476.
Steel, primary forms thousands tons	1,075	1,893	19	Brazil 643; Republic of South Africa 246; U.S.S.R. 142.
Semimanufactures:				
Bars, rods, angles, shapes, sections	214,469	304,860	10	Italy 79,051; Yugoslavia 42,220; Republic of South Africa 29,653.
Universals, plates, sheets	539,507	984,775	3,234	Belgium-Luxembourg 248,201; West Germany 147,288; Italy 110,095.
Hoop and strip	8,532	9,212	19	West Germany 4,442; Austria 1,296; Italy 1,172.
Rails and accessories	14,588	9,656	48	Republic of South Africa 9,065; Belgium-Luxembourg 273.
Wire	17,260	14,609	10	Republic of South Africa 5,037; United Kingdom 4,722; Italy 1,534.
Tubes, pipes, fittings	287,514	244,464	555	Japan 144,751; West Germany 38,964; Spain 20,932.
Castings and forgings, rough value, thousands	$793	$729	$1	United Kingdom $459; West Germany $120.
Lead:				
Oxides	560	478	1	France 245; Spain 115; Italy 87.
Metal including alloys:				
Scrap	4,021	2,773	—	Italy 1,587; Republic of South Africa 999.
Unwrought	12,863	13,629	—	Spain 5,525; Mexico 2,367; Belgium-Luxembourg 1,449.

See footnotes at end of table.

TABLE 9—Continued

TURKEY: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS—Continued				
Lead—Continued				
Metal including alloys—Continued				
Semimanufactures	116	3	([2])	France 2.
Lithium:				
Oxides and hydroxides	84	NA		
Metal including alloys, all forms kilograms	212	NA		
Magnesium: Metal including alloys:				
Unwrought	74	147	29	Norway 79; France 34.
Semimanufactures	38	50	16	Italy 15; West Germany 10.
Manganese:				
Ore and concentrate, metallurgical-grade	840	1,618	—	Belgium-Luxembourg 919; Gabon 699.
Oxides	486	698	—	China 190; Republic of Korea 150.
Mercury value, thousands	$2	$3	—	Mainly from West Germany.
Molybdenum:				
Oxides and hydroxides kilograms	365	NA		
Metal including alloys, all forms	2	14	—	Austria 6; West Germany 3.
Nickel:				
Matte and speiss	16	34	—	United Kingdom 30; Canada 2.
Oxides and hydroxides	25	NA		
Metal including alloys:				
Unwrought	1,247	1,157	—	Canada 574; United Kingdom 147; Zimbabwe 109.
Semimanufactures	247	752	1	Sweden 511; West Germany 178.
Platinum-group metals: Metals including alloys, unwrought and partly wrought value, thousands	$3,958	$551	—	West Germany $345; Republic of South Africa $72.
Selenium, elemental kilograms	4	NA		
Silver: Metal including alloys, unwrought and partly wrought value, thousands	$771	$1,651	—	Switzerland $872; West Germany $644.
Tin:				
Ore and concentrate	—	2,026	—	All from China.
Metal including alloys:				
Unwrought	1,097	1,052	5	United Kingdom 759; Brazil 108.
Semimanufactures	17	6	—	West Germany 4; Italy 1.
Titanium:				
Ore and concentrate	9,337	NA		
Oxides	2,694	2,917	—	West Germany 946; United Kingdom 877; France 409.
Tungsten:				
Ore and concentrate value, thousands	$1	NA		
Oxides and hydroxides kilograms	3	NA		

See footnotes at end of table.

TABLE 9—Continued

TURKEY: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS—Continued				
Tungsten—Continued				
Metal including alloys, all forms	38	66	3	Belgium-Luxembourg 27; West Germany 16.
Uranium and thorium: Ore and concentrate	2	—		
Vanadium: Oxides and hydroxides	24	NA		
Zinc:				
Ore and concentrate	4,509	—		
Oxides	344	327	—	West Germany 314.
Ash and residue containing zinc	234	NA		
Metal including alloys:				
Scrap	—	785	—	Spain 750; Italy 34.
Unwrought	24,064	33,616	—	Belgium-Luxembourg 13,484; Italy 12,489; Yugoslavia 4,184.
Semimanufactures	69	253	—	Belgium-Luxembourg 177; West Germany 49.
Zirconium: Ore and concentrate	644	NA		
Other:				
Ores and concentrates	—	5,287	—	Australia 3,202; Austria 799.
Oxides and hydroxides	146	703	88	West Germany 356; Netherlands 56.
Base metals including alloys, all forms	204	156	(2)	Netherlands 72; United Kingdom 45.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	1	242	19	China 200; France 19.
Artificial:				
Corundum	2,462	2,807	1,007	Italy 1,770.
Silicon carbide	893	NA		
Dust and powder of precious and semiprecious stones including diamond value, thousands	$1,402	$2,145	$276	Ireland $875; United Kingdom $542; Zaire $312.
Grinding and polishing wheels and stones	379	245	4	Italy 72; United Kingdom 61; Austria 21.
Asbestos, crude	34,112	33,341	275	Greece 11,552; Canada 9,511; Republic of South Africa 7,926.
Boron materials:				
Crude natural borates	5	29	—	All from Italy.
Oxides and acids	3	7	—	Italy 5; West Germany 2.
Bromine kilograms	230	NA		
Cement thousands tons	62	1,834	—	Greece 690; U.S.S.R. 409; Iraq 320.
Chalk	36	33	—	France 23; Spain 10.
Clays, crude:				
Bentonite	20	NA		
Chamotte earth	3,054	NA		

See footnotes at end of table.

TABLE 9—Continued

TURKEY: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
INDUSTRIAL MINERALS—Continued					
Clays, crude—Continued					
Fire clay		75	NA		
Kaolin		5,442	NA		
Unspecified		2,668	15,948	143	United Kingdom 11,266; Portugal 2,000; Republic of South Africa 1,007.
Cryolite and chiolite		23	22	—	All from Denmark.
Diamond, natural:					
Gem, not set or strung	value, thousands	$527	$165	—	Belgium-Luxembourg $118; Italy $39.
Industrial stones	do.	$438	$341	$42	Netherlands $114; United Kingdom $107.
Diatomite and other infusorial earth		146	147	143	Italy 2.
Feldspar, fluorspar, related materials:					
Feldspar		23	NA		
Fluorspar		100	NA		
Unspecified		—	80	—	United Kingdom 60; Netherlands 20.
Fertilizer materials:					
Crude, n.e.s.		20,634	16,881	—	U.S.S.R. 16,879.
Manufactured:					
Ammonia		557,995	590,662	—	U.S.S.R. 500,620; Saudi Arabia 32,486.
Nitrogenous	thousand tons	885	1,914	51	Romania 728; U.S.S.R. 300; Netherlands 213.
Phosphatic		21,221	74,065	—	Iraq 57,691; Romania 16,375.
Potassic		90,655	42,142	4,877	Israel 21,008; Jordan 5,775; U.S.S.R. 5,716.
Unspecified and mixed		369,549	815,050	326,746	Romania 168,897; Italy 118,590.
Graphite, natural		440	509	—	West Germany 309; China 164.
Gypsum and plaster	value, thousands	$161	$246	—	Cyprus $238.
Lime		41	—		
Magnesium compounds		132	141	19	West Germany 61; France 25.
Mica:					
Crude including splittings and waste		326	9	—	West Germany 5; Austria 3.
Worked including agglomerated splittings		47	65	([2])	Belgium-Luxembourg 28; Spain 16.
Phosphates, crude		702,400	813,581	—	Jordan 494,182; Israel 137,803; Tunisia 92,883.
Pigments, mineral: Iron oxides and hydroxides, processed		640	1,729	6	Iraq 1,124; West Germany 532.
Precious and semiprecious stones other than diamond:					
Natural	value, thousands	$183	$120	—	West Germany $68; Thailand $41.
Synthetic	do.	$20	$166	—	Switzerland $146; West Germany $11.
Pyrite, unroasted	do.	$791	$2,523	—	Sweden $1,415; Spain $1,078.
Salt and brine		255	486	—	West Germany 311; Iran 175.

See footnotes at end of table.

TABLE 9—Continued

TURKEY: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987	
				United States	Other (principal)
INDUSTRIAL MINERALS—Continued					
Sodium compounds, n.e.s.:					
Carbonate, manufactured		30	17	—	Netherlands 15.
Sulfate, manufactured		85,180	73,465	11,681	France 41,492; Italy 10,682.
Stone, sand and gravel:					
Dimension stone:					
Crude and partly worked		100	4	4	
Worked		44	80	1	Italy 57; Greece 21.
Dolomite, chiefly refractory-grade		3	—		
Gravel and crushed rock		5	368	—	West Germany 305; France 63.
Quartz and quartzite		228	312	—	West Germany 172; Sweden 100; France 30.
Sand other than metal-bearing	value, thousands	$632	$717	$150	Belgium-Luxembourg $523.
Sulfur:					
Elemental:					
Crude including native and byproduct		129,108	108,254	17,557	Poland 25,865; Kuwait 22,000; Saudi Arabia 20,002.
Colloidal, precipitated, sublimed		55	59	—	West Germany 49; France 10.
Sulfuric acid		135,153	165,810	(2)	Italy 131,102; Spain 34,547.
Talc, steatite, soapstone, pyrophyllite		549	506	—	West Germany 280; Austria 80; Norway 68.
Vermiculite		2	NA		
Other:					
Crude		3,362	5,565	6	West Germany 2,743; Italy 1,158; United Kingdom 914.
Slag and dross, not metal-bearing		—	175	—	West Germany 123; Italy 50.
MINERAL FUELS AND RELATED MATERIALS					
Asphalt and bitumen, natural		56	68	49	West Germany 19.
Carbon black		13,111	15,066	49	Italy 10,600; France 1,695.
Coal:					
Anthracite and bituminous	thousand tons	2,645	3,442	1,656	Australia 1,030; Republic of South Africa 480.
Lignite including briquets		262,155	392,885	—	Republic of South Africa 228,290; U.S.S.R. 99,296; Colombia 65,299.
Coke and semicoke		67,059	32,695	14,766	Yugoslavia 9,692; Italy 6,602.
Peat including briquets and litter		79	216	—	Netherlands 172; Denmark 22.
Petroleum:					
Crude	thousand 42-gallon barrels	120,542	141,782	—	Iraq 56,948; Iran 48,087; Algeria 6,224.
Refinery products:					
Liquefied petroleum gas	do.	5,632	8,195	—	Kuwait 4,896; Iraq 1,730; U.S.S.R. 1,393.
Gasoline, motor	do.	(3)	134	24	Italy 48; Austria 29.
Mineral jelly and wax	do.	16	16	(2)	West Germany 5; United Kingdom 4; Netherlands 3.

See footnotes at end of table.

TABLE 9—Continued

TURKEY: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987	
				United States	Other (principal)
MINERAL FUELS AND RELATED MATERIALS—Continued					
Petroleum—Continued					
Refinery products—Continued					
Kerosene and jet fuel	thousand 42-gallon barrels	61	77	—	Greece 37; Spain 16.
Distillate fuel oil	do.	4,017	35,132	—	U.S.S.R. 16,842; Iraq 16,014.
Lubricants	do.	114	207	14	Iraq 41; Greece 26; Romania 22.
Residual fuel oil	do.	1,155	7	7	
Bitumen and other residues	do.	27	202	—	Spain 201.
Bituminous mixtures	do.	1	20	(2)	United Kingdom 19.
Petroleum coke	do.	2,043	1,495	1,054	Romania 302; Syria 80.

NA Not available.
[1] Table prepared by Virginia A. Woodson.
[2] Less than 1/2 unit.
[3] Unreported quantity valued at $5,257,000.

at Aliaga. Another private sector company, Ege Celik, was building a new steel plant at Aliaga. The new plant was expected to have startup production in 1989 and was to have a production capacity perhaps as high as 700,000 tons per year.

The Turkish Iron and Steel Board invited bids to modernize the integrated plants at Karabuk and Iskenderun. Iskenderun Iron and Steel Works (ISDEMIR) was planning to increase its production during the next few years to 2.7 million tons per year from the current 2.3 million tons per year. Funding for this expansion was being sought from the Soviet Union. The Islamic Development Bank approved a $10.9 million loan to modernize ISDEMIR's bar rolling mill and expand its capacity by almost 90% to 600,000 tons per year. In an effort to cut costs, ISDEMIR cut its staff in 1988 to 13,000, down from 15,000 employees in 1986. Modernization work continued at the Karabuk Iron and Steel Works with the construction of a new oxygen-injection furnace. Raw steel production capacity was about 600,000 tons per year at yearend and was expected to reach 900,000 tons by 1990. The labor force was expected to be cut by 1,500 as a cost-cutting measure.

The Eregli Iron and Steel Works commenced a major capacity improvement and modernization project. The project was planned for three stages over the next 11 years for a total cost of $865 million, including $276 million for the first stage. Much of the financing was expected to come from foreign sources. The project's aims were to increase the plant's raw steel capacity from 1.8 million to 2.4 million tons per year and to increase finished products from 1.7 million to 3 million tons per year. The company further solicited bids for a computerized production system.

Silver.—The Etibank silver mine at Gumuskoy, about 200 kilometers west of Ankara, experienced numerous production problems during the year, and produced only about 16 tons (about 514,000 troy ounces) in 1988. This was only about one-half of the predicted production, but was more than double the country's annual production in recent years, all of which had been byproduct. Etibank predicted that 1989 production would be between 40 and 50 tons (1.28 and 1.6 million troy ounces). Eventually, the mine was expected to produce 120 tons (3.8 million troy ounces) per year.

***Industrial Minerals.*—Cement.**—Turkish cement production increased only 1.8% in 1988, compared to a 10% increase in 1987 and a 13.8% increase in 1986. The small increase reflected a lack of demand, which was not expected to increase in 1989.

Turkey produced 18.4 million tons of clinker, the equivalent of 22.7 million tons of cement. The country's cement consumption increased 500,000 tons to 23.9 million tons. Turkey had net imports of 335,000 tons of clinker and 1.05 million tons of cement. Major regional imbalances in cement supply and demand were being addressed by expanding the production capacity of several cement plants. It was felt that the increased production capacity would obviate the need for most cement imports in 1990 and would return certain producing regions to the status of significant cement exporters.

Mineral Fuels.—More than 15 power stations were commissioned in 1988. Several of these were hydroelectric facilities. The Soviet Union was assisting in the construction of a lignite-fired 200-megawatt power station at Orhaneli. Turkey was negotiating loans from a variety of sources to build a 1,400 megawatt coal-fired powerplant at Yumurtalik on the southeast coast.

In August, Turkey's second natural gas power station began experimental production in Istanbul. Commercial operations at the Ambarli plant began in September. The plant was to have five power units in operation in 1989, producing about 9 billion kilowatt hours per year. The plant was to burn Soviet natural gas.

Coal.—The Turkish Hard Coal Board awarded a contract to Davy McKee (United Kingdom) to prepare a feasibility study for modernization of the coal washing plants at the Zonguldak and Catalagzi coal mines. Negotiations were held during the year with the Soviet Union for the actual work.

Natural Gas.—Turkiye Petrolleri Anonim Ortakligi (TPAO) announced plans to drill 149,000 meters of test wells in 1988, mostly in the Thrace region. This region's 530 billion cubic feet of gas were the largest proven reserves in the country, and TPAO estimated that it would be possible to produce 16 billion cubic feet per year from that area.

Petroleum.—Turkish Petroleum Refineries Corp. (TUPRAS) invited bids from 10 international firms for the construction of a hydrocracker at the Aliaga refinery. Four firms bid on a project to build another hydrocracker at Kirikkale, near Ankara. The World Bank was reportedly providing $55 million towards the total cost of $80 million for this project.

Petroleum exploration in Turkey was conducted by Turkish firms: TUPRAS; TPAO; Pipe Lines and Petroleum Transport Corp.; and Railways, Harbors and Airfields Construction Corp., as well as by several international companies.

Late in the year, TPAO announced the discovery of oil at Karakus. The new well was producing 4,500 bbl/d at yearend. The potential of the new field was not known, and further drilling was planned for 1989. There were expectations that the new field would increase Turkish petroleum production by almost 50%. The producing zone was said to be at a depth of 8,200 feet.

TPAO and Chevron International Ltd. (United States) agreed to form a 50-50 joint venture to explore a 500,000-acre offshore tract in Turkey. Chevron, the operator, was to conduct a test seismic program before shooting 150 line-kilometers of seismic survey. Chevron agreed to drill a wildcat well within 4 years. This marked Chevron's reentry into Turkish exploration after an absence of 20 years.

Atlantic Richfield Co. (ARCO) was negotiating with TPAO for the latter to take over most of ARCO's concessions in Turkey. ARCO was retaining title to one concession, but wanted TPAO to assume ARCO's exploration obligations on the others.

Neste Oy (Finland) was allowed to assign 40% of their 90% interest in six exploration concessions in southeast Turkey to Idemitsu Turkey Oil Exploration Co. Ltd. The concessions covered about 1,000 square miles near Cizre and Mardin.

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[1] By Jozef Plachy, physical scientist, Division of International Minerals.

[2] Where necessary, values have been converted from Cypriot pounds (£C) to U.S. dollars at the rate of £C0.4668 = US$1.00.

[3] By Bernadette Michalski, mineral specialist, Division of International Minerals.

[4] Where necessary, values have been converted from New Israeli shekels (NIS) to U.S. dollars at the rate of NIS1.60 = US$1.00.

[5] By Thomas P. Dolley, physical scientist, Division of International Minerals.

[6] Where necessary, values have been converted from Jordanian dinars (JD) to U.S. dollars at the rate of JD0.51 = US$1.00.

[7] By Bernadette Michalski, mineral specialist, Division of International Minerals.

[8] By Bernadette Michalski, mineral specialist, Division of International Minerals.

[9] By Hendrik G. van Oss, physical scientist, Division of International Minerals.

[10] Where necessary, values have been converted from Turkish lira (TL) to U.S. dollars at a rate of TL1,416.50 = US$1.00.

THE MINERAL INDUSTRY OF

BRAZIL

By Henry R. Ensminger[1]

INTRODUCTION

Brazil's gross domestic product (GDP) grew only slightly in 1988 to $277 billion at current prices.[2] The growth rate was the smallest registered since 1983, when the rate was minus 2.8%. The economy's performance was strongly influenced by a 2% to 3% decrease in industrial production and civil construction. The mineral industry, however, countered the downward trend in the industrial sector and grew a modest 1.4%.

In November, Brazil adopted a new Constitution that placed significant restrictions on foreign investment in the mineral industries. Under certain provisions of the new Constitution, foreign companies were prohibited from establishing new mining ventures in Brazil as sole or majority owners. They could now enter the mineral industry only as minority shareholders with Brazilian partners. Foreign companies already established in Brazil had a 4-year grace period to find majority Brazilian partners, or to establish vertically integrated processing operations (mining, processing, smelting, and refining). The new Constitution also prohibited foreign risk contracts for petroleum exploration.

Since legislation had not yet been drafted to define "Brazilian capital" and to clarify other provisions of the Constitution, the issuance of new mining permits was paralyzed. Also worrisome to both Brazilian and multinational companies was a provision permitting States to impose higher sales and export taxes on minerals. These levels would replace the tax of 2% to 3% formerly imposed by the Federal Government and distributed to the States. The Congress still needed to write implementing legislation for the Constitution, which was itself subject to review in 1992.

In mid-1988, British Petroleum Co., Ltd. (BP) announced that it was scrapping its plan to invest $200 million in a cobalt, copper, and nickel mine in the State of Minas Gerais. Because of the pending changes in the mining laws, ALCAN Aluminum Ltd. (Canada) also announced concern for the future prospects of majority holdings in a power company and a bauxite mine.

At yearend, Shell do Brasil S.A. announced the sale of its 50% share in the Bacaja Mine in the State of Pará and plans to sell its wholly owned Ibiajara gold mine in Bahía State. Shell also announced plans to invest $223 million in Brazil in 1989, none of it for mineral prospecting. One-half of Shell's investment was to be allocated to the second expansion phase of the Alumínio do Maranhao S.A. (ALUMAR) smelter (40% ownership). The balance of the investment was to be allocated to the petroleum sector and to Mineração Rio do Norte S.A. (MRN), the bauxite mining company (10% ownership).

GOVERNMENT POLICIES AND PROGRAMS

At yearend, the Government was planning to introduce a macroeconomic adjustment program called the "Summer Plan." This plan, to be effected in early 1989, was designed to combat rampant inflation, which exceeded 1,000% in 1988. The plan provided for deindexation of the economy, a reduced Federal payroll, a wage and price freeze, high interest rates, and introduction of the "novo cruzado" whose value would equal 1,000 old cruzados and additionally would be devalued by about 17%.

Three State-owned companies involved in the mineral industry were put up for sale in 1988: Caraiba Metais S.A. Indústria e Comercio, the State copper company; Siderúrgica do Mogi das Cruzes (COSIM), a State steel company; and the Vitoria Railway Company.

In May, the President of Brazil signed a series of decrees formulated to open Brazil's internal market to increased imports and foreign investment and to encourage growth in the Nation's export sector. Also in May, Brazil and Czechoslovakia signed a long-term trade agreement designed to lead both countries to a more equitable trade balance and to provide for trade expansion and new forms of cooperation. Brazil planned to import the following products from Czechoslovakia: complete plants, such as hydro and thermal power stations, and cement works; diesel engines; transport equipment; and irrigation systems. Exports to Czechoslovakia were to be iron ore, coffee, machine equipment computers, food products, and consumer goods.

Argentina and Brazil announced a joint venture to produce iron ore pellets. The plant, to be in Argentina, was to use Brazilian iron ore. The plant was estimated to cost $150 million and was scheduled to come on-line in 1991.

The Brazilian Government offered to reschedule Guyana's $15.4 million debt and to allow a new $10 million credit line to the country. Negotiations also continued on possible Brazilian assistance to rehabilitate Guyana's bauxite industry, whose sole alumina plant has been closed since 1982.

PRODUCTION

In 1988, Brazil's mineral production increased by 1.4% over that of the previous year. The total value of all mineral production represented approximately 3% of the GDP. Gold was the principal contributor to the increase in total mineral production value for 1988. Registered gold production from mines and garimpos (small mines operated by garimpeiros, independent miners) was up 58% over that of the previous year, while the unregistered gold total increased an estimated 20%. In 1988, Brazil increased its iron ore production by 8% relative to 1987, a record high. Crude steel production increased 11% over that of 1987, while semimanufactured steel production increased by about 5%. Ferroalloys were at a record high. Brazil moved into first place as a world tin producer in 1988, producing a record 44,000 tons.

Production of crude petroleum declined by more than 2% from 215.4 million barrels for 1987 to 210.6 million in 1988. In early January, Brazil became the first country to completely eliminate tetraethyl lead from gasoline produced and sold in the country. In 1988, the average lead in all gasoline produced stood at 0.07 milliliter per liter of gasoline, much less than the 0.8 milliliter per liter permitted by Brazilian law.

TRADE

Total foreign trade for 1988, as officially announced by the Foreign Trade Department, was the highest ever recorded in Brazilian history, producing a trade surplus exceeding $18 billion. This positive trade balance resulted from total exports of $31 billion and total imports of $13 billion. Mineral exports were down 10% from 1987, to $2 billion, while mineral imports were also down 10% from 1987, to $4.4 billion.

The leading mineral commodity exports were, alphabetically, aluminum, bauxite, columbium, copper, ferroalloys, gemstones, gold, iron ore, manganese, silicon metal, steel, and tin. Companhia Vale do Rio Doce (CVRD) exported 88 million tons of iron ore and pellets in 1988, exceeding the 1987 figure by 8.1 million tons. Minerações Brasileiras Reunidas (MBR), a private company, was the second largest exporter of iron ore with almost 13 million tons. Petroleum imports comprised 77% of total mineral imports, followed by coking coal, 9.9%; copper concentrates, 4.6%; natural gas, 3%; sulfur, 2.6%; and zinc concentrates, 0.7%.

Although Brazil is not a member of the Association of Tin Producing Countries (ATPC), it had agreed to cooperate with ATPC to maintain prices. Therefore Brazil held its tin exports in 1988 to 31,000 tons and agreed to limit 1989 exports to 31,500 tons.

COMMODITY REVIEW

Metals

Alumina, Aluminum, and Bauxite.—Primary aluminum production in Brazil increased by more than 3% over that of the previous year. In addition, Brazil produced almost 50,300 tons of secondary aluminum in 1988. Of the total, 41% was for domestic consumption and the remainder for export.

Alumina production in 1988 was at approximately the same level as that of 1987. Bauxite production was at a record high and reached almost 8 million tons, of which approximately 6 million tons was produced by Mineração Rio do Norte (MRN). MRN is a joint venture with 46% owned by CVRD, 10% owned by Cia. Brasileira de Alumínio (CBA) and the remaining 44% held by Alcan, Billiton Metais S.A., (a subsidiary of Shell) Norsk Hydro A/S (Norway), and Reynolds Aluminio S.A.

MRN announced plans to increase output in 1989, to about 7 million tons of bauxite, of which 2 million tons would go into the domestic market.

In May, Alumínio Brasileiro S.A. (ALBRAS) announced that construction to double the capacity of its 160,000-ton-per-year plant, in northern Pará State, would commence immediately. The expansion would cost $625 million, of which 60% was to be provided by CVRD and Nippon Amazon Aluminium Co. (NAAC), the joint-venture partners. The remainder of the financing was to be provided by the Banco Nacional de Desenvolvimento Economico e Social (BNDES). In the past, ALBRAS exported most of its aluminum, with Japan receiving 49% and the remainder going to the London Metal Exchange (LME). Most of the ALBRAS aluminum available through LME was purchased by the United States and Europe.

According to CVRD, construction of the Alumina do Norte do Brasil S.A. (ALUNORTE) alumina plant in Pará State was resumed in December. CVRD had proceeded on its own since the withdrawal of NAAC in 1987. The plant's capacity was redesigned upward from 800,000 tons per year to 1 million tons per year. As of December 1987, the plant was 37% complete, at a cost of $230 million. The plant was expected to cost $700 million upon completion.

Reynolds Latas de Alumínio, a subsidiary of Reynolds Metals Company of the United States, contracted to build Brazil's first aluminum can plant, a $55 million venture to produce 700 million beverage cans annually. Construction, which began in 1988, was scheduled for completion in 1989. The plant, at Pouso Alegre, Minas Gerais, was expected to cost approximately $15 million.

The Associação Brasileira de Metais não Ferrosos (ABRANFE), Brazil's nonferrous metals association, had urged the imposition of controls on aluminum exports in an effort to improve the economic viability of the country's nonintegrated aluminum transforming (fabricated products) sector. Some independent transformers experienced great difficulty obtaining metal owing to low domestic aluminum prices, of $1,300 per ton versus export prices of $2,300 per ton. This difference encouraged aluminum producers either to export more or to transform increasing amounts themselves.

Columbium.—At yearend, Paranapanema S.A. Mineração Indústria Construcao announced that it expected to commence production of columbium and tantalum at its new plant at Pirapora do Bom Jesus, Acre State, by 1990. By 1988, $4 million had already been invested in the plant, which in the first year was scheduled to produce 1,000 tons of material, 90% columbium and 10% tantalum. The reserves at the site were estimated to contain 300,000 tons of columbium oxide and 40,000 tons of tantalum oxide. In addition, the company announced plans to become a major world producer of columbium oxide and tantalum oxide.

Copper.—In August, BNDES sold 67% of Caraiba Metais S.A., a copper producer in Bahía State, to the association of S.A. Marvin, Cia. Paraibuna de Metais (CPM), and the Banco de Bahía Investimento S.A. for $90 million. Of the total, $27 million was due on August 30, with the remainder to be financed by BNDES over 10 years. In December, Caraiba exported copper cathodes for the first time. Based on the drop in domestic consumption of electrolytic copper, plans called for the export of 2,000 tons per month in 1989.

In 1988, CVRD began looking for foreign or domestic partners to participate in the development of the Salobo copper deposit near the Carajás iron ore mining complex in the State of Pará. The copper deposit had proven ore reserves of 250 million tons and possible reserves of 1.2 billion tons of chalcocite-bornite ore grading 0.83% copper with silver, gold, and molybdenum values. The cost of the proposed project was estimated at $461 million.

Gold.—In 1988, registered official gold production was 1,814,000 troy ounces. Of the total, "garimpeiro" production was 1,101,500 troy ounces, while the major mining companies produced 712,500 troy ounces. The major mining company group included Mineração Morro Velho, 40%; Rio Paracatu Mineração Ltda., 16%; Cia. de Mineração e Participacoes S.A., 11%; Sao Bento Mineração, 9%; Manati Mineração S.A., 8%; and CVRD, 7%. It was estimated that total unoffical gold production was 3,220,000 troy ounces in 1988.

Mining activity virtually was halted at the huge Serra Pelada open pit mine in the State of Pará because of the depletion of easily mined, high-grade ore. The garimpeiros consequently abandoned the area and moved to the upper Amazon region and to other areas.

Rio Tinto Zinc Corp. Ltd. do Brasil (RTZ) acquired all British Petroleum Ltd.'s (BP) world wide mineral assets, including the Cabacal gold deposit from Manati Mineração S.A., a subsidiary of BP. RTZ was active in mineral exploration of metals, with nearly 100 exploration licenses in Brazil as of 1988.

CVRD, which produced a minor amount of gold in 1988, was planning to produce 400,000 troy ounces by 1993. A major part of the plan was to expand production at its Fazenda Brasileiro Mine in the State of Bahía from 65,000 to 200,000 troy ounces per year. CVRD also planned to open four new mines, including the Igarape Bahía Mine in the Carajás region.

Iron and Steel.—**Ferroalloys.**—The Brazilian ferroalloy industry produced more than 973,000 tons, an 18% increase over the 1987 figure to a record level, thus making Brazil the fifth largest producer in the world. The domestic market received 457,600 tons, and 515,500 tons went for export. The major importers were Japan, the United States, the Netherlands, and the Federal Republic of Germany, in that order. The value of ferroalloy exports in 1988 was $453 million, an increase of 68% over that of the previous year. The increased capacity of ferroalloy producers to almost 1.1 million tons per year was reflected in the increased number of furnaces, from 99 to 104.

Eletrovale S.A., Brazil's largest ferrosilicon producer, increased production to just under 20,000 tons at its plant in the State of Minas Gerais. The major portion of the increase was destined for increased exports of 3,000 tons during the year.

In early 1988, Cia. Paulista de Ferro-Ligas (Paulista) acquired controlling interest in Eletrosiderúrgica Brasileira S.A. (SIBRA), making Paulista the largest ferromanganese producer in Brazil. Paulista acquired 58% of the voting capital and 18% of the total capital of SIBRA. The former State-controlled company was released to private bidders by BNDES, the national bank for economic and social development.

Iron Ore.—Iron ore production increased by 8.2% to a new high of 145 million tons in 1988. CVRD, the State-operated mineral giant, produced 84.1 million tons, which represented 58% of the total. The Carajás region produced 28 million tons of CVRD's output of iron ore. The private company MBR, the second largest iron ore producer, produced 15 million tons, of which 13 million tons was exported.

At the beginning of 1988, Brazil had 18 billion tons of measured and indicated iron ore reserves containing not less than 60% iron. It appears that Brazil may be operating at near capacity and may require additional capital investments. This fact was reflected in tight supplies of some direct-reduction grades of iron ore. CVRD-controlled iron ore deposits in Minas Gerais State are large but declining, resulting in the company's increased dependence on the Carajás deposits. However, it was estimated that to increase Carajás production would require an investment of about $80 per ton of new capacity, not including the costs of a pelletizing plant. Industry sources in Brazil estimated that iron ore prices needed to increase by 20% to attract additional capital investments in the area.

MBR's iron ore transportation capacity was scheduled to increase in April 1989 with the inauguration of the "Steel Railway" from the "Iron Quadrangle" in Minas Gerais to the port of Sepitiba, near Rio de Janeiro.

The iron ore industry continued to be concerned about higher domestic taxes on exports. Of primary interest was the provision in the new constitution subjecting iron ore exporters to State sales and export taxes that could reach 17% of the sales price, which already included high domestic transportation costs.

S.A. Mineração da Trinidade (SAMITRI) announced plans to invest $10 million in 1989 and 1990 to expand iron ore output at its Minas Gerais mine. The company budgeted $40 million to establish a supply of iron ore concentrates to its subsidiary, SAMARCO Mineração S.A. (SAMARCO).

CVRD announced in mid-1988 that it would supply Libya with one 60,000-ton shipment of direct-reduction iron ore pellets for the startup of its Misurata iron and steel complex. CVRD also announced that an additional 120,000 tons would likely be required by Libya in the near future.

In 1988, Brazil produced 26.1 million tons of iron ore pellets, which was an increase of 5% over the previous year's production.

Pig Iron.—Brazil's pig iron production in 1988 was 23.7 million tons, a 10% increase over that of 1987. In mid-1988, the Itaminas Group, Brazil's largest pig iron producer, announced that plans were underway to set up a joint-venture trading company with China's Minmetals and Metallgesellschaft AG (Federal Republic of Germany). The trading company was to be in Brazil and would export pig iron produced by Itaminas and other companies.

Itaminas indicated that the high cost of charcoal in Brazil threatened to further erode the country's competitiveness in pig iron production. The company also stated that prices were expected to rise further with the advent of the rainy season late in the year. The association of pig iron producers in Brazil protested a 2,000% increase in port handling charges, backdated to August 1985. The association of companies, which produced 4.3 million tons in 1987, about 50% for export, stated that the new port tariffs would increase their total transport costs by 20%, therefore eroding their competitiveness in the export market.

Steel.—In 1988, Brazil increased its raw steel production by 11% to almost 25 million tons, a record high that continued a strong uptrend. This made Brazil the sixth largest producer in the world following the Soviet Union, Japan, the United States, the Republic of China, and the Federal Republic of Germany. Steel industry expansion proceeded at a slower pace. Lending to the State-owned portion of the steel industry by BNDES was put on hold in 1988 owing to a resolution handed down by the Central Bank that prevented BNDES from making loans to State-owned companies. Siderúrgica Brasileira S.A. (SIDERBRAS), the State steel holding company, in mid-1988 invited bids for 67% of the voting capital and 64.8% of the overall capital of the steel company, Cia. Ferro e Aco de Vitoria (COFAVI), as it continued its drive to privatize a large segment of the State-owned steel industry. The Gerdau Group, Brazil's largest privately owned steel producer, inaugurated two additions. They included a drawing mill to produce 9,200 tons per year of wire, and a nail and staple production plant at the company's Rio-Grandense mill in southern Rio de Janeiro State. The cost of the additions was $30 million.

SIDERBRAS announced at yearend that it would open coking coal contract negotiations with U.S. coal companies the second week of February 1989. U.S. companies holding contracts to supply coke to SIDERBRAS in 1988 were A.T. Massey Coal Co., Consolidation Coal Co., Island Creek Corp., Jno. McCall Coal Co., Pittston Coal Co., United Coal Co., and Westmoreland Coal Co. In the past, annual coking coal purchases from foreign sources were in the 10-million-ton range, with U.S. companies accounting for approximately 55% of the total. SIDERBRAS also bought coal from Australia, Canada, China, Colombia, and Poland in 1988.

Cia. Acos Especiais Itabira-Acesita (ACESITA), a stainless and speciality steelmaker, signed technical assistance contracts with Inchon Iron and Steel Co. (the Republic of Korea) and Acerías Paz del Río S.A. (Colombia) for production of stainless flat products and low-carbon steels, respectively. These were the first international contracts for ACESITA. According to the Ministry of Industry and Commerce, early in the year, the U.S.S.R. negotiated with the Government on partial financing of a projected $3 billion mill to be built by Usimar Steel in northern Brazil. The planned capacity of the plant would be 3 million tons per year of mainly hot-rolled products.

Manganese.—Indústria e Comercio de Minerios (ICOMI), attracted by steadily rising prices, produced 960,000 tons of manganese concentrate, a 30% increase over 1987 production. About 200,000 tons was sold on the domestic market, while Argentina, Belgium, the Federal Republic of Germany, and the United States were ICOMI's principal export clients. ICOMI's revenues increased 108% in 1988 to $37.4 million. ICOMI planned to reduce its production by 33% in 1989 to extend dwindling reserves of high-grade ore that otherwise would have been exhausted by 1990. In this manner, production of high-grade ore was to be extended over 4 years, and production of lower grade ore was to be extended over 10 years. CVRD, which was projected to replace ICOMI as the largest manganese producer in 1989, had its own problems at the Igarapé Azul Mine in Carajás. The reserves were fairly small at 65 million tons, of which 11 million tons was battery grade. The deposit contains undesirable high amounts of aluminum, requiring blending with other ores.

Tin.—In 1988, Brazil became the world's leading producer of tin at a level of over 44,000 tons, an increase of 59% over the previous year. Paranapanema was by far the largest producer, with 18,000 tons from its Pitinga Mine in Amazonas State. The other major source was the Alto Paraiso deposit, which was mined by 12,000 to 18,000 garimpeiros, in the State of Rondonia. The garimpeiros produced 18,000 tons that was sold to Paranapanema, which holds the exploration licenses in the Alto Paraiso area. Given the Government's commitment to the ATPC's supply rationalization scheme, Paranapanema received the exclusive right to buy the concentrates from the garimpeiros. Of the total garimpeiro production, about 50% was transferred by Paranapanema to the other tin-producing and exporting companies.

Titanium.—CVRD announced plans to construct two commercial beneficiation plants to produce anatase, or octahedrite (TiO_2) concentrate. The plants were to be located at Araxá and Tapira, both in Minas Gerais State. The plants were to use the process developed by CVRD then in use at the 15,000-ton-per-year pilot plant operated by CVRD at Tapira.

E.I. duPont de Nemours & Co. Inc. of the United States announced that it would build a titanium dioxide plant at Uberaba, Minas Gerais, through its Brazilian subsidiary, DuPont do Brasil S.A. The plan called for the construction of a 60,000-ton-per-year plant using DuPont's proprietary chloride-route process. The cost of the plant was estimated at $200 million and had an estimated startup date of 1992–93. Plans called for the feedstock to be supplied by CVRD from its Araxá Mine.

Industrial Minerals

Gem Stones.—Brazil produced approximately 65% of the world's supply of precious and semiprecious stones, excluding diamonds. In recent years, the demand for Brazilian gem stones rose between 15% and 20% per year. In 1988, the export of amethyst, aquamarine, diamond, emerald, opal, topaz, tourmaline, and 90 other gem stones officially earned in excess of $100 million. Probably the same amount left the country illegally via black-market trading.

The Australian companies Titan Resources Ltd. and Gem Exploration and Minerals Ltd. entered into a joint venture with Sharp S.A. Equipmentos Electronicos of Sao Paulo to explore a major diamond-bearing conglomerate near Estrela do Sul, Minas Gerais, about 725 kilometers northwest of Rio de Janeiro. The terms of the joint venture would have enabled the Australian companies' Brazilian subsidiary, Brasaust Mineracao Ltda., to earn 51% equity by an expenditure of $1.5 million on exploration and development. The prospect, owned by Sharp, covers an area of some 30,000 hectares and was believed to contain the largest diamond-bearing conglomerate in Brazil.

Phosphate Rock.—Phosphate rock production decreased by about 2% to 27 million tons in 1988. Fertilizantes Fosfatados S.A. (Fosfertil) announced plans at yearend to increase phosphate rock output at its Tapira mine in Minas Gerais State from 1.3 million tons per year to 1.5 million tons per year by 1991. Araxá S.A. Fertilizantes e Produtos Quimicos (Arafertil), operator of the Araxá Mine 50 kilometers north of the Tapira Mine, indicated that it planned to increase production capacity at the mine from its rated capacity of 900,000 tons per year.

The Brazilian National Association of Fertilizer Distributors (ANDA) warned that imported fertilizer materials from countries including the United States could cost Brazil as much as $1 billion per year by 1992, unless further development of the industry takes place.

Quartz.—CVRD reached a joint-venture agreement with Brazil's Telequartz Group and Nisso Iwai Ltd. of Japan in mid-1988 to build a quartz powder plant at Piqueri, Minas Gerais. The $20 million commercial plant was scheduled to come on-stream by yearend. Nisso Iwai was to supply the technology for the process. The three companies each own one-third of the venture. The material was tested for its suitability for use in certain lamp tubes and in preform tubes for optical fibers.

Mineral Fuels

Coal.—Unrealistic Government pricing policies, aimed at helping to fight rampant inflation and a shortage of cash continued to hamstring development of Brazil's domestic coal industry in 1988. Two of the most objectionable new policies were the ending of transport subsidies, and the potential for offering importers a possibly larger portion of the steam coal market. The two southernmost States, Rio Grande do Sul and Santa Catarina, producers of most of the steam coal, especially objected to the lifting of the transport subsidy. The two States wanted the subsidy reinstated and then phased out slowly while improvements are made in existing transport systems. They also stressed that the subsidy was paid to carriers, not to coal producers, and provided little incentive for improved efficiency.

The Governments of Brazil and Colombia signed an agreement in February whereby Brazil would purchase 300,000 tons of steam coal from Colombia. Other cooperative arrangements discussed were a program for mixing Colombian coal with lower quality Brazil coal to expand its export market, the setting up of new power-generating plants in northern Brazil using Colombian coal to provide electricity for portions of the Amazon Basin, and joint establishment of a coking coal mine, in Colombia, whose total production was to be imported by Brazil. A second agreement with Colombia was signed later in the year setting up a 10-year contract, under which Brazil was to purchase between 600,000 tons and 1,100,000 tons of steam coal each year.

Representatives of Rio Grande do Sul State and Eletro Meccanico per Impianti All Estero SpA of Italy met in August to discuss a barter arrangement whereby Brazil would trade steam coal for electrical-generating equipment. The deal, if consummated, would total $16 million.

Natural Gas.—In 1988, natural gas production decreased by less than 2% from that of 1987. The Brazilian Government announced plans to build a 1,000-kilometer natural gas pipeline from the Entre Rios Province in Argentina into Rio Grande do Sul State. The project was expected to cost an estimated $280 million. The Rio de Janeiro-Sao Paulo gas pipeline, 425 kilometers in length, supplies natural gas from the offshore Campos Basin off Rio de Janeiro State to various firms and municipalities in both States. Initially, the daily volume of the Rio-Sao Paulo pipeline was 300,000 cubic meters of gas. Volume was to be increased to 1.1 million cubic meters early in 1989 and was to reach 1.7 million cubic meters per day by yearend 1989.

Petrobrás Distribuidora, the marketing subsidiary of PETROBRÁS, began developing a plan to convert diesel-powered vehicles to operate on natural gas in mid-1988. The plan was to convert approximately 33,000 buses and trucks that operated along the entire Brazilian seacoast, where there was an infrastructure available to supply natural gas.

Petroleum.—Production of crude petroleum in 1988 averaged 577,000 barrels per day. The production level decreased more than 2% from that of 1987. The proven reserves at yearend were 2.55 billion barrels. The 1988 production was hampered by a fire that damaged PETROBRÁS' important Enchova-1 offshore platform early in the year and by a workers' strike in November. Before the fire, the Enchova platform handled up to 132,500 barrels per day from Enchova and other southern Campos Basin fields. In 1988, the Campos Basin accounted for almost 60% of Brazil's total petroleum production.

PETROBRÁS' net profit decreased by 95% to $9.4 million in 1988. The loss was attributed to higher world oil prices that raised the cost of crude oil imports, delays in payments by domestic customers and Government purchasers, and the failure of the Government to raise prices for refined product imports. In late 1988, PETROBRÁS submitted to the Government an $11.15 billion upstream exploration and development program aimed at increasing production from then-current levels to 1 million barrels per day by 1993. The plan envisaged increases in the yearly upstream budget from $1.75 billion in 1988 to $4 billion in 1991.

PETROBRÁS announced plans to open a network of service stations in the United States as part of the company's plan to prepare itself for the next century. Part of the plan was to reduce the company's current diversification by selling off some of its unrelated subsidiaries and basing its business mainly on petroleum, both domestic and foreign. At yearend, PETROBRÁS commenced a $300 million project to boost the capacity of its refinery at Mataripe, Bahía State to 233,350 barrels per day, up from 100,640 barrels per day. PETROBRÁS also revised a 1986 agreement with Sweden's Gotaverken International Ltd. dealing with the construction of two semisubmersible drilling rigs. Work under the revised pact was to move from Sweden to Brazil and to focus on semisubmersible production platforms adapted to Brazil's Campos Basin.

Nuclear Power.—In August, Brazil's President decreed a restructuring of the Federal Government entities in the nuclear energy field. This included the abolition of Nucleares Brasileiro S.A. (NUCLEABRÁS) and the folding of some of its subsidiaries into a new firm, Nuclear Industries of Brazil, with the remaining subsidiaries to be abolished. A new Government body, the Superior Council of Nuclear Energy, was to oversee the Brazilian Government's nuclear activities. It was reported in mid-1988 that the Nuclear and Energy Research Institute (IPEN) located in Sao Paulo had announced the manufacture of the first nuclear fuel element in Brazil. The Government reported that this development had come at a fortuitous time because Brazil, which had not signed the Nuclear Non-Proliferation Treaty, had been unable to import fuel elements for some time.

Nonmineral Energy Sources

Alcohol.—In May, the Government announced plans for a 5% reduction in the price differential between gasoline and alcohol fuels. This move represented a victory for PETROBRÁS, which for years had tried to force the sugar lobby into a reduction of the cost to the company of the alcohol program that was consuming much of the resources needed for other investments.

Hydroelectric.—At yearend, the International Bank for Reconstruction and Development was to have decided whether or not to advance Brazil $500 million to augment its electrical grid, which included the construction of a number of dams in the Amazon Basin. The loan was to be conditioned on balancing development with environmental protection.

Planners indentified approximately 100 sites in the Amazon Basin, each with the potential capacity of at least 100 megawatts. Two sites have been developed, Tucurui and Balbina; each created a lake the size of Long Island, New York, United States.

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[1] Physical scientist, Division of International Minerals.

[2] Where necessary, values have been converted from Brazilian new cruzados (CZ$) to U.S. dollars at the rate of CZ$0.36 = US$1.00, the average rate for 1988.

TABLE 1

BRAZIL: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons, unless otherwise specified)

Commodity[2]		1984	1985	1986	1987[p]	1988[e]
METALS						
Aluminum:						
Bauxite, dry basis, gross weight		6,433,100	5,846,000	6,544,000	6,566,500	[3]7,727,600
Alumina		891,300	1,095,900	1,196,800	1,396,300	[3]1,416,700
Metal:						
Primary		454,999	549,167	757,375	843,500	[3]873,500
Secondary		48,946	44,828	47,971	50,284	[3]50,283
Beryllium: Beryl concentrate, gross weight		1,407	877	907	1,000	[3]913
Cadmium: Metal, primary		[r]224	[r]224	233	214	[3]161
Chromium:						
Crude ore		709,000	727,000	[e]780,000	[e]780,000	810,000
Concentrate		128,910	130,696	129,000	123,900	[3]145,800
Marketable product[4]		255,914	189,504	222,990	[e]220,000	240,000
Columbium-tantalum ores and concentrates, gross weight:						
Columbite and tantalite		170	267	274	[e]300	380
Djalmaite concentrate		10	10	10	[e]10	10
Pyrochlore concentrate		27,775	29,400	28,737	26,666	[3]20,275
Copper:						
Mine output, Cu content		35,212	41,000	40,183	37,800	[3]44,400
Metal:						
Primary		61,334	93,900	115,990	146,969	[3]147,880
Secondary		[r]40,377	49,000	50,000	52,200	[3]38,050
Gold:[e 5]						
Mine output	troy ounces	[r]220,000	[r]720,000	767,000	1,008,000	990,000
Garimpeiros (prospectors)	do.	[r]1,760,000	[r]1,600,000	[r]1,403,000	[r]1,682,000	2,230,000
Total	**do.**	**[r]1,980,000**	**[r]2,320,000**	**[r]2,170,000**	**[r]2,690,000**	**3,220,000**
Iron and steel:						
Ore and concentrate (marketable product):[4]						
Gross weight	thousand tons	112,133	128,251	132,288	134,105	[3]145,040
Fe content	do.	72,900	87,200	89,956	91,200	[3]98,600
Metal:						
Pig iron[6]	do.	17,200	18,970	20,350	21,509	[3]23,650
Ferroalloys, electric-furnace:						
Chromium metal		123	124	138	123	[3]155
Ferroboron		11	29	35	—	—
Ferrocalcium silicon		17,755	22,179	23,715	25,673	[3]31,519
Ferrochromium		125,125	127,288	109,392	105,394	[3]130,024
Ferrochromium-silicon		7,628	8,875	9,512	8,079	[3]9,177
Ferrocolumbium		16,522	17,676	17,391	10,880	[3]19,106
Ferromanganese		106,459	134,835	164,093	155,252	[3]180,588
Ferromolybdenum		437	509	511	422	[3]427

See footnotes at end of table.

TABLE 1—Continued

BRAZIL: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons, unless otherwise specified)

Commodity[2]	1984	1985	1986	1987[p]	1988[e]
METALS—Continued					
Iron and steel—Continued					
Metal—Continued					
Ferroalloys, electric-furnace—Continued					
Ferronickel	33,661	33,460	34,296	35,496	[3]33,930
Ferrophosphorus	926	1,281	1,461	1,784	[3]1,469
Ferrosilicon	151,101	181,784	217,715	231,159	[3]267,538
Ferrosilicon magnesium	15,429	14,876	13,053	17,575	[3]17,000
Ferrosilicon zirconium	244	421	852	398	[3]793
Ferrotitanium	551	1,372	755	80	[3]549
Ferrotungsten	239	218	173	123	[3]133
Ferrovanadium	456	905	439	88	[3]261
Inoculant	1,992	1,748	3,244	3,308	[3]7,678
Silicomanganese	185,631	180,271	177,568	188,022	[3]193,490
Silicon metal	26,783	29,477	37,077	39,982	[3]79,287
Total	**691,073**	**757,328**	**811,420**	**823,838**	**[3]973,124**
Steel, crude, excluding castings thousand tons	16,680	18,557	20,014	22,228	[3]24,657
Semimanufactures, flat and nonflat do.	18,385	20,457	21,234	21,213	[3]22,243
Lead:					
Mine output, Pb content	[r]18,775	[r]16,997	13,614	11,633	[3]14,314
Metal:					
Primary	25,965	29,811	32,718	29,842	[3]29,501
Secondary	45,656	51,764	51,973	58,361	[3]68,681
Magnesium:					
Metal:					
Primary	[r]1,195	[r]2,615	4,356	5,488	[3]5,865
Secondary	—	2,006	1,767	1,376	1,500
Manganese ore and concentrate, marketable, gross weight[4]	[r]2,693,131	2,523,194	2,696,799	2,070,000	[3]1,944,596
Nickel:					
Mine output, Ni content	23,532	20,300	21,240	21,897	[3]20,832
Ferronickel, Ni content	9,187	[r]9,401	9,579	9,739	9,500
Rare-earth metals: Monazite concentrate gross weight	[r]1,162	[r]1,177	1,246	1,560	1,600
Silver[7] thousand troy ounces	2,275	3,018	3,264	3,550	[3]3,989
Tin:					
Mine output, Sn content	19,957	26,514	26,246	27,364	[3]44,102
Metal, smelter, primary	18,877	24,701	24,427	29,365	[3]41,857
Titanium concentrates, gross weight:					
Ilmenite	40,945	76,354	75,472	111,649	[3]134,580
Rutile	412	713	495	511	[3]1,142
Tungsten, mine output, W content	1,037	1,090	875	672	[3]529

See footnotes at end of table.

TABLE 1—Continued

BRAZIL: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons, unless otherwise specified)

Commodity[2]		1984	1985	1986	1987[p]	1988[e]
METALS—Continued						
Zinc:						
Concentrate and salable ore		573,260	673,166	[e]650,000	[e]675,000	675,000
Mine output, Zn content		113,691	123,811	123,902	133,375	[3]155,531
Metal, smelter:						
Primary		106,927	116,136	130,555	138,652	[3]139,667
Secondary		7,522	4,601	4,741	9,384	[3]7,000
Zirconium: Zircon concentrate, gross weight[8]		6,375	21,039	15,116	18,131	19,000
INDUSTRIAL MINERALS						
Asbestos:						
Crude ore		1,889,326	2,254,922	2,582,500	2,500,000	2,500,000
Fiber		134,788	165,446	204,460	212,807	[3]227,653
Barite:						
Crude		101,301	83,817	101,917	92,924	100,000
Beneficiated		104,920	125,957	102,956	101,465	105,000
Marketable product[4]		143,173	142,575	103,072	110,000	125,000
Calcite		48,915	56,798	41,554	[e]50,000	50,000
Cement, hydraulic	thousand tons	19,741	20,612	25,297	25,470	[3]25,328
Clays:						
Bentonite		201,025	236,021	206,021	194,586	[3]214,767
Kaolin:						
Crude		1,569,063	2,156,787	2,207,600	2,264,000	2,200,000
Beneficiated		486,359	524,182	623,822	680,000	[3]794,500
Marketable product[4]		596,688	655,205	706,017	[e]700,000	800,000
Other:[e]						
Crude	thousand tons	[3]22,477	23,000	25,000	25,000	25,000
Beneficiated	do.	[3]984	1,000	1,000	1,000	1,000
Diamond:[e]						
Gem	thousand carats	200	[3]233	[3]310	320	300
Industrial	do.	550	[3]217	[3]315	325	233
Total[9]	**do.**	**750**	**[3]450**	**[3]625**	**645**	**[3]533**
Diatomite:						
Crude		9,069	24,387	35,000	50,000	50,000
Beneficiated		16,029	17,463	19,601	33,189	30,000
Marketable product[4]		[r]16,109	[r]18,231	20,189	35,000	33,000
Feldspar and related materials:						
Feldspar, marketable product[4]		105,491	110,150	120,572	[e]120,000	120,000
Leucite, marketable product[4]		3,680	2,567	10,207	10,000	10,000
Sodalite, crude, marketable product		1,214	1,077	1,452	1,500	1,500
Total		**110,385**	**113,794**	**132,231**	**131,500**	**131,500**

See footnotes at end of table.

TABLE 1—Continued

BRAZIL: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons, unless otherwise specified)

Commodity[2]		1984	1985	1986	1987[p]	1988[e]
INDUSTRIAL MINERALS—Continued						
Fluorspar:						
Crude		368,130	276,623	234,944	[e]250,000	250,000
Concentrates, marketable product:						
Acid-grade		44,341	42,681	53,560	58,736	[3]54,050
Metallurgical-grade		31,369	29,714	31,015	31,212	[3]35,310
Total		**75,710**	**72,395**	**84,575**	**89,948**	**[3]89,360**
Graphite:						
Crude		290,007	191,823	462,815	[e]450,000	450,000
Marketable product:						
Direct-shipping crude ore		2,633	16,425	19,074	[e]20,000	20,000
Concentrate		30,047	27,239	28,586	[e]31,000	[3]32,000
Total		**32,680**	**43,664**	**47,660**	**[e]51,000**	**52,000**
Gypsum and anhydrite, crude		493,732	560,077	706,463	823,978	[3]788,773
Kyanite:						
Crude		1,587	2,800	1,489	[e]1,500	1,500
Marketable product[4]		1,290	2,350	950	[e]1,000	1,000
Lime, hydrated and quicklime	thousand tons	4,584	4,767	4,909	5,300	[3]5,500
Lithium mineral concentrates:						
Amblygonite		[r]49	32	49	50	50
Lepidolite		[r]8	[r]26	30	30	35
Petalite		[r]477	[r]1,323	1,614	1,600	1,700
Spodumene		[r]288	[r]107	366	300	400
Total		**[r]822**	**[r]1,488**	**2,059**	**1,980**	**2,185**
Magnesite:						
Crude		724,280	623,330	648,752	778,502	[3]810,837
Beneficiated		321,643	260,754	296,792	383,378	[3]404,126
Mica, all grades[10]		4,007	2,881	2,185	[e]2,500	[3]2,520
Nitrogen: N content of ammonia		[r]963,000	[r]1,042,000	972,000	1,049,000	[3]1,031,000
Phosphate rock including apatite:						
Crude:						
Mine product	thousand tons	22,704	23,698	[e]27,000	[e]27,000	27,000
Of which, sold directly	do.	29	23	[e]35	[e]35	35
Concentrate:						
Gross weight	do.	3,855	4,148	4,509	4,777	[3]4,672
P_2O_5 content	do.	1,345	1,496	1,620	1,694	[3]1,663
Pigments, mineral: Other, crude		5,450	6,320	5,474	[e]6,000	6,000
Potash: Marketable product (K_2O)		—	—	17,542	37,111	[3]55,732

See footnotes at end of table.

TABLE 1—Continued

BRAZIL: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons, unless otherwise specified)

Commodity[2]		1984	1985	1986	1987[p]	1988[e]
INDUSTRIAL MINERALS—Continued						
Precious and semiprecious stones except diamond, crude and worked:[10]						
Agate	kilograms	1,671,287	2,067,267	[e]1,850,000	[e]2,000,000	2,000,000
Amethyst	do.	336,341	472,652	[e]360,000	[e]400,000	400,000
Aquamarine	do.	10,238	17,012	[e]17,000	[e]17,000	17,000
Cat's-eye	do.	220	—	—	—	—
Citrine	do.	30,244	63,077	[e]38,000	[e]45,000	45,000
Emerald	do.	6,259	5,133	[e]8,000	[e]8,000	8,000
Garnet	do.	313	—	—	—	—
Opal	do.	679	334	[e]650	[e]650	650
Ruby	value	$17,455	$29,440	$987	[e]$10,000	$10,000
Sapphire	do.	$14,613	$31,767	$2,474	[e]$15,000	$15,000
Topaz	kilograms	440	6,567	[e]3,000	[e]3,000	3,000
Tourmaline	do.	5,577	12,659	[e]9,000	[e]9,000	9,000
Other[e]	kilograms	[3]544,593	600,000	650,000	650,000	650,000
Quartz crystal, all grades		4,727	7,456	4,214	3,371	4,000
Salt:						
Marine	thousand tons	3,578	1,734	1,600	3,600	[3]3,020
Rock	do.	950	995	600	950	[3]1,336
Silica (silex)		1,479	2,024	3,576	3,500	3,500
Sodium compounds:						
Caustic soda[e]		[3]950,000	950,000	975,000	975,000	975,000
Soda ash, manufactured (barilla)		215,000	179,000	[e]225,000	[e]225,000	225,000
Stone, sand and gravel:						
Dimension stone:						
Marble, rough-cut	cubic meters	174,531	232,797	103,966	[e]200,000	200,000
Slate		60,801	45,779	119,297	115,000	115,000
Crushed and broken stone:						
Basalt	cubic meters	484,302	491,000	669,150	650,000	650,000
Calcareous shells		994,545	883,282	[e]1,000,000	[e]1,000,000	1,000,000
Dolomite	thousand tons	1,917	2,208	[e]2,000	[e]2,000	2,000
Gneiss	cubic meters	376,001	363,421	523,232	500,000	500,000
Granite	thousand cubic meters	38,815	38,817	48,091	50,000	50,000
Limestone	thousand tons	45,757	36,329	[e]40,000	[e]40,000	50,000
Quartz[11]		109,964	113,282	147,023	150,000	150,000
Quartzite:						
Crude		235,314	268,560	333,124	350,000	350,000
Processed		100,825	169,120	172,776	175,000	175,000
Sand[e]	thousand cubic meters	[3]24,957	30,000	30,000	30,000	30,000

See footnotes at end of table.

TABLE 1—Continued

BRAZIL: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons, unless otherwise specified)

Commodity[2]		1984	1985	1986	1987[p]	1988[e]
INDUSTRIAL MINERALS—Continued						
Sulfur:						
Frasch		3,596	4,277	5,642	5,742	6,000
Pyrites		88,983	91,080	91,596	76,704	105,000
Byproduct:						
Metallurgy		52,403	79,002	100,033	153,038	160,000
Petroleum		71,287	54,591	73,572	77,322	80,000
Total		**216,269**	**228,950**	**270,843**	**312,806**	**351,000**
Talc and related materials:						
Talc, marketable product[4]		348,915	343,647	336,706	[e]375,000	375,000
Pyrophyllite, marketable product[4]		64,432	43,401	41,351	45,000	45,000
Other: Algalmatolite, marketable product		86,268	102,461	124,989	120,000	120,000
Vermiculite:						
Crude		49,890	41,455	84,139	85,000	85,000
Marketable product[4]		9,157	9,291	14,150	[e]15,000	15,000
MINERAL FUELS AND RELATED MATERIALS						
Coal, bituminous, marketable[4]	thousand tons	7,752	[r]7,649	7,441	6,057	[3]6,985
Coke, metallurgical, all types	do.	1,315	1,396	1,416	1,053	[3]951
Gas, natural: Gross	million cubic feet	173,119	193,008	199,841	209,695	[3]206,378
Natural gas liquids	thousand 42-gallon barrels	5,475	6,500	4,586	9,529	9,400
Petroleum:						
Crude	do.	168,788	205,500	217,175	215,419	[3]210,605
Refinery products:						
Gasoline	do.	69,999	107,675	77,015	[e]79,000	75,000
Jet fuel	do.	18,000	21,900	20,075	[e]21,000	20,000
Kerosene	do.	5,000	2,555	2,555	[e]5,800	5,000
Distillate fuel oil	do.	126,784	128,845	142,715	[e]148,000	140,000
Residual fuel oil	do.	90,000	78,110	90,520	[e]106,000	100,000
Lubricants	do.	5,500	4,745	4,745	[e]6,500	4,500
Other	do.	NA	88,330	118,990	[e]74,000	70,000
Refinery fuel and losses	do.	NA	17,155	18,980	[e]12,700	15,000
Total	**do.**	**NA**	**449,315**	**475,595**	**453,000**	**429,500**

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

[1]Table includes data available through Oct. 2, 1989.

[2]In addition to the commodities listed, bismuth, molybdenite, and uranium oxide are produced, but output is not reported and available information is inadequate to make reliable estimates of output levels.

[3]Reported figure.

[4]Direct sales and beneficiated.

[5]Officially reported figures are as follows, in troy ounces: Major mines: 1984-213,963; 1985-244,249; 1986-300,545; 1987-421,000; and 1988-712,460. Small mines (garimpos): 1984-982,623; 1985-698,475; 1986-1,000,000 (estimated); 1987-1,100,000 (estimated); and 1988-1,101,485.

[6]Includes sponge iron as follows, in thousand metric tons: 1984-246; 1985-285; 1986-295; 1987-202; and 1988-195.

[7]Officially reported output; of total production, the following quantities are identified as placer silver (the balance being silver content of other ores and concentrates), in thousand troy ounces: 1984-250 (estimated); 1985-434 (estimated); 1986-640 (estimated); 1987-650 (estimated); and 1988-650 (estimated).

[8]Includes baddeleyite-caldasite.

[9]Figures represent officially reported output plus official Brazilian estimates of output by nonreporting miners.

[10]Exports.

[11]Apparently includes crude quartz used to produce quartz crystal (listed separately in this table) as well as additional quantities of common quartz.

TABLE 2

BRAZIL: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
METALS				
Aluminum:				
Ore and concentrate thousand tons	[r]3,061	2,814	NA	NA.
Oxides and hydroxides	41,994	NA		
Metal including alloys, all forms	[r]368,850	468,514	72,339	Japan 193,034; Netherlands 111,673.
Beryllium: Ore and concentrate	[r]812	693	NA	NA.
Chromium:				
Ore and concentrate	—	8	NA	NA.
Oxides and hydroxides	52	NA		
Metal including alloys, all forms	[r]3	—		
Cobalt: Metal including alloys, all forms	[r]6	50	NA	NA.
Columbium and tantalum:				
Ore and concentrate	[r]273	187	NA	NA.
Metal including alloys, all forms:				
Columbium (niobium), Nb content	6	13	NA	NA.
Copper:				
Matte and speiss including cement copper	391	NA		
Metal including alloys, all forms	[r]21,775	14,426	7,282	Canada 1,432; Singapore 780.
Iron and steel:				
Iron ore and concentrate: Including roasted pyrite thousand tons	92,846	94,837	NA	NA.
Metal:				
Pig iron, cast iron, related materials do.	2,402	2,045	119	Taiwan 449; China 428; Republic of Korea 320.
Ferroalloys:				
Ferrochromium	20,121	14,980	4,500	Japan 7,500; Netherlands 2,000.
Ferrocolumbium	12,332	11,069	2,835	Netherlands 2,648; Japan 1,849.
Ferromanganese	45,508	50,049	NA	NA.
Ferromolybdenum value, thousands	$2	—		
Ferronickel	4,693	2,208	—	All to West Germany.
Ferrosilicomanganese	70,299	55,208	NA	NA.
Ferrosilicon	[r]129,264	176,349	55,734	Japan 90,310; Netherlands 11,774.
Ferrovanadium	42	98	—	Netherlands 65; Japan 33.
Silicon metal	[r]26,222	30,267	3,973	Japan 17,166; Netherlands 3,666.
Unspecified	10,139	150	—	Japan 90; Netherlands 60.
Steel, primary forms thousand tons	6,139	6,546	1,302	Japan 678; Turkey 546.
Lead: Metal including alloys:				
Unwrought	592	—		
Semimanufactures	12	2	—	Mainly to Uruguay.
All forms	6	—		

See footnotes at end of table.

TABLE 2—Continued

BRAZIL: EXPORTS OF MINERAL COMMODITIES [1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
METALS—Continued				
Lithium: Ore and concentrate	109	NA		
Magnesium: Metal including alloys, all forms	—	72	NA	NA.
Manganese:				
Ore and concentrate: Metallurgical-grade	[r]759,875	579,408	NA	NA.
Oxides	2,872	2,400	NA	NA.
Metal including alloys, all forms	[r]20	35	NA	NA.
Molybdenum: Metal including alloys, semimanufactures value, thousands	$3	—		
Nickel:				
Oxides and hydroxides	4	NA		
Metal including alloys, all forms	[r]1,198	578	—	West Germany 502; Argentina 33; Paraguay 26.
Platinum-group metals: Metals including alloys, unwrought and partly wrought:				
Platinum troy ounces	547	—		
Silver: Metal including alloys, unwrought and partly wrought do.	5,466	NA		
Tin:				
Oxides	1	NA		
Metal including alloys, all forms	[r]19,163	21,038	11,442	Netherlands 5,508; Bulgaria 2,720.
Titanium: Ore and concentrate	5,474	6,600	NA	NA.
Tungsten: Ore and concentrate	137	—		
Vanadium: Metal including alloys, scrap	15	—		
Zinc:				
Oxides	11	NA		
Metal including alloys, all forms	[r]123	187	51	West Germany 56; Bolivia 39.
Zirconium: Ore and concentrate	[r]5	6	NA	NA.
Other:				
Oxides and hydroxides	733	NA		
Ashes and residues	40,631	NA		
Base metals including alloys, all forms	11	NA		
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	5	NA		
Artificial:				
Corundum	35,339	NA		
Silicon carbide	[r]6,217	10,356	NA	NA.
Grinding and polishing wheels and stones	1,097	NA		
Asbestos, crude	[r]29,688	32,953	NA	NA.
Barite and witherite	6,000	125	—	Mainly to Paraguay.
Boron materials: Oxides and acids	4	NA		

See footnotes at end of table.

TABLE 2—Continued

BRAZIL: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
INDUSTRIAL MINERALS—Continued					
Cement		80,122	67,359	NA	NA.
Clays, crude:					
Fuller's earth		10	NA		
Kaolin		213,697	216,880	NA	NA.
Unspecified		2,337	NA		
Diamond:					
Gem, not set or strung	carats	220,000	NA		
Industrial stones	do.	310,000	NA		
Dust and powder	kilograms	11	NA		
Diatomite and other infusorial earth		16	—		
Feldspar		10	2,500	—	All to France.
Fertilizer materials:					
Crude, n.e.s.		3	NA		
Manufactured:					
Ammonia		183	NA		
Nitrogenous		10,756	NA		
Phosphatic		4,357	NA		
Potassic		4,163	NA		
Unspecified and mixed		22,983	NA		
Fluorspar		5	35	—	Paraguay 28; Venezuela 5; Bolivia 1.
Graphite, natural		9,416	10,500	NA	NA.
Gypsum and plaster		57	6	(2)	Colombia 3; Suriname 2.
Kyanite and related materials, unspecified		135	NA		
Lime		2,389	NA		
Magnesium compounds:					
Magnesite, crude		20	94	NA	NA.
Other		76,774	73,399	NA	NA.
Mica:					
Crude including splittings and waste		1,662	1,500	NA	NA.
Worked including agglomerated splittings	value	$3,800	NA		
Pigments, mineral: Iron oxides and hydroxides, processed		1,348	NA		
Precious and semiprecious stones other than diamond:					
Natural	thousand kilograms	5,554	NA		
Synthetic	kilograms	1,500	NA		
Quartz crystal, piezoelectric		6	2	NA	NA.
Salt and brine	thousand tons	38	29	—	Nigeria 23; Iraq 4.
Sodium compounds, n.e.s.: Carbonate, manufactured		1,344	NA		

See footnotes at end of table.

TABLE 2—Continued

BRAZIL: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Destinations, 1987	
				United States	Other (principal)
INDUSTRIAL MINERALS—Continued					
Stone, sand and gravel:					
Dimension stone:					
Crude and partly worked		199,184	NA		
Worked		35,086	NA		
Dolomite, chiefly refractory-grade		607	NA		
Gravel and crushed rock		3,054	NA		
Limestone other than dimension		1,763	NA		
Quartz and quartzite		6,241	3,378	NA	NA.
Sand other than metal-bearing		2,385	1,441	NA	NA.
Sulfur:					
Elemental, all forms		8	NA		
Sulfuric acid		102	NA		
Talc, steatite, soapstone, pyrophyllite		2,216	3,362	NA	NA.
Vermiculite		138	1,605	NA	NA.
Other:					
Crude		149	NA		
Slag and dross, not metal-bearing		98,913	NA		
MINERAL FUELS AND RELATED MATERIALS					
Carbon black		315	NA		
Coal: All grades excluding briquets		111,136	600	NA	NA.
Coke and semicoke		90	NA		
Petroleum refinery products:					
Liquefied petroleum gas	thousand 42-gallon barrels	173	NA		
Gasoline	do.	21,131	NA		
Mineral jelly and wax	do.	288	NA		
Kerosene and jet fuel	do.	3,082	NA		
Distillate fuel oil	do.	3,434	NA		
Lubricants	do.	447	NA		
Nonlubricating oils	do.	([2])	NA		
Residual fuel oil	do.	8,792	NA		
Bitumen and other residues	do.	29	NA		
Bituminous mixtures	do.	23	NA		
Petroleum coke	do.	([2])	NA		
Unspecified	do.	104	NA		

[r] Revised. NA Not available.
[1] Table prepared by H. D. Willis.
[2] Less than 1/2 unit.

TABLE 3

BRAZIL: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987	
			United States	Other (principal)
METALS				
Alkali and rare-earth metals	205	154	17	United Kingdom 92; France 34.
Aluminum:				
Ore and concentrate	1,022	2,998	18	Poland 1,943; Guyana 1,001; United Kingdom 30.
Oxides and hydroxides	285,471	393,438	89,112	Suriname 162,913; Venezuela 66,066.
Metal including alloys:				
Scrap	3,119	4,931	4,855	Panama 41; United Kingdom 35.
Unwrought	1,414	2,310	43	West Germany 766; Argentina 719; Netherlands 360.
Semimanufactures	1,394	4,691	1,013	West Germany 1,573; Italy 661.
Antimony:				
Ore and concentrate	815	NA		
Oxides	30	NA		
Metal including alloys, all forms	853	NA		
Arsenic: Metal including alloys, all forms	2	NA		
Bismuth:				
Oxides and hydroxides	4	NA		
Metal including alloys, all forms	67	NA		
Cadmium:				
Oxides and hydroxides	120	NA		
Metal including alloys, all forms	3	NA		
Chromium:				
Ore and concentrate	10,757	14,381	—	Philippines 9,953; Republic of South Africa 4,428.
Oxides and hydroxides	73	81	([2])	Netherlands 54; West Germany 25; Japan 1.
Metal including alloys, all forms	15	NA		
Cobalt:				
Ore and concentrate	3	NA		
Oxides and hydroxides	15	26	11	Belgium-Luxembourg 12; Netherlands 3.
Metal including alloys, all forms	584	NA		
Columbium and tantalum: Metal including alloys, all forms: Tantalum value, thousands	$47	$42	$38	Switzerland $3; Austria $1.
Copper:				
Ore and concentrate	261,304	340,529	—	Chile 237,452; Peru 62,682; Canada 10,497.
Oxides and hydroxides	163	NA		
Metal including alloys:				
Scrap	8,884	19,348	12,456	Chile 3,742; Netherlands 1,232.
Unwrought	111,148	125,412	495	Chile 109,627; Peru 10,475; Zaire 3,552.
Semimanufactures	2,165	3,265	862	West Germany 1,156; United Kingdom 387.
Gold: Metal including alloys, unwrought and partly wrought thousand troy ounces	444	NA		
Iron and steel:				
Iron ore and concentrate excluding roasted pyrite	13	10	6	Japan 4.

See footnotes at end of table.

TABLE 3—Continued

BRAZIL: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS—Continued				
Iron and steel—Continued				
Metal:				
Scrap	490,601	145,922	47,913	Netherlands 67,974; U.S.S.R. 30,034.
Pig iron, cast iron, related materials	2,322	2,022	1,730	Argentina 100; West Germany 75.
Ferroalloys:				
Ferrochromium	749	NA		
Ferromanganese	37	9	([2])	Mainly from Canada.
Ferrosilicochromium	91	NA		
Ferrosilicon	153	NA		
Unspecified	87	1,632	269	Republic of South Africa 1,084; Italy 182.
Steel, primary forms	464,528	422,328	30,833	Netherlands 142,754; Belgium-Luxembourg 117,124; West Germany 57,923.
Semimanufactures:				
Bars, rods, angles, shapes, sections	7,683	11,252	402	United Kingdom 5,455; Japan 2,086; Canada 1,975.
Universals, plates, sheets	61,945	51,423	468	Japan 11,606; Italy 9,806; France 8,471.
Hoop and strip	5,967	6,476	1,149	West Germany 2,740; United Kingdom 967.
Rails and accessories	12,199	21,221	3,306	Japan 11,750; Romania 5,772.
Wire	2,234	3,211	240	Uruguay 794; Japan 792; Belgium-Luxembourg 531.
Tubes, pipes, fittings	10,961	9,620	342	West Germany 3,809; Japan 1,806; France 1,148.
Castings and forgings, rough	257	152	15	Italy 76; Czechoslovakia 32.
Lead:				
Ore and concentrate	30,120	38,095	—	Peru 24,949; Canada 5,040; Ireland 2,556.
Oxides	651	900	5	Mexico 761; Peru 133.
Metal including alloys:				
Scrap	16,308	25,192	13,964	Canada 11,228.
Unwrought	3,410	15,745	45	Mexico 12,396; Peru 2,407; West Germany 746.
Semimanufactures	3	9	1	West Germany 8.
Lithium: Oxides and hydroxides	388	NA		
Magnesium: Metal including alloys:				
Scrap	—	164	65	Republic of South Africa 88; Canada 11.
Unwrought	3,368	2,705	694	Norway 1,997; West Germany 14.
Semimanufactures	2	9	3	West Germany 6.
Manganese:				
Ore and concentrate, metallurgical-grade	2,106	NA		
Oxides	3	107	55	Japan 40; Belgium-Luxembourg 11.
Metal including alloys, all forms	1,249	NA		
Mercury 76-pound flasks	6,440	7,861	754	Netherlands 2,205; Mexico 2,089; West Germany 1,944.
Molybdenum:				
Ore and concentrate	2,493	NA		
Oxides and hydroxides	484	NA		

See footnotes at end of table.

TABLE 3—Continued

BRAZIL: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS—Continued				
Molybdenum—Continued				
Metal including alloys:				
Scrap	1	NA		
Unwrought	6	NA		
Semimanufactures	65	NA		
All forms	—	60	41	West Germany 9; Netherlands 5.
Nickel:				
Matte and speiss	3	16	1	Canada 5; Republic of South Africa 5; West Germany 3.
Metal including alloys:				
Unwrought	1,912	1,700	148	Netherlands 708; Norway 520; Canada 224.
Semimanufactures	109	114	59	West Germany 37; United Kingdom 5.
Platinum-group metals: Metals including alloys, unwrought and partly wrought troy ounces	24,113	NA		
Selenium, elemental	38	NA		
Silver:				
Ore and concentrate	6	NA		
Metal including alloys, unwrought and partly wrought thousand troy ounces	5,466	NA		
Tellurium, elemental	6	NA		
Tin: Metal including alloys:				
Unwrought	24	(2)	(2)	
Semimanufactures	6	5	(2)	Mainly from West Germany.
Titanium:				
Oxides	3,074	2,300	134	West Germany 1,237; United Kingdom 440; France 207.
Metal including alloys:				
Scrap	139	NA		
Unwrought	17	NA		
Semimanufactures	56	NA		
Tungsten:				
Ore and concentrate	2,494	3,224	72	Chile 3,004; Bolivia 130.
Metal including alloys:				
Unwrought	24	NA		
Semimanufactures	39	NA		
All forms	—	59	19	West Germany 26; United Kingdom 6.
Zinc:				
Ore and concentrate	76,853	95,246	—	Peru 75,504; Argentina 7,187; Iran 5,597.
Oxides	743	3,551	49	France 1,550; Peru 888; Uruguay 802.
Blue powder	158	140	130	West Germany 10.
Metal including alloys:				
Unwrought	23,153	49,043	—	Mexico 17,641; Peru 10,296; Australia 8,407.
Semimanufactures	46	319	—	West Germany 163; Peru 150; Japan 5.

See footnotes at end of table.

TABLE 3—Continued

BRAZIL: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS—Continued				
Zirconium: Ore and concentrate	12,697	NA		
Other:				
Ores and concentrates	15,118	20,966	—	West Germany 10,105; Republic of South Africa 6,390; Australia 3,644.
Oxides and hydroxides	321	327	—	West Germany 251; Italy 74; Japan 2.
Ashes and residues	18,527	11,561	3,047	Canada 7,864; Uruguay 650.
Base metals including alloys, all forms	177	3,829	717	Republic of South Africa 924; Bolivia 448.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	518	630	140	Italy 451; West Germany 38.
Artificial:				
Corundum	275	311	77	Japan 121; Austria 88.
Silicon carbide	948	1,022	2	Argentina 595; Norway 256; West Germany 156.
Dust and powder of precious and semiprecious stones value, thousands	$4,906	$5,038	$3,974	Ireland $617; West Germany $335.
Grinding and polishing wheels and stones	207	NA		
Asbestos, crude	3,658	4,134	89	Canada 3,112; Republic of South Africa 708; Greece 175.
Barite and witherite	33	20	—	All from West Germany.
Boron materials:				
Crude natural borates	20,731	32,909	—	Argentina 16,612; Peru 12,063; Chile 4,234.
Oxides and acids	6,085	5,567	57	Argentina 5,339; France 96.
Bromine	13	NA		
Cement	5,832	21,980	129	Argentina 12,009; Uruguay 7,690; Netherlands 1,212.
Chalk	30	180	—	Switzerland 120; France 60.
Clays, crude	23,378	15,813	6,970	Argentina 7,570; France 1,018.
Cryolite and chiolite	2	2	—	All from Switzerland.
Diamond:				
Gem, not set or strung value, thousands	$524	$34	—	All from Israel.
Industrial stones do.	$725	$546	$377	West Germany $121; United Kingdom $24.
Diatomite and other infusorial earth	1,309	1,750	623	Mexico 975; West Germany 152.
Feldspar, fluorspar, related materials	1	14,592	([2])	Mexico 14,591; Switzerland 1.
Fertilizer materials:				
Crude, n.e.s.	23	19	8	Japan 11.
Manufactured:				
Ammonia	51,545	35,346	1	Trinidad and Tobago 35,345.
Nitrogenous	1,073,095	814,433	439,642	West Germany 151,487; Netherlands 123,602.
Phosphatic	201,372	259,194	199,457	Uruguay 45,737; Morocco 14,000.
Potassic	2,277,351	2,449,753	302,971	East Germany 729,832; Canada 692,085.
Unspecified and mixed	201,086	278,817	152,160	Chile 88,926; Uruguay 33,761.

See footnotes at end of table.

TABLE 3—Continued

BRAZIL: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
INDUSTRIAL MINERALS—Continued					
Graphite, natural		19	22	—	Madagascar 18; West Germany 4.
Gypsum and plaster		2	2	2	
Iodine		253	NA		
Lime		70	27	—	Belgium-Luxembourg 25; Panama 2.
Magnesium compounds:					
Magnesite, crude		1	745	443	West Germany 259; Japan 21.
Oxides and hydroxides		160	NA		
Other		1,214	NA		
Mica:					
Crude including splittings and waste		25	43	([2])	India 23; Netherlands 20.
Worked including agglomerated splittings		53	NA		
Nitrates, crude		12,251	12,753	—	All from Chile.
Phosphates, crude		119,240	152,675	62,060	Morocco 59,884; Israel 30,731.
Phosphorous, elemental		7,718	NA		
Pigments, mineral: Iron oxides and hydroxides, processed		1,104	989	137	West Germany 803; Italy 34.
Precious and semiprecious stones other than diamond:					
Natural	value, thousands	$70	$5	$5	
Synthetic	do.	$1	$12	—	West Germany $6; Switzerland $6.
Pyrite, unroasted		111	128	11	West Germany 117.
Salt and brine		783,352	1,231,509	—	Chile 307,224; Mexico 237,800; Colombia 227,775.
Sodium compounds, n.e.s.:					
Carbonate, manufactured		155,933	302,293	177,252	West Germany 125,041.
Sulfate, manufactured		60,718	62,700	1,008	Mexico 32,567; Chile 21,974; West Germany 3,144.
Stone, sand and gravel:					
Dimension stone:					
Crude and partly worked		19	36	—	All from Italy.
Worked		6	3	([2])	West Germany 2; Hong Kong 1.
Dolomite, chiefly refractory-grade		413	212	([2])	Italy 210; United Kingdom 2.
Gravel and crushed rock		60	200	—	All from France.
Quartz and quartzite		13	13	11	West Germany 1; Netherlands 1.
Sand other than metal-bearing		8	12	12	
Sulfur:					
Elemental:					
Crude including native and byproduct	thousand tons	1,155	1,190	229	Canada 556; Poland 401.
Colloidal, precipitated, sublimed		791	748	732	West Germany 14; Japan 1.
Sulfuric acid		203,172	43,753	17	Spain 40,335; Uruguay 3,400.
Talc, steatite, soapstone, pyrophyllite		15	69	66	Sweden 3.

See footnotes at end of table.

TABLE 3—Continued

BRAZIL: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987	
				United States	Other (principal)
INDUSTRIAL MINERALS—Continued					
Other:					
Crude		9,837	11,666	615	Argentina 11,032; Spain 10.
Slag and dross, not metal-bearing		26,636	18,311	—	Republic of South Africa 17,907; West Germany 400; Netherlands 4.
MINERAL FUELS AND RELATED MATERIALS					
Asphalt and bitumen, natural		173	332	180	Argentina 152.
Carbon black		2,787	2,624	1,246	West Germany 735; East Germany 413.
Coal: All grades excluding briquets	thousand tons	8,946	10,591	5,174	Poland 2,129; Australia 1,626.
Coke and semicoke		77,300	765,818	31,142	Japan 647,163; Australia 54,669.
Petroleum:					
Crude	thousand 42-gallon barrels	219,769	228,465	—	Iraq 83,384; Saudi Arabia 50,147; Iran 19,658.
Refinery products:					
Liquefied petroleum gas	do.	7,519	8,084	1,220	Saudi Arabia 2,467; Algeria 2,100; Angola 1,628.
Gasoline	do.	1,017	120	74	Netherlands Antilles 31; Netherlands 12.
Mineral jelly and wax	do.	(2)	1	(2)	Mainly from Republic of South Africa.
Kerosene and jet fuel	do.	543	35	—	All from Netherlands Antilles.
Distillate fuel oil	do.	4,953	4,402	110	Venezuela 2,452; Netherlands Antilles 1,315; Italy 215.
Lubricants	do.	157	511	60	Netherlands Antilles 167; Spain 115; Venezuela 112.
Nonlubricating oils	do.	66	59	29	Romania 30.
Residual fuel oil	do.	1,486	5,995	—	Venezuela 3,639; Netherlands Antilles 1,660; Spain 696.
Bitumen and other residues	do.	(2)	—		
Bituminous mixtures	do.	—	(2)	(2)	Mainly from Uruguay.
Petroleum coke	do.	1,091	680	296	Argentina 317; Netherlands 67.

NA Not available.
[1] Table prepared by H. D. Willis.
[2] Less than 1/2 unit.

THE MINERAL INDUSTRIES OF

BOLIVIA, ECUADOR, AND PERU

By Ivette E. Torres, Alfredo C. Gurmendi, and Pablo Velasco

INTRODUCTION[1]

All three countries in this Andean group have diversified mineral industries that play an important role in their respective domestic economies. Peru, as the largest country with a population of over 21 million, is the most diversified mineral producer with the highest value of total output. The values added by the mineral industries in 1988 were $2.78 billion for Peru, $1.98 billion for Ecuador, and $0.64 billion for Bolivia. Each value encompasses production of petroleum, natural gas, metals, and industrial minerals. During the period 1980–88, Ecuador's mineral output in terms of value expanded while that of Bolivia and Peru contracted.

The importance of the mineral industries in each country's economy is most evident in the export sector. In Bolivia, exports of all mineral commodities (oil, gas, metals, and industrial minerals) accounted for 82% of total exports; in Ecuador for 41%; and in Peru for 51% of the total. The percentages indicate the status of trade diversification in each country and the dependency on mineral exports as earners of foreign exchange to meet the burdensome foreign debt.

Crude oil and natural gas are produced in each country of the group, and Ecuador is the leading producer. Ecuador also has the largest proven reserves of oil in this group and was the only supplier of small amounts of crude oil and petroleum products to the U.S. market. Ecuador was the only country in which petroleum exports dominated the mineral sector. In Bolivia and Peru, nonfuel mineral exports were relatively more important—headed by copper, lead, and zinc exports in Peru and tin and zinc exports in Bolivia. Bolivia's main hydrocarbon export was natural gas to Argentina. Because of decreasing oil output, Peru was a net importer of petroleum in 1988 for the first time in recent years. Only Peru produced very small quantities of coal.

In terms of the world mineral economy, Peru is significant for its output of copper, lead, silver, tellurium, and zinc, and Bolivia for antimony, tungsten, and tin. Within Latin America, Peru ranks with Mexico as major world producers of silver. The level of oil output by the group is modest by world standards. All three countries produced modest amounts of gold.

Bolivia and Ecuador were involved with efforts to restructure their mining industries, including revision of the respective mining codes. In the near term, Bolivia evidenced the best prospects for expanded local and foreign investments in the mining sector because of political stability, improved investment climate, and access to mineral potential surveys in process or being planned.

Bolivia, Ecuador, and Peru were signatories of the Cartagena Agreement that became effective in 1969 forming a part of the "Grupo Andino" within the Latin American Integration Association (LAIA). The Latin American Energy Association (OLADE) is headquartered in Quito, Ecuador. Within Latin America, Ecuador is listed with Venezuela as members of the Organization of Oil Exporting Countries (OPEC). Peru is a member of the Intergovernmental Council of Copper Exporting Countries (CIPEC).

BOLIVIA[2]

Introduction

In 1988, Bolivia's nonfuel mineral production continued to be one of the most important sources of foreign exchange. The mining industry began to recover slightly after several years of reduced world prices and output and the collapse of the International Tin Council in 1985. The value of nonfuel minerals exports increased 32% from that of 1987, surpassing hydrocarbons for the first time since 1982 as Bolivia's leading foreign exchange earner. Tin, traditionally the country's most important mineral commodity, continued to be the focus of the industry. Low but stable world tin prices, improved economic conditions, and increased mineral production were responsible for the recovery of the tin sector.[3]

Mineral production continued to be shared between the Government and private industry. However, the mineral industry was in transition after a couple of years of Government restructuring and closeouts. The Government mining corporation, Corporación Minera de Bolivia (COMIBOL), formerly the largest mineral producer in the country, continued to evaluate and rehabilitate a large portion of its properties. Because of Supreme Decree 21377 of 1986, which decentralized COMIBOL in an effort to increase efficiency, production from this sector, the large-sized mining sector, continued to be very small in comparison with past production.

In contrast, production from the private mining sector composed of medium-sized mines and small-sized mines and cooperatives remained at traditional levels. As a result of the reduced COMIBOL output, the private sector increased in relative importance in terms of output distribution and general contribution to the economy.

Bolivia's economy improved for the second consecutive year after 5 years of deterioration. The gross domestic product (GDP) increased 2.8% in real terms from that of 1987. The largest growth in the economy was registered by the mining industry. Also, significant growth was experienced by the hydrocarbons, manufacturing, and construction sectors. The rate of inflation was about 22%. This rate was twice the planned level, but it was low compared with that of most of the neighboring countries. Because of recent changes in Government policies, economic stability after years of hyperinflation, and efforts to restructure and rehabilitate the mining industry, interest in Bolivia from foreign investors was increasing.[4]

Exports of nonfuel minerals and natural gas continued to generate a large percentage of the country's foreign exchange, together contributing to 82% of the cost, insurance, and freight value of exports. Although Bolivia achieved a trade surplus of $5.5 million,[5] it continued to be affected by a low level of investment, a high external debt, and health and education problems.

Government Policies and Programs

In an effort to increase investment in the mineral sector, the Government continued to release state-controlled areas with mineral potential for exploration by private domestic and foreign firms. Late in the year, the Government released a 43,290-square-kilometer zone in the northern part of the country, in the Provinces of Federico Román and Vaca Diez, Pando and Beni Departments, respectively. With this release, the Government has relinquished control of about 90% of its State land reserves. Other significant actions to increase exploration included the effort to liberalize the Mining Code, which was still under consideration by Congress at yearend, and to change the tax structure.

On September 14, the mining taxes established on August 29, 1985, were revised by the Permanent Committee of Actualization of Mining Royalties. The new royalty schedule is as follows:

Commodity	Quantity (metric tons)	Category A[1] (dollars)	Category B[2] (dollars)
Antimony[3]	20.0	$18.87	$19.98
Bismuth[4]	3.0	2.77	2.94
Copper[4]	10.0	.66	.71
Lead[4]	25.0	.06	.07
Silver[5]	.2	3.88	4.10
Tin[4]	4.0	2.44	2.58
Tungsten[3 6]	15.0	88.00	94.00
Zinc[4]	15.0	.088	.094

[1] For producers with production of more than the indicated tonnage.
[2] For producers with production of less than the indicated tonnage.
[3] Per long ton unit.
[4] Per metric ton of metallic fine content.
[5] Per troy ounce.
[6] WO_3 content.
Source: Gaceta Oficial, Sept. 1988.

The estimated marketing cost, expressed as a percentage of the official market price, remained unchanged in 1988. This artificial freeze of that element of the estimated cost resulted in a cost break to the mining industry.

The Minister of Mining and Metallurgy announced that a $29.5 million[6] loan for improvements in the mining industry was received from the Government of the Federal Republic of Germany. Portions of the loan were for the reconstruction of the Bolívar tin-zinc-silver mine in Oruro Department, fuel conversion for the COMIBOL Vinto smelter near Oruro, assistance to cooperatives in Potosí, and maintenance of the Karachipampa smelter unit.

Bolivia also received a $114 million loan for the mining sector from the International Bank for Reconstruction and Development (World Bank). Most of the World Bank loan was allocated for COMIBOL, the private mining sector, and the Servicio Geológico de Bolivia.

Production

Bolivia's production of most nonfuel minerals increased from that of 1987. Mine output of tin, Bolivia's most important nonfuel mineral, increased by 30% to more than 10,500 tons but remained far below historic levels. Tin smelter production also increased sharply, but it too was below past levels. Production of zinc, the second most important nonfuel mineral in terms of export value, increased 31% to almost 57,000 tons. Production of gold and silver, also very significant nonfuel mineral commodities, increased 77% and 63%, respectively. Other nonfuel mineral commodities that registered output increases include bismuth, cadmium, cement, iron ore, and tungsten. However, production of antimony and sulfur decreased.

Employment by the mining sector was about 3% of Bolivia's workforce in 1988. COMIBOL continued to operate as a holding company with five autonomous subsidiary mining companies and two autonomous subsidiary smelting companies. Some of the mine properties controlled by COMIBOL have been leased to mining cooperatives.

The private mining sector in Bolivia consists of medium-sized mines and small-sized mines and cooperatives. In 1988, the Asociación Nacional de Mineros Medianos continued to be the representative body of 18 medium-sized mining companies. Estalsa Boliviana S.A. left the association after its alluvial tin operation at the Antequera River was closed in September because of serious damage to the dredge. On the other hand, the Empresa Minera Copromín Ltda., a tin-antimony producer in Oruro, joined the association in 1988. During the year, the association registered increased production in all of its mined minerals. The number of small mines operating in Bolivia increased from 600 in 1987 to 800 in 1988; this number was still a reduction compared with previous years. Mining cooperatives were involved in the production of antimony, gold, iron ore, salt, sulfur, tin, and tungsten.

Trade

Minerals and hydrocarbons continued to be Bolivia's leading exports, together contributing 82% of the total value of exports. Exports of nonfuel minerals increased in terms of volume and value. In fact, for the first time

TABLE 1

BOLIVIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]	1984	1985	1986	1987[p]	1988[e]
METALS[3]					
Antimony:					
Mine output, Sb content	9,281	8,925	10,243	10,635	[4]9,943
Metal including Sb content of trioxide	861	762	1,171	1,723	662
Arsenic, mine output, arsenic trioxide, arsenic sulfide	144	361	241	132	[4]191
Beryllium: Beryl concentrate:					
Gross weight	—	—	—	42	[4]—
BeO content	—	—	—	3	—
Bismuth, mine output, Bi content	3	159	45	1	[4]13
Cadmium, mine output, Cd content[5]	124	104	36	15	[4]39
Copper, mine output, Cu content	1,610	1,665	338	9	[4]153
Gold, mine output, Au content[6] troy ounces	40,827	18,037	24,531	88,575	157,177
Iron ore:[7]					
Gross weight	[r]14,192	—	10,586	7,490	[4]33,840
Fe content	[r]8,941	—	6,669	4,718	21,319
Lead:					
Mine output, Pb content	7,448	6,242	3,121	9,043	[4]12,544
Metal including alloys	185	231	182	201	359
Silver, mine output, Ag content thousand troy ounces	4,560	3,580	3,058	4,565	7,451
Tin:					
Mine output, Sn content	19,911	[r]16,471	10,462	8,128	[4]10,573
Metal, smelter	15,842	12,859	7,673	2,667	5,461
Tungsten, mine output, W content	1,893	1,643	1,095	638	900
Zinc, mine output, Zn content	37,770	37,110	33,472	39,292	[4]56,957
INDUSTRIAL MINERALS					
Barite	984	1,282	129	1,337	—
Calcite	[e]150	23	300	600	600
Cement, hydraulic	285,600	379,500	295,176	396,018	[4]452,285
Gypsum, crude[e]	700	700	700	700	700
Salt[e]	10,000	10,000	10,000	10,000	10,000
Sulfur, native	1,878	2,741	4,730	8,746	[4]6,733
Ulexite	—	—	—	—	[4]586
MINERAL FUELS AND RELATED MATERIALS					
Gas, natural:					
Gross million cubic feet	173,206	164,118	160,858	161,197	169,875
Marketable do.	[r]84,021	[r]85,246	86,319	84,556	88,983
Natural gas liquids:					
Natural gasoline thousand 42-gallon barrels	601	593	540	514	544
Plant liquids do.	1,136	1,460	1,406	2,097	1,357

See footnotes at end of table.

TABLE 1—Continued

BOLIVIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1984	1985	1986	1987[p]	1988[e]
MINERAL FUELS AND RELATED MATERIALS—Continued						
Petroleum:						
Crude including condensate	thousand 42-gallon barrels	7,621	7,245	6,956	6,890	7,020
Refinery products:						
Liquefied petroleum gas	do.	1,712	1,788	542	473	1,859
Gasoline	do.	2,728	2,784	2,988	3,318	3,347
Jet fuel	do.	548	573	587	547	578
Kerosene	do.	653	578	358	360	325
Distillate fuel oil	do.	[r]2,223	[r]2,204	2,432	2,330	2,275
Residual fuel oil	do.	(7)	(7)	(7)	(7)	—
Lubricants	do.	74	67	107	107	107
Unspecified	do.	20	12	66	73	311
Refinery fuel and losses	do.	87	8	5	348	169
Total	**do.**	**8,045**	**7,834**	**7,085**	**7,556**	**8,971**

[e]Estimated. [p]Preliminary. [r]Revised.
[1]Table includes data available through Oct. 1989.
[2]In addition to the commodities listed, a variety of crude construction materials (clays, crushed and broken stone, dimension stone, and sand and gravel) are produced, but available information is inadequate to make reliable estimates of output levels.
[3]Unless otherwise specified, data represent actual production by COMIBOL and small- and medium-size mines.
[4]Reported figure.
[5]Cadmium contained in zinc concentrates produced by COMIBOL. (Cadmium is not recovered in elemental form in Bolivia.)
[6]Small- and medium-size mines output sales to BAMIN and COMIBOL exports.
[7]Revised to zero.

since 1982, the nonfuel minerals sector surpassed the hydrocarbon sector as the leading foreign exchange earner. The total value of Bolivian nonfuel mineral exports increased by about 32% from that of 1987 to $273.1 million; this represented 46% of total export value. Exports of refined tin and concentrate, historically Bolivia's most important mineral export, increased by 7% in volume and about 12% in value to almost $77 million. Most other metal exports increased in value also. The largest such increases were as follows: zinc, 83%; gold, 57%; and silver, 35%. According to preliminary data, gold was Bolivia's third most important nonfuel mineral export, after tin and zinc, contributing $59 million to export earnings. In contrast, exports of antimony decreased in volume and value.

In terms of value, the European Community was the leading importer of ore concentrates and metals from Bolivia. It was followed by the United States, the Latin American Integration Association, the European Free Trade Association, the Centrally Planned Economy Countries, the Andean market, Asia, and others.

For the first time, the private sector's contribution to the nonfuel minerals exports exceeded 40% of the total, reaching over 70%. The medium-sized mining sector accounted for about 41%, followed by the small-sized mining sector and mining cooperatives with 30%.

Argentina continued to be the sole importer of Bolivia's natural gas. Although exports of natural gas to Argentina increased in volume, they decreased in value. Total exports of hydrocarbons, mainly natural gas, decreased by $33 million in 1988 to $215 million.

Commodity Review

***Metals.*—Antimony.**—Bolivia was the world's second largest producer of antimony, after China. Mine production of antimony, all by the private sector, decreased by almost 7% from that of 1987, to about 10,000 tons. The medium-sized mining sector contributed to about 66% of the total production. Their production increased by almost 4%. The largest producer of antimony continued to be Empresa Minera Unificada S.A., with an output of 3,300 tons. Production from the small-sized mining sector decreased by about 21%.

In 1988, Bolivia exported 7,381 tons

TABLE 2

BOLIVIA: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1987	1988	Principal destinations, 1988
Antimony:			
Ore and concentrate	10,761	7,381	NA.
Trioxides	683	554	United Kingdom 521; Chile 33.
Metal including alloys:			
Regulus	652	124	West Germany 59; Peru 58; Chile 7.
All forms	388	337	United Kingdom 318; Chile 19.
Arsenic: Trioxides and other compounds	132	191	NA.
Barite and witherite	1,337	—	
Beryllium: Ore and concentrate	42	—	
Bismuth: Ore and concentrate	—	11	NA.
Boron materials: Crude natural borates	—	586	NA.
Cadmium: Ore and concentrate	—	4	NA.
Copper: Ore and concentrate	7	111	NA.
Gold:			
Ore and concentrate, Au content troy ounces	39,429	60,236	NA.
Metal including alloys, unwrought and partly wrought do.	44,040	76,516	NA.
Iron and steel: Iron ore and concentrate	7	9	NA.
Lead:			
Ore and concentrate	7,436	9,871	NA.
Metal including alloys	8	24	Panama 11; Ecuador 8; Chile 5.
Silver:			
Ore and concentrate thousand troy ounces	4,884	6,852	NA.
Metal including alloys, unwrought and partly wrought do.	—	114	United States 99; France 15.
Sodalite	—	4	NA.
Sodium compounds, n.e.s.: Carbonate, natural	20	—	
Stone, sand and gravel: Dimension stone:			
Crude and partly worked	—	187	NA.
Sulfur, all forms	8,746	6,733	NA.
Tin:			
Ore and concentrate	8,255	4,734	NA.
Metal including alloys, all forms	2,096	6,297	Chile 2,397; United States 2,145; Colombia 367.
Tungsten: Ore and concentrate	1,220	1,033	NA.
Zinc: Ore and concentrate	39,639	53,969	NA.

NA Not available.
[1] Table prepared by H. D. Willis. Table includes partial provisional export data. Import data for 1985-88 were not available at time of publication.

of antimony. As in 1987, the Vinto antimony smelter remained closed. Vinto did, however, export a very small amount of metallic antimony from its limited stocks to the Federal Republic of Germany and Chile. The Empresa Minera Hermanos Bernal S.A. Palala Smelter in Tupiza, Potosí Department, produced 662 tons of antimony in antimony trioxide. The Bernal exports of antimony trioxide and alloys went to the United Kingdom and Chile.

Gold.—Official gold production, based on gold sold to the Banco Minero de Bolivia (BAMIN), increased by 77% to more than 157,000 troy ounces. This rise has been attributed to actual production increases as well as to more gold that had been exported legitimately as a result of the new decree that permits the BAMIN to pay 5% above the London gold price for domestic gold.

Cooperatives operating in the gold fields of Guanay, Huayti, Mapiri, Teoponte, and Tipuani and the small-sized mines continued to be the main sources of gold production. This sector contributed about 78% of the total official output. The remainder (22%) was produced by the medium-sized mining sector. Inti Raymi S.A., the largest gold producer in Bolivia, contributed most of the production from the medium-sized mining sector. The only other producer from this sector, San Juan Ltda., produced less than 1% of the total.

A 1-year, $15 million option to purchase 33% of Inti Raymi, a joint venture between Westworld of Texas and EMUSA, was acquired by Battle Mountain Gold Co. of Houston, Texas. During the option period, which began on October 1, Battle Mountain planned to invest $1.5 million in exploration and reserve evaluation. In 1988, EMUSA and Westworld announced that the Inti Raymi operation would increase its production by 25% in 1989.

Silver and Zinc.—In 1988, Golden Star Resources Ltd., of Canada, purchased the Empresa Minera Reminsa S.A.'s outstanding shares in 1988 for an undisclosed amount. Reminsa's Carquaicollo mine has proven ore reserves of 70,200 tons, with an average grade of 6.5% zinc, 5 troy ounces of silver per ton, 0.5% antimony, and 0.5% lead. Golden Star also reached an agreement to develop and operate the Candelaria Mine in Potosí. Outlined proven and probable reserves total 419,000 tons with significant values of silver and gold and lesser values of antimony, lead, and zinc.

Tin.—Tin continued to be Bolivia's most important nonfuel mineral commodity. Its production increased 30% from that of 1987 to about 10,600 tons. The largest production increase in the private sector was by small-sized mines and cooperatives, which in 1987 replaced COMIBOL as the leading tin-producing sector, and in 1988, accounted for about 60% of Bolivia's tin production. The COMIBOL production, only about 15% of the total, increased from 384 tons to 1,594 tons. Tin production from the medium-sized mining sector increased about 14% to 2,610 tons.

COMIBOL continued to work under the restructuring program established by Supreme Decree 21377 of August 1986. At that time, COMIBOL had closed its Huanuni tin mine; the mine was reopened in September 1988 with a 52% reduction in the workforce. With COMIBOL's Catavi-Siglo XX Mine (operated by Empresa Minera Catavi) being closed, Huanuni became the world's largest tin mine in operation and Bolivia's richest tin mine. The Huanuni Santa Helena mill was rehabilitated to process 1,000 tons of ore per day. Ore content was 1.7% tin and was expected to increase to a grade of 2% tin. Reportedly, initial concentrate output was planned at 200 tons per month of 50% tin to be increased to 500 to 600 tons per month later in the year. Rehabilitation investment for the mine and mill by 1988 was estimated at $3 million. As a result of the $1 million loan by Vinto for the rehabilitation of the mill, COMIBOL and Vinto agreed that Vinto would receive about 50% of the Huanuni tin concentrate for smelting. Tin production from Huanuni, which became the COMIBOL leading tin producer in 1988, was 806.2 tons.

The COMIBOL Colquiri tin-zinc mine, originally scheduled to be leased to mining cooperatives, remained closed, owing to rehabilitation of the 1,000-ton-per-day concentrator. COMIBOL planned to reopen the mine in mid-1989.

In September 1987, the miners' union, Federación Sindical do Trabajadores Mineros Bolivianos (FSTMB), proposed a plan to COMIBOL for the reactivation and rehabilitation of Empresa Minera Catavi. The plan focused on the selective recovery of high-grade tin waste dumps generated by the Victoria mill and the Siglo XX flotation plant by open pit methods to be treated at the Victoria mill to produce tin concentrate. The 3-year reactivation project was designed to utilize the existing equipment and technology. The rehabilitation part of the program, which would involve the extraction of tin from the rest of the dumps, would require more advanced technology. COMIBOL rejected the proposal in February 1988. Reportedly, the FSTMB objective was for COMIBOL to retain Catavi under its control instead of transferring it to the cooperatives.

According to reports, after a year of crisis in 1987, Vinto slightly exceeded its planned production in 1988. The smelter produced 5,373 tons of tin metal. Production for 1989 was projected at 8,000 tons. In addition, after securing a loan from the Government of the Federal Republic of Germany, Vinto was planning to upgrade its existing technology, convert its energy source from oil to natural gas, improve emissions control, and update its equipment.

In 1988, Vinto also obtained new equipment from China to replace its smelting method from electrolysis, which is one of the reasons why the Bolivia refining costs are the highest in the world, to continuous crystallization. Reportedly, with this new method scheduled to be in place in 1989, Vinto will save about $800,000 per year.

Bolivia's measured and indicated tin reserves at yearend 1988 were estimated at 420,000 tons and were distributed as follows: COMIBOL, 130,000 tons (underground); medium-sized mining sector, 230,000 tons; and small-sized mining sector, 60,000.

Tungsten.—Production of tungsten in concentrate increased 41% from the depressed level of 1987. However, both value and volume of concentrate exports decreased. International Mining Co. (IMCO) continued to be Bolivia's largest producer of tungsten concentrate, contributing 39% of the national total from its Chojlla Mine. The IMCO Chambillaya and Enramada Mines, closed in 1986, remained closed. Production by the medium-sized mining sector was 54% of the total. The remainder was produced by the small-sized mining sector. COMIBOL ceased production from its Kami and Bolsa Negra mines in 1986. In 1988, the COMIBOL mines were being operated by cooperatives.

At yearend, Bolivia's measured and indicated tungsten reserves, in concentrate (wolframite content) at yearend 1988 were as follows: COMIBOL, 8,000 tons; medium-sized mining sector, 55,000 tons; and small-sized mining sector, 10,000 tons.

***Industrial Minerals.*—Cement.**—Production of cement increased 14% from that of 1987 to 452,285 tons. Domestic sales in 1988 totaled 444,105 tons. Most of the cement production capacity was under Government control and owned and managed by regional development corporations.

In April, the El Puente cement plant began production in the Méndez Province, Department of Tarija. The plant, completed in 1984, is one of four operating in Bolivia. Of the four plants, only one, property of Sociedad Boliviana de Cementos S.A. (SOBOCE), is privately owned. With El Puente coming on-stream, cement production capacity in Bolivia was increased to 700,000 tons per year. The 60,000-ton-per-year, $19 million plant is the smallest plant in the country. It was designed and constructed by the United States-French consortium GATX-Fuller S.A. and CGEE Alsthon. The plant operates with clinker imported from Argentina. Initial production from El Puente in 1988 was only 2,150 tons.

The other two Government-owned plants, Compañía Boliviana de Cementos S.A.M., in Irpa-Irpa, Department of Cochabamba, and Fábrica Nacional de Cementos S.A., at Cal Orko, Department of Chuquisaca, have production capacities of 100,000 tons per year and 330,000 tons per year, respectively. The SOBOCE plant in Viacha, Department of La Paz, has a capacity of 210,000 tons per year.

Lithium.—Industria Minera Tierra Ltda., a Bolivian company, and two U.S. companies expressed interest in developing the Salar de Uyuni, the world largest salt flat. Early in the year, Industria Minera Tierra requested permission from the Government to establish a pilot plant to begin producing 40 tons of lithium carbonate per year, but with plans to eventually expand production to 240 tons per year. However, the Government showed interest in joint-venture arrangements by announcing plans to call for international bids.

Reportedly, at yearend the Government of Bolivia and Lithium Corp. of America (LITHCO), a U.S. company, were negotiating a joint-venture operation in the Salar de Uyuni. The LITHCO plans included an exploration program and, possibly, a 7,000-ton-per-year plant. The brines would be evaporated in solar ponds.

Preliminary studies of the Salar de Uyuni, which is over 3,600 meters above sea level, indicated that the brines contain reserves of 5.5 million tons of lithium, 110 million tons of potassium, and 3.2 million tons of boron.

Mineral Fuels.—Bolivia's production of hydrocarbons continued to be negligible, and reserves were modest by world standards. However, this sector of the mineral industry continued to play a major role in Bolivia's economy. Hydrocarbons were Bolivia's second largest foreign exchange, contributing 36% of the total value of exports. Levies on exports and domestic sales of hydrocarbons accounted for about 55% of National Treasury revenues. The contribution of hydrocarbons to the gross national product was 6.5%.

Bolivia's hydrocarbon industry continued to be controlled by the Government. The State-owned Yacimientos Petrolíferos Fiscales Bolivianos (YPFB), the industry operating unit under the Ministerio de Energía e Hidrocarburos, has total control of exploration, production, refining, transportation, and retail sales. Although YPFB is not authorized to participate in joint ventures, the law allows for operational-service contracts with private companies. In 1988, only two contractors, Occidental Boliviana Inc. (a subsidiary of Occidental Petroleum Corp.) and Tesoro Bolivia Petroleum Co. (owned by Tesoro Petroleum Corp. and Mobil Corp.), remained active in Bolivia.[7]

In May, YPFB signed an agreement with Occidental Boliviana and Tesoro Bolivia regarding contractor payment for natural gas exported to Argentina and crude and condensate sold to YPFB. The agreement, formalized by the Government in August, provided for payments of past due receivables and future invoices for oil and gas to be met through sales of Argentine goods and services obtained under credit arrangements. Also, an investment account was created for funds to be reinvested by the two contractors in exploration and development in Bolivia.

YPFB signed two exploration contracts with Occidental Boliviana in August. Contract XXII, covering 2.6 million hectares, targets the reservoirs in Carboniferous and Denovian formations in the Lapacho Block. Under the contract, YPFB and Occidental Boliviana would each receive 50% of the production from this area. Contract XXIII was for the exploration of 2.5 hectares in the Madre de Dios Block. Production-sharing for this block would vary based on production rates.

Only YPFB performed field exploration activity in 1988. YPFB ran 1,432 kilometers of exploration seismic lines, a 22% decrease from that of 1987 and drilled 21,787 meters in eight exploratory wells. Occidental Boliviana drilled 4,160 meters in the Bordo Alto structure in the Chaco Block. Of the exploratory wells drilled in 1988, only the Sirari X-2 in Bolivia's Central District was a discovery well.

Natural Gas.—Production of natural gas increased 5.4% from that of 1987. Almost 68% of the total production was produced by YPFB and the remainder was produced by Occidental Boliviana and Tesoro Bolivia. Of Bolivia's natural gas production, 6% was for domestic consumption, 36% was re-injected in the reservoir, and 46% was exported. Argentina continued to receive 100% of Bolivia's natural gas exports.

In August 1988, the Presidents of Bolivia and Brazil signed an agreement by which Bolivia will supply natural gas to Brazil. Negotiations between the two countries began with a 20-year sales agreement in 1974. A 1978 letter of intent revised the sales volume upward, but this volume was reduced in 1982. In 1983, YPFB and Brazil's Petróleo Brasileiro S.A. (PETROBRÁS) formed a joint economic and technical committee to draft the sales contract between the two countries. The resulting 25-year agreement signed in 1988 was to become effective in 1992.

The agreement included the construction of a pipeline from Santa Cruz to Corumbá in Brazil at the border with Bolivia. Brazil was to purchase between 105 and 110 million cubic feet of natural gas per day; this gas would be used by a 500-megawatt plant to be constructed to generate electrical energy for the Matto Grosso State. Other projects to be implemented under the agreement include the construction of a 200,000-ton fertilizer plant at the Bolivian-Brazilian border, construction of a 100,000-ton polymers plant, exports of liquefied petroleum gas to Brazil totaling 12 million cubic feet per day, and construction of a 30-megawatt hydroelectrical plant to provide energy to the Brazilian States of Acre and Rondonia.

According to YPFB, quantified and certified natural gas reserves at yearend were estimated at 5.5 trillion cubic feet.

Petroleum.—Production of crude oil and condensate increased slightly from that of 1987. Of the approximately 7 million barrels produced, the YPFB share was 82%. Domestic consumption of refined products increased slightly. The value of domestic sales increased by almost one-third, because of increases in the local price of petroleum products. In 1988, the price of petroleum products was increased by the Government 10 times. The only liquids exported by Bolivia were wet gas to Argentina and 175,026 barrels of diesel oil bartered for gasoline with PETROBRÁS.

Estimates by YPFB indicate that crude oil and condensate reserves at yearend totaled 182 million barrels.

ECUADOR[8]

Introduction

Ecuador is planning to develop an important and viable mining industry, and the Government is prepared to attract investors to explore and develop mines and prospects throughout the country. Ecuador and the Overseas Private Investment Corp. of the United States signed an accord to provide investors with guaranties against political uncertainties.

The GDP increased about 9.7% to $10.2 billion,[9] an increase of $0.9 billion from 1987. The oil and mining industries grew by 86% compared with the depressed output level of 1987. The non-oil sector grew slowly by 1.5%. The manufacturing sector growth of 0.7% continued to be stagnant, and construction declined 6.8%. The unemployment rate averaged 7.2%.

Ecuador's foreign debt amounted to $9.6 billion. Significant commercial bank lending was not available, and disbursements from multilateral banks virtually ceased after July, because of the arrearage that accumulated by yearend to $1.0 billion.

Government Policies and Programs

In August, the Government announced its intention of maintaining an open-door policy with respect to foreign investments. Ecuador's mining industry continued to be marginal; however, Government policies, such as the current mining code, promote growth to complement the oil industry and improve the economy, which was affected by high inflation, unemployment, and debt burden.

The Instituto Ecuatoriano de Minería (INEMIN), the official mining regulating agency, is also in charge of exploration and development of minerals, precious metals, and industrial minerals in Ecuador. INEMIN also is involved in the exploration of polymetallic ore deposits, assisted by Japan and the Government of Belgium.

Production

The major mineral commodities produced and exported by Ecuador were cement, gold, limestone, liquefied natural gas, and crude oil and related derivatives.

The total value and volume of Ecuadorian mineral production increased in 1988 compared with that of 1987. Value of output, including metals, industrial

TABLE 3

ECUADOR: PRODUCTION OF MINERAL COMMODITIES[1]

Country and Commodity		1984	1985	1986	1987[p]	1988[e]
ECUADOR[2]						
Cadmium, mine output, Cd content[e]	kilograms	300	300	300	300	300
Cement, hydraulic	thousand metric tons	1,874	1,742	3,866	[3]1,601	2,000
Clays:						
Common Clay	metric tons	92,750	133,749	26,472	[3]29,200	30,000
Kaolin	do.	2,484	2,981	2,000	[e]2000	2,000
Copper, mine output, Cu content	do.	180	100	100	[e]100	100
Feldspar	do.	2,084	3,389	2,298	[3]1,558	3,000
Gas, natural:						
Gross	million cubic feet	18,111	21,495	[e]22,000	[e]12,300	NA
Marketable	do.	4,769	4,583	5,140	3,233	NA
Gold, mine output, Au content	troy ounces	280,000	300,000	317,327	[3]305,432	305,000
Gypsum (for cement)	metric tons	213,941	316,468	290,680	[3]255,289	262,000
Feldspar	do.	2,084	3,389	2,298	1,558	1,600
Iron and steel:						
Steel, crude	do.	18,143	17,874	17,084	[3]25,200	[3]23,500
Semimanufactures	do.	138,611	133,182	181,850	[3]172,400	[3]173,600
Lead concentrate, Pb content	do.	200	200	200	[e]200	200
Natural gas, liquids:						
Natural gasoline	thousand 42-gallon barrels	[r]186	229	232	186	200
Liquefied petroleum gas	do.	[r]499	591	789	278	300
Total	**do.**	**[r]687**	**820**	**1,021**	**464**	**500**
Petroleum:						
Crude	do.	[r]94,721	[r]100,631	106,580	63,510	[3]111,630
Refinery products:						
Gasoline	do.	[r]7,844	[r]7,642	8,788	6,904	6,900
Jet fuel	do.	1,045	[r]1,117	1,170	1,288	1,200
Kerosene	do.	2,279	[r]2,179	2,187	1,581	1,600
Distillate fuel oil	do.	10,077	13,646	6,281	6,371	6,400
Residual fuel oil	do.	[r]13,959	[r]12,583	13,667	11,769	11,000
Lubricants	do.	283	291	287	294	300
Liquefied petroleum gas	do.	[r]1,098	[r]1,293	1,635	770	800
Unspecified	do.	575	718	730	620	600
Refinery fuel and losses	do.	514	1,089	840	[e]812	800
Total	**do.**	**[r]37,674**	**[r]40,558**	**[r]35,585**	**30,409**	**29,600**
Silica	metric tons	21,437	22,441	36,649	[3]14,675	15,000
Silver, mine output, Ag content[e]	troy ounces	2,400	2,000	2,000	2,000	2,000
Stone, sand and gravel:						
Limestone (for cement manufacture)	thousand metric tons	3,135	3,762	6,500	[3]2,773	3,000
Marble	metric tons	6,679	11,435	15,195	[3]15,210	15,000

See footnotes at end of table.

TABLE 3—Continued

ECUADOR: PRODUCTION OF MINERAL COMMODITIES[1]

Country and Commodity		1984	1985	1986	1987[p]	1988[e]
Sulfur[e]						
Native	metric tons	5,000	4,000	4,000	4,500	4,500
Byproduct:						
From petroleum	do.	5,000	5,000	5,000	5,000	5,000
From natural gas	do.	5,000	5,000	5,000	5,000	5,000
Total	**do.**	**15,000**	**14,000**	**14,000**	**14,500**	**14,500**
Zinc, mine output, Zn content	do.	100	100	[e]100	[e]100	100

[e]Estimated. [p]Preliminary. [r]Revised. NA Not available.
[1]Includes data available through mid-June 1989.
[2]In addition to the commodities listed, a variety of crude construction materials (common clays, sand gravel, and stone) undoubtedly were also produced, but output was not reported, and available information was inadequate to make reliable estimates of output levels.
[3]Reported figure.

minerals, and mineral fuels and related derivatives was $1.1 billion in 1988 compared with $870 million in 1987. The mineral fuel and its derivatives sector accounted for more than $970 million of the overall value of mineral production. The metals sector, mostly gold, accounted for almost $100 million output, and the industrial minerals sector accounted for the remainder.

Trade

The value of total exports amounted to $2.2 billion and imports amounted to $2.0 billion. U.S. exports to Ecuador reached $680 million, an increase of 11% over that recorded in 1987. In 1988, the value of U.S. imports from Ecuador decreased to $1.2 billion, a decline of 8% relative to the previous year. Fifty-six percent of Ecuador's total exports were sold to the United States, and the United States supplied 31% of Ecuador's total imports.

Commodity Review

Metals.—**Gold.**—Portovelo Mine, in El Oro Province, is administered by INEMIN. The mine produced 15 to 20 tons per day of gold ore, and recovered about 1 kilogram of gold per month by conventional gravimetric methods. Proven and probable gold ore reserves at yearend were 120,000 tons containing 1% copper, 1.17% zinc, 63 grams of silver per ton, and 12 grams of gold per ton.

Most gold operations in Ecuador are concentrated in three important areas, known as Nambija, Portovelo, and Ponce Enríquez, where gold is mined by underground methods and recovered by gravimetry followed by amalgamation. Gold also was extracted from alluvial deposits and placers, where producers used wooden sluice boxes, small dredges, and washing plants. The three main areas are in the southern part of the country, and have been experiencing a "gold rush" since 1985. Gold production in 1988 of about 8,000 kilograms was sold to agencies of the Central Bank in the producing centers; however, it was thought that real production ranged from 8 to 9 tons per year, and that placer production was about 50 kilograms.

The Ecuadorian Government is encouraging joint ventures, mainly to install plants to treat gold ores in the three important operating centers.

Geevor del Ecuador Cooperativa Anónima (Geevor) has been active in Ecuador since the spring of 1988, developing business opportunities based on the recovery of gold from rich mill tailings and ore produced from local mines in the Portavelo area.

Minera La Trocha Cooperativa Anónima is 90% owned by Geevor del Ecuador C.A. Geevor was developing two projects in the southern part of Ecuador. About 16 kilometers north of Zaruma, in El Oro Province, Geevor was building an 80-ton-per-day grinding plant; north of Zaruma at Curva Grande, overlooking the Río Calera, Geevor was constructing a leaching plant at a capacity of 150 tons per day to recover gold and silver together with concentrates of copper and antimony.

Orolab Cooperativa Anónima (Orolab), a subsidiary of Geevor, was formed to establish laboratory and refining services in Quito. Orolab built a fully operational assay laboratory to serve company needs and the gold mining industry as well. Geevor also built a refinery to produce gold and silver bullion.

Minera Gowanda Sociedad Anónima, a U.S. company established in 1973, operated gold placer deposits in the Esmeralda area, northwest of Ecuador. Compañía Minera Ecuatoriana Sociedad Anónima (COMINECSA) is another Canadian firm that operated the Río Amarillo gold placer in El Oro Province.

Other Metals.—INEMIN's La Plata Mine, once privately operated, was closed. The massive sulphide deposit in Cotopaxi Province contained proven and probable ore reserves of 300,000 tons containing 4% copper, 2.3% zinc, 43 grams of silver per ton, and 2.5 grams of gold per ton. The Ecuadorian Government is planning to privatize it.

Minera Molleturo S.A. owns the Molleturo polymetallic ore deposit 113 kilometers southwest of Quito, Cotopaxi Province; this deposit is of the vein type containing lead, zinc, silver, and gold. After initial exploration and underground development, the company at yearend calculated reserves of 150,000 tons at 1.3% copper, 5.2% lead, 6.9% zinc, 18 grams of silver per ton, and 1.5 grams of gold per ton. However, the mine was on standby because of the lack of financing to continue exploration, development, and the construction of infrastructure.

The only active polymetallic mining project in Ecuador is at the San Bartolomé Mine owned by Armeño Resources Inc., a Canadian firm based in Vancouver, British Columbia. The property is 16 kilometers from Cuenca City. Since 1986, Armeño Resources was involved in underground exploration and development work at the Ocashuaico area. Ore reserves for the San Bortolomé Mine increased to 120,000 tons at 1.86% zinc, 0.57% lead, 560 grams of silver per ton, and 0.55 gram of gold per ton. The ore deposit has a potential of an additional 500,000 tons of ore with comparable contents. The company was planning to bring the mine into production and install a processing plant to treat 100 tons of ore per day by early 1989.

Industrial Minerals.—Nonmetallics also played a significant role in the mining sector of Ecuador. The major operations were in the cement industry, which has large quarries for limestones and clays. The Italian Government assisted the marble and ceramic industries to achieve much improved and competitively finished products to be sold in foreign markets. Other important industrial minerals were silica sands, pumice, kaolin, feldspar, and semiprecious gems.

Mineral Fuels.—**Petroleum.**—Ecuador's oil production was 110 million barrels, an increase of 73% over the previous year. Ecuador's oil exports increased by 65% to 69 million barrels; of the oil exported, 10.4 million barrels went to repay an "in-kind loan" from Venezuela, which was made after the earthquake of 1987. Domestic consumption increased by 3% to 37.1 million barrels. The main production of oil in Ecuador was a joint venture of the Ecuadorian State Petroleum Corp., La Corporación Estatal Petrolera Ecuatoriana (CEPE) (61.5%) and Texaco Inc. of the United States (38.5%). The Minister of Energy and Mines announced in September that CEPE would exercise contractual rights to take over operations managed by Texaco. The partnership will expire in July 1992.

Investments made by foreign firms in Ecuador for oil and gas exploration totaled $200 million. Results to date have been somewhat disappointing; however, CEPE found a large oil field in the Amazón area. Ecuador's oil reserves were estimated at 1.2 billion barrels. The major foreign oil companies involved in Ecuador since the mid-1980's were British Petroleum Ltd. of the United Kingdom and Conoco Inc. of the United States. These companies have so far successfully discovered oil saturated sands in the eastern part of the country. Production tests were being conducted to determine the precise volume of the oil reservoirs. Other foreign companies involved in offshore and inland oil explorations are Occidental Inc., Tenneco Inc., Exxon Corp., Arco Inc., and Conoco Inc. of the United States; Belco Corp. of Belgium; Braspetro S.A. of Brazil; Cogema S.A. and Elf-Aquitane S.A. of France; and Petrocanada Ltd. of Canada.

PERU[10]

Introduction

The mineral sector of Peru suffered another major setback in 1988 as a result of the lengthy work stoppages by the National Federation of Mine, Metallurgical, and Steelworkers Union, which paralyzed the mining industry for over 80 days. These events seriously affected the country's mining output. Mining companies continued to suffer from the country's severe shortage of foreign currency, which was urgently needed to import equipment and spare parts. This was the result of the Government's decision to maintain its policy of severe controls over the allocation of foreign currency to importers. The mining industry also had to cope during the year with poor prospects for foreign investment, isolation from the international financial community, and increasingly frequent terrorist attacks.

Production figures for most metals fell sharply, especially those for copper, lead, silver, and zinc, all of which were more than 20% below the previous year's figures. As a result, mineral producers were unable to benefit from improved world metal prices prevailing over the year. Expansion activities at Southern Peru Copper Corp. (SPCC), the state-owned companies, and the small- and medium-scale mining sector of the economy were limited.

The country's GDP, which had been growing steadily since the current administration took office, decreased by 8.5% to $16.0 billion[11] during 1988. The most affected sectors were mining (-17.6%), manufacturing (-14%), and construction (-5.4%). The only sectors of the economy that experienced relatively modest growth were agriculture and fishing. Accumulated inflation by yearend reached 1,722%, a rate never recorded in the country's recent history. In 1988, there was a $60 million negative trade balance, and for the third consecutive year Peru failed to have a $1 billion surplus. The value of the total Peruvian exports increased by 1.2% during 1988 reaching $2.69 billion, while imports value dropped by 13.6% to $2.75 billion. The country's total foreign debt reached $16.5 billion in 1988.

Government Policies and Programs

One of the main, if not the most important, impediments in the performance of the mining sector in 1988 was the Government's problematical exchange rate policy. According to the Peruvian National Mining Society, the multiple exchange rate policy cost mineral exporters approximately $1.1 billion between July 1985 and December 1988.

The continuous fall in purchasing power of mine workers, as a result of the hyperinflation noted above, became a highly politicized issue for the National Federation of Mine, Metallurgical, and Steelworkers Union, which insisted on a nationwide collective bargaining agreement for the mining sector. Miners were getting an exchange rate closer to parity, and the right to convert up to 30% of the value of their exports for import certificates. Although this was a move in the right direction, mining sector leaders considered the changes insufficient and were publicly demanding that the Government implement a single rate of exchange. This would allow mining companies to import foreign equipment, spare parts, and supplies at the same exchange rate applicable to their exports.

The Finance Ministry published regulations in early December designed to encourage foreign investors to swap discounted debt paper for new export-oriented ventures in Peru. But the scheme was not expected to materialize in the foreseeable future. Under the new regulations, creditors or investors who have picked up Peruvian foreign debt on the secondary market would be invited to exchange it for Intis, local currency, to spend in Peru on new export-oriented projects. The Central Bank will buy the debt paper at a discount set in quarterly auctions. A maximum value, somewhere above the paper's value on the secondary market, will be set by the Government according to how soon the project will earn foreign exchange income and on its value to the country in dollars.

Debt-for-equity swaps have been tried in a few Latin American countries. In Chile, the scheme's showcase, the medium- and long-term debt has been reduced by $5.2 billion in 3 years. Peru's rules differ from Chile's in two important respects, however. With foreign debt arrears at $6.5 billion and climbing, the focus of the regulations is on attracting foreign risk capital in dollar-earning ventures rather than simply reducing the debt. One proposal being discussed at yearend emphasized the need for an immediate inflow of dollars to the country. Under this proposal, the debt was to be paid in Intis at face value rather than at a discount, and the investor was to pay a fee in dollars based on the amount of the debt. The other variation on the Chilean scheme is that investors will not be able to buy into assets that are already producing. Additionally, investors will be obligated to spend up to the dollar equivalent of one-third of the project cost on imports.

The scheme has met with little interest in Peruvian and foreign financial circles. One criticism is that it would require new Government spending at a time when public funds are not covering basic imports and wages. Furthermore, foreign investors are unlikely to be attracted to exporting from Peru when Government policies, since 1985, have discriminated consistently against exporters.

Production

According to preliminary statistics released by the Ministry of Energy and Mines, the country's mining industry contracted significantly in 1988. Decreases in mine production of Peru's five most important metals, including copper (−27%), lead (−27%), silver (−24%), zinc (−21%), and iron ore (−16.5%), were registered. Smaller production losses were registered in other metals such as cadmium (−20%), tin (−17%), and molybdenum (−27%). Increases were registered in tungsten (+110%) and gold (+2.1%). All the production decreases were the result of serious labor unrest, financial disincentives resulting from an overvalued exchange rate, lack of foreign currency to finance improvements, and frequent terrorist attacks against mining installations. Mining companies with limited output were unable to benefit from higher metal prices during the year. However, despite this significant drop in mineral production, export earnings declined only 8.2% during the year. Summarizing the production activity of Peru's main mineral commodities, the main copper producers were SPCC (65%), with two large mines (Cuajone and Toquepala), Empresa Minera Especial Tintaya S.A. (11.4%), Empresa Minera del Perú S.A. (Minero Perú) (8.6%), and Empresa Minera del Centro del Perú S.A. (Centromín) (7.4%), with six mines (Casapalca, Cobriza, Mahr Tunnel, Morococha, Yauricocha, and Andaychagua). The remainder (7.6%) was represented by 35 mines (Pativilca, Condestable, and Raura were the main ones). The main lead producer was Centromín (42.7%) with six mines. The remainder (57.3%) was represented by 43 mines, of which Milpo, Atacocha, and Santa Luisa were the main ones.

The main silver producers were Centromín (21.7%) with seven mines (Casapalca, Cerro de Pasco, Cobriza, Mahr Tunnel, Morococha, Yauricocha, Andaychagua), and SPCC (4.2%) with two mines (Cuajone and Toquepala). The remainder (74.1%) were represented by 47 mines, of which Orcopampa, Santa Luisa, Atacocha, and El Brocal were the main ones.

Iron ore production declined 16.5% in 1988; the state-owned Hierro Perú was the sole iron ore producer. Tin production from the country's sole producer, Minsur S.A. decreased by 17% relative to 1988 output. Total crude oil output decreased 13.4% in response to lower demand. Natural gas production was approximately at the same level of 1987.

Trade

Despite a decrease in volume, the sharp increase in metals and fish meal prices pushed the value of Peruvian

TABLE 4

PERU: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987[p]	1988[e]
METALS						
Antimony:						
Mine output, Sb content		672	594	[e]670	[e]590	420
Metal		372	377	356	318	[2]246
Arsenic, white[3]		1,090	1,257	1,273	1,221	[2]828
Bismuth:						
Mine output, Bi content		650	785	605	438	386
Metal		[r]504	738	569	412	[2]363
Cadmium:						
Mine output, Cd content		674	579	463	461	[2]368
Metal		390	420	387	351	[2]303
Chromium, mine output, Cr content		—	—	—	461	[2]368
Copper:						
Mine output, Cu content		353,927	391,332	397,364	406,430	[2]298,332
Sulfate (Cu content)		2,535	2,539	2,234	2,073	[2]1,268
Metal:						
Smelter		298,806	326,592	286,167	234,924	[2]192,621
Refined		188,571	226,787	225,614	224,808	[2]179,455
Electrowon		31,450	27,434	27,533	24,461	[2]19,915
Gold:						
Mine output, Au content	troy ounces	187,406	212,870	284,373	263,186	[2]268,683
Metal	do.	79,734	84,653	84,074	64,977	[2]76,904
Indium	kilograms	2,903	3,863	3,333	3,877	[2]2,120
Iron ore and concentrate:						
Iron and steel:						
Gross weight	thousand tons	3,979	4,892	5,036	5,019	[2]4,189
Fe content	do.	2,663	3,290	3,356	3,305	[2]2,794
Metal:						
Pig iron[4]	do.	4	163	216	192	[2]202
Ferroalloys		—	—	739	2,362	2,000
Steel ingots and castings	thousand tons	337	397	487	503	[2]496
Semimanufactures	do.	346	304	377	396	[2]392
Lead:						
Mine output, Pb content		193,652	201,460	194,378	203,950	[2]149,037
Metal		70,192	81,895	66,417	71,333	[2]53,601
Manganese, mine output, Mn content		273	334	119	[e]200	146
Molybdenum, mine output, Mo content		2,974	3,807	3,484	3,353	[2]2,444
Selenium metal, refined	kilograms	20,758	14,506	12,035	11,430	[2]4,937
Silver:						
Mine output, Ag content	thousand troy ounces	53,080	58,230	61,916	66,052	[2]49,885
Metal, refined	do.	26,885	24,159	21,442	21,271	[2]16,406
Tellurium metal	kilograms	14,066	15,007	9,836	7,317	[2]4,078

See footnotes at end of table.

TABLE 4—Continued

PERU: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987[p]	1988[e]
METALS—Continued						
Tin, mine output, Sn content		3,314	3,807	4,817	5,263	[2]4,378
Tungsten, mine output, W content		699	771	742	205	[2]432
Zinc:						
Mine output, Zn content		465,890	523,434	597,576	612,477	[2]485,429
Metal		148,372	[r]162,725	155,811	144,169	[2]123,125
INDUSTRIAL MINERALS						
Barite		46,323	21,661	9,945	8,354	8,500
Boron materials, crude (borates)		[e]10,000	[e]10,000	22,557	22,710	15,000
Cement, hydraulic	thousand tons	1,869	1,947	2,207	2,584	2,500
Chalk[e]		470,000	470,000	470,000	470,000	470,000
Clays:						
Bentonite		12,971	2,017	33,080	18,700	20,000
Fire clay		5,601	4,305	[e]5,000	50	100
Kaolin		[e]1,000	210	6,328	233	200
Common clay		269,123	115,588	406,587	1,083,528	600,000
Diatomite		7,471	14,854	8,905	20,916	15,000
Feldspar		3,225	—	19,467	64,749	20,000
Gypsum, crude		66,722	28,640	171,347	228,845	150,000
Lime[e]		35,000	35,000	35,000	[r]12,500	13,000
Mica[e]		550	550	550	550	550
Nitrogen: N content of ammonia[e]		85,000	85,000	[r]100,000	[r]80,000	95,000
Phosphates, crude		12,694	12,216	5,167	60,713	60,000
Salt, all types		253,027	204,992	399,387	130,741	130,000
Stone, sand and gravel:						
Stone:						
Dolomite		4,565	1,635	[e]2,000	60	100
Flagstone		—	—	467,766	[e]400,000	300,000
Granite		—	—	—	64,296	60,000
Limestone	thousand tons	1,906	2,031	2,935	1,657	1,600
Marble		5,396	1,550	7,258	9,926	8,000
Onix		[r]294	—	143	577	500
Quartz and quartzite (crushed)		2,465	2,150	[e]2,200	848	1,000
Shell, marl		—	—	5,437	[e]5,000	4,000
Slate[e]		18,000	18,000	18,000	18,000	18,000
Travertine		[r]22,655	[r]550	4,082	6,524	5,000
Sand and Gravel:						
Construction	thousand tons	2,421	1,902	4,847	6,911	5,000
Silica sand	do.	53	2	99	76	75

See footnotes at end of table.

TABLE 4—Continued

PERU: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987[p]	1988[e]
INDUSTRIAL MINERALS—Continued						
Sulfur:						
Elemental:						
Native[e]		100	100	100	100	100
Byproduct of metallurgy		64,256	64,145	66,300	[e]66,000	66,000
Sulfuric acid, gross weight		199,431	182,031	207,190	[e]200,000	200,000
Talc and related materials:						
Talc		510	500	1,754	1,447	1,500
Pyrophyllite		8,728	—	7,354	705	1,000
Total		**9,238**	**500**	**9,108**	**2,152**	**2,500**
MINERAL FUELS AND RELATED MATERIALS						
Carbon black		5,329	5,949	5,439	5,877	5,500
Coal:						
Anthracite, run-of-mine[e]		84,000	92,750	90,000	90,000	90,000
Bituminous, run-of-mine		[r]42,429	[r]32,691	61,077	107,501	67,000
Total		**[r]126,429**	**[r]125,441**	**151,077**	**197,501**	**157,000**
Coke, all types[e]		10,000	10,000	10,000	10,000	10,000
Gas, natural:						
Gross	million cubic feet	45,484	47,256	50,012	49,279	48,001
Marketed	do.	[e]22,000	[e]22,000	22,124	17,418	[2]15,365
Natural gas liquids:						
Natural gasoline and other[5]	thousand 42-gallon barrels	190	249	240	335	[2]368
Propane	do.	49	81	69	29	[2]24
Butane	do.	6	6	6	9	[2]5
Total	**do.**	**245**	**336**	**315**	**373**	**[2]397**
Petroleum:						
Crude	do.	67,374	[r]68,620	65,262	59,730	[2]51,717
Refinery products:						
Gasoline, motor	do.	11,539	11,627	11,702	11,425	[2]11,694
Jet fuel	do.	2,654	2,377	2,551	2,260	[2]1,991
Kerosene	do.	6,220	6,353	6,940	6,464	[2]7,404
Distillate fuel oil	do.	12,020	12,389	10,577	10,444	[2]9,503
Residual fuel oil	do.	26,617	25,652	27,441	28,829	[2]27,306
Lubricants	do.	63	58	61	63	[2]54
Liquefied petroleum gas	do.	1,429	1,407	1,577	1,620	[2]1,649
Asphalt	do.	212	271	333	446	[2]1,009
Refinery fuel and losses	do.	386	537	1	2	[2]39
Other	do.	1,074	1,536	1,131	397	[2]252
Total	**do.**	**62,214**	**62,207**	**62,314**	**61,950**	**60,901**

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

[1] Table includes data available through Aug. 1989. Where appropriate, data have been revised to conform with that reported in Anuario de la Mineria Peru, 1977-1985, Ministerio de Energia y Minas, Lima, 1986, 167 tables. Production figures for 1986-88 do not necessarily reflect recoverable metal content as do those for prior years.

[2] Reported figure.

[3] Output reported by Empresa Minera del Centro del Peru S.A.

[4] Excludes sponge iron production as follows, in tons: 1984-62,121; 1985-49,300 (revised); 1986-55,500 (revised); 1987-60,100; and 1988-51,000.

[5] Includes hexane.

exports up 5% in 1988 compared with that of the previous year. Earnings were held back by two nationwide strikes that paralyzed more than three-quarters of the mineral sector's labor force for almost 80 days between July and August and between October and December. Mineral production losses due to the strikes, which in turn helped to push up the prices of copper and zinc in London and New York during the second half of 1988, were estimated at $300 million. Imports in 1988 were down by 13.6%, and the trade deficit at yearend fell to approximately $60 million, compared with a $521 million deficit in 1987.

According to figures released by the Peruvian Central Reserve Bank for 1988, the export volume of all major metals, except iron ore, decreased as follows: Copper (-18%) to 287,000 tons, silver (-34%) to 9.1 million troy ounces, lead (-18%) to 121,000 tons, zinc (-11%) to 384,000 tons, and gold (-64%) to 764 troy ounces. Iron ore exports increased (18%) to 4.6 million tons. Despite this decrease in export volume, the value of all minerals exported rose 3% to about $1.2 billion in 1988 compared with that of 1987, because of increased metal prices during the year.

Exports of nonfuel minerals accounted for 45% of total exports. Copper alone represented 22.1% of the total, while lead, zinc, and silver accounted for 7.4%, 9.5%, and 2.2%, respectively. After 3 years of decreasing oil production, at yearend the country became a net importer when crude oil and petroleum products imports exceeded exports by $48 million for the first time. Crude oil and petroleum products exports accounted for 6% of the total value of exports.

Commodity Review

Metals.—**Copper.**—In addition to the sizable decrease in mine output, refined copper production decreased 20% to about 179,500 tons compared with the 1987 output. Total copper exports during the year were valued at approximately $606,600 (including the value of silver contained in copper concentrates), 19% higher than the 1987 value, despite the 18% drop in volume exported.

SPCC, the country's largest copper producer, reported a total mine output of 193,648 tons, a decrease of 22% from the 1987 figure. The Cuajone Mine contributed 108,030 tons and the Toquepala Mine 85,618 tons. Output from both mines accounted for 65% of Peru's total copper production.

Serious labor problems during the year resulted in production declines. SPCC's blister copper production fell to 83,752 tons (99.2% Cu) containing 650,409 troy ounces of silver and 2,076 tons of molybdenum concentrate (92.7% MOS_2). Following the workers' decision to return to work, SPCC renewed its deliveries of blister copper to Minero Perú's Ilo refinery on December 19. Approximately 60% of SPCC's blister copper output is usually refined at Ilo under a toll agreement. SPCC was expecting to receive its first deliveries of copper cathodes from the Ilo refinery during the first week of January 1989. The controversy over the recovery of the $727 million investment made by SPCC to develop the Cuajone Mine was still unresolved by yearend. According to the contract, the date when the total investment would be recovered was to be established by a joint declaration of the Ministry of Energy and Mines and the Ministry of Finance. There were some disagreements between the Ministries as to the rate of exchange to be applied for the calculation of the amount of investment to be recovered, so SPCC decided to take its case to court.

Centromín, the state-owned mining company, reported copper production of 22,031 tons from its mines, a 49% drop relative to the previous year's figures reflecting the serious effect of the 87-day strike. One of the most affected mine units of Centromín was Cobriza, an underground, highly mechanized copper mine with a plant capacity of 10,000 tons per day of ore. Cobriza's ore production during the year declined 50% and continued operating at 50% of its installed capacity, mainly because of a severe shortage of spare parts for its mining equipment and terrorist attacks at La Oroya metallurgical complex.

Centromín nonetheless developed important projects which will enable the company to improve operations, subject to the availability of funds and normal working conditions. Centromín reached an agreement with the Canadian International Development Agency (CIDA), which was to provide $5 million for the purchase of mining equipment. Another project calls for the construction of an oxygen plant (300-ton-per-day capacity) for the La Oroya copper smelter requiring an investment of $28 million, 50% of which will be financed by the Andean Development Corp. The Inter-American Development Bank (IDB) was considering a $75 million loan to implement a project for massive equipment replacement in all of Centromín's mines, concentrators, smelters, refineries, railroads, workshops, and other support services. The $13.3 million expansion of the Cerro de Pasco Mine from 3,000 to 7,000 tons per day was underway.

Centromín approved and initiated a 4-year exploration program in areas surrounding its existing mines with an annual investment of $5 million. This program was originally designed and financed by the United Nations.

Metallurgical research and development programs to improve recovery, especially of silver, from the Cerro de Pasco Mine were underway with the assistance of the Japanese Metallic Mining Association.

Minero Perú continued operating its Cerro Verde copper mine, the Ilo copper refinery, the Cajamarquilla zinc refinery, the Bayóvar phosphate plant, and the San Antonio de Poto gold placer project. At Cerro Verde, Minero Perú planned to treat secondary copper sulfides by the hydrometalurgicalflotation process with an average production of 60,000 tons per year of concentrates containing about 35% copper. Minero Perú has already issued a public international tender for an extimated $50 million turnkey contract. Bids were scheduled to be opened on February 13, 1989. With its current facilities, Cerro Verde produced 19,915 tons of refined copper cathodes from its electrowinning plant, a 19% drop compared with the previous year, and 15,000 tons of copper concentrates from its small flotation plant. Minero Perú installed a small 3-ton-per-day pilot plant to obtain aluminum sulfate crystals for sales to SODAPAR, the Arequipa water distribution company. Minero Perú planned to increase production gradually to 60 tons per day and was also carrying out studies for the production of magnesium sulfate, copper sulfate, and copper exychloride crystals. Minero Perú's Ilo copper refinery produced 128,269 tons of copper cathodes, 1.6 million troy ounces of silver, and 3.0 million ounces of gold. The project to increase the refining capacity of its Ilo plant from 150,000 tons per year to 175,000 tons per year was affected by the shortage of foreign currency required to import equipment; nonetheless, the company was expecting to complete installation of the 28 new electrolytic cells by mid-1989. Aside from Cerro Verde, Bayóvar, and San Antonio de Potos, the other deposits assigned to Minero Peru (Antamina, Michiquillay, Quellaveco, Berenguela, the Bambas, Canariaco, etc.) remained without developments during the year.

Tintaya, the most recently opened state-owned copper and silver mine and the second largest copper producer in Peru, contributed with 33,990 tons of the fine copper and 486,119 troy ounces of silver, a 40% and 41% decrease in output, respectively, compared with output of 1987. During the year, Tintaya shipped about 126,000 tons of copper concentrates averaging 31.3% copper worth $78.4 million.

Tintaya, owned 45% by Minero Perú, 45% by Centromín, and 10% by Inversiones COFIDE, continued its operations at Espinar, in the Cuzco Department. Although the company faced a series of labor problems and severe operating restrictions, because the Central Reserve Bank had limited the availability of foreign currency to import equipment and spare parts, it was able to maintain the high quality of its product and meet its sales commitments. Tintaya also continued studying the feasibility of developing the nearby Coroccohuayco copper deposit, which has proven reserves of over 14 million tons assaying 2.6% copper. This project, requiring an investment of about $43 million, was being reviewed as a joint venture by the China International Trust Investment Corp. (CITIC) and China's National Nonferrous Metals Industry Corp. (CNNC). Another possible joint-venture project with China was related to the treatment of 8 million tons of 2.7% copper oxide ore from the overburden removed during the preparation of the open pit mine, which exposed the copper sulfides ore. The latter was treated in its 8,000-ton-per-day flotation plant. The proposed new project would produce about 16,000 tons of copper cathodes per year from an electrowinning process.

The medium-sized mining sector's most important copper producers in 1988 were again Minera Pativilca S.A. and Minera Condestable S.A. The medium-sized mining sector was comprised of about 33 mining companies, 31 of which were Peruvian-owned and 2 of which were joint ventures with foreign companies, that produced 7.4% of the total copper output, 57.3% of the lead, 63.3% of the zinc, and 74.1% of the silver in Peru. The Santa Luisa S.A. copper, lead, silver, and zinc producer, is 100% owned by Mitsui Mining and Smelting Co. and Mitsui and Co. Ltd. of Japan. The Corporación Minera NorPerú S.A. operates the Quiruvilca polymetallic deposit 80% owned by ASARCO Incorporated of the United States.

Gold.—Despite increased output from the alluvial gold placer deposits, the total production of gold as reported by the Ministry of Energy and Mines increased slightly compared with that of the previous year. Placer gold production was based on purchases by the Banco Minero. The difficulty of making a reasonable estimate of the gold produced continued because of the thousands of gold panners operating along river banks throughout the country.

Gold purchases deteriorated since September when the 15% premium paid by Banco Minero was reduced to 5%. At yearend, Banco Minero was still paying a 5% premium over the world gold price payable in local currency at the bank exchange rate.

PERU'S GOLD PRODUCTION

(Troy ounces)

	1986[r]	1987[r]	1988[e]
In ores and concentrates	130,050	109,248	100,000
Refined	84,074	64,977	77,000
Placer production	70,249	88,961	92,000
Total	**284,373**	**263,186**	**269,000**

[e] Estimated. [r] Revised.

The southeastern region of Peru comprising the Madre de Dios, Puno, and Cuzco Departments continued to be the largest source of alluvial gold. Compañía Aurífera Río Inambari S.A. (CARISA), continued to be the only company operating a gold dredge on the Madre de Dios River with a monthly average output of 7,000 troy ounces, which was sold entirely to Banco Minero. In 1988, officials from the International Finance Corp. (IFC) returned from an inspection and review of the expansion project of the gold dredge operation. It was in the process of obtaining from its Board of Directors approval for a $2.7 million loan to implement the second stage of the project, which included a second dredge estimated to cost around $4 million, additional camp facilities, and other infrastructure. The company expected to obtain a decision from IFC by the middle of 1989.

Compañía Aurífera El Sol S.A. and Aurífera Los Incas S.A. entered into a joint-venture agreement to develop the gold placer concession owned by Aurífera El Sol in the Madre de Dios eastern jungle. Texas Gulf of the United States maintained its 10% interest in the venture.

Minero Perú announced by yearend that it had signed a $22 million contract with the Swiss-based company Alluvial Dredge for the engineering and supervising of the construction of a dredge to treat 3.5 million cubic meters per year of gold-bearing gravel in the Pampa Blanca area of San Antonio de Poto. The project was expected to start production at the level of 35,400 troy ounces of gold per year by 1990. Minero Perú also announced that the San Jacinto dredge, which was to be operated by the Natomas Co. of the United States until 1972, was being repaired at a cost of $7 million and was to be ready to treat up to 1.7 million cubic meters per year of material containing 0.23 gram of gold per ton at the Arequipa Pampa zone by 1990.

Cía. de Minas Orcopampa S.A., a subsidiary of the Cía. Minera Buenaventura S.A. with its Polymetallic Castilla Mine in Arequipa, continued as the main private producer with a total output of 32,500 troy ounces of gold contained in its concentrates.

Asesoría Contable Minera S.A. (ACOMMSA), operator of the Ocona, Santa Clarita, Explatoro, and Molino de Oro lode gold mines, in the Department of Arequipa, was the second largest producer of refined gold in the medium and small sector. ACOMMSA produced 22,500 troy ounces of fine gold, a 10% drop with respect to 1987. All ACOMMSA's production was sold to the Banco Minero. Compañía Minera Poderosa S.A. continued operating its Poderosa lode gold mine in the Province of Pataz, Department of La Libertad, with positive results from its exploratory efforts. Reserves were estimated at 254,000 tons of ore grading an average of 13.7 grams per ton. Poderosa Mine was the largest producer of refined gold in the medium mining sector with an output of 25,600 troy ounces, a 37% increase relative to that of 1987.

Lead, Zinc, and Silver.—Production of lead, zinc, and silver was seriously affected by labor problems and energy supply disruptions as a result of terrorist attacks. In line with decreased output of concentrates, production of refined lead, zinc, and silver declined by 25%, 15%, and 23%, respectively, compared with that of 1987. Centromín continued to be one of the most important lead, zinc, and silver producers in the country and contributed 43%, 38%, and 22% of lead, zinc, and silver, respectively, of the country's total output. It operated seven mines and a smelting and refining complex at La Oroya.

Centromín's output of lead, zinc, and silver decreased by 24%, 28%, and 33%, respectively, below that of the previous year. Centromín's most important producers of lead, zinc, and silver were lead from the Cerro de Pasco, Casapalca, and Yauricocha Mines; zinc from the Cerro de Pasco, Mahr Tunnel, and Casapalca Mines; and silver from the Cerro de Pasco, Casapalca and Morococha Mines.

In the private sector, the most important producers of lead, zinc, and silver were lead from Cía. Minera Milpo S.A., Cía. Minera Atacocha S.A., and Cía. Minera Santa Luisa S.A.; zinc from Cía. Minera San Ignacio de Morococha S.A., Perubar S.A., and Cía. Minera Santa Luisa S.A.; and silver from Cía. de Minas Orcopampa S.A., Cía. de Minas Buenaventura S.A., Minas de Arcata S.A., Corporación Minera NorPerú S.A., Cía. Minera Caylloma S.A., Cía. Minera Huarón S.A., Southern Peru Copper Corp., sucursal del Perú, and Cía. Minera Milpo S.A.

Exports during 1988 amounted to 44,943 tons of refined lead and 75,902 tons of lead concentrates (containing silver), valued at $202 million; 57,485 tons of refined zinc and 326,191 tons of zinc concentrates, valued at $261 million; and 9.07 million troy ounces of refined silver, valued at $60 million. The average price for silver in 1988 was $6.53 per troy ounce compared with $7.02 per troy ounce in 1987.

With assistance from the IDB, Centromín was expecting to finance its $200 million investment plan aimed at restoring its productive capacity, which has been deteriorating steadily since 1985. The plan includes 42 different projects, most of them aimed at modernizing and expanding current operations. Centromín was also hoping to benefit from part of a donation of $15 million in mining equipment made to the country by CIDA.

Cía. de Minas Orcopampa S.A., a subsidiary of Cía. de Minas Buenaventura S.A., operated a polymetallic deposit in the Department of Arequipa, containing mainly gold and silver. In 1988, Orcopampa outranked its parent company, traditionally the largest private silver producer. Despite labor problems, output of concentrates increased slightly to 12,719 tons containing 339 troy ounces of silver per ton, 2.6 troy ounces of gold per ton, and 3.5% copper valued at $34.3 million compared with $38.6 million in 1987. Proven and probable ore reserves at yearend were 2.3 million tons of ore with an average grade of 0.14 troy ounce of gold and 14.7 troy ounces of silver per ton. Work on the Orcopampa cyanide processing plant was completed in 1988. Cía. de Minas Buenaventura S..A., the second largest silver producer in the medium sector, continued operating its Julcani and Uchucchacua deposits in Huancavelica near Huancayo. Operations during the year were seriously affected by labor strikes, the longest ever in the company's history. The Julcani Mine produced 4,177 tons of lead concentrates assaying an average of 300 troy ounces of silver per ton, 10.6% lead, 13.8% copper, and some gold and bismuth values.

Ore reserves by yearend were estimated at 384,000 tons of ore grading 15.8 troy ounces of silver per ton, 0.69% copper, and 0.85% lead.

Production at the Uchucchacua Mine totaled 12,900 tons of leached concentrates averaging 240 troy ounces of silver per ton, 13.2% lead, and 2,607 tons of zinc concentrates averaging 45.9% zinc and 13.3 troy ounces of silver per ton. Reserves by yearend were estimated at 1.8 million tons of ore grading 13.2 troy ounces of silver per ton, 1.0% lead, and 1.5% zinc. The total value of production from Julcani and Uchucchacua Mines was $26.2 million compared with $33.3 million in 1987. Silver represented 90.9% of Cía. Buenaventura's mineral sales, followed by gold with 3.4%, lead 3.3%, copper 1.9%, and zinc 0.5%.

Cía. de Minas Arcata, S.A. also experienced the negative effects of labor problems during the year. Ore production dropped by 15% to 265,000 tons in 1988. Silver production decreased 6.3% to 3.6 million troy ounces while gold decreased from 11,124 troy ounces to 10,610 troy ounces. Arcata's sales in 1988 reached 11,264 tons of ore concentrate containing 3.6 million troy ounces of silver valued at $23 million. Of this tonnage, 10,443 tons was exported, and 821 tons was delivered to La Oroya smelter of Centromín.

Output by the Cía. Minera Caylloma S.A. declined from 2.5 million troy ounces of silver and 6,719 troy ounces of gold in 1987 to 2.1 million troy ounces of silver and 6,430 troy ounces of gold in 1988. Reserves by yearend increased to 1 million tons of ore averaging 13.7 troy ounces of silver per ton. Sales during the year amounted to 1.7 million troy ounces of silver compared with 2.2 million troy ounces of silver in 1987.

Tin.—MINSUR S.A., Peru's only tin producer, continued operating its San Rafael and Santa Bárbara Mines in Melgar Province, Puno Department. The San Rafael Mine was the only producer of tin concentrate in the country. MINSUR's production of tin concentrate dropped 17% to 4,378 tons in 1988 and were shipped to Tex Tin Corp. in the United States, and to RTZ Corp. and PLC's Capper Pass smelter, both in the United Kingdom. Ore reserves at San Rafael Mine amounted to 2.3 million tons of tin at yearend. MINSUR has deferred a $9 million investment project to build a tin refinery in Pisco, 230 kilometers south of Lima. According to local sources, the company has decided to postpone major investments until after the 1990 presidential elections. COFIDE S.A., the state-owned financing development corporation, was to cancel a $5 million loan approved in February because FUNSUR S.A., the MINSUR subsidiary setup for the project, had not requested disbursements for more than 6 months. MINSUR, part of the BRESCIA Group, first decided to postpone the construction when the Government boosted interest rates as part of the September 1987 economic policy adjustment. The project had been scheduled to begin at the end of 1988. At the same time, the deteriorating economic situation in Peru led the IFC of the World Bank to freeze a $1 million loan to the project. The project plan was to refine all MINSUR's tin concentrate production to obtain around 5,300 tons per year. Domestic refining of all the tin concentrates would provide Peru with added value estimated at $10 million per year. The total estimated investment for this project was about $13 million, which included $5 million in foreign currency and the balance in local currency (Intis). The plant would have an annual capacity for treating 12,000 to 15,000 tons of tin concentrates yielding between 5,000 and 6,250 tons of tin ingots with a purity of 99.85%.

Tungsten.—Cía. Minera Regina S.A. continued as the country's sole producer of tungsten concentrate, operating its Palca XI deposit about 140 kilometers north of Juliaca in Puno Department. Plant operations, which were stopped at the end of August 1987 to implement design changes to improve recovery and capacity, were reopened in mid-January, and by December recovery had reached 65.0%. During 1988, Minera Regina processed 60,913 tons of tungsten ore, producing 834 tons of concentrates containing 538 tons of WO_3, an increase of 94% compared with that of 1987. The company was planning to increase production by 110% in 1989. Three types of concentrates were produced: ferberite (an iron tungsten, $FeWO_4$), and, for the first time, scheelite (calcium tungsten, $CaWO_4$), and a mixed concentrate. Sales of $2.5 million were made to Walter Metals Ltd. and two United States companies (General Electric and Strategic Minerals, which received 90% of the exports). The Federal Republic of Germany and Japan received 5% each. By yearend, proven and probable ore reserves increased to 1.1 million tons of tungsten ore grading 1.83% WO_3. These reserves assure feed for the concentration plant at the projected capacity of 9,000 tons of ore per month for 10 years.

***Industrial Minerals.*—Phosphate Rock.**—Minero Perú's plans to develop Area 1 of the Bayóvar phosphate deposit in Sechura Province in the northern Department of Piura became uncertain, following the decision made by Fletcher Challenge Ltd. of New Zealand to concentrate large new investments in Chile. However, Minero Perú officials stated that they were still waiting for a final reply from the New Zealand company on a $7 million loan request to expand the Bayovár concentration plant. The previous plans to establish a joint mining company and build a 400,000-ton-per-year treatment plant were apparently abandoned and replaced by the loan request, which would allow Minero Perú to expand the current plant's capacity from 90,000 tons per year to 200,000 tons per year. The arrangement under discussion included the repayment of the loan with 50,000 tons per year of phosphate concentrates over a period of 5 years and would grant Fletcher the right to an additional 50,000 tons per year of concentrates.

The Government has approved the basis for a public international tender for a turnkey contract, which required financing for the exploitation, transportation, and marketing of the Bayóvar phosphate deposit in Area 2, also located in the Sechura desert in the Department of Piura. The estimated $168 million project includes the installation of a 1.5-million-ton-per-year beneficiation plant, port facilities for ships of up to 50,000 tons, a 15-megawatt powerplant, freshwater supply system, mining camp, and road reconstruction. Empresa Promotora Bayóvar (Pro Bayóvar), the state-owned company responsible for the project, was very optimistic with respect to possible bidders from the Soviet Union, the United States, and Mexico. A $7.5 million World Bank technical assistance loan to help finance engineering for the project could result in the establishment of a major new phosphate fertilizer company. Pro Bayóvar currently operates under the control of the Government of the Grau Region. Meanwhile, Minero Perú continued with the exploitation of the Bayóvar deposit Area 1, a zone not included in Pro Bayóvar's mineral rights.

***Mineral Fuels.*—Coal.**—The first industrial coal conversion plant in Peru was under construction by Lar Carbón S.A., a subsidiary of Cementos Lima S.A. and Cemento Andino S.A., the main cement manufacturers of the country in association with Rheinbraun Verkauf of the Federal Republic of Germany. The coal-fired plant is located at Atacongo near Lima and was expected to start burning 200,000 tons of bituminous coal per year by mid-1989, instead of the 900,000 barrels of oil used in 1988. The coal conversion plant will have a design treatment capacity of 300,000 tons of coal per year at a cost of $16 million. The coal-fired plant was expected to save $4 million annually in oil imports.

The Government has authorized the importation of 200,000 tons of bituminous coal during the first year of plant operations from producers in the United States, Colombia, Australia, and Chile until domestic coal production can meet demand. Since most of Perú's known coal deposits contain anthracite coal, Lar Carbón was conducting research on the utilization of a combination of bituminous and anthracite coals as fuel with the anthracite component ranging 20% to 35%. In addition, Lar Carbón was planning to initiate exploration for bituminous coal in the jungle.

Cementos Norte Pacasmayo, the second largest cement manufacturer in the country, was also looking into coal fuel utilization, but was considering the possibility of using a mix of oil and anthracite coal, a type of coal that is abundant in the northern part of Peru, where the plant is located. The company signed a contract with Fuller International Inc. of the United States to study its $8 million project, which would allow the plant to burn either oil or a coal-oil mix.

The Government coal company, Procarbón, continued working on some of its projects, but with very limited resources and support from the central Government. The small anthracite briquetting plant installed in Huaraz Department with the aid of the U.S. Agency for International Development continued operating during the year, and the market for this inexpensive domestic fuel started expanding around the marketing area of the pilot plant. Minero Perú continued developing the Callacuyán anthracite mine, located within the Alto Chicama coalfield, and the company was expected to start supplying state-owned Empresa Siderúrgica del Perú S.A. (Siderperú) steel plant with coal for its Chimbote unit during 1989.

With the technical cooperation of the Republic of Korea, and the support of COFIDE, Siderperú, Minero Perú, Petroperú, and the Ministry of Energy and Mines, Procarbón installed an 80-ton-per-day coal plant near Chimbote (Ancash Department) on the coast north of Lima to produce coal briquets, which will initially be used instead of kerosene by the low income families in the area for domestic cooking. It was estimated that some 60,000 families will benefit from this fuel substitution considering that coal briquets are cheaper than kerosene.

Petroleum and Natural Gas.—Peruvian crude oil production averaged around 141,700 barrels per day, which represents a decrease of 13% relative to the 1987 production figure, owing mainly to lower output by Occidental Petroleum. Occidental reduced output while waiting for payment on accumulated debt. Petroperú, the state-owned oil company, also fell behind on payments to its offshore subsidiary Petromar S.A. with the consequence of lower output.

After 3 years of decreasing oil production, the country became a net importer by yearend when the value crude oil and petroleum products imports exceeded exports by $48 million. Petroperú continued to experience severe difficulties because of the Government's decision to maintain subsidies on the selling price of fuels in the domestic market, which, according to its officials, represented a daily loss in the order of $3 million. The company also faced serious problems due to Government restrictions regarding foreign currency availability to purchase spare parts and equipment. This affected the company's flexibility in its operations. Petroperú's operating deficit during 1988 was estimated at $396 million, 40% higher than that reported in 1987.

Petroperú operated four subsidiaries: Petroleros del Mar S.A. (Petromar), Petrolera Transoceánica S.A. (Transo), Servicios Petroperú (Serpetro), and Cía. Peruana de Gas S.A. Petromar operated Peru's only offshore oilfields (Blocks

Z1-A, Z2-A, covering 814,000 hectares) near Talara on the northern coast. Transo was in charge of all maritime and coastal transportation of crude and petroleum products, using its own and chartered ships. Serpetro provided technical assistance to the petroleum industry in general and sought new investors under exploration and production contracts. Peruana de Gas, 85% owned by Petroperú, competed in the domestic marketing of liquid petroleum gas and electric and gas appliances.

For the seventh consecutive year, crude oil reserves continued to declined to 457 million barrels by yearend; natural gas reserves, on the other hand, increased significantly with Shell Del Perú S.A.'s discovery in Bock 42 in the southern jungle region. In the Aguaytia Field in the central jungle region, scheduled to be developed in the near future, Petroperú expected to recover a total of 255 billion cubic feet of gas and 21 million barrels of condensate. In addition, Perú has proven gas reserves in the coastal and offshore fields in the northwest amounting to 348 billion cubic feet by yearend.

Occidental Petroleum decided to increase its exploration budget in the jungle, following the settlement reached with the Government on an outstanding dispute over fees, taxes, and exchange rates to be applied to the company's financial operations in Peru. By yearend, Government officials announced a large oil find in Occidental's first wildcat, La Colpa IX, in its central jungle Block 36 concession. A spokeman for Occidental in Lima stated that the La Colpa find was a very positive indication of the presence of oil in the Ucayali basin, where Royal Dutch/Shell and Mobil Oil Corp. had previously detected the existence of natural gas. Following a heated dispute over the right of Royal Dutch/Shell to develop the Camisea Gasfields discovered by the company in the central southern jungle, with estimated reserves of 10 trillion cubic feet of natural gas and around 600 million barrels of condensate, the Government decided to call for international bids rejecting the legal complaint made by Shell to regain control of Blocks 38 and 42, where $175 million of exploration work led to the discovery of the gas reservoir. While Shell maintained that negotiation for the $1.3 billion natural gas development project had not terminated, Petroperú argued that the Dutch company had failed to start developing the gas find. Exxon Corp. of Houston was unable to reach agreement with Petroperú over its payment for the Belco Petroleum assets expropriated by Peru in 1985. The Government made an offer of $147 million, provided the money was invested in Peru. The company was reported to be ready to accept the conditions but disputed the amount, which they claimed should be in the order of $400 million.

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[1] Prepared by Orlando Martino, physical scientist, Division of International Minerals.

[2] Prepared by Ivette E. Torres, physical scientist, Division of International Minerals.

[3] U.S. Embassy, La Paz, Bolivia. Industrial Outlook Report—Minerals. State Dept. Airgram A-12, July 6, 1989.

[4] ———. Economic Trends Report. State Dept. Airgram A-09, May 18, 1989.

[5] Where necessary, values have been converted from Bolivianos ($b) to U.S. dollars at the rate of $b2.4=US$1.00.

[6] Where necessary, values have been converted from Deutsche Mark (DM) to U.S. dollars at the rate of DM1.78=US$1.00.

[7] U.S. Embassy, La Paz, Bolivia. Industrial Outlook Report for Hydrocarbons and Natural Gas. State Dept. Airgram A-10, June 13, 1989.

[8] Prepared by Alfredo C. Gurmendi, physical scientist, Division of International Minerals.

[9] Where necessary, values have been converted from Ecuadorian Sucres (S/.) to U.S. dollars at the rate of S/459=US$1.00.

[10] Prepared by Pablo Velasco, physical scientist, Division of International Minerals.

[11] Where necessary, values have been converted from Peruvian intis (I/) to U.S. dollars at the financial or banking rate of I/312.50=US$1.00.

THE MINERAL INDUSTRY OF

CANADA[1]

By Alfredo C. Gurmendi[2]

INTRODUCTION

The Canadian mining industry made impressive gains in 1988. This strong momentum was expected to continue through 1989. Mining is a thriving industry within the Canadian economy. Canada is among the world's mining leaders, but mining is not its leading industry; it contributes 25% of the total value of Canada's exports. In 1988, mining employed about 392,000 workers, an increase of 6,000 workers from 1987.

Canada is a lower cost mineral producer with improved productivity, high-quality mineral deposits, and substantial byproduct values. As an innovative mineral seller, Canada combined strong prices for base metals and high volumes of output for nearly all mineral and metal commodities and benefited from the market recovery. However, the energy sector was bleaker because of the stronger Canadian dollar, reduction or phase-out of Government incentives for exploration and drilling, and sharply lower energy prices.

The gross domestic product improved about 4.2%. The Consumer Price Index increased about 4.2%. Financial results were affected adversely by the firming of the Canadian dollar from 75.41 U.S. cents in 1987 to 81.25 U.S. cents in 1988. The unemployment rate averaged 7.8%, which was the lowest unemployment rate since 1981.

GOVERNMENT POLICIES AND PROGRAMS

The Federal-Provincial Mineral Development Agreements (MDA) with Newfoundland, Nova Scotia, New Brunswick, Manitoba, Saskatchewan, Prince Edward Island, Yukon Territory, and the Northwest Territories entered the fifth and final year in 1988. These MDA's could be extended, but no decision on an extension had been made yet. The MDA's with Quebec, Ontario, and British Columbia are to end in 1990.

Geological data bases generated under the Canada-Newfoundland MDA provided geologists with high potential target areas and improved understanding of gold environments in the Province.

The Canada-Nova Scotia MDA provided, in addition to geoscience projects, market, and feasibility and mineral commodity studies that were well received by the industry.

In New Brunswick, exploration interest was dominated by gold and was spurred by the availability of geological data produced under the Canada-New Brunswick MDA. Reports included studies on mineral aggregates, offshore mining, peat moss markets, and an evaluation of industrial minerals markets in the east coast area of the United States.

In Quebec, more than $20 million[3] was invested under the Canada-Quebec MDA in projects covering geoscience, mineral exploration, and infrastructure and feasibility studies to produce magnesium metal from asbestos tailings.

The $30 million Canada-Ontario MDA was in the fourth of 5 years. More than 250 projects were in progress or had been completed at yearend. Reports and maps produced under this MDA have been a major factor in increased exploration. Studies on backfill techniques and bulk mining at depth have led to reduced underground mining costs and increased safety and productivity, which were quite well received, particularly by the nickel industry.

An estimated $50 million in exploration activities resulted from the 5-year $24.7 million Canada-Manitoba MDA, which entered its fifth and final year in 1988.

The $6.38 million Canada-Saskatchewan MDA research and development programs, in cooperation with the Saskatchewan Potash Producers Association, contributed to the prevention of brine flow and to improved separation methods applicable in new or modified potash-processing plants.

The 5-year Canada-British Columbia MDA will expire in March 1990. Work continued on geoscience projects, environmental impact studies, infrastructure projects, and industrial mineral projects. Early in 1988, the British Columbia Provincial government passed a new Mineral Tenure Act (MTA) to streamline the acquisition of placer rights and to reinforce environmental safeguards by increasing monitoring and inspection.

The Canada-Yukon MDA contributed geochemical surveys and research in placer methods leading to improved gold recoveries. The Yukon Government and native leaders met in December 1988 to resolve outstanding land claim issues in the Council for Yukon Indians. An agreement-in-principle was expected to be signed in 1989.

The National Transportation Act of 1987 and the Motor Vehicle Transport Act of 1987 became effective on January 1, 1988. Both acts reduced shipping costs for the mineral industry.

The Free Trade Agreement (FTA) between the United States and Canada was to take effect on January 1, 1989. The agreement signals a new period in international trade when bilateral and regional (European Community) trade accords assume greater importance in setting the trends and rules of international commerce. The FTA was the culmination of more than 100 years of trade negotiations between the two countries to reduce tariffs. The FTA will give continuity to their trading relations. The elements of the FTA pertaining to minerals and metals include tariff elimination, creation of trading rules on services, rules on investment and energy, and the means to resolve trade disputes.

The Canadian exploration program, called flow through financing, allowed the tax credit for exploration expenditures to flow through to the shareholders of a corporation. The earned depletion allowance also flowed through to the investor. The introduction of the Mining Exploration Depletion Allowance (MEDA) in 1983–84 had a dramatic impact on mine exploration and development. Exploration expenditures totaled $513 million in 1986, $1.09 billion in 1987, and about $840 million in 1988. The program allowed the investor to deduct depletion in the year it was earned from income of any source.

The sale of flow-through shares has raised $3 billion for exploration from 1983 to 1988. Where exploration was financed at least in part with flow-through shares, mineral deposits have either come into production since 1983 or are currently being prepared for production. At least 17 of the 25 new commitments in 1988 are for gold projects. During the 1975–87 period, emphasis on base metal projects declined from 62.6% of total mineral exploration expenditures in 1975 to 13% in 1987. Expenditures on exploration for precious metals (gold, silver, and platinum-group metals) increased from 6.7% in 1975 to 82% in 1987.

The new Canadian Exploration Incentive Program (CEIP) instituted on July 21, 1988, replaced MEDA as of January 1, 1989. Only those exploration expenditures that have been financed by flow-through shares will be eligible for CEIP. The program provides a Government grant equal to 30% of eligible exploration expenses up to $8.4 million per year; the depletion allowance will be reduced to 16% beginning on January 1, 1990. The new CEIP was expected to reduce exploration activity, particularly when Canada has an urgent need of more exploration for copper, lead, zinc, and nickel to replenish its declining ore reserves.

PRODUCTION

The value of total mineral output, including metals, industrial minerals, and fuels, increased by almost 10% from 1987 to $30.1 billion. According to the Canadian Department of Energy, Mines and Resources (EMR), the metals sector had an extraordinary performance with its output value reaching $10.8 billion, an increase of 36%. The output value of industrial minerals grew to $4.0 billion, an increase of 16%. The value of structural materials was $2.3 billion, an increase of 9.5%. The total nonfuel sector value increased to $15.7 billion, an increase of 29%. The value of fuels produced, excluding uranium, decreased by $800 million or 12%, mainly as a result of lower oil prices. Nevertheless, this sector, which included oil, natural gas, natural gas byproducts, and coal, contributed $14.5 billion or 48% of the total value of Canadian production. The dollar values of gold, uranium, lead, sulfur, oil, and natural gas byproducts were adversely affected by a combination of the decrease in market prices and by the firming of the Canadian dollar.

The 10 leading mineral commodities, based on value of output, were petroleum, natural gas, nickel, copper, gold, zinc, coal, natural gas byproducts, iron ore, and uranium. The text tables show the production values of the Provinces and Territories in billion dollars and the values of principal mineral production in million dollars.

Province or Territory	1987	1988[p]
Alberta	12.9	12.1
Ontario	4.2	5.8
British Columbia	2.7	3.2
Saskatchewan	2.4	2.5
Quebec	2.1	2.2
Manitoba	.8	1.3
Northwest Territories	.7	.8
Newfoundland	.5	.7
New Brunswick	.5	.7
Yukon	.3	.4
Nova Scotia	.3	.4
Prince Edward Island	(1)	(1)
Total	**27.4**	**30.1**

[p] Preliminary.
[1] Less than 1/2 unit.

Source: Energy, Mines and Resources Canada, Ottawa, 1988.

Commodity	1987[r]	1988[p]
Metals:		
Nickel	960	2,646
Copper	1,450	1,883
Gold	1,663	1,800
Zinc	1,112	1,678
Iron ore	1,053	1,128
Uranium	891	900
Silver	320	307
Lead	298	271
Platinum-group	137	140
Molybdenum	95	88
Total[1]	**7,979**	**10,841**
Industrial Minerals:		
Potash	562	860
Cement	752	823
Sand and gravel	580	636
Stone	440	488
Sulfur, elemental	394	375
Asbestos	179	218
Salt	180	210
Lime	127	154
Clay products	159	150
Gypsum	66	72
Sulfur in smelter gas	60	60
Total[1]	**3,499**	**4,046**
Mineral Fuels:		
Petroleum, crude	9,156	7,597
Natural gas	3,480	4,041
Coal	1,238	1,550
Natural gas byproducts	1,415	1,308
Total[1]	**15,289**	**14,496**

[p] Preliminary. [r] Revised.
[1] Data may not add to totals shown because of independent rounding.

Source: Energy, Mines and Resources, Canada, Ottawa, 1988.

The Canadian minerals industry improved its performance as a result of reduced production costs, increased productivity, and higher commodity prices, especially for base metals.

New projects announced to be brought on-stream will require capital expenditure of more than $610 million. One-half of this new investment will be for gold projects; 17 of the 25 new projects committed for production will be gold mines. Since 1977, 160 mineral deposits

TABLE 1

CANADA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987	1988[p]
METALS						
Aluminum:						
Alumina, gross weight	thousand tons	1,126	1,019	1,100	953	950
Metal:						
Primary		1,227,000	1,282,316	1,364,000	1,530,000	1,530,000
Secondary		64,000	65,000	68,000	69,000	69,000
Antimony[e 2]		554	1,075	3,805	[r]3,706	2,977
Bismuth[3]		166	201	153	165	195
Cadmium[4]		1,605	1,717	1,484	1,481	1,742
Calcium	kilograms	W	W	W	W	W
Cobalt:						
Mine output, Co content[5]		2,325	2,067	2,486	2,490	2,764
Metal[6]		2,213	2,023	1,990	2,200	2,200
Columbium and tantalum:						
Pyrochlore concentrate:						
Gross weight		4,400	4,944	5,216	4,304	5,321
Cb content		1,987	2,223	2,340	1,937	2,357
Tantalite concentrate:						
Gross weight		—	—	—	—	91
Ta content		—	—	—	—	27
Copper:						
Mine output, recoverable Cu content[7]		721,826	738,637	698,527	794,149	756,480
Metal, primary and secondary:						
Blister and anode		470,600	489,700	472,700	499,400	537,000
Refined		504,252	499,626	493,445	491,178	528,723
Gold	thousand troy ounces	2,683	2,815	3,308	3,724	4,110
Iron and steel:						
Iron ore:[8]						
Gross weight	thousand tons	39,930	39,502	36,167	37,702	38,742
Fe content	do.	25,156	24,847	22,785	23,658	24,300
Metal:						
Pig iron	do.	9,643	9,665	9,249	9,500	9,500
Ferroalloys	do.	216	227	240	260	260
Steel, crude	do.	14,715	14,600	14,100	14,700	14,500
Lead:						
Mine output, Pb content		264,301	284,600	349,281	413,685	368,444
Metal, refined:						
Primary		173,000	173,220	169,934	139,475	179,461
Secondary		79,000	68,384	87,746	91,186	89,863
Lithium: Spodumene[9]		[r]1,300	[r]4,600	7,500	11,500	14,000
Magnesium metal, primary[e]		8,000	7,000	7,000	7,000	7,000
Molybdenum		11,557	7,852	11,251	14,771	12,388
Nickel:						
Mine output, Ni content[10]		173,725	169,971	163,639	189,086	198,960
Metal, plant production[11]		111,591	108,041	111,279	131,500	151,300

See footnotes at end of table.

TABLE 1—Continued

CANADA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987	1988[p]
METALS—Continued						
Platinum-group metals	troy ounces	333,363	338,676	391,917	433,681	368,386
Selenium, refined[12]	kilograms	463,000	361,000	354,000	300,000	300,000
Silver	thousand troy ounces	42,655	38,484	34,979	44,207	44,094
Tellurium, refined[12]	kilograms	21,000	19,000	20,000	13,000	10,000
Tin, mine output, Sn content		217	120	2,450	3,390	3,300
Titanium:						
Ilmenite, gross weight	thousand tons	1,800	2,500	2,400	2,800	2,800
Sorel slag (80% TiO_2)[13]		[r]726,000	[r]844,000	850,000	925,000	1,025,000
Tungsten, mine output, W content		3,715	3,174	1,416	—	—
Uranium oxide (U_3O_8)		12,113	12,312	13,564	15,560	15,130
Zinc:						
Mine output, Zn content		1,207,098	1,172,200	1,290,765	1,504,412	1,351,664
Metal, refined, primary		683,156	692,418	570,981	609,909	703,206
INDUSTRIAL MINERALS						
Asbestos	thousand tons	837	750	662	665	705
Arsenic trioxide[e] [14]		3,000	3,000	3,000	2,000	2,000
Barite		64,197	71,049	40,000	42,000	54,000
Cement, hydraulic[15]	thousand tons	9,240	10,192	10,602	12,590	12,611
Clays and clay products[16]	value, thousands	$100,200	$138,246	$180,353	$159,000	$150,600
Diatomite[e]		4,000	3,800	4,100	4,200	4,200
Gypsum and anhydrite	thousand tons	7,756	8,447	8,803	9,094	8,522
Lime	do.	2,266	2,212	2,243	2,330	2,535
Magnesite, dolomite, brucite		69,000	136,000	144,000	150,000	150,000
Mica, scrap and flake		10,881	11,500	12,000	13,500	12,000
Nepheline syenite		521,000	467,000	469,000	500,000	500,000
Nitrogen: N content of ammonia		3,493,464	3,620,286	3,540,000	3,511,719	4,010,161
Potash, K_2O equivalent	thousand tons	7,527	6,661	6,752	7,668	8,070
Pyrite and pyrrhotite, gross weight[e]		5,000	6,000	6,000	5,000	5,000
Salt	thousand tons	10,235	10,085	10,332	10,129	10,975
Sand and gravel	do.	233,759	256,183	257,971	278,550	276,100
Silica (quartz)		2,624	2,669	2,640	2,560	2,600
Sodium compounds, n.e.s.:						
Sodium carbonate[e]		365,000	350,000	350,000	325,000	325,000
Sodium sulfate, natural[17]		389,000	366,000	371,000	342,000	310,000
Stone[18]	thousand tons	81,754	86,632	97,602	113,300	112,400
Sulfur:						
Elemental byproduct:						
Of smelter gases	do.	875	822	758	723	820
Of sour natural gas	do.	5,260	5,306	6,966	5,809	5,915
Of refineries[e]	do.	165	174	189	190	200
Of tar sands	do.	296	392	435	426	400
Talc, soapstone, pyrophyllite		126,000	127,000	123,000	141,000	140,000
MINERAL FUELS AND RELATED MATERIALS						
Carbon black		176,543	173,022	154,418	160,000	180,697
Coal:						
Bituminous and subbituminous		47,510,000	[r]51,000,000	48,700,000	51,200,000	57,500,000
Lignite		9,918,000	9,672,329	8,281,312	10,000,000	12,000,000

See footnotes at end of table.

TABLE 1—Continued

CANADA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987	1988[p]
MINERAL FUELS AND RELATED MATERIALS—Continued						
Coke, high-temperature		4,900,478	4,683,770	4,552,600	4,636,629	4,663,000
Gas, natural:						
Gross	million cubic feet	3,173,708	3,250,000	3,214,000	3,525,000	3,896,000
Marketed	do.	2,505,818	2,831,200	2,695,680	2,844,700	3,144,100
Natural gas liquids:						
Gross:						
Butane	thousand 42-gallon barrels	30,492	20,068	18,733	[e]20,000	20,000
Propane	do.	37,322	32,656	31,288	[e]30,000	30,000
Pentanes plus	do.	34,513	36,654	36,932	[e]36,000	40,000
Ethane	do.	35,765	34,664	32,444	[e]30,000	30,000
Condensate	do.	1,057	1,043	828	[e]900	1,000
Total	**do.**	**139,149**	**125,085**	**120,225**	**[e]116,900**	**121,000**
Peat		541,000	643,000	738,000	648,000	708,000
Petroleum:						
Crude[19]	thousand 42-gallon barrels	526,350	538,200	538,000	560,000	584,000
Refinery products:						
Gasoline:						
Aviation	do.	1,297	1,131	2,214	[e]1,600	2,200
Other	do.	203,797	203,793	201,115	[e]202,000	200,000
Jet fuel	do.	26,434	27,707	30,660	[e]30,000	30,000
Kerosene	do.	13,831	13,573	14,235	[e]14,000	14,000
Distillate fuel oil, diesel and light	do.	145,497	140,334	143,810	[e]135,000	140,000
Residual fuel oil, heavy	do.	54,723	44,240	41,975	[e]40,000	40,000
Lubricants	do.	5,808	5,755	6,205	[e]6,000	6,000
Liquefied petroleum gas, propane and butane	do.	21,041	20,421	27,375	[e]18,000	27,000
Petrochemical feedstocks	do.	27,527	27,595	37,836	[e]34,000	35,000
Asphalt	do.	16,108	18,236	19,286	[e]18,000	19,000
Petroleum coke, Unspecified	do.	30,922	41,244	35,929	[e]32,000	30,000
Refinery fuel and losses	do.	12,823	24,872	33,215	[e]30,000	30,000
Total	**do.**	**559,808**	**568,901**	**593,855**	**[e]560,600**	**573,200**

[e]Estimated. [p]Preliminary. [r]Revised. W Withheld to avoid disclosing company proprietary data.
[1] Table includes data available through May 1989.
[2] Sb content of antimonial lead alloys, flue dust, and dore slag estimated on the basis of reported gross production.
[3] Refined metal and bullion from domestic ores plus recoverable Bi content of exported concentrates.
[4] Refined metal from domestic ores plus recoverable Cd content of exported ores and concentrates.
[5] Actual output not reported. Data represent the Co content of all products derived from ores of Canadian origin, including nickel oxide sinter shipped to the United Kingdom and nickel-copper-cobalt matte shipped to Norway for further processing.
[6] Actual output not reported. Data represent the output within Canada of metallic cobalt from ores of both Canadian and non-Canadian origin.
[7] Blister copper from domestic ores plus recoverable Cu content of exported matte and concentrates.
[8] Series represent gross weight and metal content of usable iron ore as mine shipments.
[9] Based on all of Canada's spodumene concentrates (Tantalum Mining Corp. of Canada Ltd.'s Tanco property.)
[10] Refined nickel from domestic ores plus recoverable Ni content of exported matte.
[11] Includes metallic nickel, nickel oxide, Incomet, nickel powder and pellets, utility nickel, nickel carbonate, and nickel residue.
[12] From all sources, including imports and secondary sources.
[13] Refined sorel slag contained 80% TiO_2 in 1984–88.
[14] Refined arsenic (AS_2O_3) from Nerco's Con Mine in Yellow Knife, Northwest Territories.
[15] Cement shipped and/or used by producers.
[16] Includes bentonite products from common clay, fire clay, stoneware clay, and other clays.
[17] Excludes byproduct production from chemical plants.
[18] Crushed, building, ornamental, paving, and similar stone.
[19] Including synthetic crude (from oil shale and/or tar sands).

with promising production potential have been discovered. In 1977, only 1 promising deposit out of 10 was a gold deposit; in 1988, 9 out of 10 were gold deposits.

TRADE

The Free Trade Agreement (FTA) between the United States and Canada, signed on January 2, 1988, was the major trade event of the year. The agreement was the central issue of a parliamentary election in November 1988 and was ratified by the Canadian Senate in December 1988.

The FTA was intended to eliminate tariffs and to substantially reduce other impediments to bilateral trade in goods and services between the United States and Canada within 10 years. The FTA agreement was planned to promote fair competition and liberalize trade in several areas, including agricultural, automobiles, energy, financial services, and Government procurement; liberalize conditions for investment; establish effective administrative procedures and lay the foundation for further bilateral and multilateral cooperation.

The FTA, effective on January 1, 1989, specified phasing out tariffs on metals and industrial minerals trade between the two countries over a 5- to 10-year period (see the FTA tariffs schedule). In 1988, about 70% of all Canadian goods and 85% of minerals and mineral products entered the United States duty free.

The FTA does not eliminate subsidies on either side of the border. It called for a 5-year study of subsidies, which can be extended 2 years for negotiations. In the meantime, antidumping and countervailing duty-trade laws in both countries would remain in effect.

More than 70% of Canada's exports entered the United States, although 22% of U.S. exports went to Canada. About one-third of the 1988 bilateral

Commodity	Existing tariffs[1] (percent)		Phaseout
	Canada	United States	
METALS			
Chromium	10.2	3.7	5-year elimination starting Jan. 1, 1989; 20% reduction per year.
Cobalt	10.2	5.5	Do.
Columbium (niobium)	4.0	4.9	Do.
Copper:			
Refined	10.3	1.0	Do.
Alloys	10.2	1.0	10-year elimination starting Jan. 1, 1989; 10% reduction per year.
Ferroalloys:			
Ferromolybdenum	10.2	4.5	5-year elimination starting Jan. 1, 1989; 20% reduction per year.
Ferrosilicon chromium	10.2	10.0	Immediate lifting of tariffs on Jan. 1, 1989.
Ferrotitanium	10.2	3.7	5-year elimination starting Jan. 1, 1989; 20% reduction per year.
Ferrotungsten and ferrosilicon tungsten	10.2	5.6	Do.
Ferrovanadium	10.2	4.2	Do.
Minor metals:			
Beryllium, waste and scrap	10.2	8.5	Do.
Germanium, unwrought	10.2	3.7	Do.
Magnesium containing at least 99.8% by weight of Mg	4.0	8.0	10-year elimination starting Jan. 1, 1989; 10% reduction per year.
Lead:			
Refined (metal content)	10.2	3.5	Do.
Oxide	12.5	15.0	5-year elimination starting Jan. 1, 1989; 20% reduction per year.
Rare-earth metals	12.5	3.7	5-year elimination starting Jan. 1, 1989; 20% reduction per year.
Vanadium	10.2	3.0	Do.
Zinc:			
Refined	—	1.5	10-year elimination starting Jan. 1, 1989; 10% reduction per year.
INDUSTRIAL MINERALS			
Granite, cut	5.5	4.2	5-year elimination starting Jan. 1, 1989; 20% reduction per year.
Graphite, powder	9.2	—	Do.
Gypsum, wallboard	9.4	2.4	10-year elimination starting Jan. 1, 1989; 10% reduction per year.

[1] Tariff rates under the General Agreement on Tariffs Trade (GATT).

TABLE 2

CANADA: RELATIVE IMPORTANCE OF MINERAL PRODUCTION IN 1988, BY COMMODITY

(Percent)

Commodity	Share of total value[p]
Petroleum, crude	25.2
Natural gas	13.4
Nickel	8.8
Copper	6.2
Gold	6.0
Zinc	5.6
Coal	5.1
Natural gas byproducts	4.3
Iron ore	3.7
Uranium	3.0
Potash	2.9
Cement	2.7
Sand and gravel	2.1
Others	11.0
Total	**100.0**

[p] Preliminary.

Source: Energy, Mines and Resources Canada, Ottawa, 1988.

trade, valued at $150 billion, was freely exchanged. Reducing restrictions on the rest was expected to make both economies more efficient. The Economic Council of Canada, a research organization of the Federal Government, forecast that by 1998 free trade would bring a net gain of 251,000 jobs to Canada, increasing employment by almost 2% and Canada's gross national product by 2.5%. The U.S. Department of Commerce estimated that the elimination of tariffs alone would result in a $25 billion increase in trade between the two countries over a 5-year period, with more than 14,000 new U.S. jobs created.

U.S. exports to Canada amounted to $69.2 billion, of which $2.9 billion was mineral related. U.S. imports from Canada amounted to $80.9 billion, of which $15.1 billion was composed of metals, metal products, oil, and natural gas.

COMMODITY REVIEW

Metals

Aluminum.—The Canadian aluminum industry benefited from higher prices, cheap hydroelectric power, lower operating costs, and increased productivity. The stabilization of inventories, expectations of additional production from smelter projects to be completed in 1991, and labor agreements caused prices to moderate toward yearend. Production of primary aluminum decreased 1% although shipments of aluminum to the United States increased 11% to a new level of 893,000 tons.

At yearend, Canadian smelters were operating at full capacity, with the exception of Alcan Aluminium Ltd.'s Arvida plant in Jonquière, Quebec, which operated at 88% of its 432,000-ton capacity.

In 1988, as a result of a favorable climate for the aluminum industry in Canada and firm worldwide demand, Alcan reported a record high net income of $931 million, an increase of $498 million from 1987.

Two important projects were undertaken to ensure Alcan's position as the lowest cost aluminum producer in the world. Construction began on a new 200,000-ton-per-year smelter at Laterrière, Quebec. The new smelter was projected to cost $600 million and will replace part of the Soderbeg facility at the Arvida smelter. It will result in a 60% reduction in polycyalic aromatic hydrocarbon (PAH) emissions and appreciable savings in energy and labor. Production from the first of four 50,000-ton-per-year potlines was expected to begin in 1989. The project will be completed in 1991. Alcan also announced that expansion of the Kemano, British Columbia, hydroelectric plant will begin in 1989. The additional capacity of 520 megawatts in the Kemano plant will cost $480 million. When the plant expansion is completed in 1994, Alcan planned to sell surplus power to BC Hydro & Power Authority, the Provincially owned utility.

Construction has begun on a $30 million facility at Jonquière, Quebec, for production of 12,000 tons per year of aluminum and ceramic composites which offer superior strength and stiffness at a low cost.

Aluminerie de Bécancour announced in late 1988 that it would proceed with a 120,000-ton-per-year expansion of its smelter in Quebec, beginning in May 1989. This expansion was projected to cost $550 million. Total expenditure will amount to $1.4 billion and the work force will increase from 775 to 1,000 employees. Initial production from the 360,000-ton-per-year expanded facility was expected to start in January 1991.

A consortium of Société Générale de Financement du Quebec (SGF), Reynolds Metals Co., Austria Metal AG, Mitsubishi Metal Corp., Kobe Steel Ltd., and Yoshida Kogyo KK Quebec, undertook a feasibility study for a new 270,000-ton-per-year aluminum smelter at Sept-Îles, Quebec.

In Manitoba, Alumax Inc. and the Provincial government held discussions for the possible establishment of a new smelter. According to Alumax, Manitoba was just one of several possible locations including sites in Quebec, British Columbia, Iceland, and Venezuela.

Connecticut Metal Industries Inc. of the United States and Exalloy Metals of Canada announced, in October 1988, that they would construct a pilot plant in Toronto, Ontario, to recycle plastic-coated aluminum scrap. The facility was expected to process 90 metric tons per month. Environmental protection remained a high priority in the facility's current operations and planned investments.

Copper.—The price of copper on the London Metal Exchange (LME) increased late in 1988 because of labor strikes in Peru, strong world demand, and falling inventories. The average LME price was $1.18 per pound. Canadian copper producers benefited

TABLE 3

CANADA: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986[r]	1987	Destinations, 1987	
				United States	Other (principal)
METALS					
Aluminum:					
Ore and concentrate		45,434	45,625	38,327	United Kingdom 2,900; West Germany 2,027.
Metal including alloys:					
Scrap		125,019	127,181	107,601	Japan 16,315; United Kingdom 868.
Unwrought		1,163,875	1,171,888	859,301	NA.
Semimanufactures		59,953	98,448	82,924	Belgium-Luxembourg 8,405; Bahrain 1,382.
Cadmium: Metal including alloys, all forms[2]		1,383	1,157	875	United Kingdom 175; Netherlands 80.
Cobalt: Oxides and hydroxides		374	440	—	All to United Kingdom.
Copper:					
Ore and concentrate, Cu content		341,392	381,123	221	Japan 273,535; China 25,861; Republic of Korea 15,980.
Metal including alloys:					
Scrap		70,755	72,102	56,003	West Germany 3,315; Republic of Korea 2,311.
Unwrought		306,891	288,811	197,815	United Kingdom 39,381; Sweden 9,620.
Semimanufactures		50,962	58,596	48,469	India 1,954; Venezuela 1,613.
Gold:[2]					
Ore and concentrate, Au content	troy ounces	234,764	276,689	1,286	Japan 200,524; West Germany 23,952; Belgium-Luxembourg 13,664.
Metal including alloys, unwrought and partly wrought	thousand troy ounces	5,321	2,245	1,464	Japan 460; Belgium-Luxembourg 231.
Iron and steel:					
Iron ore and concentrate:					
Excluding roasted pyrite	thousand tons	30,995	29,662	8,861	United Kingdom 7,045; West Germany 3,032.
Pyrite, roasted		34,722	16,896	16,896	
Metal:					
Scrap	thousand tons	921	1,087	777	Republic of Korea 118; Thailand 42.
Pig iron, cast iron, related materials		556,610	500,355	223,302	Netherlands 183,822; Spain 29,866.
Ferroalloys:					
Ferromanganese		45,132	23,103	23,048	Japan 55.
Unspecified		57,842	38,362	26,466	Japan 7,901; United Kingdom 1,872.
Steel, primary forms		233,428	104,756	91,536	Turkey 12,191; Netherlands 643.
Semimanufactures:					
Bars, rods, angles, shapes, sections		1,074,692	1,053,616	1,032,283	Thailand 7,656; Mexico 2,610.
Universals, plates, sheets		1,486,148	1,755,533	1,443,324	Thailand 88,319; Mexico 34,147.
Rails and accessories		103,586	189,457	40,974	Mexico 69,002; India 24,766.
Wire		193,888	195,376	193,382	Republic of South Africa 300; New Zealand 207.
Tubes, pipes, fittings		367,048	492,356	484,108	Pakistan 1,605; United Kingdom 1,257.

See footnotes at end of table.

TABLE 3—Continued

CANADA: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986[r]	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
METALS—Continued					
Iron and steel—Continued					
Metal—Continued					
Castings and forgings, rough		120,804	139,142	138,336	United Kingdom 272; West Germany 189.
Lead:					
Ore and concentrate, Pb content		118,375	207,938	8,607	Japan 64,165; Belgium-Luxembourg 52,259; Australia 29,283.
Metal including alloys:					
Scrap		25,564	21,970	4,264	Brazil 11,881; West Germany 1,051.
Unwrought		111,853	100,207	62,994	United Kingdom 19,423; Italy 5,959.
Semimanufactures		23,225	23,583	16,236	Brazil 4,108; Japan 1,117.
Magnesium: Metal including alloys, semimanufactures		4,767	4,627	988	United Kingdom 1,134; Japan 1,076.
Nickel:					
Ore and concentrate including matte, Ni content[2]		57,780	56,558	—	Norway 30,798; United Kingdom 25,760.
Oxides, Ni content[2]		13,917	20,715	NA	NA.
Metal including alloys:					
Scrap		6,252	7,663	4,607	Finland 1,082; Netherlands 839.
Unwrought		86,057	96,165	—	NA.
Semimanufactures		10,880	14,818	11,196	Japan 1,233; Netherlands 419.
Platinum-group metals: Metals including alloys, unwrought and partly wrought	value, thousands	$22,717	$23,881	$7,706	United Kingdom $13,134; Singapore $1,614.
Silver:					
Ore and concentrate[3]	do.	$185,210	$243,636	$3,031	Japan $114,555; United Kingdom $71,327; Belgium-Luxembourg $15,189.
Waste and sweepings[3]	do.	$82,353	$95,475	$64,736	United Kingdom $15,270; West Germany $12,041.
Metal including alloys, unwrought and partly wrought	do.	$233,906	$124,144	$122,565	Singapore $737; France $320.
Tin:					
Ore and concentrate, Sn content		3,725	2,783	55	United Kingdom 2,422; Mexico 216; Malaysia 90.
Titanium: Metal including alloys, all forms[2]		605	495	495	
Uranium and thorium: Ore and concentrate	value, thousands	$120,217	$209,843	$171,011	United Kingdom $19,480; France $18,070.
Zinc:					
Ore and concentrate, Zn content		450,252	613,180	33,792	Belgium-Luxembourg 259,161; Japan 111,249; Italy 47,822.
Metal including alloys:					
Unwrought		427,175	441,220	342,968	United Kingdom 26,154; China 10,482.
Semimanufactures		5,103	8,909	5,140	Hong Kong 2,367; China 577.

See footnotes at end of table.

TABLE 3—Continued

CANADA: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986[r]	1987	Destinations, 1987	
				United States	Other (principal)
METALS—Continued					
Other:					
Ores and concentrates		166,610	130,366	13,790	Italy 59,430; West Germany 20,097; Japan 16,854.
Ashes and residues		47,798	59,748	25,101	Japan 7,282; West Germany 3,440.
Base metals including alloys, all forms		2,915	2,565	1,731	United Kingdom 332; Belgium-Luxembourg 127.
INDUSTRIAL MINERALS					
Abrasives, n.e.s.:					
Natural: Corundum, emery, pumice, etc.		265	1,388	1,384	NA.
Artificial:					
Corundum		127,552	139,926	129,101	United Kingdom 10,105; West Germany 490.
Silicon carbide	value, thousands	$52,225	$66,263	$60,062	Japan $1,694; West Germany $931.
Dust and powder of precious and semiprecious stones	do.	$204	$507	$507	
Grinding and polishing wheels and stones	do.	$6,297	$8,363	$7,189	West Germany $315; New Zealand $222.
Asbestos, crude		717,703	648,843	84,223	Japan 87,321; Thailand 34,411.
Barite and witherite		6,627	6,052	5,852	Madagascar 200.
Cement	value, thousands	$141,571	$146,984	$145,860	Cuba $331; United Kingdom $172.
Clays, crude		2,269	6,868	2,060	Finland 4,130; West Germany 259.
Diamond:					
Gem, not set or strung	value, thousands	$22,914	$27,443	$13,393	Israel $7,250; Belgium-Luxembourg $5,291.
Industrial stones	do.	$550	$336	$270	Belgium-Luxembourg $27; Ireland $27.
Feldspar, fluorspar, related materials		338,260	356,144	318,743	Netherlands 21,028; Australia 6,017.
Fertilizer materials:					
Manufactured:					
Ammonia	thousand tons	930	1,317	1,269	Philippines 12; Republic of South Africa 12.
Nitrogenous	do.	1,740	1,923	1,440	China 159; Australia 75.
Phosphatic		21,879	34,979	29,596	Philippines 5,018; New Zealand 75.
Potassic	thousand tons	9,894	10,984	6,029	China 794; Brazil 654.
Unspecified and mixed	do.	257	243	214	Jamaica 10; Portugal 8.
Gypsum and plaster		5,942,849	5,723,359	5,723,176	Comoros 143; West Germany 21.
Lime		189,693	163,777	163,637	Bermuda 99; Australia 34.
Magnesium compounds: Magnesite, crude	value, thousands	$29,913	$24,847	$20,563	West Germany $987; Mexico $631.
Pigments, mineral: Iron oxides and hydroxides, natural and processed		16,216	17,532	17,373	Brazil 106; Philippines 25.
Precious and semiprecious stones other than diamond, synthetic	value, thousands	$10,262	$9,072	$5,915	United Kingdom $455; Belgium-Luxembourg $392.
Salt and brine	thousand tons	2,553	1,960	1,955	St. Pierre and Miquelon 2; Barbados 1.

See footnotes at end of table.

TABLE 3—Continued

CANADA: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986[r]	1987	Destinations, 1987 United States	Destinations, 1987 Other (principal)
INDUSTRIAL MINERALS—Continued					
Sodium compounds, n.e.s.: Sulfate, natural[2]		233,390	168,095	150,840	New Zealand 17,113; unspecified 142.
Stone, sand and gravel:					
Dimension stone:					
Crude and partly worked		400,399	874,273	812,387	Jamaica 29,711; Cuba 10,675.
Worked	value, thousands	$22,700	$24,569	$20,463	Japan $2,883; United Kingdom $529.
Dolomite, chiefly refractory-grade		728,722	506,746	506,746	
Limestone other than dimension		1,350,344	1,709,508	1,709,501	United Kingdom 7.
Quartz and quartzite		88,394	60,681	60,681	
Sand other than metal-bearing		249,879	414,849	392,393	Cuba 22,232; France 128.
Sulfur:					
Elemental, crude including native and byproduct	thousand tons	6,257	6,572	766	Morocco 1,366; Brazil 547.
Sulfuric acid		755,651	804,395	804,347	St. Christopher and Nevis 27; Mexico 18.
Other: Slag and dross, not metal-bearing	value, thousands	$169,377	$171,580	$48,018	West Germany $35,115; France $35,054.
MINERAL FUELS AND RELATED MATERIALS					
Coal:					
Briquets of anthracite and bituminous coal		13	75	75	
All grades excluding briquets	thousand tons	25,900	25,466	278	Japan 16,625; Republic of Korea 3,766; Brazil 1,182.
Coke and semicoke		108,807	152,245	148,758	Norway 3,487.
Peat including briquets and litter		535,129	477,507	436,604	Japan 35,113; United Kingdom 3,426.
Petroleum:					
Crude	thousand 42-gallon barrels	211,245	224,816	223,226	Japan 886; unspecified 704.
Refinery products:					
Liquefied petroleum gas	do.	168,571	214,008	213,974	Mexico 30; St. Pierre and Miquelon 3.
Gasoline, motor	do.	13,103	12,720	11,742	Japan 948; St. Pierre and Miquelon 26.
Distillate fuel oil	do.	22,660	30,109	27,912	Japan 885; Republic of Korea 412.
Lubricants	do.	544	435	414	Hong Kong 2; St. Pierre and Miquelon 2.
Residual fuel oil	do.	8,279	7,034	7,034	
Asphalt	do.	([4])	—	—	
Bituminous mixtures	do.	1,493	1,753	1,744	United Kingdom 4; Gambia 3.

[r] Revised. NA Not available.
[1] Table prepared by H. D. Willis.
[2] Energy, Mines and Resources Canada.
[3] May include other precious metals.
[4] Reclassified as bituminous mixtures.

TABLE 4

CANADA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986[r]	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS					
Alkali and rare-earth metals, unspecified		3,900	9,542	9,432	United Kingdom 96; Brazil 9.
Aluminum:					
Ore and concentrate	thousand tons	2,113	2,019	69	Guinea 493; Brazil 434; Guyana 363.
Oxides and hydroxides	do.	1,744	2,096	490	Australia 893; Jamaica 503.
Metal including alloys:					
Scrap		67,668	53,691	53,653	West Germany 38.
Unwrought		64,461	53,480	48,314	United Arab Emirates 1,224; Brazil 910.
Semimanufactures		173,561	207,342	175,937	France 9,471; Belgium-Luxembourg 6,255.
Antimony: Oxides[2]		1,278	1,526	551	United Kingdom 809; Belgium-Luxembourg 96.
Beryllium: Metal including alloys, all forms	value, thousands	$615	$375	$356	West Germany $18.
Chromium:					
Ore and concentrate, Cr content		15,975	13,546	6,117	Philippines 4,059; Republic of South Africa 1,187.
Oxides and hydroxides		2,476	2,978	1,304	West Germany 845; United Kingdom 456.
Cobalt: Oxides and hydroxides		31	38	17	United Kingdom 9; Finland 7.
Columbium and tantalum: Metal including alloys: Tantalum	value, thousands	$292	$1,167	$968	Japan $119; France $80.
Copper:					
Ore and concentrate, Cu content		53,148	45,153	5,881	Chile 18,836; Indonesia 8,076; Peru 6,881.
Matte and speiss, Cu content		1,996	1,346	920	Italy 426.
Metal including alloys:					
Scrap		65,768	69,322	65,127	Finland 3,505; France 349.
Unwrought		20,770	16,087	4,562	Zaire 11,506; Chile 17.
Semimanufactures		40,347	51,681	37,851	West Germany 2,737; Japan 2,633.
Gold:[2]					
Ore and concentrate, Au content	troy ounces	22,827	34,112	2,636	Peru 11,735; Chile 8,456; Indonesia 7,330.
Metal including alloys, unwrought and partly wrought	thousand troy ounces	3,702	1,927	1;511	Uruguay 206; Nicaragua 65.
Iron and steel:					
Iron ore and concentrate excluding roasted pyrite	thousand tons	5,367	5,213	4,905	Brazil 308.
Metal:					
Scrap	do.	750	779	777	Bermuda 1.
Pig iron, cast iron, related materials		18,063	16,123	16,109	United Kingdom 8; West Germany 3.
Ferroalloys:					
Ferrochromium[2]		39,045	44,121	14,117	Republic of South Africa 25,475; Finland 1,816.
Ferromanganese		20,283	39,607	4,944	Norway 13,200; Republic of South Africa 5,928; Mexico 5,230.

See footnotes at end of table.

TABLE 4—Continued

CANADA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986[r]	1987	Sources, 1987 United States	Sources, 1987 Other (principal)
METALS—Continued				
Iron and steel—Continued				
Metal—Continued				
Ferroalloys—Continued				
Ferrovanadium[2]	162	205	183	Austria 17; West Germany 5.
Unspecified	34,453	40,762	20,848	Republic of South Africa 5,997; Brazil 5,583.
Steel, primary forms	255,465	726,754	48,157	United Kingdom 246,225; Netherlands 155,632; Brazil 145,147.
Semimanufactures:				
Bars, rods, angles, shapes, sections	614,814	679,662	188,670	Spain 110,030; Brazil 65,068.
Universals, plates, sheets	875,091	919,406	271,443	West Germany 154,354; United Kingdom 100,746.
Hoop and strip	39,124	42,121	33,726	West Germany 4,759; Japan 1,104.
Rails and accessories	83,111	67,007	5,134	Japan 50,105; Belgium-Luxembourg 5,111.
Wire	60,536	61,683	19,714	Belgium-Luxembourg 9,483; France 8,132.
Tubes, pipes, fittings	154,578	166,775	64,473	Japan 33,434; United Kingdom 11,583.
Castings and forgings, rough	33,914	42,866	38,881	Italy 871; France 850.
Lead:				
Ore and concentrate, Pb content	38	158	127	Chile 31.
Oxides	2,148	5,524	5,157	Mexico 182; Republic of South Africa 162.
Metal including alloys:				
Scrap	61,530	74,152	73,821	Australia 281; United Kingdom 50.
Unwrought	4,309	12,600	6,075	Mexico 4,317; Japan 1,299.
Semimanufactures	545	1,342	1,277	Denmark 38; United Kingdom 25.
Magnesium: Metal including alloys:				
Scrap	378	173	173	
Unwrought	3,146	2,742	2,563	France 124; Norway 55.
Semimanufactures value thousands	$9,047	$13,791	$10,655	Norway $2,405; France $647.
Manganese:				
Ore and concentrate:				
Metallurgical-grade, Mn content	95,205	81,133	3,965	Gabon 25,078; Comoros 23,762; Republic of South Africa 12,444.
Oxides	6,027	5,399	3,854	Japan 1,245; Netherlands 117.
Mercury 76-pound flasks	2,234	957	957	
Molybdenum: Metal including alloys, all forms value, thousands	$1,485	$1,023	$767	Austria $130; West Germany $73.
Nickel:				
Ore and concentrate, Ni content	1,094	3,092	2,887	East Germany 188; United Kingdom 15.
Matte and speiss, Ni content	8,273	2,792	—	All from Australia.

See footnotes at end of table.

TABLE 4—Continued

CANADA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986[r]	1987	Sources, 1987	
				United States	Other (principal)
METALS—Continued					
Nickel—Continued					
Metal including alloys:					
Scrap		28,964	17,647	7,171	United Kingdom 6,485; Norway 2,244.
Unwrought		2,633	2,540	648	Norway 1,882; West Germany 8.
Semimanufactures		3,130	3,519	2,222	West Germany 929; United Kingdom 283.
Platinum-group metals: Metals including alloys, unwrought and partly wrought:					
Platinum	value, thousands	$26,954	$28,005	$20,437	United Kingdom $5,372; U.S.S.R. $2,174.
Silver:					
Ore and concentrate[3]	do.	$23,284	$40,677	$2,768	Peru $17,264; Chile $7,554.
Waste and sweepings[3]	do.	$451,173	$234,748	$226,666	United Kingdom $2,579; France $1,662.
Metal including alloys, unwrought and partly wrought	do.	$24,919	$27,449	$25,297	Chile $1,964; West Germany $89.
Tin:					
Ore and concentrate, Sn content		202	—	—	
Metal including alloys:					
Unwrought		3,881	3,767	1,765	Brazil 801; China 253.
Semimanufactures		132	89	78	Bolivia 10; Hong Kong 1.
Titanium:					
Ore and concentrate, Ti content[2]		2,894	19,311	2,101	Australia 16,321; Norway 889.
Oxides		7,863	10,312	4,776	West Germany 4,152; France 365.
Metal including alloys[2]		941	937	469	United Kingdom 403; Japan 66.
Tungsten:					
Ore and concentrate, W content		11	1	1	
Metal including alloys, all forms	value, thousands	$2,312	$2,236	$2,137	United Kingdom $41; Belgium-Luxembourg $24.
Uranium and thorium:					
Ore and concentrate	do.	$65,525	$62,532	$19,496	Australia $26,714; Republic of South Africa $6,365.
Metal including alloys, all forms	do.	$105	$84	$84	
Vanadium: Oxides[2]		1,177	1,410	136	Republic of South Africa 1,168; China 66.
Zinc:					
Ore and concentrate, Zn content		29,468	26,015	16,231	Chile 7,686; Peru 2,081.
Oxides		1,628	2,229	2,082	Mexico 100; Netherlands 25.
Metal including alloys:					
Scrap		544	466	266	Belgium-Luxembourg 200.
Unwrought		7,440	11,031	4,664	Spain 3,000; Belgium-Luxembourg 1,304.
Semimanufactures		1,263	2,631	1,373	West Germany 1,215; Italy 26.
Other:					
Ores and concentrates, metal content		25,183	16,278	4,511	Peru 3,403; Australia 3,247.

See footnotes at end of table.

TABLE 4—Continued

CANADA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986[r]	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS—Continued					
Other—Continued					
Oxides and hydroxides		19,361	19,008	17,665	United Kingdom 644; Japan 157.
Ashes and residues		36,021	26,019	25,638	United Kingdom 303; Chile 41.
Base metals including alloys, all forms	value, thousands	$59,371	$55,537	$37,022	Zaire $5,550; France $5,130.
INDUSTRIAL MINERALS					
Abrasives, n.e.s.:					
Natural: Corundum, emery, pumice, etc.		27,927	28,386	24,430	Turkey 2,100; Ecuador 796.
Dust and powder of precious and semiprecious stones	value, thousands	$2,105	$2,217	$1,749	U.S.S.R. $404; Ireland $46.
Grinding and polishing wheels and stones	do.	$23,733	$28,428	$16,704	Italy $4,693; West Germany $2,489.
Asbestos, crude		325	237	227	Zimbabwe 10.
Barite and witherite		10,525	4,660	3,672	Netherlands 901; China 87.
Boron materials:					
Crude natural borates	value, thousands	$460	$585	$582	Hong Kong $3.
Oxides and acids		5,148	4,620	4,221	Italy 375; Japan 20.
Cement		489,957	586,152	356,720	Spain 115,801; Greece 61,106.
Chalk	value, thousands	$711	$1,151	$1,083	West Germany $59; Belgium-Luxembourg $9.
Clays, crude		877,312	990,363	911,821	Greece 73,648; Italy 1,600.
Cryolite and chiolite		3,537	8,607	1,045	Netherlands 7,332; Denmark 230.
Diamond:					
Gem, not set or strung	value, thousands	$119,049	$126,178	$30,079	Belgium-Luxembourg $49,731; Israel $33,649.
Industrial stones	do.	$6,776	$9,579	$8,130	Ireland $1,293; United Kingdom $71.
Diatomite and other infusorial earth		26,338	24,483	24,483	
Feldspar, fluorspar, related materials	value, thousands	$16,642	$13,839	$2,059	Mexico $5,764; Morocco $2,421.
Fertilizer materials:					
Crude, n.e.s.		20,190	24,200	23,675	West Germany 205; United Kingdom 193.
Manufactured:					
Ammonia		26,775	13,672	13,648	Japan 20; West Germany 3.
Nitrogenous		280,039	374,811	141,770	Netherlands 67,857; East Germany 55,204.
Phosphatic		436,539	486,047	478,461	Israel 6,394; Belgium-Luxembourg 1,111.
Potassic		53,385	64,283	64,111	Italy 132; West Germany 40.
Unspecified and mixed		29,656	42,576	41,679	West Germany 316; United Kingdom 207.
Graphite, natural	value, thousands	$2,143	$2,727	$2,279	Switzerland $199; West Germany $146.
Gypsum and plaster		242,953	243,523	41,472	Mexico 118,461; Spain 83,327.
Lime		46,916	44,289	42,268	Belgium-Luxembourg 2,021.
Magnesium compounds: Magnesite, crude		46,782	73,017	41,119	Netherlands 10,091; Brazil 6,001.

See footnotes at end of table.

TABLE 4—Continued

CANADA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986[r]	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
INDUSTRIAL MINERALS—Continued					
Mica:					
Crude including splittings and waste	value, thousands	$592	$568	$568	
Worked including agglomerated splittings	do.	$2,748	$2,620	$1,794	France $369; India $329.
Nitrates, crude		7,941	4,980	853	Chile 4,109; United Kingdom 18
Phosphates, crude	thousand tons	2,356	1,968	1,623	Togo 258; Morocco 73.
Pigments, mineral: Iron oxides and hydroxides, processed		8,484	11,886	9,483	West Germany 1,019; Spain 721.
Precious and semiprecious stones other than diamond:					
Natural	value, thousands	$16,504	$17,455	$7,867	Thailand $2,008; West Germany $1,518.
Synthetic	do.	$6,354	$6,086	$1,855	Austria $2,217; West Germany $736.
Pyrite, unroasted	do.	$96	$70	$70	
Salt and brine	thousand tons	1,331	1,113	662	Mexico 341; Chile 53.
Sodium compounds, n.e.s.:					
Carbonate, manufactured		1,087	1,143	1,143	
Sulfate, manufactured		55,226	52,216	16,711	United Kingdom 20,515; Norway 4,215.
Stone, sand and gravel:					
Dimension stone:					
Crude and partly worked		47,920	67,445	33,020	Republic of South Africa 18,061; Italy 4,014.
Worked	value, thousands	$27,251	$42,648	$4,656	Italy $30,293; Spain $2,705.
Dolomite, chiefly refractory-grade		3,101	29,005	29,005	
Gravel and crushed rock		551,051	594,103	590,317	West Germany 1,540; Australia 1,295.
Limestone other than dimension	thousand tons	2,357	2,695	2,695	
Quartz and quartzite		349	515	368	Sweden 139; Brazil 7.
Sand other than metal-bearing	thousand tons	1,638	1,626	1,624	Australia 1; Philippines 1.
Sulfur:					
Elemental:					
Crude including native and byproduct		10,760	24,711	24,690	West Germany 21.
Colloidal, precipitated, sublimed		31	151	59	Belgium-Luxembourg 80; West Germany 12.
Sulfuric acid		29,126	44,624	37,853	United Kingdom 6,696; Australia 33.
Talc, steatite, soapstone, pyrophyllite		39,488	49,711	48,978	Finland 218; United Kingdom 157.
Vermiculite[2]		24,199	25,260	17,125	Republic of South Africa 8,135.
Other:					
Crude	value, thousands	$12,964	$16,704	$15,403	Republic of South Africa $969; France $169.
Slag and dross, not metal-bearing		188,394	187,904	144,845	United Kingdom 81; Japan 3.

See footnotes at end of table.

TABLE 4—Continued

CANADA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986[r]	1987	Sources, 1987 United States	Sources, 1987 Other (principal)
MINERAL FUELS AND RELATED MATERIALS					
Asphalt and bitumen, natural		3,766	8,050	8,050	
Carbon black		24,762	12,851	12,542	West Germany 187; Mexico 45.
Coal:					
Briquets of anthracite and bituminous coal		251	172	172	
Lignite including briquets		10,397	9,388	9,388	
All grades excluding briquets	thousand tons	13,368	14,150	14,136	Colombia 14.
Coke and semicoke		881,084	699,016	655,314	East Germany 43,702.
Peat including briquets and litter	value, thousands	$510	$463	$257	United Kingdom $56; France $49.
Petroleum:					
Crude	thousand 42-gallon barrels	124,175	134,092	6,276	United Kingdom 71,051; Venezuela 11,349; Nigeria 9,867.
Refinery products:					
Liquefied petroleum gas	value, thousands	$141,852	$123,472	$122,540	Netherlands $759; West Germany $83.
Gasoline, motor	do.	$172,421	$239,892	$94,788	Netherlands $28,833; United Kingdom $26,341.
Mineral jelly and wax	thousand 42-gallon barrels	101	177	170	United Kingdom 4; France 2.
Kerosene and jet fuel	do.	12,441	11,463	5,576	U.S. Virgin Islands 1,727; Venezuela 1,532.
Distillate fuel oil	do.	5,055	3,777	2,811	Venezuela 441; Spain 244.
Lubricants	do.	4,082	6,887	2,611	Venezuela 1,486; Netherlands 830.
Residual fuel oil	do.	9,182	13,875	4,258	Venezuela 6,383; Gabon 754.
Bitumen and other residues	do.	1,045	1,193	829	Spain 186; Venezuela 178.
Petroleum coke	do.	5,175	5,303	5,209	Unspecified 94.

[r] Revised.
[1] Table prepared by H. D. Willis.
[2] Energy, Mines and Resources Canada.
[3] May include other precious metals.

from the higher prices. Mine production was 725,000 tons, and actual shipments totaled 713,000 tons.

Cominco Ltd.'s major Canadian copper-molybdenum mine is Highland Valley Copper (HVC) at Logan Lake, British Columbia, a partnership of Cominco Ltd. (50%), Rio Algom Ltd. (33.5%), Teck Corp. (11.5%), and Highmont Mining Co. (5%). In February 1988, HVC announced a $70 million expenditure to expand the Lornex milling complex and relocate the two Highmont mills to a site adjacent to the Lornex mill. HVC expected the current effective capacity of 91,000 tons to be increased to 131,000 tons per day by this expansion. The former Bethlehem Copper mill, part of the Lornex complex, currently producing 29,000 tons per day, will be placed on a standby basis once the expanded Lornex mill becomes fully operational. The Bethlehem mill will be maintained to supplement production, should market conditions warrant. Total ore processed at Lornex mill was 44,100,000 tons. Most of the copper concentrate was sold to Japan under long-term contracts. The remaining concentrate was sold to other countries in Asia, Europe, and South America.

Noranda Inc. (60%) and BP Canada Inc. (40%) continued exploration of the Tally Pond joint venture in central Newfoundland. Drilling at yearend provided 4 million tons of ore at 3.5% copper, 6.6% zinc, 1.1% lead, 67.4 grams of silver per ton, and 1 gram of gold per ton; eventually, this could be an important feed source for Noranda's Murdochville, Quebec, copper smelter.

Noranda Inc. committed $20 million to reopen its Murdochville Mine which closed in April 1987 because of an underground fire. At the Horne smelter, work started on the $125 million acid plant, which should be completed by the end of 1989. Noranda initiated a tankhouse modernization at its Montreal East copper refinery.

Minnova Inc.'s Lac Dufault Div. (Ansil Mine Project, Norbec Mill) continued development of its Ansil Mine in Quebec. Work continued with development of the upper part of the mine and the 1,460-meter level at the bottom of the mine. As of December 1988, about 10,000 tons of development ore were stockpiled at the Norbec Mill. Full production at 450,000 tons per year is expected to commence by mid-1990.

Geddes Resources Ltd.'s Windy Craggy copper, gold, silver, and cobalt property in the extreme northwest part of British Columbia is the largest copper deposit being explored in Canada. Drilling indicated resources are in excess of 90 million tons with 2% to 3.5% copper, plus gold, silver, and cobalt values. About 600 meters of the 1,800 meters of known underground mineralization have been proven. Exploration activity will continue in 1989.

Hudson Bay Mining & Smelting Co. Ltd. (HBM&S) of Manitoba proposed a $130 million program to reduce SO_2 emissions and to modernize operations at its Flin Flon copper smelter. The company's Ruttan Mine was closed by a strike from June 1 to September 8, 1988. During this time, the Flin Flon smelter operated on purchased concentrates and production from the company's other mines.

Gold.—Gold prices trended downwards from $480 per ounce in the early part of the year to slightly more than $400 per ounce at yearend. The 1988 average price was about $10 less than the 1987 average of $497 per ounce.

At yearend, there were 61 primary gold mines operating in Canada, which accounted for about 80% of the annual production of 127.7 tons of gold. Canadian proven and probable gold reserves, including operating mines, mines under development, and tailings, increased by 15% to 1,700 tons of gold.

Placer Dome Inc. (PDI) is one of the world's significant gold producers and was the leading gold producer in Canada. The company operated 12 gold mines out of 18; 13 mines are in Canada and the United States, and the others are in Australia, Papua New Guinea, and Chile. PDI has a production capacity of about 1 million ounces of gold annually.

PDI's Dona Lake Mine and mill at Pickle Lake, Ontario, with a capacity of 550 tons per day, were completed on schedule at a cost of $43 million. Production will commence in February 1989 at an estimated production cost of $244 per ounce of gold. Proven and probable reserves were 754,000 tons at 0.24 ounce per ton, plus 1.17 million tons at 0.17 ounce per ton at depth as a potential source of gold.

The Dome Mine in Timmins, Ontario, has a modern carbon-in-pulp recovery circuit, which was completed in 1988, and a 10% increase in capacity to 3,300 tons per day was achieved. The expected annual gold production will be about 133,000 ounces.

Houston Metals Corp. announced the discovery of more ore at the Silver Queen Mine, which is under development near Houston, British Columbia. Currently estimated reserves were 1.73 million tons at 0.09 ounce per ton of gold, 10.55 ounces per ton of silver, and 6.2% zinc with associated copper and lead values.

Canamax produced its first gold from the Kremzar Mine, 32 kilometers northeast of Wawa in Northern Ontario. The mine officially opened on October 4, 1988, and was expected to produce about 33,000 troy ounces of gold per year at an estimated cost of $295 per ounce.

ERG Resources Inc. opened its $78 million tailings project. The expected annual gold production will be 110,000 ounces. The new mill in Schumacher will process more than 200 million tons of tailings from the Timmins area, which can support 17 years of recovery operations.

Doyon Mine was Quebec's largest gold producer, accounting for 25% of gold output from the Province. Production in 1988 was 260,000 ounces compared with 248,000 ounces of gold in 1987. The partners, Cambior Inc. and Lac Minerals, invested $74 million to bring the mine into production and $21 million to expand the mill. An additional $16 million expenditure was planned to boost underground production to 3,000 tons per day.

Iron Ore.—About 53% of Canadian iron ore was exported to Europe and Japan. Canada shares about 4% of world production and about 8% of world trade. Six iron ore mines operated in Canada, and production was estimated at 39.8 million tons. Canadian shipments of iron ore increased 2.3 million tons to 40.7 million tons, including shipments from stockpiles, at a value of $1.4 billion. Exports exceeded 30 million tons, and Western Europe was the largest market for Canadian iron ore. The U.S. imported more than 9 million tons.

Iron Ore Co. of Canada (IOC) shipped about 37% of Canadian iron ore production. IOC and the Canada Centre for Mineral and Energy Technology (CANMET) entered into a joint venture to use their combined technology on magnetic and flotation concentration of iron ore to improve IOC's recovery of fine iron ore particles.

Quebec Cartier Mining Co. (QCM) sold about 16.8 million tons of pellets and concentrates. QCM produced products that are tailored to customer requirements. Main grades of pellets were acid, low silica, and self-fluxed. Pellet plant production exceeded 8 million tons.

Production from Wabush mines at Labrador, Newfoundland, was more than 6 million tons. Wabush offered three products; namely, acid pellets with 1% and

2% manganese and fluxed pellets with 1% manganese.

Dofasco Inc.'s two iron mines, in northern Ontario, Adams and Sherman, experienced labor strikes in 1988. The Adams concentrator and mine closed for 5 weeks in July and August, and the Sherman Mine stopped all operations for 5 weeks in the summer. As a result, production at Adams was less than 1 million tons and at Sherman less than 0.9 million tons.

Lead and Zinc.—The price of zinc at the beginning of 1988 averaged 39.8 cents per pound closing the year at 73 cents per pound. The LME High Grade (HG) price averaged 56.4 cents per pound. The LME lead price remained steady until late in 1988, when seasonally high battery demand and strikes in Peru resulted in a higher price. The price rose from 27.0 cents in 1987 to 29.7 cents per pound of lead in 1988.

Cominco Ltd.'s integrated smelter and refining complex at Trail, British Columbia, produced a wide range of metals, principally refined lead, zinc, silver, and gold. Annual effective capacity was 122,500 tons of refined lead and 272,200 tons of refined zinc. More than 50% of Cominco's lead and zinc concentrates were refined at Trail. Refined lead production was 120,100 tons. Refined zinc production was 283,400 tons. Production was affected by a 17-week labor strike in Canada.

Cominco's Sullivan Mine at Kimberly, British Columbia, was the main supplier of lead and zinc concentrates to Trail. Mill feed increased by 61%, the second highest level in more than 20 years.

A joint venture between Cominco (55%) and Pine Point Mines Ltd. (45%) operated the Polaris lead-zinc mine at Little Cornwallis Island, Northwest Territories. This mine was the Western World's most northerly base metals operation. Concentrates were shipped to European smelters during a 10-week period in the summer, when shipping channels were open for navigation. The facility, which went into production in March 1982, is internationally recognized for its modern mining and milling technologies in permafrost operation. The Polaris Mill treated a record 1,016,000 tons of ore. Ore reserves at yearend amounted to 14 million tons. Exploration in the mine area will recommence in 1989.

HBM&S began development of its Callinan zinc and copper deposit in northern Manitoba and expansion of its Chisel Lake lead and zinc mine in Manitoba.

Nickel.—This commodity had an impressive performance in 1988. Costs were reduced from $1.97 per pound in 1984 to $1.41 in 1988. In 1988, the LME averaged $6.28 per pound of nickel, an increase of $4.07 per pound of nickel from 1987. The stainless steel industry worldwide consumed 55% of the nickel produced. Major nickel consumers were Japan, the United States, and Western Europe, which accounted for 90% of nickel demand. The demand for nickel in the Western World increased by about 13,000 tons.

Inco Ltd. and Falconbridge Ltd. had major corporate developments. Inco implemented a recapitalization process of more than $1.2 billion, which included a special dividend of $10 per share to shareholders to avoid unfriendly takeover. Noranda Inc. acquired a 19.6% interest in Falconbridge to become its largest shareholder.

Sulfur dioxide containment programs were announced by Inco and Falconbridge to comply with Ontario's regulations, effective in 1994.

Inco announced a $454 million capital investment program. Falconbridge will spend $38 million on research, development, and capital requirements to increase pyrrhotite rejection and roasting capacity to minimize SO_2 emissions. Inco announced that it would proceed with the $100 million development of the Thompson south open pit and reactivation of the Birchtree Mine. Falconbridge plans to spend $33 million at its underground Lindsley project near Sudbury, the development of which is expected to be completed in 1991.

Sherritt Gordon Ltd. produced 24,000 tons of nickel in briquets and powder at its Fort Saskatchewan, Alberta, refinery. HBM&S (60%) and Outokumpu Mines Ltd. (40%), owners of the Namew Lake nickel mine, about 40 miles south of Flin Flon in Manitoba, developed the $70 million project to produce 9,200 tons of nickel in concentrate and 3,500 tons of copper in concentrate annually. Known reserves were 2.6 million tons at 2.44% nickel and 0.9% copper.

Silver.—Average silver prices decreased to $6.51 per ounce. Production of most of Canada's silver was as a byproduct of base metals. In Ontario, the largest silver-producing Province, output declined by 5% to 14.6 million ounces partly because of the decline in production of base metals.

Agnico Eagle Mines Ltd., Canada's only primary silver producer, operated three silver mines in the cobalt area of eastern Ontario. The company's refinery produced about 1.3 million ounces of silver.

Other Metals.—The strong performance of cadmium, at $6.94 per pound, reflected the unprecedented growth in demand for nickel-cadmium batteries in the consumer goods market. Cominco announced the construction of a new indium plant at its British Columbia Trail facility, by which the company expected to increase production capacity to 1 million ounces per year.

Rio Algom Ltd.'s subsidiary, Rio Kemptville Tin Corp., owns and operates the East Kemptville open pit and concentrator near Yarmouth, Nova Scotia. These facilities were reacquired on March 1, 1988. East Kemptville processed 2.7 million tons of ore to produce 5,700 tons of tin concentrate containing 55.9% tin with minor values of copper and zinc. Proven and probable tin reserves at yearend were 36.4 million tons at 0.175% tin, 0.10% copper, and 0.18% zinc.

In 1986, low tungsten prices had forced the closure of Canada Tungsten Mining Corp. Ltd.'s Cantung Mine in the Northwest Territories. Continuing low prices for tungsten led to the shutdown of the mine during 1988. Carbovan Inc. began building a plant in Alberta to recover approximately 1,000 tons per year of vanadium oxide from fly ash derived from Athabasca tarsands. Construction completion was expected in late 1989.

After a lapse of 6 years, Tantalum Mining Corp. of Canada Ltd. (Tanco) resumed in August production of tantalum at its Bernic Lake lithium-tantalum-cesium mine in Manitoba. Highwood Resources Ltd. and Hecla Mining Co. of Canada Ltd. planned to evaluate the Lake Zone deposit of the Thor Lake rare metals project about 100 kilometers southeast of Yellowknife, Northwest Territories. Canadian molybdenum production decreased to 12,388 metric tons, and production value decreased to $108 million. The five molybdenum producers were Placer Dome Inc., Brenda Mines Ltd., Highland Valley Copper, Utah Mines Ltd., and Gibraltar Mines Ltd. The Endako Mine of Placer Dome Inc., Canada's only primary molybdenum producer, operated at capacity since October 1988. Canada was the third largest cobalt producer in the world; about 90% of production was exported. Cobalt from Canadian sources was recovered as a byproduct of nickel refining by Inco at Port Colborne, Ontario; Sherrit Gordon Ltd. in Fort Saskatchewan, Alberta; and Falconbridge in Norway.

Industrial Minerals

Asbestos.—Canadian production of asbestos fiber, despite health concerns about asbestos, increased almost 8%. Developing countries consumed an estimated 42% of Canada's output. The balance was consumed by Japan, the United States, and Western Europe. Total sales were 705,000 tons valued at $268 million.

Cliff Resources of Toronto acquired controlling interest in Baie Verte Mines (BVM) of Newfoundland. The firm was constructing a wet-milling process, which will allow secondary recovery of short asbestos fibers from tailings. BVM ore reserves neared depletion, but this new process was expected to extend the life of BVM by about 13 years.

Cassiar Mining Corp. negotiated a $25 million development loan from the British Columbia government to finance the $43 million development of the underground McDame asbestos deposit. Mine development started in 1988.

Potash.—The value of potash output increased sharply to $889 million, a gain of almost 50%. Canada produced 8.3 million tons.

Potash Corp. of Saskatchewan (PCS) made a dramatic comeback to profitability, with net profit of more than $100 million after a $21 million loss in 1987 and a $104 million loss in 1986. PCS produced about 5 million tons of potash. PCS indicated that productivity increased by 15% to 20% at each of its five potash mines.

Cominco's potash operations near Vanscoy, Saskatchewan, completed a very successful year as a result of improved productivity, record sales, and higher prices. Production increased by 14.5%.

Noranda's Central Canada Potash subsidiary produced 1.1 million tons of potash.

Potash Company of America (PCA), a subsidiary of Rio Algom, was a major Canadian producer of potash for use in fertilizers. PCA operated its mining and processing facilities at Sussex Mine in Sussex, New Brunswick, and at Saskatoon Mine in Saskatoon, Saskatchewan. The Sussex facilities operated at 87% capacity to produce 608,000 tons of potash. At the Saskatoon Mine, which ceased production in 1987 because of mine flooding, work resumed in August 1988 under a $23 million program to produce potash by solution mining. Overall, utilization of capacity was 73% compared with 66% in 1987. It was expected that full capacity could be reached by the mid-1990's to produce more than 700,000 tons of potash.

Other Industrial Minerals.—Cominco Fertilizers produced three main nutrients for agriculture usage: nitrogen, phosphates, and potash. The principal commercial products were anhydrous ammonia, ammonium nitrate, ammonium sulfate, potash, and urea. Cominco also produced sulfur in the form of sulfur dioxide as a byproduct of metal smelting. Most of the sulfur dioxide was converted to sulfuric acid, which was then used to process phosphate rock into fertilizer-grade phosphate compounds.

Brunswick Mining and Smelting Corp. produced about 137,400 tons of diammonium phosphate (DAP) at its New Brunswick fertilizer plant, from phosphate rock imported from Florida.

Silica shipments increased in Quebec, Manitoba, and British Columbia, and decreased in Ontario and Newfoundland. Consumption of foundry sand and silica sand used in the silicon carbide industry increased because the iron, steel, and base metal industries increased their activity.

Canada's shipments of all types of salt increased by 8% to about 11 million tons of which 63% was from Ontario. Production of salt was 9% higher than in 1987 or 11.1 million tons because of high operating levels, particularly in New Brunswick, Ontario, and Quebec. Canadian Salt Co. Ltd. continued development of a new mining level at its Pugwash property in Nova Scotia. The development is expected to be completed in 1990. A new brine evaporator was installed to improve recovery. At Sarnia, Ontario, workers at Dow Chemicals Canada Inc. ended a 7-month strike in late November 1988 after negotiating a 2-year contract.

Canadian cement production capacity decreased to 14.8 million tons per year. Given the strong demand in 1988, imports of both clinker and cement increased.

St. Mary's Cement planned to double production capacity at Bowmanville, Ontario, by mid-1991 at a cost of $160 million. St. Lawrence Cement Inc. began work at its Mississauga, Ontario, facility on a $13.5 million kiln modification to reduce production costs.

Domtar Inc. began developing a new underground gypsum mine adjacent to its Caledonia complex in Ontario at a cost of $13 million. Full production was expected to begin in early 1990.

Newfoundland Resources & Mining Co. Ltd. continued development of its limestone aggregate operation at Port Peninsula, Newfoundland.

Mineral Fuels

Coal.—Demand in the worldwide steam coal market strengthened in the second half of 1988 because electricity use grew. However, low prices more than offset that favorable trend. Canada's record coal production was attributed to high exports to Japan and Korea. Canadian coal production increased to a record 69.5 million tons. Exports reached an alltime high of 31.5 million tons.

The dollar value of coal output increased to $1.6 billion in 1988, a 14.3% gain. Canada exported almost 21% more coal to Japan or 15.7 million tons, and sustained a 26% share of the Japanese market. The Coal Association of Canada estimated that total coal output was composed of 58.7% thermal coal and 41.3% of metallurgical coal.

Teck Corp.'s Bullmoose open pit coal and processing facilities are in northwestern British Columbia about 30 kilometers northwest of Tumbler Ridge. More than 2 million tons of coal were processed there, resulting in the recovery of 1.7 million tons of metallurgical coal.

Gulf Canada Corp. shipped test quantities of anthracite from the Mount Klappan Mine, in the northwestern part of the Groundhog coalfield of Intermontane, British Columbia, to Korea and Western Europe with favorable results. The mine estimated coal reserves of 6 billion tons. Relatively large-scale mining operations were being considered.

Natural Gas.—The value of natural gas produced increased to $5.3 billion. The soaring demand for natural gas created a rebound in pipeline construction activity.

Gulf Canada and partners applied for a license from the Canadian Government to export 3.2 trillion cubic feet of gas for 20 years. Most of the gas will come from the Parsons Lake field in the Mackenzie Delta and Amauligak field in the Beaufort Sea.

Petroleum.—Lower prices of crude oil continued to affect petroleum exploration and development activities in Canada. Despite a 4.2% increase in crude oil production, price reductions forced a 17.4% decline in the value of crude oil produced to $7.6 billion.

A consortium of Esso Resources Canada Ltd. (25%), Canadian Occidental Petroleum Ltd. (20%), Gulf Canada Resources Ltd. (20%), Petro-Canada Inc. (15%), Pan-Canadian Petroleum Ltd. (10%), and Alberta Oil Sands Equity (10%), signed a statement of principles with the Governments of Canada and Alberta to proceed with the development of a massive oilsand, called the Other Six Leases Operation (OSLO), about 80 miles north of Fort McMurray in northeast Alberta. OSLO will cost $3.5 billion, and production at 77,000 barrels of oil per day was expected to start in 1996. Lease 31, among the six OSLO leases, covers 75 square miles and contains an estimated 3.5 billion barrels of bitumen. Bitumen is a tarlike substance that contains the hydrocarbons that are processed into light crude oil.

The Canadian Government also approved two other large oil projects, the $4.4 billion Hibernia Oilfield development off Canada's east coast and the $1.1 billion heavy-oil upgrader near Lloydminster on the western edges of Saskatchewan. Canada provided substantial financial aid to each of the OSLO, Hibernia, and Lloydminister projects.

The Athabasca oilsands, which includes OSLO, and the two other oil ventures, Hibernia and Lloydminister, contained an estimated 900 billion barrels of bitumen. This was equivalent to five times the proven crude oil reserves of Saudi Arabia.

Uranium.—Canada, with uranium mines in Saskatchewan and Ontario, produced about one-third of the world's supply.

The Canadian Mining and Energy Corp. (Cameco) of Saskatoon, Saskatchewan, was formed in October 1988 through the merger of provincially owned Saskatchewan Mining Development Corp. (61.5%) and federally owned Eldorado Nuclear Ltd. (38.5%). Both partners agreed to go public by selling 30% of Cameco in 1990, 30% in 1992, and 40% in 1995. Cameco's $1.26 billion of assets and almost 500 million pounds of uranium ore reserves made it the "Saudi Arabia" of the uranium industry worldwide. Cameco's largest asset was its 49% share of Cigar Lake's uranium deposit, which contained 14% of uranium oxide or 280 pounds of U_3O_8 per ton of ore. Cameco planned to go into production by 1993.

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[1] For more detailed information on the mineral industry, see the Canadian Mineral Surveys for 1985 and 1986, both of which were prepared by the Mineral Policy Sector and the Energy Sector, Department of Energy, Mines and Resources, Ottawa, Canada. The U.S. Department of the Interior, Bureau of Mines, has arranged to have these Canadian publications placed in libraries in each of the 50 States and Puerto Rico as follows: University of Alabama, Tuscaloosa; 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 Library, Tallahassee; P. Gilbert Memorial Library, Georgia Institute of Technology, Atlanta; University of Hawaii, Hilo; University of

Idaho, Moscow; Morris Library, Southern Illinois University, Carbondale; Indiana University, Bloomington; Iowa State University of Science and Technology, Ames; Watson Library, University of Kansas, Lawrence; M. L. King Library, University of Kentucky, Lexington; University of Southwestern Louisiana, Lafayette; R. H. Folger Library, University of Maine, Orono; M.S. 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 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, NJ; New Mexico Institute of Mining and Technology, Socorro; Columbia University, New York NY; D.H. Hill Library, University of North Dakota, Grand Forks; Ohio State University, Columbus; University of Oklahoma, Norman; Multnomah County Library, Portland, OR; Pennsylvania State University, University Park; University of Rhode Island, Kingston; Thomas Cooper Library, University of South Carolina, 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; University of Washington, Seattle; West Virginia University, Morgantown; Memorial Library, University of Wisconsin, Madison; University of Wyoming, Laramie; and University of Puerto Rico, Mayaguez.

[2] Physical scientist, Division of International Minerals.

[3] Where necessary, values have been converted from Canadian dollars (CAN$) to U.S. dollars at the rate of CAN$1.3260 = US$1.00 for 1987 and CAN$1.2307 = US$1.00 for 1988.

THE MINERAL INDUSTRIES OF

CENTRAL AMERICA

By Ivette E. Torres[1]

INTRODUCTION

Central America, with its diversity in political structures, varied economic conditions, and small mining industries, produced a variety of metals and industrial minerals. Most countries in the area were trying to promote and facilitate international investment to develop their minerals resources. Exploration of nonfuel minerals was carried out by (or with the assistance of) several international organizations, including the British Geological Survey and the U.S. Geological Survey.

The United Nations Revolving Fund for Natural Resources Exploration, after identification and evaluation of mineral resources in the Trifino area, announced final preparation for exploration. The evaluation was directed toward precious and base metals and industrial minerals to determine economic potential for mine development. The Trifino region covers 1,158 square kilometers in El Salvador, 3,392 square kilometers in Guatemala, and 3,034 square kilometers in Honduras. The project covered 7,584 square kilometers. The Fund also was requested to assist in the development of the mineral potential of the area.

BELIZE

Belize's real gross domestic product (GDP) grew an estimated 5.9%. The economy continued to be based mainly on agriculture and merchandising. Mining, insignificant by any standards, continued to be limited to limestone and sand and gravel. The oil-base fuels used in Belize were imported by multinational companies, and imported fuel represented 41% of the cost of electricity generation in 1988. The United States continued to be Belize's main trading partner.

COSTA RICA

Costa Rica's real GDP increased an estimated 3.8% in 1988. The country's external debt was $4 billion[2] and inflation increased 21%, after averaging 15% during 1984-87. Costa Rica, in an effort to reduce its high debt, continued to negotiate with commercial banks on a debt reduction package. The Government continued with programs to stabilize the economy. Efforts to reduce the fiscal deficit, privatize Government enterprises, reform the banking system, and promote exports were part of the policies that persisted.

Mining's contribution to the economy continued to be small. Although mining activity continued to be centered around gold and construction materials, Costa Rica's other mineral occurrences include bauxite, coal, chrome, copper, iron, lead, manganese, nickel, sulfur, titanium-bearing sands, and zinc.

The Ministerio de Recursos Naturales, Energía y Minas (MRNEM), responsible for the control and the development of Costa Rica's mineral resources, is also responsible for the country's environmental protection. MRNEM policies are geared to the development of an environmentally sound mining industry attractive to foreign investment and with guaranteed and adequate income to the state. Under the Ministry, mining aspects are covered by three agencies, Dirección de Geología y Minas, Minera Nacional S.A. (MINASA), and Refinadora Costarricense de Petróleo S.A. (RECOPE). MINASA, reorganized in 1987, is a technical-promotional Government agency with legislative authority to exploit minerals reserves independently. Its mission includes the coordination of efforts between the private sector and other Government agencies and legal assessment to private entities. In 1988, MINASA entered into its first joint-venture agreement with NOVACAN of Canada for the exploration of gold in Guanacaste Province. It also operated an alluvial gold extraction pilot project in the Osa region. The purpose of the project was to develop extraction technology without the use of chemicals.

Gold exploration and development by international companies continued to intensify. Ariel Resources Ltd. continued to work on the Esperanza Mine in Líbano, Guanacaste Province. Reportedly, the company agreed to option four mining exploration claims in the area.

Greenstone Resources Ltd. of Canada completed an initial drilling program on its El Recio property. Reportedly, the property has four major epithermal veins with near-surface and underground reserves. Main open pit zone reserves were estimated to be at least 668,000 tons averaging 2.7 grams of gold per ton to a depth of 80 meters, with a potential for 1.23 million tons. Underground probable and possible reserves were estimated at 251,300 tons of ore at 11.6 grams of gold per ton. Inferred reserves were estimated at almost 600,000 tons at 13.4 grams of gold per ton. Greenstone planned to begin production from the open pit in 1989.

Rayrock Yellowknife Resources Inc., the operator of the joint venture between Midland Energy Corp. and Westlake Industries Ltd. for exploration and development of the Bellavista and Montezuma properties, continued testing the low-grade gold zone surrounding many of the higher grade vein systems. This zone was discovered during the company's initial exploration.

RECOPE continued to play a key role in Costa Rica's energy sector. Responsible for the importation, refinery, and distribution of oil and its products, RECOPE was also the Government agency assigned to oil exploration and coal and peat research and development.

With continued financial and technical assistance from Petro-Canada International Assistance Corp. (PCIAC), RECOPE drilled two wells in 1988, the Curime 1, and the San Clemente 1. In 1987, the Matina 1, Pataste 1 and

TABLE 1

CENTRAL AMERICAN COUNTRIES: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Country and commodity		1984	1985	1986	1987[p]	1988[e]
BELIZE						
Stone, sand and gravel:[e]						
Limestone		600,000	600,000	600,000	600,000	600,000
Sand and gravel		500,000	500,000	500,000	500,000	500,000
COSTA RICA						
Cement		468,600	475,500	520,000	556,360	556,360
Clays: Kaolin		[e]500	—	—	—	—
Diatomite		[e]450	—	—	—	[2]5,000
Gold	troy ounces	[e]35,000	[3]15,997	[3]11,600	[3]9,645	[2 3]10,075
Lime[e]		10,000	10,000	10,000	10,000	10,000
Petroleum refinery products	thousand 42-gallon barrels	2,200	3,045	[e]3,000	4,594	[2]4,557
Pumice[e]		1,500	1,500	1,500	[2]6,000	[2]6,000
Salt, marine		[e]110,000	29,484	[e]30,000	12,650	[2]275,000
Silver[e]	troy ounces	2,000	2,000	2,000	2,000	2,000
Stone, sand and gravel:						
Crushed rock and rough stone[e]	cubic meters	500,000	500,000	500,000	500,000	500,000
Limestone and other calcareous materials[e]		100,000	100,000	100,000	100,000	[2]203,957
Sand and gravel[e]	cubic meters	250,000	250,000	250,000	[2]80,000	100,000
EL SALVADOR						
Aluminum metal including alloys, semimanufactures		1,154	1,266	1,295	1,526	[2]1,681
Cement		399,170	450,026	442,625	606,462	[2]623,224
Gold	troy ounces	285	—	—	—	—
Gypsum[e]		4,500	4,000	4,000	4,500	4,500
Iron and steel: Metal:						
Steel, crude		11,197	11,845	9,263	13,106	[2]11,269
Semimanufactures		27,985	23,472	35,460	32,654	[2]32,934
Limestone		870,000	890,000	[e]900,000	1,450,000	[2]1,450,000
Petroleum refinery products	thousand 42-gallon barrels	4,450	4,831	[e]4,800	[e]4,800	[2]5,113
Salt, marine[e]		2,500	2,700	[2]2,950	[2]3,100	[2]3,200
Silver, fine	troy ounces	21,750	—	—	—	—
GUATEMALA						
Antimony, mine output, Sb content		[r]74	[r]1,638	1,530	1,575	[2]1,335
Barite		77	[r]3,703	750	—	[2]2,415
Cement	thousand metric tons	419	526	644	1,324	[2]1,506
Clays:						
Bentonite		[r]682	2,727	3,836	5,600	[2]4,100
Kaolin		1,236	1,042	2,017	1,880	[2]3,459
Unspecified		587	[r]494	636	1,319	[2]3,667
Copper		—	([4])	([4])	—	—
Feldspar		[r]4,262	5,582	5,446	7,669	[2]7,200

See footnotes at end of table.

TABLE 1—Continued

CENTRAL AMERICAN COUNTRIES: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Country and commodity		1984	1985	1986	1987[p]	1988[e]
GUATEMALA—Continued						
Gas, natural, gross	million cubic feet	1,200	1,000	[e]1,100	600	600
Gypsum, crude: For cement manufacture		[r]22,147	[r]16,888	30,608	51,495	[2]34,448
Iron and steel:						
Iron ore, gross weight		[r]319	[r]2,334	7,186	10,706	[2]8,092
Steel, crude		26,600	10,277	16,800	20,700	[2]22,500
Semimanufactures		34,500	19,200	[e]19,000	[e]19,000	20,000
Lead, metal including secondary		64	70	78	92	[2]100
Lime		50,534	61,761	36,798	79,418	[2]71,306
Petroleum:						
Crude	thousand 42-gallon barrels	[r]1,715	1,068	1,802	1,327	[2]1,248
Refinery products	do.	[r]5,009	[r]5,017	3,819	4,480	[2]4,504
Pumice and related materials:						
Pumice		[e]13,200	16,038	11,442	15,191	15,000
Volcanic ash		(4)	—	(4)	(4)	—
Salt[e]		16,000	17,300	39,400	[2]37,088	[2]42,184
Stone, sand and gravel:						
Limestone	thousand tons	1,200	990	1,938	467	[2]407
Marble	cubic meters	1,200	380	1,332	1,330	[2]2,500
Sand and gravel	do.	[r]369,020	[r]317,389	252,573	378,157	[2]375,000
Sand, silica		[r]24,571	22,355	22,859	30,665	[2]32,000
Tungsten, mine output, W content of concentrate		[r]14	[r]18	(4)	—	—
HONDURAS						
Antimony, mine output, Sb content		111	87	50	80	[2]19
Cadmium, mine output, Cd content		415	598	[e]350	124	[2]205
Cement		534,183	347,500	[e]350,000	[e]400,000	400,000
Copper, Cu content of lead and zinc concentrates		770	5,051	[e]5,000	582	[2]538
Gold	troy ounces	2,784	5,023	2,018	4,222	[2]3,945
Gypsum[e]		22,000	22,000	22,000	22,000	22,000
Iron and steel:						
Steel, crude[e]		—	19,200	7,200	7,200	7,200
Semimanufactures[e]		22,000	[2]11,850	12,000	12,000	12,000
Lead, mine output, Pb content		20,544	21,250	12,558	5,041	[2]11,195
Petroleum refinery products	thousand 42-gallon barrels	3,303	2,386	1,472	[e]1,500	1,500
Salt[e]		30,000	30,000	30,000	30,000	30,000
Silver	thousand troy ounces	2,697	2,765	1,745	747	[2]795
Stone:						
Limestone[e]		500,000	500,000	500,000	[2]448,820	450,000
Marble		[e]40,000	[e]40,000	6,726	962	[2]3,175
Zinc, mine output, Zn content		41,483	44,026	25,443	15,417	23,475

See footnotes at end of table.

TABLE 1—Continued

CENTRAL AMERICAN COUNTRIES: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Country and commodity		1984	1985	1986	1987[p]	1988[e]
NICARAGUA						
Cement[e]		100,000	100,000	100,000	100,000	100,000
Gold, mine output, Au content	troy ounces	25,316	[r]24,491	28,664	30,486	[2]28,237
Gypsum and anhydrite, crude		[e]10,000	8,310	[e]8,000	7,299	7,000
Lime[e]		3,000	[2]3,702	3,500	3,500	3,500
Petroleum refinery products	thousand 42-gallon barrels	3,277	3,715	[e]3,700	[e]3,500	3,500
Salt, marine[e]		15,000	15,000	15,000	15,000	15,000
Sand and gravel[e]	cubic meters	490,000	450,000	450,000	450,000	450,000
Silver, mine output, Ag content	troy ounces	[e]50,000	29,665	[e]25,000	28,558	25,000
PANAMA						
Cement		303,950	305,200	336,000	[e]350,000	300,000
Clays and clay products:						
Crude		71,104	98,382	111,335	78,000	[2]56,000
Products	cubic meters	32,649	37,343	29,598	33,105	[2]20,647
Manganese ore		—	—	6,000	[e]6,000	—
Petroleum refinery products	thousand 42-gallon barrels	10,622	8,864	[e]9,000	[e]9,000	9,000
Salt, marine[5]		18,585	16,024	9,816	[e]10,000	9,000
Stone, sand and gravel:						
Limestone[6]		212,205	293,726	462,414	[e]450,000	400,000
Sand and gravel	thousand cubic meters	712	674	669	792	[2]566
Sand, silica		[e]20,000	13,882	16,290	[e]17,000	15,000

[e]Estimated. [p]Preliminary. [r]Revised.
[1]Includes data available through Sept. 1, 1989.
[2]Reported figure.
[3]Gold from placer deposits and mines purchased by Banco Central. Actual production estimated to be at least twice that amount.
[4]Revised to zero.
[5]Represents sales.
[6]Excludes approximately 8,000 cubic meters per year, apparently dimension stone.

Tonjibe 1 were drilled. Cooperation from PCIAC began in 1986 and covers a variety of technical activities.

Coal exploration by RECOPE began in 1983 with the cooperation of the U.S. Agency for International Development. Two of the most important coal projects resulting from the active exploration program by RECOPE, Uatzi and Zent, are found in the Atlantic zone. Total coal reserves are for Uatzi, in the Baja Talamanca area, 32.5 million tons; Zent, 14.8 million tons; and Venado, 2 million tons. The Zent project, a result of coal exploration by RECOPE in Limón, progressed in 1988. According to geochemical analysis, coal from Zent is subbituminous with an average of 5,000 kilocalories per kilogram (as received). Of the 14.8-million-ton reserves, 5.6 million are proven, 5.4 million are probable, and 3.8 million are possible. Production from Zent was planned for 1989. A pilot project was initiated for the utilization of coal from the project by the industrial sector. Initial production would be used to supply energy to the cement industry, to be expanded later into other industrial, residential, and electrical sectors. The consumption expansion plans took into consideration the startup of the Uatzi and Venado projects.

EL SALVADOR

Economic activity in El Salvador continued to be affected by high levels of guerrilla activity. The GDP only increased 0.5% from that of 1987 to $4.77 billion,[3] and inflation decreased slightly to 19.8%. Construction activity, on the rise since 1986, continued to be relatively strong. As a result, cement production in 1988 increased slightly. The United States continued to be El Salvador's most important trading partner and continued to provide much needed foreign economic assistance.

Mineral production in El Salvador

continued to be limited to construction materials. In 1987, mining contributed to 0.1% of the GDP. Gold and silver production ceased in 1985, but plans to reactivate the San Sebastián Mine, closed since 1977, were announced in 1988. Included in the plans were the rehabilitation of the mine and mill as well as heap-leaching production start-up. Initially, heap-leaching production would come from 300,000 tons of old tailings grading 4 grams of gold per ton, followed by the leaching of old dumps. Reserves of previously mined materials were estimated at 700,000 tons with 3.4 grams of gold per ton. The rehabilitation project was being financed by the Commerce Group of the United States, the principal shareholder (82%) of San Sebastián Gold Mines Inc., the mine operator.

The Comisión Ejecutiva Hidroeléctrica del Río Lempa (CEL), the national electric power utility, published a power report in 1988. According to the report, power demand was increasing at an average rate of 7.6% per year and was expected to double by the year 2000. At that rate, the country's demand for electric energy would surpass installed capacity by 1993. In 1988, rated capacity was 641 megawatts. The Government's long-term plans to expand the generating capacity by 547 megawatts continued to emphasize geothermal power generation. Along with the generating capacity, the CEL planned to invest in the transmission system and distribution network. Planned investment for the distribution network was estimated by CEL at $8.5 million per year. However, guerrilla activity, oriented toward the destruction of the country's economic infrastructure, could affect implementation of the expansion plans.

GUATEMALA

Guatemala's metal production was limited to small amounts of antimony, iron ore, lead, and tungsten. Production of copper, nickel, and zinc ceased in 1980. The suspension of nickel production from the Estor Mine was the result of poor nickel prices and high oil prices. Although nickel prices have increased and oil prices are low, there seem to be no plans to resume production in the near future. Production of industrial minerals in 1988 included barite, clays, feldspar, gypsum, limestone, pumice, and construction materials.

At yearend, the Congress was working on a bill to promote mine exploration and exploitation in small concession areas.

Because of the Trifino exploration program (see introductory section), the United Nations Revolving Fund for Natural Resources Exploration and the Government signed a gold exploration agreement at yearend at two sites, El Pato and Managua Quebrada. The program to be carried out includes geological mapping, geochemical stream sediment and soil surveys, pitting and diamond drilling, and mineral-processing testing.

According to the Ministerio de Energía y Minas, oil production totaled about 1.25 million barrels, a slight decrease from that of 1987. Exports of crude oil decreased 16% from 1.3 barrels in 1987 to about 1.09 barrels in 1988. Domestic consumption of refinery products increased 7% to about 8.8 million barrels. Of that total, about 50% was imported.

Exploration efforts by foreign companies, stimulated by the hydrocarbons law (Decree 109-83) promulgated in September 1983, continued to increase in 1988. International companies operating in Guatemala were Amoco Guatemala Petroleum Co., ESSO-Exploration, Hispánica de Petróleos S.A. (Hispanoil), and Basic Resources International. In 1987, the Government began new contract negotiations with Petén Petroleum Co. Total investment by those companies was about $30 million[4] in 1988.

Oil activity in Guatemala has been concentrated in five Departments: Huehuetenango, Izabal, Quiché, Alta Verapaz and Petén. Production comes from Alta Verapaz and Petén Departments. In 1988, three wells the Atzam-1A of Hispanoil, the Cotzal, and Tierra Blanca II of Basic Resources were being drilled. Basic Resources' Tierra Blanca I and Xan-1 began producing oil during the year. The production from Xan-1 was destined for the internal market. In addition, the Government, with Japanese financing, was carrying out a feasibility study for the construction of a crude oil and refined products terminal. However, development of the energy sector could be limited by the guerrilla activity. During the year, citing equipment sabotage and demand for payments by the guerrillas, Amoco Guatemala requested permission from the Government to halt prospecting operations in its exploration block in northern Quiché and Huehuetenango Departments.

Electricity accounts for less than 4% of the energy consumption in Guatemala, but demand for electric power is growing at a rate of 8% per year. This energy subsector is integrated by public and private entities that generate, transmit, and distribute electric energy throughout the country. The Instituto Nacional de Electricidad (INDE), with its large capacity, autonomy, and decentralization, is the most important Government agency having responsibility for technical development. Its transmission and distribution structure covers most of the urban and rural sectors of the country. The Empresa Eléctrica de Guatemala S.A., second in capacity, covers only the Guatemala Department and parts of the Escuintla and Sacatepéquez Departments. In different municipalities, smaller companies distributed energy purchased from INDE or generated in their own plants. In addition, some private companies produced their own energy to meet their internal consumption requirements.

In November, the Government published a national electrification plan prepared by INDE. The report included policies, strategies, objectives, and specific goals for the period 1988–2000.

HONDURAS

The Honduran economy continued to recover modestly from the recession suffered in 1981–83. In 1988, real GDP grew an estimated 4% from that of 1987. Sectors contributing to the economic expansion were public administration and defense, 7.0%; mining, 6.7%; and manufacturing, 4.9%. The growth in agriculture and related sectors was 2.5%. The Government reported a 7.5% increase in exports and a 3.8% increase in imports. The country suffered from large fiscal and balance-of-payment deficits. In September, the Government and the International Bank for Reconstruction and Development (World Bank) concluded negotiations on a $50 million[5] structural adjustment loan. Later, it received an additional $50 million loan from Japan to be disbursed through the World Bank. During the year, negotiations with the International Monetary Fund (IMF) continued and in November, the Government announced that the IMF approved a $98 million loan that included $28 million for compensatory loss of export income and standby credit to support the balance of payment and help keep the country's debt payments current.

The mining sector's contribution to the economy continued to be small. However, mineral production and exports increased significantly mainly because the Mochito Mine, closed during part of 1987, operated throughout 1988. Purchased by American Pacific Mining Co. Inc. of Canada in September 1987 for $12 million, the mine was operating with one-half the personnel it had employed under Rosario Resources Corp.'s (a subsidiary of AMAX Incorporated) ownership. With reserves that will allow the mine to operate for about another 8 years, the company was exploring and drilling near the main ore body. The diamond drill program in the San Juan ore body, with the purpose of further delineating the Todos Santos Manto ore below, resulted in rich zinc ore values. By August, four holes had been drilled. The best result of the drilling in the San Juan ore body was a 102-foot intersection of 22.04% zinc, 5.66 ounces of silver per ton, 1.13% lead, and 0.89% copper. Reportedly, the company's main objective was to increase reserves. That would allow increased mining, which in turn would result in lower production costs. In 1988, American Pacific Mining costs were $28 to $31 per ton. To further decrease production costs, the company was investing $2 million to undercut the main ore body and move the ore to the surface through a conveyor belt.

NICARAGUA

Nicaragua's economy in 1988 was characterized by hyperinflation, failed economic recovery programs, and electrical power outages. The effects of the civil war were evident throughout the economy. The real GDP decreased by 8% and inflation reached 24,000%. In October, the economic problems were aggravated by the damage caused by Hurricane Joan. The estimated cost of Nicaragua's worst natural disaster was $830 million.[6] In November, fuel prices increased as high as 65%.

On February 15, the Government, in an effort to stabilize the economy, implemented a major economic program that included the introduction of the new córdoba, equivalent to 1,000 córdobas. With the introduction of the new córdoba, the exchange rate was unified, replacing the system with a commercial and a free rate. Also, the minimum and maximum wage rates were increased, and the general budget expenditures were reduced by 10%. Subsidies of food and other basic goods were removed.

Almost immediately, the private sector's evaluation of the program was negative. Its assessment was that the new policies would not have the effects the Government sought for reducing inflation, improving the standard of living, restoring the purchasing power of the córdoba, and helping the poor. They concluded that without correcting the fiscal deficit, inflation would not be stopped. For the month of December, inflation was 2,000%. The new córdoba rate of exchange began at 10 to 1 against the U.S. dollar but with continuous devaluations, it averaged the year at 200 to 1.

The crisis of the electrical sector was due to equipment failure, low water levels in reservoirs, and transmission interruption caused by guerrilla attacks on towers. This crisis had a severe effect on factory and agricultural production, water supply, and availability of consumer goods. The Government was forced to implement electricity rationing programs. The Government policy was to give preference of electrical supply to agricultural export products.

During 1988, Nicaragua signed trade and economic agreements with China, Cuba, and the U.S.S.R. In February, Cuba and Nicaragua signed a cooperation protocol that included assistance in Nicaragua's mining sector. Cuba's assistance covers practically every sector. In 1987, Cuba's most important donation was the delivery of 665,000 barrels of oil. At the beginning of 1988, the Soviet Union delivered about 151,000 barrels of oil to Nicaragua. Canada and Italy were assisting Nicaragua in the restoration of its electric capacity and in the development of its geothermal subsector, respectively. Nicaragua received from Canada equipment for installation in its electric plants. With the first 35-megawatt Momotombo geothermal plant completed, Italy continued to assist in the construction of a second 35-megawatt plant.

The Asturias hydroelectric project, begun in 1982 with a $34 million loan from the Inter-American Development Bank, was nearing completion at yearend 1988. The project included the creation of a new Lake Asturias to increase the water provided to the Centroamérica and the Carlos Fonseca hydroelectric plants. The new lake will increase the county's hydroelectric capacity by 84 million kilowatt hours per year. The project also included the construction of a dam, a diversion dam, a water conduction system, a pumping station, and a 69-kilovolt transmission line.

Mining in Nicaragua continued to contribute very little to the economy. Nevertheless, the Government, in need of hard currency, had plans to revitalize its mining industry and activity centered around gold and silver. Over the next few years, Nicaragua planned to open a new mine, La Talavera, in Chinandega Department. It also planned to reactivate different mines throughout the country, including La India Mine, closed since 1956. La Talavera was expected to begin production of 10,600 troy ounces of gold in 1992 and to increase to 15,900 troy ounces of gold per year thereafter. Gold production in 1988 totaled 28,237 troy ounces. Gold mining shifted from the Zelaya Department to EL León Department, mostly at the Limón mining complex. The Government's production goals for 1989 were 22,463 troy ounces from El Limón Mine, 5,521 troy ounces from Bonanza Mine, 3,482 troy ounces from La Libertad Mine, and 4,080 troy ounces from Siuna Mine for a total of 35,466 troy ounces.

Bulgaria has invested $19 million in the Siuna Mine. Also, with Soviet assistance, Nicaragua was planning to increase gold production to 60,000 troy ounces by 1992. Because Nicaraguan gold mines are old and the equipment is obsolete, Bulgaria, Cuba, and the U.S.S.R. have provided technical advisers at the mines.

For 2 days during December, the guerillas attacked the mining towns of Bonanza, Rosita, and Siuna. This was the largest attack to the mining areas since the beginning of the war. Apparently, there was no damage to the mining infrastructure.

Reportedly, because of arbitration proceedings in 1988, Neptune Mining Co., operator of the Vesubio lead-zinc mine for many years until the nationalization of the industry in 1979, was to receive $11.41 million in compensation from the Government and was to pay the Government $18.46 million in fines and other charges. At yearend, scheduled payments remained to be established.

Reports indicate that, with assistance from the Soviet Union and support from Cuba, Hungary and, the United Nations Industrial Development Organization, the Government of Nicaragua was in the process of reopening its aluminum processing plant. Original investment was estimated at $25 million, and the U.S.S.R. was guaranteeing the supply of raw material for the period of 1 year. About 60% of the aluminum products would be destined for exports to Central American and Caribbean markets.

PANAMA

In early 1988, after the President of Panama was ousted and a new President assumed power, the United States imposed trade sanctions against Panama, froze Panamanian assets, and removed the country's eligibility under the Caribbean Basin Initiative. This happened at a time when Panama was affected by severe economic conditions owing to its high external debt, its banking crisis, and the reluctance from international banks to invest in the country. At one point during 1988, commerce and industry were functioning at 40% of the normal level, and unemployment was 27%. The economic crisis began in mid-1987, and the GDP in 1988 decreased an estimated 20%. Bank closures in February and March affected the agricultural sector's purchasing ability and resulted in food shortages.

Mining continued to be limited and was affected by the political and economic instability that prevailed throughout the year. Exploration activity, which increased significantly in 1987, slowed down in 1988 despite legislation in January and other efforts by the Government to stimulate mining. Reportedly, the new legislation guarantees the right to mine, process, and market minerals found in exploration. No customs duty would apply to equipment used in mining, and attractive new tax incentives and a depletion allowance form part of the new regulations. Other efforts by the Government to stimulate mining activity included the release of long-held concession areas where work had not been performed.

In 1987, the Inter-American Development Bank approved a $950,000[7] grant to Panama from the Fund for Special Operations to assist the Government in the preparation of geological maps in three areas that total 15,000 square kilometers. The maps would identify metals and industrial minerals and short- and medium-term potential economic value. The grant also was to assist the Dirección General de Recursos Minerales in developing training programs in geology and mining. In 1988, Panama awarded the minerals inventory contract to Sweden's Sveriges Geologiska AB. However, the project was delayed because of Panama's inability to contribute its share of $500,000.

Skryker Resources Ltd., of Canada, and Freeport Resources Inc. increased their concession area in the Darién project, originally covering 95,000 acres at Río Turquesa, Río Marraganti, and Río Tupisa, into the Río Sábalo. The new concession, southwest of the original areas, totals 23,844 acres. The companies, after encouraging pan sampling, resumed mapping and sampling.

A contract for the exploitation of the Remnance gold mine was approved by the Government of Panama. Plans for the mine to begin production in 1989 were announced in 1988 by the Ministerio de Recursos Naturales, Comercio e Industria. With an initial investment of $2.5 million, Transworld Co. of Panama and Minera Remnance Co. of Peru were to begin operating the mine in the San Francisco de Veraguas District. Planned output was 63,900 troy ounces per year. The mine reserves were estimated at 260,000 troy ounces of gold.

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[1] Physical scientist, Division of International Minerals.

[2] Where necessary, values have been converted from Costa Rican colones (c) to U.S. dollars at the rate of c75.1 = US$1.00.

[3] Where necessary, values have been converted from Salvadoran colones (c) to U.S. dollars at the rate of c5.0 = US$1.00.

[4] Where necessary, values have been converted from Guatemalan quetzales (Q) to U.S. dollars at the rate of Q2.7 = US$1.00.

[5] Where necessary, values have been converted from Honduran lempiras (L) to U.S. dollars at the rate of L2.0 = US$1.00.

[6] Where necessary, values have been converted from Nicaraguan nuevo córdobas (C$) to U.S. dollars at the rate of C$200 = US$1.00.

[7] Where necessary, values have been converted from Panamanian balboas (B) to US dollars at the rate of B1.00 = US$1.00.

TABLE 2

HONDURAS: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1984	1985	Destinations, 1985 United States	Destinations, 1985 Other (principal)
METALS					
Aluminum: Metal including alloys, semimanufactures		8	7	1	Guatemala 6.
Cadmium: Cd content of zinc concentrate		283	NA		
Copper: Ore and concentrate excluding matte		94,347	111,200	23,280	Belgium-Luxembourg 39,461; United Kingdom 24,048.
Gold: Au content:					
Of lead concentrate	value, thousands	$293	NA		
In activated charcoal	do.	$880	NA		
Iron and steel: Metal: Semimanufactures:					
Universals, plates, sheets		13	65	—	Guatemala 35; El Salvador 30.
Wire		149	4	—	All to Costa Rica.
Tubes, pipes, fittings		2	2	—	All to Panama.
Castings and forgings, rough		—	2	2	
Lead:					
Pb content:					
Of copper concentrate		257	NA		
Of lead concentrate		17,893	NA		
Metal including alloys, semimanufactures		3	3	—	All to Guatemala.
Silver: Ag content:					
Of copper concentrate	value, thousands	$192	NA		
Of lead concentrate	do.	$21,137	NA		
Of silver concentrate	do.	$26	NA		
Of zinc concentrate	do.	$4,486	NA		
In activated charcoal	do.	$5	NA		
Zinc:					
Ore and concentrate, Zn content		40,456	—		
Metal including alloys, semimanufactures		11	73	—	Guatemala 72; Nicaragua 1.
Other:					
Ashes and residues		552	274	274	
Base metals including alloys, all forms		170	—		
INDUSTRIAL MINERALS					
Cement		—	2,720	2,720	
Clays, crude		24	—		
Gypsum and plaster		215	74	—	All to El Salvador.
Salt and brine		15	—		
Stone, sand and gravel:					
Dimension stone:					
Crude and partly worked		(2)	201	200	West Germany 1.
Worked		—	65	65	
Limestone other than dimension		133	—		
Sand and gravel		1	—		

See footnotes at end of table.

TABLE 2—Continued

HONDURAS: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1984	1985	Destinations, 1985	
				United States	Other (principal)
MINERAL FUELS AND RELATED MATERIALS					
Petroleum refinery products:					
Distillate fuel oil	42-gallon barrels	233,252	286,941	—	Panama 285,278; Guatemala 1,663.
Lubricants	do.	1,673	280	—	All to Nicaragua.

NA Not available.
[1] Table prepared by H. D. Willis.
[2] Revised to zero.

TABLE 3

HONDURAS: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1984	1985	Sources, 1985: United States	Sources, 1985: Other (principal)
METALS				
Aluminum: Metal including alloys, semimanufactures	757	1,001	248	Brazil 174; Mexico 161.
Copper:				
Ore and concentrate	533	541	232	Mexico 308; West Germany 1.
Sulfate	156	—		
Metal including alloys:				
Unwrought	1	1,534	1	Chile 1,533.
Semimanufactures	627	703	219	Peru 373; Japan 37.
Iron and steel: Metal:				
Scrap	5	1,125	1,094	Unspecified 31.
Ferroalloys	20	57	—	Mexico 34; West Germany 23.
Steel, primary forms	5,515	6,022	4,066	Venezuela 1,794; West Germany 103.
Semimanufactures:				
Bars, rods, angles, shapes, sections	11,187	9,268	1,217	North Korea 1,833; Belgium-Luxembourg 1,440.
Universals, plates, sheets	12,683	18,095	2,273	France 5,494; Japan 5,205; Belgium- Luxembourg 2,651.
Hoop and strip	641	720	149	Austria 335; West Germany 108.
Rails and accessories	262	1,025	253	Costa Rica 563; Guatemala 209.
Wire	12,176	14,621	3,118	France 5,355; Venezuela 2,853.
Tubes, pipes, fittings	3,599	10,956	2,633	Costa Rica 4733; North Korea 1,638.
Castings and forgings, rough	604	112	3	Italy 106; Switzerland 2.
Lead: Metal including alloys:				
Unwrought	818	262	24	Mexico 237; Costa Rica 1.
Semimanufactures	11	192	2	Mexico 188; Nicaragua 2.
Nickel: Metal including alloys:				
Unwrought	([2])	22	1	Mexico 21.
Semimanufactures	4	3	3	
Platinum-group metals: Metals including alloys, unwrought and partly wrought troy ounces	10,353	NA		
Silver: Metal including alloys, unwrought and partly wrought do.	48,097	NA		
Tin: Metal including alloys:				
Unwrought	23	11	6	Spain 2; United Kingdom 2.
Semimanufactures	32	28	8	United Kingdom 14; West Germany 6.

See footnotes at end of table.

TABLE 3—Continued

HONDURAS: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1984	1985	Sources, 1985	
				United States	Other (principal)
METALS—Continued					
Zinc: Metal including alloys:					
Unwrought		1,084	892	21	Mexico 659; Belgium-Luxembourg 210.
Semimanufactures		371	377	23	Mexico 260; Guatemala 74; Italy 18.
Other: Base metals including alloys, all forms		10	10	10	
INDUSTRIAL MINERALS					
Abrasives, n.e.s.:					
Natural: Corundum, emery, pumice, etc.		([2])	—		
Grinding and polishing wheels and stones		59	60	5	West Germany 29; Czechoslovakia 9; China 5.
Asbestos, crude		1,902	1,202	—	All from Canada.
Boron materials: Oxides and acids		4	4	2	West Germany 1; Netherlands 1.
Cement		1,255	2,449	5	Denmark 1,278; West Germany 724; Mexico 399.
Clays, crude		1,724	1,548	1,093	Guatemala 417; El Salvador 21.
Diamond: Industrial stones	thousand carats	60	—		
Diatomite and other infusorial earth		398	502	290	Mexico 159; United Kingdom 52.
Fertilizer materials:					
Crude, n.e.s.	kilograms	8	—		
Manufactured:					
Nitrogenous		63,848	32,045	9,215	West Germany 15,124; Japan 2,891.
Phosphatic		11,341	3,316	3,316	
Potassic		9,728	6,727	3,809	West Germany 2,917.
Unspecified and mixed		14,053	15,069	6,163	Costa Rica 8,460; Japan 437.
Graphite, natural		7	([2])	([2])	
Gypsum and plaster		39	48	43	West Germany 5.
Lime		15	16	1	United Kingdom 15.
Mica:					
Crude including splittings and waste	kilograms	425	—		
Worked including agglomerated splittings	do.	129	NA		
Phosphates, crude	do.	208	—		
Pigments, mineral: Natural, crude		1	15	([2])	Mainly from Mexico.
Precious and semiprecious stones other than diamond: Natural	value, thousands	$3	$2	$1	West Germany $1.
Salt and brine		451	274	141	El Salvador 70; United Kingdom 54.

See footnotes at end of table.

TABLE 3—Continued

HONDURAS: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1984	1985	Sources, 1985: United States	Sources, 1985: Other (principal)
INDUSTRIAL MINERALS—Continued					
Sodium compounds, n.e.s.:					
Carbonate, manufactured		938	1,013	114	Belgium-Luxembourg 795; Netherlands 37.
Sulfate, manufactured		2,838	205	192	West Germany 11; U.S.S.R. 1.
Stone, sand and gravel:					
Dimension stone:					
Crude and partly worked		53	22	—	All from Guatemala.
Worked		6	7	—	Do.
Dolomite, chiefly refractory-grade		19	—		
Gravel and crushed rock		36	96	53	Trinidad and Tobago 43.
Limestone other than dimension		51	20	—	All from Mexico.
Quartz and quartzite		287	126	47	West Germany 74; Netherlands 5.
Sand and gravel		36	—		
Sulfur:					
Elemental: Crude including native and byproduct		(2)	15	5	West Germany 10.
Sulfuric acid		362	297	68	Netherlands 141; Canada 76.
Talc, steatite, soapstone, pyrophyllite		154	251	185	China 30; Italy 21.
MINERAL FUELS AND RELATED MATERIALS					
Carbon black		58	—		
Coal: All grades excluding briquets		59	68	68	
Coke and semicoke		526	377	376	Guatemala 1.
Petroleum:					
Crude	thousand 42-gallon barrels	1,415	3,820	—	Venezuela 2,782; Mexico 1,038.
Refinery products:					
Liquefied petroleum gas	do.	92	105	102	Mexico 3.
Gasoline	do.	265	519	43	Panama 165; Venezuela 158; Trinidad and Tobago 96.
Mineral jelly and wax	do.	10	14	3	West Germany 8; Japan 1.
Kerosene and jet fuel	do.	220	376	39	Venezuela 219; Panama 58; Trinidad and Tobago 46.
Distillate fuel oil	do.	591	1,509	106	Venezuela 668; Panama 358; Trinidad and Tobago 247.
Lubricants	do.	85	69	65	Jamaica 2; Netherlands Antilles 1.

NA Not available.
[1] Table prepared by H. D. Willis.
[2] Less than 1/2 unit.

THE MINERAL INDUSTRIES OF THE

ISLANDS OF THE CARIBBEAN

By Ivette E. Torres[1]

INTRODUCTION

With the Caribbean Basin Initiative (CBI), in effect since January 1984, the United States has been giving duty-free access to most products from 22 Caribbean beneficiary countries. Under the CBI, these nations also offer a variety of investment incentives, including duty-free entry of raw materials for production and a liberal policy of profit repatriation to the United States. In 1988, traditional exports from the region continued to decline. However, there was a strong performance by the nontraditional export sectors. While exports to the United States remained at about the same level of 1987, U.S. exports to the beneficiary countries increased. Exports of crude petroleum and petroleum products to the United States declined by 24% relative to 1987. Other traditional exports, with the exception of bauxite which increased by 22%, also declined.

The strongest economic performance under the CBI was observed in the apparel sector. Other sectors that produced positive performance, in order of growth, were medical instruments and appliances, organic chemicals and related products, electronic equipment, furniture and parts, and meat.

ARUBA

After reports in 1987 that indicated that the Government of Aruba and the Caribbean Development & Commerce Co. had agreed to reopen the former Exxon Corp. Lago refinery, in January 1988, Aruba and Exxon signed an agreement to dismantle the refinery. The dismantling, according to reports, was to begin by September 30 and would be completed by 1994. The powerplant and other installations of interest to the Government were to be left in place. The agreement relieved Exxon of its obligation to return the property to its original condition. Other issues such as back taxes and environmental damage were not resolved. Exxon expressed interest in using some of the facilities for an oil transshipment operation.

Occidental Petroleum Corp.'s subsidiary, Occidental International Exploration & Production Co. obtained a production-sharing contract with Aruba for the 173,000-acre Block II. Occidental International, with an 80% interest in the venture, committed itself under contract to drill an exploration well on the offshore block within 18 months. According to Occidental Petroleum Corp.'s annual report, the company had actively pursued exploration in this area since 1981.

BAHAMAS

In 1988, because of increased demand for electricity resulting from economic expansion, the Inter-American Development Bank (IDB) approved a $109 million[2] loan from its ordinary capital. The loan was destined for the expansion of the two Bahamas Electric Corp.'s (BEC) thermal generating plants, Blue Hill and Clifton Pier, and for the building of a new one. The Blue Hill power station was to receive two new gas turbines to increase capacity by 32,000 kilowatts. The Clifton Pier power station was to be expanded with a 10,000-kilowatt diesel power unit; a new 40,000-kilowatt diesel power station was going to be built next to it. Also, the country's transmission system was to be expanded with a 13-mile, 132-kilovolt single-circuit line from the Big Pond substation to the Clifton Pier substation. The IDB financing includes a $164,000 technical assistance loan for strengthening the BEC.

The Bahamas Oil Refining Co. refinery, fully owned by Chevron Overseas Petroleum Ltd. since 1987 and a subsidiary of Chevron International Oil Co., has been closed since 1985. In 1988, it continued to operate as a storage, transshipment, blending, and bunkering service facility. About 95% of the crude oil and petroleum products were destined for the United States.

BARBADOS

The gross domestic product of Barbados increased 3.5% in real terms in 1988. All major export categories increased in value. The value of chemical product exports increased 18% and reached a record-high level of almost $20 million.[3] Expansion of the economy was reflected in the recovery of the manufacturing industry as well as in the increase of construction activity. The United States continued to be the Island's main trading partner. The value of exports to the United States increased about 12% while imports from the United States also increased. At midyear, the Prime Minister announced that Barbados had lifted a 10% duty on imports from Caribbean Community countries. However, the duties would remain for Belize, Grenada, St. Lucia, and St. Kitts-Nevis, which still have stamp duties in place.

In April, the Prime Minister, also Minister of Finance and Development, presented the new budget to the Parliament. The new budget was oriented towards reducing the fiscal deficit, stimulating manufacturing and agriculture, and increasing employment. Consumption taxes for petroleum products were increased in the budget.

Installation of the liquefied petroleum gas (LPG) plant purchased by the Barbados National Oil Co. Ltd. in 1987 was completed and the plant was in operation at the beginning of 1988. The $4 million plant, inaugurated in March, has a capacity of 25,000 barrels of LPG per year and will reduce imports of LPG by about 25%.

Efforts by the Government to reduce oil imports for domestic consumption suffered a setback when Cluff Oil Ltd., of the United Kingdom abandoned its

TABLE 1

ISLANDS OF THE CARIBBEAN: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Country[2] and commodity		1984	1985	1986	1987[p]	1988[e]
BAHAMAS[3]						
Cement, hydraulic		—	—	91	—	[4]—
Petroleum refinery products[e]	thousand 42-gallon barrels	44,000	6,000	—	—	—
Salt	thousand tons	[e]870	[e]850	899	736	[4]616
Stone: Aragonite	do.	[e]2,200	[e]2,000	427	1,524	[4]897
Sulfur, byproduct of petroleum[e]	do.	3	1	—	—	—
BARBADOS[3]						
Cement, hydraulic	do.	[e]150	[e]215	199	205	[4]184
Gas, liquefied petroleum	42-gallon barrels	—	—	—	—	15,000
Gas, natural:[e]						
Gross	million cubic feet	893	900	900	800	800
Marketed	do.	370	370	370	360	360
Petroleum:						
Crude	thousand 42-gallon barrels	635	679	559	[e]510	500
Refinery products[e]	do.	1,500	1,500	1,500	1,400	1,400
CUBA[3 5]						
Cement, hydraulic	thousand tons	3,347	3,182	3,305	3,540	3,700
Chromite	do.	38	38	50	60	60
Cobalt[6]		1,397	1,490	1,578	[r e]1,660	1,950
Copper, mine output, Cu content		2,701	3,076	3,257	3,461	[4]2,951
Gas, natural:						
Gross[e]	million cubic feet	2,300	2,400	[r]2,000	2,300	2,300
Marketed	do.	120	244	201	[e]240	250
Gypsum[e]	thousand tons	130	130	130	130	130
Iron and steel: Steel, crude	do.	325	401	412	425	450
Lime	do.	151	170	177	[r e]170	175
Nickel:						
Mine output, Ni-Co content of oxide and sulfide		33,227	33,577	35,101	35,860	43,850
Metallurgical products, Ni content:[6]						
Granular oxide and powder		8,447	8,853	8,382	[r e]9,000	16,900
Oxide sinter		8,894	7,054	8,278	[r e]8,200	8,000
Sulfide		14,489	16,180	16,863	[r e]17,000	17,000
Total		**31,830**	**32,087**	**33,523**	**[e]34,200**	**41,900**
Nitrogen: N content of anhydrous ammonia	thousand tons	[r]169	[r]163	163	160	160
Petroleum:						
Crude[7]	thousand 42-gallon barrels	5,125	5,771	6,240	6,000	4,800
Refinery products	do.	48,340	46,020	50,144	[r e]50,000	50,000
Salt	thousand tons	185	221	266	[r e]275	275
Sulfur, byproduct of petroleum	do.	[r]5	[r]5	5	5	5

See footnotes at end of table.

TABLE 1—Continued

ISLANDS OF THE CARIBBEAN: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Country[2] and commodity		1984	1985	1986	1987[p]	1988[e]
DOMINICAN REPUBLIC[3]						
Aluminum: Bauxite, dry equivalent, gross weight	thousand tons	—	—	—	211	[4]106
Cement, hydraulic	do.	1,143	1,007	1,066	1,100	[4]1,495
Coal, subbituminous[e]		—	600	600	600	600
Gold	thousand troy ounces	[r]342	328	284	246	[4]186
Gypsum	thousand tons	210	310	132	59	[4]153
Iron and steel:						
Ferroalloys, ferronickel		[r]62,819	[r]64,542	55,954	81,303	73,363
Steel, crude		63,942	59,850	100,043	87,800	[4]75,327
Lime[e]		40,000	34,000	34,000	36,000	36,000
Mercury	76-pound flasks	[e]40	[r]20	13	2	[4]6
Nickel:						
Mine output, Ni content		23,923	25,394	21,878	32,521	29,300
Metal:						
Smelter, Ni content of ferronickel		[r]24,311	[r]25,365	21,878	32,521	[4]29,345
Shipments, Ni content of ferronickel		24,220	25,809	21,989	29,051	[4]32,377
Petroleum refinery products	thousand 42-gallon barrels	[e]11,000	12,647	[e]13,000	[e]13,000	13,000
Salt[e]		60,000	[4]47,159	54,000	55,000	[4]17,021
Silver	thousand troy ounces	[r]1,222	[r]1,610	1,318	1,148	[4]1,273
GUADELOUPE[3]						
Abrasives, natural: Pumice[e]	thousand tons	250	215	221	[e]220	220
Cement	do.	170	173	181	[e]190	200
HAITI[3]						
Cement, hydraulic[e]	do.	220	220	180	200	200
JAMAICA[3]						
Aluminum:						
Bauxite, dry equivalent, gross weight	do.	[r]8,735	[r]6,239	6,964	7,660	[4]7,408
Alumina	do.	[r]1,713	[r]1,622	1,586	572	[4]1,522
Cement, hydraulic	do.	261	240	241	306	[4]371
Gypsum	do.	180	179	117	176	[4]146
Iron and steel: Steel, crude		11,380	11,734	11,095	18,950	[4]25,334
Lead, refined (secondary)[e]		1,000	1,000	1,000	1,000	1,000
Lime	thousand tons	115	86	92	90	[4]80
Petroleum refinery products	thousand 42-gallon barrels	8,243	[r]8,726	9,597	9,108	[4]9,801
Salt		15,490	15,706	13,090	15,665	[4]15,466
Silica sand	thousand tons	14	16	13	20	[4]13
Stone:						
Limestone		([8])	5,304	5,331	5,848	5,984
Marble		370	50	200	500	[4]2,700
Marl[e]	thousand tons	8,640	6,210	7,020	7,560	7,020
Sand and gravel[e]	do.	[r]863	[r]1,375	[r]1,525	[r]1,700	2,025

See footnotes at end of table.

TABLE 1—Continued

ISLANDS OF THE CARIBBEAN: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Country[2] and commodity		1984	1985	1986	1987[p]	1988[e]
MARTINIQUE[3]						
Cement, hydraulic[e]	thousand tons	[4]190	200	200	200	200
Lime[e]		5,000	5,000	5,000	5,000	5,000
Petroleum refinery products[e]	thousand 42-gallon barrels	4,300	4,300	[4]4,938	4,800	4,800
Pumice, converted from cubic meters[e]	thousand tons	[4]136	150	140	130	130
NETHERLANDS ANTILLES[3]						
Petroleum refinery products	thousand 42-gallon barrels	[r]147,864	[r]73,000	67,160	83,600	80,000
Phosphate rock[e]	thousand tons	[4]19	20	20	16	16
Salt[e]	do.	356	350	350	350	350
Sulfur, byproduct of petroleum[e]	do.	63	25	40	60	60
ST. VINCENT[3]						
Salt[e]	do.	50	50	50	50	50
TRINIDAD AND TOBAGO[3]						
Asphalt, natural	do.	34	33	27	[e]26	[4]21
Cement, hydraulic	do.	405	328	327	327	[4]360
Gas, natural:						
Gross	million cubic feet	268,369	318,954	226,953	[r e]270,000	280,000
Marketed	do.	119,695	124,197	[e]132,300	[r e]135,000	160,000
Iron and steel:						
Iron, sponge	thousand tons	239	205	208	475	[4]593
Steel, crude	do.	[r]187	[r]172	326	361	[4]361
Semimanufactures (wire rod)	do.	135	103	217	291	[4]251
Lead, refined (secondary)[e]		2,000	2,000	2,000	1,800	1,800
Natural gas liquids[e]	thousand 42-gallon barrels	40	40	40	40	40
Nitrogen: N content of ammonia	thousand tons	[r]1,080	[r]1,080	1,141	1,127	1,388
Petroleum:						
Crude	thousand 42-gallon barrels	62,042	64,259	61,435	56,621	55,208
Refinery products	do.	31,077	29,678	[e]30,860	31,392	[4]31,123
Stone: Limestone	thousand tons	232	663	580	[e]600	600
Sulfur, byproduct of petroleum[e 9]	do.	7	5	5	5	5

[e]Estimated. [p]Preliminary. [r]Revised.
[1]Table includes data available through July 14, 1989.
[2]In addition to the countries listed, Antigua, Bermuda, Dominica, Grenada, Montserrat, and St. Lucia presumably produce crude construction materials (clays, sand and gravel, and stone), but output is not always reported, and information is inadequate to make reliable estimates of output levels.
[3]In addition to commodities listed, crude construction materials (lime, salt, sand and gravel, stone, etc.) may also be produced, but data on such production are not always available and information is inadequate to make reliable estimates of output levels.
[4]Reported figure.
[5]In addition to the commodities listed, iron ore and manganese ore presumably were produced during the period covered by this table, but available information is inadequate to make reliable estimates of output levels.
[6]Anuario Estadistico de Cuba provides figures of nickel-cobalt content of granular and powder oxide, oxide sinter, and sulfide production. Using an average cobalt content in these products of 0.9% in total granular and powder oxide, 1.1% in total oxide sinter, and 4.5% in total sulfide, the cobalt content of reported Ni-Co production was determined to be 1.16% of granular and powder oxide, 1.21% of oxide sinter, and 7.56% of sulfide. The remainder of reported figures would represent the nickel content. Cobalt and nickel figures are revised as necessary.
[7]Cuba reports crude oil production in metric tons. A conversion to barrels was made using a factor of 6.652.
[8]Revised to zero.
[9]Sulfur as a byproduct of natural gas may also be produced but information is inadequate to make reliable output estimates.

exploration efforts because of depressed oil prices and the depth of water. Nonetheless, the Government continued to seek ways for the Island to become self-sufficient in energy.

Cement production decreased 10% to 184,482 tons. The decrease was attributed to a 2-month shutdown of the Arawak Cement Co. caused by failure of a raw mill fan impeller. About 21% of the cement was produced from imported clinker.

CUBA

Cuba's global social product (equivalent to the gross domestic product) increased 2.3% in 1988, compared with a 3.2% decrease in 1987. Increases in output of the industrial sector, especially the sugar industry, accounted for the increase. The Government continued with austerity measures and called for increased productivity and conservation of raw materials and natural resources, including water. Priority was to be given to the replacement of imports with domestic products, the increase of exports, and the improvement of economic efficiency.

The 1989 budget was approved during the plenum of the Cuban Communist Party Central Committee that opened on December 15. In December, the Minister President of the Cuban State Committee for Economic Cooperation announced in a press conference that Cuba and the Soviet Union had signed an agreement in May that outlined cooperation plans between the two countries for the next 15 to 20 years.

The Minister indicated that trade between the two countries was likely to increase during this period. Soviet technical and financial cooperation in Cuba, extended throughout the industrial sector, included major investment programs such as the construction of the Juraguá nuclear powerplant, the modernization of two oil refineries and the construction of another, construction of the Amistad pipeline linking the new refinery to the deepwater dock and oil storage facilities in Matanzas, and an oil drilling program in eastern Havana, Cárdenas, and Varadero. Reportedly, bilateral trade between Cuba and the U.S.S.R. exceeded $8.5 billion[4] in 1988, accounting for 72% of Cuba's total trade. Cuban exports to the Soviet Union totaled $4.5 billion.

In addition to the Soviet Union, Cuba signed trade, economic, and/or scientific-technical cooperation agreements with Albania, Czechoslovakia, North Korea, Mexico, Spain, Tunisia, Uganda, and Yugoslavia. The agreement with Mexico, signed in April, established preferential treatment on trade between the two countries. Among the products to be exported from Cuba were marble and scrap metal. Products from Mexico included chemicals.

The agreement with North Korea included increased cooperation in basic steelworks and light industries. According to the signed protocol, trade in 1989 would increase 11% from that of 1988. The $60 million agreement with Spain's Astilleros Españoles S.A. for the acquisition of six freighters included two for ammonia transport.

A set of metallogenic and minerogenic maps of Cuba at a scale of 1:500,000 was nearing completion at yearend. The maps, which show deposits and occurrences of metallic minerals, mineral waters, industrial minerals, and hydrocarbons, were being produced by the Institute for Geological Research in Leningrad, the Soviet Union, with the assistance of experts from the Council of Mutual Economic Assistance (CMEA). The maps locate deposits and occurrences according to geological nature and indicate their relative size and importance. In addition to describing deposits already being exploited, the maps draw attention to resources not fully utilized and offering potential for future development.

Nickel-cobalt production increased from 35,800 tons in 1987 to 44,000 tons in 1988, a record-high level. The increase was attributed to increased production at Punta Gorda's Comandante Ché Guevara plant to about 9,000 tons, almost one-third of its design capacity, and to improved efficiency at Moa as a result of an overhaul.

Cuba's nickel-cobalt production had exceeded 40,000 tons in 1981 but decreased to 35,227 in 1984 because of maintenance problems and mechanical breakdowns. To repay the construction costs of the Ché Guevara plant, 75% of the output is exported to CMEA countries. Production from the Ché Guevara refinery for 1989 was forecast at 15,000 to 16,000 tons.[5] That would bring Cuba's production to 50,000 tons. Full production (30,000 tons) from Ché Guevara was expected by 1990.

Reportedly, in 1988, ministers from Bulgaria, Czechoslovakia, Cuba, the German Democratic Republic, Hungary, Romania, and the Soviet Union signed an agreement with Cuba for the construction of the Camariocas nickel complex in Moa, in the eastern part of the island. Construction of the plant had begun in 1985 with financial assistance from Hungary but was stopped because of the technical problems with the Ché Guevara plant. Commissioning of the 30,000-ton Las Camariocas refinery has been delayed. The refinery is expected to begin production at the level of 10,000 tons by 1992 and to reach full production no sooner than 1995. Although Cuba has been planning and working on the expansion of its nickel industry for the last 15 years, progress has been very slow because of technical problems and lack of adequate equipment. In 1988, after years of delays in the Ché Guevara refinery's progress, the Soviet Union reportedly sent 1,200 technicians to work on Cuba's nickel projects. In addition, Cubaniquel, the state-owned operating company, has established a technical institute to train its employees.

A 150,000-ton stainless steel plant was being constructed in the eastern Province of Las Tunas, where Cuba wants to establish a metal manufacturing industrial zone. At present, that

Province is one of the least industrialized in the country. The plant, scheduled for completion in 1991, would employ 600 to 800 people. Reports indicate that the plant will be built with Italian technology and equipment. One-half of the construction costs of the plant will be reimbursed in the form of stainless steel products. The infrastructure to transport the hot- and cold-rolled products was completed in 1988. Cuba has been exporting various steel products since 1980, including bars, ingots, sheets, and wire rods to Asia, Latin America and the Middle East, and reports indicated that it would be exporting stainless steel beginning in 1989.

In 1988, Cuba signed a $5.9 million contract with the Colombian company Hojalata y Laminados S.A. (HOLASA) to import 5,800 tons of electrolytic tinplate during the period November 1988 to April 1989. In addition, a letter of intent was signed between Cuba and HOLASA for the importation of 4,000 additional tons by Cuba during the second semester of 1989, with a value exceeding $4 million.

On June 3, 1988, Cuba and Guyana signed an agreement for the joint exploitation of the kaolin resources at Topira, Guyana's bauxite belt. Under the agreement, development of the deposit was to be carried out in two stages. During the first stage, scheduled to begin by yearend and not to exceed 5 years, crude kaolin would be mined jointly and exported to Cuba. During this period, a feasibility study would be undertaken of a kaolin processing plant in Guyana for the export of refined kaolin. The second stage was to include the final design and construction of the processing plant. Joint-venture discussions between Cuba and Guyana began in 1987 and continued in January 1988, at the 13th meeting of the joint commission for economic, scientific-technical, and educational cooperation.

The Cuban press reported plans to increase zeolite production in 1989. Because of the recent discovery of two high-grade deposits with reserves totaling 12 million tons, four new processing plants were being constructed in the Provinces of Camagüey, Havana, Holguín and Villa Clara.

Reports at yearend indicated that work was progressing rapidly on the Amistad 200-kilometer oil pipeline between the Matanzas Bay supertanker oil terminal and the refinery being built in Cienfuegos. Reportedly, this is the first economic/technical project between Cuba and the Soviet Union supported by a contract, with a Soviet building organization headquartered in Cuba. The pipeline, which will connect the refinery to eastern Havana's thermoelectric system and to the Varadero oil facilities, was expected to be completed by June 1989. The refinery, with a 55,000-barrel-per-day capacity, was scheduled for first stage of completion by July 1989. The supertanker oil terminal was designed to have three fully automated piers, the largest of which was to be used by tankers with a capacity of 150,000 tons. The terminal, being constructed by Industrija Nafte of Yugoslavia, was near completion at yearend 1988. Along with this project, Cuba continued to intensify its oil exploration program.

Construction of the four-reactor, 1,668-megawatt nuclear powerplant in Juraguá, near Cienfuegos, continued. Construction of the plant, first announced in the 1976–80 5-year plan, reportedly began in 1981 with Soviet assistance. The first of two 440-megawatt reactors being constructed, originally scheduled for the late 1980's, was expected to be in operation in 1991. Heavily dependent on Soviet oil for its domestic demand and with limited hydrocarbon resources, Cuba plans to construct two similar nuclear plants, in the eastern and western regions of the country, respectively.

DOMINICAN REPUBLIC

The Dominican Republic's gross domestic product (GDP) increased 1% in 1988, with the highest inflation and monetary devaluation ever recorded. The Government continued to implement its program of public investment, which included road construction and maintenance, housing projects, urban development, public health, and investments in agriculture. However, the country continued to suffer from electricity and water shortages as well as a shortage of basic food products.

Preliminary figures indicate a 36% increase in total export value, including free zone exports. The value of traditional exports increased 5%, while mineral export value increased dramatically by 69% relative to 1987. The increase in mineral value was attributed to the increase of ferronickel prices. On the other hand, a decrease in orders from Aluminum Co. of America resulted in reduced bauxite exports.

The Dirección General de Minería granted three minerals exploration concessions in 1988, two for metals and one for industrial minerals. The Río Limpio concession, in the northwest Provinces of Elías Piña and Dajabón, was awarded to Mitsubishi Corp. of Japan through its subsidiary, C. Minerals Corp. The 14,000-acre concession is for metallic exploration. The Miches 1 concession, covering about 22,000 acres in the eastern El Seibo Province, was awarded to Homestead International Minerals Ltd. for gold exploration. The 2-year exploration concessions awarded to Homestead and C. Minerals included the option for 1-year extensions. The domestic company Espumas Industriales C. por A. was awarded the industrial mineral concession.

The low number of concessions awarded in 1988, after the opening of the Federal Reserves for exploration to private domestic and foreign companies in 1987, was attributed to a new tax policy implemented in 1988. Interest in exploration in the Dominican Republic of about 20 major mining companies was reduced when companies applying for exploration concessions were asked to submit a letter offering to pay net corporate taxes that exceeded the 40% required by the 1971 mining law.

In October, the Secretariado Técnico de la Presidencia, Oficina Nacional de Planificación, published a document that covers the minerals occurrences and deposits. The study, organized by provinces, covers metals, industrial minerals, and energy resources. Each province was analyzed in general terms, and information about each mineral sector was analyzed in terms of mineral, location, present importance, potential and limitations, and recommendations. The document is accompanied by maps, of the Cibao Region, the Southwestern Region and the Southeastern Region.

Gold production from Rosario Dominicana S.A.'s Pueblo Viejo Mine totaled 186,000 troy ounces, a 24% decrease from that of 1987. Because the oxide ore zone was expected to become depleted in 1990, Rosario Dominicana's board of directors in 1987 approved funds to develop the transition ore zone, one of two other ore zones. The transition zone reportedly contains 400,000 troy ounces of gold. On September 14, 1988, after Presidential approval, Rosario Dominicana signed a letter of intent with Fluor Corp. of the United States for development of the zone. Fluor, representing four U.S. firms in a consortium, will prepare the mine for gold and silver extraction from the transition ore zone. Mine preparation, to begin on September 19 and estimated to cost $22 million,[6] will be completed in about 2 years. Exploitation of the zone will extend the mine's life by 2 years.

A joint venture for gold exploration and mining in the Dominican Republic was formed between the U.S. companies Canyon Resources Corp.(40%) and Battle Mountain Gold Co.(60%). Canyon Resources had been exploring in the Dominican Republic and in 1987 announced findings of commercially exploitable gold deposits. Reportedly, under the joint-venture agreement, Battle Mountain will finance a $15 million exploration program by its subsidiary, Recursos Canyon Dominicanos S.A.

Falconbridge Dominicana C. por A. (Falcondo), 85.2% owned by Falconbridge Ltd. of Canada, produced 29,345 tons of nickel contained in ferronickel. Exports of nickel in ferronickel reached a new record-high level of 32,377 tons, an 11% increase over those of 1987, according to the company's annual report. Falcondo accomplished this improvement even after severe shipment restrictions that began with shipment suspension by the company in December 1987 because of export duties imposed by Presidential decree in November. Although the company had been negotiating a new contract and tax agreement with the Government since January 1988, it suspended ferronickel production from April 19 through May 22 after the Government had stopped all exports in April. On May 26, an amendment to the company's contract was signed. The agreement, based on taxable income determined by the price of nickel and production costs, replaced the peso-based export duty imposed by the Government in November 1987. The company reported net earnings of $88.4 million in 1988, up from $13.4 million reported in 1987. Falcondo's mineral reserves at yearend 1988 totaled 23.9 million tons grading 1.88% nickel.

Falcondo continued to upgrade its pollution control systems and to increase exploration efforts within its concession area.

Production of bauxite, gypsum, and marble constitutes less than 1% of the value of the country's minerals exports. The national marble company was seeking loans to finance purchase of new equipment and upgrade its plants. In Barahona, the Government was seeking loans to increase gypsum and rock salt production and upgrade the related infrastructure. The Government holding company was making an additional $5 million investment offer in the salt mine to improve the railway access. The investor in return would receive salt for sale in the United States.

Oil consumption in the Dominican Republic increased in 1988. Crude oil was imported from Mexico and Venezuela under the concessionary terms of the San José Accord. In addition, the Dominican Republic purchased petroleum products on the spot market to meet slightly over 50% of its requirements. These products were distributed by the state-owned refinery. Consumption of oil refinery products increased dramatically in 1987 and was expected to increase significantly in 1988. In addition to the refinery, petroleum products were being imported directly by Falcondo, the national electric company, and special products distributors.

The prices of petroleum products, set by the Government in 1987, remained at RD$3.60 for a gallon of 95 octane gasoline, RD$2.50 for a gallon of gasoil, and RD$2.75 for a gallon of kerosene. These prices, in terms of the currency devaluation in 1988, represent a subsidy by the Government.

GUADELOUPE AND MARTINIQUE

The latest trade data available for Guadeloupe and Martinique are included in tables 6, 7, 8, and 9.

HAITI

On February 7, 1988, after a three-member provisional Government had been in place since February 1986, a new President was inaugurated in Haiti. Four months later, on June 19, the military seized power and the President and members of his Government were sent into exile. The Army's Chief of Staff was then installed as President. The new military Government dissolved the new constitutionally mandated legislature and announced that it would rule by decree. On September

17, after a second military coup, the fourth Government since February 1986 was in place. A new, mostly civilian, cabinet was appointed.

Because of violence in November 1987, when elections had to be postponed, various countries suspended aid to Haiti. The loss of this assistance and the political uncertainty that prevailed led to economic stagnation in 1988.

Mining represents a very small sector of Haiti's mostly agrarian economy. Most construction materials, with the exception of cement, have to be imported, mainly from the United States. The United States continued to be Haiti's main trading partner in 1988.

Efforts to develop the marble industry continued throughout the year. Reportedly, an international consortium, including Canadian, French, Hong Kong, Italian, Taiwanese and West German interests invested $4 million in marble quarrying. Domestic companies also were to participate in the consortium to produce marble from several mines in the Jacmel, Gonaives, and other areas. Marble from this project was to be exported to North America and Europe. A separate West German delegation that visited Haiti in 1988 representing private interests, also was interested in marble and other mining possibilities.

JAMAICA

Economic growth increased slightly in GDP after a 5.2% increase in 1987. Strong performance was achieved by the agricultural and construction sectors during the first three quarters of the year. However, in September damage by Hurricane Gilbert affected economic performance and economic recovery because of loss revenues, especially in tourism and agriculture. Losses of agricultural products resulted in increased imports. The damage to the bauxite industry was minimal. The construction sector increased 14% relative to 1987. Average inflation, measured by the consumer price index, was 6.3%.

During the year, the Government continued with efforts to reschedule foreign debts and to seek assistance from institutions like the International Monetary Fund (IMF), the International Bank for Reconstruction and Development, and the Inter-American Development Bank (IDB). In August, the IMF and Jamaica agreed on the terms of a $114 million[7] loan to be disbursed from September 1988 through November 1989.

Production of alumina and bauxite, two of Jamaica's most important export commodities, decreased slightly. The decrease in bauxite was the result of the expiration of the 1987 Kaiser Jamaica Bauxite Co.'s short-term export arrangement. Also, the reduced bauxite output during the first 2 months of the year was attributed to suspension of shipments to the U.S.S.R. The suspension was a result of disagreement over the price applicable to Jamaican shipments to the Soviet Union from Jamaica under their 7-year contract. In March, an agreement was reached between the two countries and shipments resumed. Jamaica also continued with its efforts to renegotiate the contract when it expires in 1990; it wants to increase exports to the U.S.S.R. by 33%.

Total alumina exports remained at about the same level as that of 1987. Exports to the United States increased from 129,400 tons in 1987 to 514,100 tons in 1988, while exports to Canada decreased from 547,500 tons in 1987 to 362,200 tons in 1988. Exports to the United Kingdom increased by more than 50% but exports to Norway, Sweden, and the Netherlands decreased substantially.

The Bauxite and Alumina Trading Co. of Jamaica Ltd. signed a memorandum of understanding in April to supply China National Import-Export Corp. with 50,000 tons of alumina during the year. Reportedly, China had been seeking a 100,000-ton contract but Jamaica, owing to prior commitments, was unable to supply the increased amount.

In March, the Government amended its Bauxite Production Levy Act. Under the amendment, basic rates for bauxite produced in Jamaica were set at $20.93 per ton. This new rate represented a 20% increase from the rate established by the Parliament in 1987.

In April, the Minister announced a levy reduction for companies operating at full capacity. In addition, the companies would have to pay a 33.3% profit tax. This new system was implemented while negotiating with Aluminium Co. of Canada (Alcan) and Aluminum Co. of America (Alcoa) for individual agreements that included increased production levels. The Government's previous efforts to have Alcan and Alcoa increase their output had been unsuccessful.

The agreement reached between Alcoa and the Government in March called for the Government to increase its equity share of Alcoa's Halse Hall refinery from 6% to 50%, therefore becoming an equal partner with Alcoa in Jamalco. Among other issues resolved with this agreement was the timetable for construction of the red mud disposal lake, to begin promptly. The lake will permit the plant to continue to operate and to expand its alumina production capacity. The plant capacity will be expanded to 1 million tons and the company will pay the same levy offered to companies operating at full capacity. This agreement with Alcoa reportedly cost the Government $26.5 million.

Later in the year, Alcan and the Government also reached an agreement concerning the operation of their joint venture, Jamalcan. The agreement, similar to that reached with Alcoa, would result in increased output. With these agreements, the Government achieved its desired increased production, and with it, the possibilities for market expansion. The companies gained from a changed tax system.

In August, the Parliament approved a levy increase of $22.60 per ton retroactive to January 1. The only company without an agreement with the Government at that time was Kaiser.

During the year, Kaiser and Hydro Aluminium A.S., a subsidiary of Norsk Hydro A/S of Norway, became partners in Aluminum Partners of Jamaica (Alpart). Hydro acquired 25% in the alumina plant previously owned by Kaiser (50%) and Reynolds Metal Co. (50%). Kaiser then became the majority owner by purchasing the remaining 25% equity from Reynolds. Hydro then purchased an additional 10% from Kaiser. Agreements to begin production were signed in December. Hydro, with no other refinery, would supply its smelters with its share of Alpart's alumina. The mining lease for Alpart, closed since 1985, was cancelled by the Government at yearend 1987.

The Government of Jamaica and Canada (through the Canadian International Development Agency) in recent years funded a geochemical survey oriented towards the discovery and potential development of metallic minerals in Jamaica such as antimony, cobalt, copper, gold, lead, molybdenum, nickel, platinum, silver, and zinc. Results of the survey were close to being released simultaneously in Jamaica and Canada at yearend. The purpose of the survey was to stimulate exploration and development of Jamaica's resources by domestic and foreign private companies.

With the financial assistance of the IDB, the Caribbean Cement Co. in Kingston, sold by the Government in 1987 under its divestment program, completed its energy conversion and expansion program in November 1988. The IDB had approved two loans in 1981 totaling $57.2 million for the project. Total cost of the project was estimated at $110 million and consisted of the installation of a 1,300-ton-per-day dry-process production line and power generation equipment. The new 430,000-ton-capacity coal-fired kiln, installed in 1987, became operational in 1988, and the existing 200,000-ton kiln fuel oil system was converted to coal firing. Also, all three of the formerly existing engines were retrofitted from marine diesel oil to the less-expensive bunker C oil. At current prices, with these changes and the dual purpose burner (designed to use both oil and coal), Caribbean Cement expected to reduce energy consumption by 40%.

The Government, with assistance from the United Nations Development Program, has been working on an industrial minerals exploration and development project. During 1988, the second phase of the three-phase project was completed. The third phase was expected to be completed in 18 months. Phase 2 focused on promoting joint ventures to develop industrial minerals. The Government, through the Geological Survey Division (GSD), assisted local firms and foreign investors by providing technical assistance and geological data to potential investors.

Production of limestone increased slightly in 1988. According to the Planning Institute of Jamaica, exports of limestone totaled 89,000 tons. Efforts to increase exports, especially to the United States, continued although the industry is faced with several problems, such as high transportation costs, utilization of same pier as passenger cruise ships, and inadequate storage facilities. Jamaica's limestone resources were estimated at over 150 billion tons. According to usage, 7.5 billion tons are of high-grade filler type with greater than 98% calcium carbonate content, 30 billion to 45 billion tons are of chemical and metallurgical grade, and 100 billion tons are usable as aggregate. During the year, investigation of additional high-purity, high-brightness deposits continued in Westmoreland, St. Elizabeth, and Portland.

According to the Planning Institute, the number of marble producers in Jamaica rose from two to four, and production increased more than fourfold. Jamaica's identified marble reserves were estimated at 146 million cubic meters.

Jamaica's energy policy was directed towards reducing oil imports, diversification, development of local energy sources, and energy conservation.

TRINIDAD AND TOBAGO

Trinidad and Tobago's economic output declined by an estimated 4% in 1988. The Government continued to seek out solutions for a troubled economy heavily dependent on petroleum export revenues. The country found itself under austerity measures, attempting to restructure its foreign debt, in light of exhausted foreign exchange reserves. In June, the foreign exchange reserves fell to $20 million, equivalent to less than 1 week of imports.[8] Unemployment during the year was high and increasing, and the currency was devaluated by 18% in August against the U.S. dollar. Some Government salaries were cut and subsidies to state companies reduced. As part of the Government's short-term economic recovery plan, the Prime Minister, on January 8 announced a tax reduction program to encourage an increase in oil production, which has been in decline since 1978, except for small increases in 1984-85. Diversification, led by foreign investment in agriculture, tourism, and petrochemicals, is part of the long-term economic recovery plan.

In November, the Prime Minister announced to the Parliament that part of Trinidad and Tobago's commercial foreign debt had been successfully rescheduled and that the IMF had approved the Government's request for compensatory financing facility funds, which was base on reduced oil earnings.

During the year, the IDB approved a $5.7 million[9] loan to finance a program of preinvestment studies for projects of high priority. The Ministry of Planning and Mobilization, the program administrator, was to finance general studies, prefeasibility and feasibility studies, and engineering designs. The program included a feasibility study to improve the Point-a-Pierre petroleum refinery and a prefeasibility study for a plant in

Point Lisas petrochemical complex to produce gasoline additives.

Representatives from Petrobrás Comércio Internacional S.A. (INTERBRÁS), Brazil's largest trading company, visited Trinidad and Tobago in June to explore the possibility of trade expansion between the two countries, primarily in petrochemicals.

After the International Finance Corp., an affiliate of the International Bank for Reconstruction and Development, in 1987 made recommendations for the Government to lease the Iron and Steel Corp. of Trinidad and Tobago (ISCOTT), in 1988 the Government and the Ispat Group (India) reportedly were negotiating a lease agreement. Neue Hamburger Stahlwerke of the Federal Republic of Germany, ISCOTT's manager since 1986, had been considered the most likely candidate for leasing and perhaps purchasing ISCOTT. However, negotiations between Hamburger and the Government fell through.

In May, in harmony with the Government's diversification efforts, Trinidad Nitrogen Co. Ltd. (Tringen), a joint venture between the Government of Trinidad and Tobago (51%) and the U.S. company W. R. Grace & Co. through its subsidiary Federation Chemicals (49%), commissioned its Tringen II ammonia plant in Point Lisas. The plant, designed and constructed by S. F. Braun & Co., of Texas, has a designed capacity of 370,000 tons of anhydrous ammonia per year (about 300,000 tons of nitrogen per year). Tringen I, on stream since 1977, has a capacity of 450,000 tons of anhydrous ammonia per year (about 372,000 tons of nitrogen per year).

After the Government announced in 1987 joint-venture plans with M. W. Kellogg Co. of the United States and Norsk Hydro A/S of Norway to construct a 1,500-ton-per-day ammonia plant in Point Lisas, Norsk Hydro in 1988 dropped the plans in favor of a joint venture with Petroquímica de Venezuela S.A. to build an ammonia plant in José, near Puerto La Cruz, eastern Venezuela.

To encourage oil production and exploration, at the beginning of 1988, the Government reduced the supplementary petroleum tax for incremental production above the base level set in 1987, while seeking guaranties of increased production output from oil companies. In addition, new bids were invited for drilling rights. This temporary tax reduction under the classification of base and additional oil will be phased out by 1992 and, reportedly, and a 25% tax will be imposed on all production.

According to the Ministry of Energy, Labour, Employment & Manpower Resource, crude oil production averaged 147,146 barrels per day and 148,553 barrels per day for the first and second quarters of the year, respectively, and increased to an average of 154,231 barrels per day during the last quarter. Production from offshore fields accounted for about 75% of the total. Total crude oil production was about 55.2 million barrels in 1988, a slight decrease from 1987 production. The proportion of the country's crude oil production by Amoco Trinidad Oil Co. fluctuated between 45% and 48% during the year. Drilling for the year totaled 177,630 meters, a 6% decrease from that of 1987. Of the total 151 wells completed, 20 were oil producers, 15 were steam injectors, and 5 were abandonments. Trinidad and Tobago exported an average of 97,000 barrels per day of crude and oil products to the United States. During the year, the United States imported 47% and 31% of Trinidad and Tobago's crude and oil products output, respectively. However, the total represented only about 1% of the U.S. import requirements.

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[1] Physical scientist, Division of International Minerals.

[2] Where necessary, values have been converted from Bahamian dollars (B$) to U.S. dollars at the rate of B$1.225 = US$1.00.

[3] Where necessary, values have been converted from Barbadian dollars (BD$) to U.S. dollars at the rate of BD$2.0 = US$1.00.

[4] Where necessary, values have been converted from Cuban pesos (CP$) to U.S. dollars at the rate of CP$0.8 = US$1.00.

[5] Cuba, Financial Times, Feb. 17, 1988, 6 pp.

[6] Where necessary, values have been converted from Dominican Republic pesos (RD$) to U.S. dollars at the rate ofRD$5.6 = US$1.00.

[7] Where necessary, values have been converted from Jamaican dollars (J$) to U.S. dollars at the rate of J$5.5 = US$1.00.

[8] Trinidad and Tobago, Financial Times, Oct. 3, 1988, 6 pp.

[9] Where necessary, values have been converted from Trinidad and Tobago dollars (TT$) to U.S. dollars at the rate of TT$3.9 = US$1.00.

TABLE 2

BAHAMAS: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1984	1985	Destinations, 1985 United States	Destinations, 1985 Other (principal)
METALS					
Iron and steel: Metal:					
Scrap		—	741	741	
Steel, primary forms		61	NA		
Semimanufactures:					
Bars, rods, angles, shapes, sections		392	42	42	
Wire		343	719	719	
Tubes, pipes, fittings		52	3	3	
Other: Ashes and residues		3,683	1,287	1,287	
INDUSTRIAL MINERALS					
Cement		784	NA		
Gypsum and plaster		6,788	NA		
Lime		1	294	294	
Salt and brine		975,208	1,224,632	1,077,452	Brazil 70,169; Canada 63,726.
Stone, sand and gravel:					
Dimension stone, worked	value, thousands	$25	NA		
Unspecified		—	39,605	39,605	
Other:					
Crude		—	772,664	772,664	
Slag and dross, not metal-bearing		3	NA		
MINERAL FUELS AND RELATED MATERIALS					
Coal: All grades including briquets		15	NA		
Petroleum:					
Crude	thousand 42-gallon barrels	59,008	NA		
Refinery products:					
Liquefied petroleum gas	do.	3	NA		
Gasoline:					
Aviation	do.	260	NA		
Motor	do.	7,587	NA		
Kerosene and jet fuel	do.	5,449	NA		
Distillate fuel oil	do.	13,977	NA		
Lubricants	do.	([2])	NA		
Residual fuel oil	do.	18,814	NA		

NA Not available.
[1] Table prepared by H. D. Willis.
[2] Less than 1/2 unit.

TABLE 3

BAHAMAS: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1984	1985	Sources, 1985: United States	Sources, 1985: Other (principal)
METALS				
Aluminum: Metal including alloys:				
Unwrought	1	([2])	([2])	
Semimanufactures	202	243	243	
Copper: Metal including alloys:				
Unwrought	([2])	([2])	([2])	
Semimanufactures	66	55	49	United Kingdom 6.
Iron and steel: Metal:				
Scrap	16	—		
Pig iron, cast iron, related materials	3	2	2	
Steel, primary forms	1,052	632	172	Trinidad and Tobago 460.
Semimanufactures:				
Bars, rods, angles, shapes, sections	3,107	3,306	2,563	Trinidad and Tobago 612; United Kingdom 111.
Universals, plates, sheets	338	297	215	United Kingdom 77; Spain 5.
Hoop and strip	38	18	18	
Rails and accessories	20	24	24	
Wire	36	60	60	
Tubes, pipes, fittings	1,080	1,087	1,055	United Kingdom 18; Canada 13.
Castings and forgings, rough	13	11	11	
Lead: Metal including alloys, all forms	12	18	17	United Kingdom 1.
Nickel: Metal including alloys, all forms	—	1	1	
Tin: Metal including alloys, all forms	8	9	7	Hong Kong 2.
Zinc: Metal including alloys, all forms	60	17	13	United Kingdom 4.
Other:				
Ores and concentrates	97	—		
Ashes and residues	10	—		
Base metals including alloys, all forms	7	11	11	
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	—	1	1	
Grinding and polishing wheels and stones value, thousands	$41	$38	$36	Canada $2.
Cement	25,656	35,131	25,146	Sweden 5,710; Argentina 2,922.
Clays, crude	133	67	67	
Diamond: Industrial stones value	$800	$3,000	$3,000	
Fertilizer materials:				
Crude, n.e.s.	339	383	374	Netherlands Antilles 9.
Manufactured:				
Nitrogenous	4,503	2,639	2,639	
Phosphatic	820	543	539	Greece 4.
Potassic	97	63	63	
Unspecified and mixed	2,036	1,305	1,305	

See footnotes at end of table.

TABLE 3—Continued

BAHAMAS: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1984	1985	Sources, 1985: United States	Sources, 1985: Other (principal)
INDUSTRIAL MINERALS—Continued					
Gypsum and plaster		699	—		
Lime		821	1,094	1,094	
Mica: Worked including agglomerated splittings	value, thousands	$178	$258	$256	United Kingdom $2.
Nitrates, crude		84	98	98	
Phosphates, crude		22	225	225	
Potassium salts, crude		49	49	49	
Precious and semiprecious stones other than diamond:					
Natural	value, thousands	$79	$8	$3	Venezuela $2; unspecified $3.
Synthetic	do.	$6	$1	$1	
Salt and brine		2,898	3,480	3,473	Canada 7.
Stone, sand and gravel:					
Dimension stone:					
Crude and partly worked		1,363	1,365	1,227	Italy 138.
Worked	value, thousands	$283	$297	$237	Italy $56; Belgium-Luxembourg $4.
Gravel and crushed rock		4,132	630	630	
Sand other than metal-bearing		10,527	2,088	2,088	
Unspecified		—	2,230	2,027	United Kingdom 203.
Sulfur: Elemental, crude including native and byproduct		—	1	1	
Other: Crude		139	193	193	
MINERAL FUELS AND RELATED MATERIALS					
Asphalt and bitumen, natural		392	250	248	United Kingdom 2.
Coal:					
All grades excluding briquets		—	109	109	
All grades including briquets		361	523	523	
Coke and semicoke		5	73	73	
Peat including briquets and litter		1,486	983	972	Unspecified 11.
Petroleum:					
Crude	thousand 42-gallon barrels	96,744	54,981	212	Nigeria 31,344; Mexico 8,120; Angola 4,386.
Refinery products:					
Liquefied petroleum gas	do.	67	176	163	Venezuela 13.
Gasoline:					
Aviation	do.	49	—		
Motor	do.	2,101	1,006	74	Netherlands Antilles 932.
Mineral jelly and wax	do.	([2])	([2])	([2])	
Kerosene and jet fuel	do.	277	293	26	Netherlands Antilles 267.
Distillate fuel oil	do.	1,841	4,117	2,127	Nigeria 1,024; Netherlands Antilles 367.
Lubricants	do.	26	23	20	Jamaica 3.
Residual fuel oil	do.	5,845	12,989	4,806	Netherlands Antilles 1,557; Colombia 1,462.

[1] Table prepared by H. D. Willis.
[2] Less than 1/2 unit.

TABLE 4

CUBA: APPARENT EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987^p	Principal destinations, 1987
METALS			
Aluminum:			
Ore and concentrate	NA	120	All to Italy.
Ash and residue containing aluminum	364	551	Netherlands 544; Spain 7.
Metal including alloys:			
Scrap	4,161	4,176	Netherlands 3,778; Spain 398.
Unwrought	90	NA	
Semimanufactures	2	263	Netherlands 208; Spain 55.
Chromium: Ore and concentrate	[2]37,826	3,212	Argentina 2,008; Canada 1,179; Italy 25.
Copper:			
Ore and concentrate	[2]2,621	NA	
Ash and residue containing copper	163	142	All to Netherlands.
Metal including alloys:			
Scrap	6,451	8,029	Netherlands 7,932; Spain 97.
Unwrought	70	NA	
Iron and steel: Metal:			
Scrap	111,035	161,364	Greece 95,200; Italy 49,091; Turkey 15,005.
Pig iron, cast iron, related materials	NA	6,402	All to Turkey
Steel, primary forms	8,080	17,441	Italy 12,516; Turkey 4,925.
Semimanufactures	[2]115,231	33,379	Canada 11,569; Italy 11,154; Turkey 10,656.
Lead:			
Ash and residue containing lead	NA	150	All to Netherlands.
Metal including alloys:			
Scrap	NA	657	Do.
Unwrought	NA	501	Do.
All forms	146	NA	
Nickel:			
Matte and speiss	983	1,409	Italy 1,392; Argentina 17.
Oxides and hydroxides, Ni content[3]	[2]8,918	NA	
Sinter, Ni content[3]	[2]7,991	NA	
Sulfide, Ni content[3]	[2]18,003	NA	
Metal including alloys, all forms	301	NA	
Tin:			
Ash and residue containing tin	21	12	All to Netherlands.
Metal including alloys, scrap	31	68	Do.
Titanium: Metal including alloys, all forms	5	NA	
Vanadium: Ash and residue containing vanadium	NA	186	All to Netherlands.

See footnotes at end of table.

TABLE 4—Continued

CUBA: APPARENT EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987[p]	Principal destinations, 1987
METALS—Continued			
Zinc:			
Ash and residue containing zinc	674	644	All to Netherlands.
Metal including alloys, scrap	286	155	Do.
Other:			
Ores and concentrates	8,105	NA	
Ashes and residues	152	30	All to Uruguay.
Base metals including alloys, all forms	5	NA	
INDUSTRIAL MINERALS			
Cement	[2]68,901	3,927	French Guiana 3,153; Guadeloupe 713; Bahamas 61.
Clays, crude	NA	8	All to Italy.
Mica: Crude including splittings and waste	503	NA	
Salt and brine	NA	92	Martinique 48; Guadeloupe 44.
Stone, sand and gravel: Dimension stone:			
Crude and partly worked	3,894	966	Italy 932; Netherlands 34.
Worked	12	116	Mainly to Netherlands.
Sulfur: Sulfuric acid	3,063	NA	
Other: Crude	18	NA	
MINERAL FUELS AND RELATED MATERIALS			
Petroleum:			
Crude thousand 42-gallon barrels	885	1,009	All to Spain.
Refinery products: Gasoline, motor do.	974	1,126	Netherlands 566; United Kingdom 560.

[p] Preliminary. NA Not available.

[1] Table prepared by H. D. Willis. Owing to a lack of official trade data published by Cuba, this table should not be taken as a complete presentation of this country's mineral trade. Unless otherwise specified, these data have been compiled from United Nations information and data published by the partner trade countries. The United States reported no mineral commodity imports from Cuba in 1986 or 1987.

[2] Anuario Estadistico de Cuba, 1986.

[3] Includes contained cobalt.

TABLE 5

CUBA: APPARENT IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987[p]	Principal sources, 1987
METALS				
Aluminum:				
Oxides and hydroxides		1,024	NA	
Metal including alloys:				
Unwrought		30	NA	
Semimanufactures		3,282	580	Spain 502; United Kingdom 52; Uruguay 19.
Cadmium: Metal including alloys, all forms		2	NA	
Cobalt: Oxides and hydroxides	value	$11,161	NA	
Copper:				
Oxides and hydroxides		123	NA	
Sulfate	kilograms	138,000	500	All from Spain.
Metal including alloys:				
Scrap		NA	1	Do.
Unwrought	kilograms	NA	200	Do.
Semimanufactures		[2]1,774	207	Spain 150; United Kingdom 38; Italy 15.
Gold: Metal including alloys, unwrought and partly wrought	value, thousands	$472	$147	All from Switzerland.
Iron and steel:				
Iron ore and concentrate excluding roasted pyrite		590	194	United Kingdom 174; Spain 20.
Metal:				
Scrap		88,755	NA	
Pig iron, cast iron, related materials		115	2	All from Spain.
Ferroalloys:				
Ferrochromium		5	NA	
Ferromanganese		1,348	NA	
Ferrosilicomanganese		15	NA	
Unspecified		5	NA	
Steel, primary forms		324	15	All from Spain.
Semimanufactures:				
Bars, rods, angles, shapes, sections		10,715	2,274	Spain 1,272; Belgium-Luxembourg 520; United Kingdom 257.
Universals, plates, sheets		[2]807,125	7,192	United Kingdom 3,215; Belgium-Luxembourg 2,397; Spain 1,342.
Hoop and strip		617	78	All from Spain.
Rails and accessories		199	NA	
Wire		5,081	203	United Kingdom 191; Canada 12.

See footnotes at end of table.

TABLE 5—Continued

CUBA: APPARENT IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987[p]	Principal sources, 1987
METALS—Continued				
Iron and steel—Continued				
Semimanufactures—Continued				
Tubes, pipes, fittings		[2]97,281	2,918	Netherlands 2,760; United Kingdom 81; United States 38.
Castings and forgings, rough		[2]284,210	105	All from Spain.
Lead:				
Oxides	kilograms	291,000	215	Do.
Metal including alloys:				
Unwrought		2,106	2	All from Netherlands.
Semimanufactures	kilograms	476,000	65	All from Spain.
Magnesium: Metal including alloys, semimanufactures		3	NA	
Manganese:				
Ore and concentrate, metallurgical grade		302	NA	
Oxides		200	NA	
Metal including alloys, all forms		2	1	All from Spain.
Mercury	76-pound flasks	116	58	Do.
Nickel:				
Oxides and hydroxides		33	NA	
Metal including alloys:				
Unwrought		2	NA	
Semimanufactures	kilograms	26,000	3	All from Spain.
Platinum-group metals: Metals including alloys, unwrought and partly wrought	value, thousands	$145	$51	All from United Kingdom.
Silicon, high-purity	kilograms	NA	506	All from Spain.
Silver: Metal including alloys, unwrought and partly wrought	value, thousands	$290	NA	
Tin: Metal including alloys:				
Unwrought		21	NA	
Semimanufactures	kilograms	1,000	108	All from Spain.
Titanium:				
Ore and concentrate		123	NA	
Oxides		68	106	All from Spain.
Metal including alloys, all forms		3	1	All from United Kingdom.
Tungsten: Metal including alloys, all forms	value, thousands	$123	NA	
Zinc:				
Oxides		372	44	United Kingdom 41; Belgium-Luxembourg 3.
Metal including alloys:				
Unwrought		117	NA	
Semimanufactures		331	NA	
Other:				
Ores and concentrates		30	NA	
Base metals including alloys, all forms		NA	3	All from Canada.

See footnotes at end of table.

TABLE 5—Continued

CUBA: APPARENT IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987[p]	Principal sources, 1987
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.		50	5	Mainly from Italy.
Artificial:				
Corundum		126	NA	
Silicon carbide		NA	72	All from Spain.
Grinding and polishing wheels and stones		223	27	Spain 23; Italy 4.
Asbestos, crude		2,374	1,212	All from Canada.
Boron materials: Oxides and acids	kilograms	151,000	150	All from Spain.
Cement		14,081	2,617	Belgium-Luxembourg 1,900; Spain 617; Argentina 100.
Chalk	value, thousands	NA	$331	All from Canada.
Clays, crude:				
Bentonite		NA	1	All from United Kingdom.
Kaolin		2,131	1,052	Spain 1,002; United Kingdom 50.
Unspecified		145	250	All from Spain.
Diatomite and other infusorial earth		6	NA	
Feldspar, fluorspar, related materials		8	169	All from Spain.
Fertilizer materials: Manufactured:				
Ammonia		[2]36,000	NA	
Nitrogenous		[2]607,000	NA	
Phosphatic (total)		348,515	NA	
Of which:				
Superphosphate, simple		[2]299,000	NA	
Superphosphate, triple		[2]37,000	NA	
Unspecified		12,515	NA	
Potassic (total)		385,000	12	All from United Kingdom.
Of which:				
Potassium chloride		[2]367,000	NA	
Potassium sulfate		[2]18,000	NA	
Graphite, natural		162	NA	
Gypsum and plaster		457	NA	
Iodine		4	NA	
Lime		4	NA	
Magnesium compounds: Magnesite, crude		243	NA	
Mica:				
Crude including splittings and waste		140	NA	
Worked including agglomerated splittings		6	2	All from Spain.
Phosphates, crude		14,700	NA	
Phosphorous, elemental		12	NA	

See footnotes at end of table.

TABLE 5—Continued

CUBA: APPARENT IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987[p]	Principal sources, 1987
INDUSTRIAL MINERALS—Continued				
Pigments, mineral:				
Natural, crude		1	NA	
Iron oxides and hydroxides, processed		283	359	Spain 341; Canada 18.
Precious and semiprecious stones other than diamond, synthetic	value, thousands	$57,908	NA	
Salt and brine		124	1	All from Switzerland.
Sodium compounds, n.e.s.:				
Carbonate, manufactured		6,867	([3])	All from Spain.
Sulfate, manufactured		NA	31	All from Uruguay.
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked		151	10,675	All from Canada.
Worked		12	4	All from Spain.
Gravel and crushed rock		135	NA	
Quartz and quartzite		8	NA	
Sand other than metal-bearing		103	22,232	All from Canada.
Sulfur:				
Elemental, all forms		[2]124,535	37,809	Do.
Sulfuric acid		14	([3])	All from Spain.
Other:				
Crude		285	105	Italy 58; United Kingdom 47.
Slag and dross, not metal-bearing	value, thousands	NA	$317	All from Canada.
MINERAL FUELS AND RELATED MATERIALS				
Asphalt and bitumen, natural		8	NA	
Carbon:				
Carbon black		3,496	5	All from Belgium-Luxembourg.
Gas carbon		NA	11	All from United Kingdom.
Coal: Anthracite		[2]83,113	NA	
Coke and semicoke		[2]62,263	NA	
Peat including briquets and litter		283	NA	
Petroleum refinery products:				
Liquefied petroleum gas	42-gallon barrels	12	NA	
Gasoline, motor	do.	215,009	26	All from United Kingdom.
Mineral jelly and wax	do.	4,305	31	All from Netherlands.
Kerosene and jet fuel	do.	113,871	NA	
Distillate fuel oil	do.	84,939	NA	
Lubricants	do.	[2]597,100	154,049	Italy 113,793; Spain 36,386; Netherlands 3,038.
Nonlubricating oils	do.	79	NA	
Residual fuel oil	do.	199,707	456,094	Spain 233,693; Trinidad and Tobago 222,401.
Bituminous mixtures	do.	431	715	All from Spain.
Petroleum coke	do.	127	NA	

[p] Preliminary. NA Not available.

[1] Table prepared by H. D. Willis. Owing to a lack of official trade data published by Cuba, this table should not be taken as a complete presentation of this country's mineral trade. Unless otherwise specified, these data have been compiled from United Nations information and data published by the partner trade countries. The United States reported no trade in mineral commodities with Cuba in 1986.

[2] Anuario Estadistico de Cuba, 1986.

[3] Less than 1/2 unit.

TABLE 6

GUADELOUPE: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Principal destinations, 1987
METALS				
Aluminum: Metal including alloys:				
Scrap		85	75	All to France.
Semimanufactures		29	(2)	All to Martinique.
Copper: Metal including alloys:				
Scrap		296	209	All to France.
Semimanufactures		1	—	
Iron and steel: Metal:				
Scrap		6	—	
Semimanufactures:				
Bars, rods, angles, shapes, sections		68	—	
Universals, plates, sheets		15	11	Dominica 9; Jamaica 2.
Wire		—	16	Martinique 8; St. Lucia 3; St. Vincent and the Grenadines 3.
Tubes, pipes, fittings		7	1	All to Martinique.
Castings and forgings, rough		5	—	
Silver: Waste and sweepings	value, thousands	—	$1	All to France.
Zinc: Oxides		5	—	
INDUSTRIAL MINERALS				
Cement		11,586	11,984	Barbados 6,113; French Guiana 5,839; Dominica 30.
Fertilizer materials: Manufactured:				
Ammonia		51	53	All to Martinique.
Unspecified and mixed		1,120	—	
Gypsum and plaster		—	1,093	All to Martinique.
Salt and brine		(3)	—	
Stone, sand and gravel:				
Dimension stone: Worked		—	4	All to Martinique.
Gravel and crushed rock		267	—	
MINERAL FUELS AND RELATED MATERIALS				
Petroleum refinery products:				
Liquefied petroleum gas	42-gallon barrels	35	—	
Gasoline, motor	do.	1,785	9	All to Martinique.
Kerosene and jet fuel	do.	109	6,812	Do.
Distillate fuel oil	do.	2,499	—	
Lubricants	do.	63	126	Martinique 91; French Guiana 35.
Bitumen and other residues	do.	12	—	

[1] Table prepared by H. D. Willis. Guadeloupe did not report any exports of mineral commodities to the United States during 1987.
[2] Quantity not available, valued at $2,198,000.
[3] Less than 1/2 unit.

TABLE 7

GUADELOUPE: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987	
				United States	Other (principal)
METALS					
Aluminum:					
Oxides and hydroxides	value, thousands	$3	$5	—	All from France.
Metal including alloys, semimanufactures		480	430	162	France 234; Italy 15.
Chromium: Oxides and hydroxides		4	5	—	West Germany 3; France 2.
Copper: Metal including alloys:					
Unwrought	value, thousands	$4	$2	—	All from France.
Semimanufactures		165	167	1	France 151; Austria 5; West Germany 4.
Iron and steel: Metal:					
Pig iron, cast iron, related materials		21	6	—	All from France.
Ferroalloys		1	—		
Steel, primary forms		—	1	—	All from France.
Semimanufactures:					
Bars, rods, angles, shapes, sections		16,111	16,560	—	France 11,204; Spain 1,657; West Germany 1,404.
Universals, plates, sheets		11,573	8,409	—	France 6,516; Martinique 1,019; Belgium-Luxembourg 681.
Hoop and strip		7	11	—	France 7; Belgium-Luxembourg 4.
Rails and accessories		—	26	—	Mainly from Belgium-Luxembourg.
Wire		993	1,597	—	France 1,409; Belgium-Luxembourg 188.
Tubes, pipes, fittings		9,450	10,323	1	France 9,693; Spain 471; Belgium-Luxembourg 83.
Castings and forgings, rough		146	146	—	All from France.
Lead:					
Oxides		—	1	—	Do.
Metal including alloys, semimanufactures		18	11	—	Do.
Mercury	value, thousands	$2	$3	—	Do.
Nickel: Metal including alloys, semimanufactures		2	25	—	Spain 24; France 1.
Platinum-group metals: Metals including alloys, unwrought and partly wrought:					
Platinum	value, thousands	$3	$8	—	All from France.
Silver: Metal including alloys, unwrought and partly wrought	value, thousands	—	$3	—	Do.
Tin: Metal including alloys, semimanufactures		1	1	—	Do.
Titanium: Oxides		10	12	—	France 7; Belgium-Luxembourg 4; United Kingdom 1.

See footnotes at end of table.

TABLE 7—Continued

GUADELOUPE: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS—Continued				
Uranium and thorium: Metal including alloys, all forms value, thousands	—	$1	—	All from France.
Zinc:				
Oxides	1	—	—	
Metal including alloys, semimanufactures	1	1	—	All from France.
Other: Ashes and residues	110	22	—	Do.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc. value, thousands	$3	$4	—	Do.
Grinding and polishing wheels and stones	18	20	—	France 14; Switzerland 5; Italy 1.
Asbestos, crude	132	98	—	All from France.
Barite and witherite	10	13	—	Do.
Boron materials: Crude natural borates	2	—		
Cement	137,828	168,457	13	Venezuela 74,800; France 59,389; Tunisia 16,000.
Chalk	557	622	1	France 621.
Clays, crude	109	51	—	United Kingdom 40; France 11.
Diamond: Gem, not set or strung value, thousands	—	$8	—	France $4; unspecified $4.
Diatomite and other infusorial earth	45	55	—	All from France.
Fertilizer materials:				
Crude, n.e.s	4	86	—	Do.
Manufactured:				
Ammonia	95	89	—	Do.
Nitrogenous	2,600	2,696	350	Netherlands 2,170; France 92; East Germany 74.
Phosphatic	99	253	—	France 167; Belgium-Luxembourg 86.
Potassic	370	337	260	Belgium-Luxembourg 56; France 21.
Unspecified and mixed	18,819	20,297	—	Martinique 9,515; Netherlands 4,493; Belgium-Luxembourg 3,545.
Gypsum and plaster	10,690	10,918	—	Spain 10,500; France 404.
Lime	621	755	—	France 735; Martinique 20.
Magnesium compounds: Magnesite, crude	126	183	—	Netherlands 162; France 20; United Kingdom 1.
Mica:				
Crude including splittings and waste	15	43	—	All from France.
Worked including agglomerated splittings	6	11	—	Do.

See footnotes at end of table.

TABLE 7—Continued

GUADELOUPE: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
INDUSTRIAL MINERALS—Continued				
Pigments, mineral: Iron oxides and hydroxides, processed	20	40	—	Belgium-Luxembourg 15; France 15; West Germany 10.
Precious and semiprecious stones other than diamond, natural value, thousands	$19	$16	—	Brazil $10; France $6.
Salt and brine	2,294	2,410	—	France 1,017; West Germany 617; Netherlands 507.
Sodium compounds, n.e.s.:				
Carbonate, manufactured	21	2	—	All from France.
Sulfate, manufactured	49	81	—	France 78; Belgium-Luxembourg 3.
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked	—	22	—	All from Italy.
Worked	119	293	—	Italy 170; France 86; West Germany 19.
Dolomite, chiefly refractory-grade	460	470	—	All from France.
Gravel and crushed rock	709	32	—	France 30; Portugal 1.
Quartz and quartzite	([2])	15	—	All from France.
Sand other than metal-bearing	1,591	315	10	France 303; Spain 2.
Sulfur:				
Elemental:				
Crude including native and byproduct	1	1	—	All from France.
Colloidal, precipitated, sublimed value, thousands	—	$1	—	All from United Kingdom.
Sulfuric acid	157	179	—	All from France.
Talc, steatite, soapstone, pyrophyllite	102	57	—	Do.
Other:				
Crude	145	186	—	France 157; West Germany 28; Spain 1.
Slag and dross, not metal-bearing	124	42	—	All from France.
MINERAL FUELS AND RELATED MATERIALS				
Asphalt and bitumen, natural	—	1	—	Do.
Carbon black	10	8	—	Do.
Coal:				
Briquets of anthracite and bituminous coal	—	1	—	Do.
All grades excluding briquets	—	2	—	Do.
Peat including briquets and litter	31	50	—	West Germany 42; France 8.
Petroleum:				
Crude value, thousands	$1	—	—	

See footnotes at end of table.

TABLE 7—Continued

GUADELOUPE: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987	
				United States	Other (principal)
MINERAL FUELS AND RELATED MATERIALS—Continued					
Petroleum—Continued					
Refinery products:					
Liquefied petroleum gas	42-gallon barrels	164,001	156,403	([3])	Netherlands Antilles 83,555; Martinique 43,616; Trinidad and Tobago 22,782.
Gasoline, motor	do.	464,559	487,577	—	Netherlands Antilles 337,000; Trinidad and Tobago 133,807; Martinique 14,943.
Mineral jelly and wax	do.	1,133	1,685	—	France 1,645; Belgium-Luxembourg 24; Martinique 16.
Kerosene and jet fuel	do.	334,699	306,567	—	Netherlands Antilles 214,884; Trinidad and Tobago 77,996; Martinique 13,687.
Distillate fuel oil	do.	258,690	95,369	—	Martinique 44,036; Netherlands Antilles 37,121; Trinidad and Tobago 13,294.
Lubricants	do.	34,790	45,850	42	France 37,716; Belgium-Luxembourg 4,991; Jamaica 1,722.
Residual fuel oil	do.	595,351	627,885	—	Martinique 528,105; France 99,780.
Bitumen and other residues	do.	39,614	49,983	—	Trinidad and Tobago 28,524; Netherlands Antilles 18,259; Venezuela 2,291.
Bituminous mixtures	do.	200	473	—	France 406; Italy 67.

[1] Table prepared by H. D. Willis.
[2] Quantity not available, valued at $1,000.
[3] Less than 1/2 unit.

TABLE 8

MARTINIQUE: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
METALS				
Aluminum: Metal including alloys:				
Scrap	44	101	37	France 64.
Semimanufactures	1	2	—	All to Guadeloupe.
Copper: Metal including alloys:				
Scrap	404	480	—	All to France.
Semimanufactures	3	—		
Iron and steel: Metal: Semimanufactures:				
Bars, rods, angles, shapes, sections	576	1,403	—	Guadeloupe 1,073; French Guiana 214; Netherlands Antilles 111.
Universals, plates, sheets	1,242	1,313	—	Guadeloupe 1,042; French Guiana 167; Netherlands Antilles 56.
Tubes, pipes, fittings	15	6	—	Netherlands Antilles 5; Guadeloupe 1.
INDUSTRIAL MINERALS				
Cement	19,557	10,392	—	French Guiana 10,384; Netherlands Antilles 8.
Clays, crude	—	14	—	All to French Guiana.
Fertilizer materials:				
Crude, n.e.s	5	—		
Manufactured:				
Nitrogenous	2,502	710	—	Guadeloupe 482; French Guiana 210; St. Lucia 18.
Potassic	800	590	—	Trinidad and Tobago 200; Guadeloupe 160; Guyana 100.
Unspecified and mixed	15,845	14,819	—	Guadeloupe 8,597; St. Lucia 5,116; Dominica 500.
Gypsum and plaster	—	20	—	All to Guadeloupe.
Lime	444	300	—	Dominica 200; French Guiana 60; St. Lucia 20.
Magnesium compounds: Magnesite, crude	—	26	—	Trinidad and Tobago 25; Guadeloupe 1.
Salt and brine	—	31	—	All to Guadeloupe.
Stone, sand and gravel:				
Gravel and crushed rock value, thousands	$2	—		
Sand other than metal-bearing	146	196	—	All to St. Lucia.
Sulfur:				
Elemental: Crude including native and byproduct	1	1	—	All to Guadeloupe.
Sulfuric acid	1	—	—	

See footnote at end of table.

TABLE 8—Continued

MARTINIQUE: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
MINERAL FUELS AND RELATED MATERIALS					
Petroleum refinery products:					
Liquefied petroleum gas	42-gallon barrels	31,668	31,877	—	All to Guadeloupe.
Gasoline, motor	do.	180,923	127,976	—	Do.
Kerosene and jet fuel	do.	51,290	63,984	—	Do.
Distillate fuel oil	do.	334,462	283,458	—	Do.
Lubricants	do.	77	217	—	Guadeloupe 119; Barbados 21; French Guiana 7.
Residual fuel oil	do.	590,502	494,445	—	All to Guadeloupe.
Bituminous mixtures	do.	—	6	—	Do.

[1] Table prepared by H. D. Willis.

TABLE 9

MARTINIQUE: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS					
Alkali and rare-earth metals	value, thousands	—	$3	—	All from France.
Aluminum:					
Oxides and hydroxides	do.	$1	—	—	
Metal including alloys, semimanufactures		459	228	64	France 153; Belgium-Luxembourg 5.
Cobalt: Oxides and hydroxides	value, thousands	$1	$1	—	All from France.
Columbium and tantalum: Metal including alloys, all forms: Tantalum	do.	$10	—	—	
Copper: Metal including alloys, semimanufactures		135	169	1	France 164; United Kingdom 2; Spain 1.
Iron and steel: Metal:					
Scrap	value, thousands	$1	—	—	
Pig iron, cast iron, related materials		3	13	—	All from France.
Steel, primary forms	value, thousands	—	$3	—	Do.
Semimanufactures:					
Bars, rods, angles, shapes, sections		16,947	20,098	—	Trinidad and Tobago 10,397; France 7,543; Spain 753.
Universals, plates, sheets		7,304	6,870	1	France 6,365; Belgium-Luxembourg 286; Spain 218.
Hoop and strip		3	1	—	All from France.
Rails and accessories		1	13	—	Do.
Wire		188	171	—	France 100; Belgium-Luxembourg 71.
Tubes, pipes, fittings		3,463	3,931	([2])	France 2,315; Spain 1,163; Italy 423.
Castings and forgings, rough		199	228	—	France 205; Belgium-Luxembourg 23.
Lead:					
Oxides		—	6	—	France 3; West Germany 3.
Metal including alloys, semimanufactures		3	8	—	All from France.
Mercury	value, thousands	—	$1	—	Do.
Molybdenum: Metal including alloys, all forms	do.	—	$1	—	All from West Germany.
Nickel: Metal including alloys:					
Unwrought	do.	$1	—		
Semimanufactures	do.	$6	$3	—	All from France.
Tin: Metal including alloys, semimanufactures		1	1	—	Do.
Titanium: Oxides		244	173	—	France 118; United Kingdom 55.
Zinc:					
Oxides		17	24	—	All from France.
Metal including alloys, semimanufactures		7	—		
Other: Ashes and residues		285	260	—	All from France.

See footnotes at end of table.

TABLE 9—Continued

MARTINIQUE: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
INDUSTRIAL MINERALS					
Abrasives, n.e.s.:					
Natural: Corundum, emery, pumice, etc.		8	1	—	All from France.
Artificial: Corundum	value, thousands	$2	$1	—	Do.
Grinding and polishing wheels and stones		27	34	—	France 23; Italy 8; Netherlands 2.
Asbestos, crude		107	61	—	All from Italy.
Barite and witherite		—	1	—	All from France.
Boron materials:					
Crude natural borates		20	2	—	Do.
Oxides and acids	value, thousands	$1	—		
Cement		134,545	216,631	—	Venezuela 71,264; France 61,652; Tunisia 35,000.
Chalk		672	712	—	All from France.
Clays, crude		392	104	—	France 102; United Kingdom 2.
Diamond: Gem, not set or strung	value, thousands	$2	$1	—	All from France.
Diatomite and other infusorial earth		17	48	—	Do.
Fertilizer materials:					
Crude, n.e.s.		281	7	—	Do.
Manufactured:					
Ammonia		72	84	—	Guadeloupe 68; France 15; Belgium-Luxembourg 2.
Nitrogenous		12,718	5,954	150	Netherlands 4,100; East Germany 800; France 477.
Phosphatic		118	202	—	All from France.
Potassic		20,033	4,561	4,074	Belgium-Luxembourg 431; France 56.
Unspecified and mixed		31,790	30,021	1,459	France 21,712; Norway 4,236; Belgium-Luxembourg 2,460.
Graphite, natural		1	1	—	All from France.
Gypsum and plaster		9,749	12,459	—	Spain 11,446; Guadeloupe 550; France 463.
Lime		201	300	—	France 282; Spain 18.
Magnesium compounds: Magnesite, crude		342	711	—	All From France.
Mica: Crude including splittings and waste		—	1	—	Do.
Nitrates, crude		7	7	—	Do.
Phosphates, crude		—	496	—	Do.
Pigments, mineral: Iron oxides and hydroxides, processed		23	25	—	France 16; West Germany 9.
Precious and semiprecious stones other than diamond:					
Natural	value, thousands	$16	$10	—	Brazil $6; France $4.
Synthetic	do.	$3	—	—	

See footnotes at end of table.

TABLE 9—Continued

MARTINIQUE: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987 United States	Sources, 1987 Other (principal)
INDUSTRIAL MINERALS—Continued				
Salt and brine	2,532	2,380	—	West Germany 1,094; United Kingdom 334; Netherlands 83.
Sodium compounds, n.e.s.:				
Carbonate, manufactured	13	16	—	All from France.
Sulfate, manufactured	305	288	—	France 285; Belgium-Luxembourg 3.
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked	17	—		
Worked	204	149	([2])	France 76; Italy 67; Portugal 5.
Dolomite, chiefly refractory-grade	680	1,193	—	All from France.
Gravel and crushed rock	5	25	—	Do.
Quartz and quartzite	8	—		
Sand other than metal-bearing	29	252	14	France 198; Netherlands 20; French Guiana 18.
Sulfur:				
Elemental:				
Crude including native and byproduct	3	5	—	All from France.
Colloidal, precipitated, sublimed	5	17	—	France 11; Belgium-Luxembourg 6.
Sulfuric acid	251	263	—	France 237; West Germany 21.
Talc, steatite, soapstone, pyrophyllite	46	48	—	All from France.
Other:				
Crude	146	410	—	France 294; Netherlands 58; West Germany 34.
Slag and dross, not metal-bearing	120	103	—	All from France.
MINERAL FUELS AND RELATED MATERIALS				
Asphalt and bitumen, natural	60	21	—	Do.
Carbon black	1	—	—	
Coke and semicoke	1	—	—	
Peat including briquets and litter	37	4	—	All from France.
Petroleum:				
Crude thousand 42-gallon barrels	3,005	4,055	—	United Kingdom 2,785; United Arab Emirates 1,270.
Refinery products:				
Liquefied petroleum gas 42-gallon barrels	31,912	20,288	6,624	Netherlands Antilles 10,718; Trinidad and Tobago 2,308.

See footnotes at end of table.

TABLE 9—Continued

MARTINIQUE: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
MINERAL FUELS AND RELATED MATERIALS—Continued					
Petroleum—Continued					
Refinery products—Continued					
Gasoline, motor	do.	38,514	69,046	—	Trinidad and Tobago 41,931; Netherlands Antilles 25,594; France 1,496.
Mineral jelly and wax	do.	2,337	2,330	(2)	Mainly from France.
Kerosene and jet fuel	do.	47,903	32,837	—	Trinidad and Tobago 20,073; Netherlands Antilles 12,764.
Distillate fuel oil	do.	3,760	22	—	All from France.
Lubricants	do.	342,034	31,031	294	France 21,511; Belgium-Luxembourg 5,936; Jamaica 2,604.
Residual fuel oil	do.	—	120,280	—	All from Trinidad and Tobago.
Bitumen and other residues	do.	37,693	31,851	—	Trinidad and Tobago 25,688; Netherlands Antilles 5,890; France 273.
Bituminous mixtures	do.	255	739	18	France 715; Italy 6.

[1] Table prepared by H. D. Willis.
[2] Less than 1/2 unit.

TABLE 10

JAMAICA: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Destinations, 1987	
				United States	Other (principal)
METALS					
Aluminum:					
Ore and concentrate	thousand tons	2,940	3,711	2,799	U.S.S.R. 912.
Oxides and hydroxides	do.	1,580	1,557	101	Netherlands 578; Canada 548; Norway 147.
Metal including alloys:					
Scrap		360	1,797	210	Japan 1,194; Spain 170.
Semimanufactures		234	288	118	Trinidad and Tobago 134; Belize 17.
Copper: Metal including alloys:					
Scrap		269	265	104	United Kingdom 161.
Semimanufactures	value	$276	$10	$10	
Iron and steel: Metal:					
Scrap		291	203	183	United Kingdom 20.
Pig iron, cast iron, related materials		25	—		
Semimanufactures:					
Bars, rods, angles, shapes, sections		89	6	—	All to Japan.
Universals, plates, sheets		3,094	8,625	5,490	Trinidad and Tobago 2,569; St. Lucia 188.
Tubes, pipes, fittings		3	222	1	Trinidad and Tobago 175; Haiti 33; St. Vincent and the Grenadines 13.
Castings and forgings, rough		—	50	50	
Unspecified	value	—	$297	—	Mainly to Japan.
Lead: Metal including alloys, unwrought		—	36	36	
Silver: Metal including alloys, unwrought and partly wrought	value	$256	$131	$131	
Tin: Metal including alloys:					
Scrap		406	569	569	
Semimanufactures		—	19	—	All to Barbados.
Titanium: Oxides		11	—	—	
Zinc: Metal including alloys, semimanufactures	kilograms	210	—	—	
Other:					
Oxides and hydroxides	do.	300	22,730	—	Mainly to Netherlands.
Ashes and residues		73	55	55	
Base metals including alloys, all forms		79	1	1	

See footnotes at end of table.

TABLE 10—Continued

JAMAICA: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Destinations, 1987	
				United States	Other (principal)
INDUSTRIAL MINERALS					
Abrasives, n.e.s.: Grinding and polishing wheels and stones	kilograms	15	2	2	
Cement		4,248	11,232	214	Haiti 5,961; Panama 2,475; Turks and Caicos Islands 1,580.
Chalk		5	(2)	—	NA.
Fertilizer materials:					
Crude, n.e.s.		—	37	37	
Manufactured:					
Ammonia		1	—	—	
Unspecified and mixed		38	1	—	All to Guyana.
Gypsum and plaster		100,143	117,577	24,987	Venezuela 26,356; Panama 26,243.
Lime		36	—		
Salt and brine		1,669	2,347	239	Trinidad and Tobago 915; Barbados 392; St. Lucia 255.
Sodium compounds, n.e.s.: Carbonate, manufactured	kilograms	—	1	—	NA.
Stone, sand and gravel:					
Dimension stone, crude and partly worked		10	11	—	All to St. Lucia.
Gravel and crushed rock		—	18	—	All to Barbados.
Limestone other than dimension		151,912	94,996	83,704	Trinidad and Tobago 6,685; Bermuda 3,208.
Sulfuric acid		159	487	75	Trinidad and Tobago 238; Haiti 114.
Other: Crude		36	—	—	
MINERAL FUELS AND RELATED MATERIALS					
Petroleum refinery products:					
Liquefied petroleum gas	42-gallon barrels	562	726	—	All to Bahamas.
Gasoline	do.	28,996	51,463	—	Do.
Mineral jelly and wax	do.	636	6	—	Mainly to United Kingdom.
Kerosene and jet fuel	do.	2,887	9,611	—	Mainly to Bahamas.
Distillate fuel oil	do.	64,710	226,559	173,052	Bahamas 40,972.
Lubricants	do.	106,115	107,070	1,636	Guyana 26,452; Guatemala 19,885; Suriname 17,382.
Residual fuel oil	do.	466,289	75,943	75,943	

NA Not Available.

[1] Table prepared by Linda Williams.

[2] Less than 1/2 unit.

TABLE 11

JAMAICA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS					
Aluminum:					
Ore and concentrate	value	—	$874	$746	Guyana $128.
Oxides and hydroxides	kilograms	1,460	3,432	1,468	United Kingdom 1,729; West Germany 160.
Metal including alloys:					
Unwrought		1,294	951	156	Canada 760; Hong Kong 19.
Semimanufactures		893	1,860	706	Canada 472; United Kingdom 412.
Chromium: Ore and concentrate		18	—	—	
Copper:					
Sulfate		1	16	14	United Kingdom 2.
Metal including alloys:					
Unwrought		1	7	(2)	United Kingdom 5; Japan 2.
Semimanufactures		615	2,459	2,280	Canada 60; Hong Kong 55.
Gold:					
Waste and sweepings	value	$184	$1,330	$846	Canada $484.
Metal including alloys, unwrought and partly wrought	troy ounces	1,672	2,218	—	Canada 2,186; United Kingdom 32.
Iron and steel:					
Iron ore and concentrate including roasted pyrite		14	—	—	
Metal:					
Scrap		36	173	1	Canada 172.
Pig iron, cast iron, related materials		3	31	2	Belgium-Luxembourg 19; United Kingdom 10.
Ferroalloys:					
Ferromanganese	value	—	$53	$53	
Ferrosilicon	do.	$23,817	$1,041	$1,041	
Unspecified	do.	$1,130	—		
Steel, primary forms		3,519	56,413	174	United Kingdom 39,547; Trinidad and Tobago 10,489; Brazil 3,983.
Semimanufactures:					
Bars, rods, angles, shapes, sections		14,942	19,394	799	Trinidad and Tobago 10,519; Taiwan 2,916; United Kingdom 1,377.
Universals, plates, sheets		17,744	463,869	1,626	United Kingdom 450,041; Venezuela 4,651; Japan 2,732.
Hoop and strip		504	224	62	United Kingdom 118; Japan 32.
Rails and accessories		14	8	(2)	Hong Kong 5; Dominican Republic 3.

See footnotes at end of table.

TABLE 11—Continued

JAMAICA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS—Continued					
Iron and steel—Continued					
Metal—Continued					
Semimanufactures—Continued					
Wire		2,636	23,317	261	United Kingdom 21,067; Venezuela 479; Republic of Korea 420.
Tubes, pipes, fittings		3,608	5,663	2,268	West Germany 2,522; Taiwan 462.
Castings and forgings, rough		21	13	9	United Kingdom 3.
Unspecified		27	354	28	Trinidad and Tobago 190; United Kingdom 82; Japan 54.
Lead:					
Oxides		207	405	369	United Kingdom 18; Netherlands 9.
Metal including alloys:					
Scrap		20	—	—	
Unwrought		286	44	24	United Kingdom 20.
Semimanufactures		62	2,920	2,916	United Kingdom 3.
Magnesium: Metal including alloys, semimanufactures	value	$1,408	$1,988	$1,988	
Manganese: Ore and concentrate		53	104	35	Mexico 51; Czechoslovakia 18.
Molybdenum: Metal including alloys:					
Unwrought	kilograms	10	—	—	
Semimanufactures		17	1	—	All from Taiwan.
Nickel:					
Ore and concentrate	value	—	$309	$309	
Metal including alloys, semimanufactures		3	4	1	West Germany 3.
Platinum-group metals: Metals including alloys, unwrought and partly wrought	value	$1,380	$5,660	$3,150	Canada $2,510.
Silver:					
Waste and sweepings	do.	$3,240	—	—	
Metal including alloys, unwrought and partly wrought	troy ounces	31,508	34,305	6,012	Canada 26,428; East Germany 1,865.
Tin: Metal including alloys:					
Scrap	value	$2,400	$2,628	$984	Canada $1,644.
Unwrought		1	2	1	United Kingdom 1.
Semimanufactures		3,885	3,372	1	Netherlands 3,206; United Kingdom 165.
Titanium: Oxides		682	903	652	United Kingdom 245; Netherlands 4.
Tungsten: Metal including alloys, semimanufactures	kilograms	70	1	—	All from Taiwan.
Uranium and thorium: Metal including alloys, all forms	do.	1,302	79	79	

See footnotes at end of table.

TABLE 11—Continued

JAMAICA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987	
				United States	Other (principal)
METALS—Continued					
Zinc:					
Ore and concentrate		2	2	—	Mainly from Canada.
Oxides		151	136	62	United Kingdom 54; Netherlands 20.
Blue powder	kilograms	699	23	—	All from United Kingdom.
Metal including alloys:					
Unwrought		629	981	119	Canada 743; Belgium-Luxembourg 119.
Semimanufactures		2	1	(2)	Mainly from United Kingdom.
Other:					
Ores and concentrates		3	15	9	United Kingdom 6.
Oxides and hydroxides		229	147	93	Japan 20; United Kingdom 17.
Ashes and residues	value	$13	—	—	
Base metals including alloys, all forms	kilograms	60	118	118	
INDUSTRIAL MINERALS					
Abrasives, n.e.s.:					
Natural: Corundum, emery, pumice, etc.		23	18	13	United Kingdom 5.
Dust and powder of precious and semiprecious stones excluding diamond	value	$644	—	—	
Grinding and polishing wheels and stones		152	24	5	Taiwan 6; United Kingdom 3.
Asbestos, crude		31	—		
Barite and witherite		(2)	4	2	West Germany 1; Netherlands 1.
Boron materials: Crude natural borates	value, thousands	—	$1,283	$166	West Germany $1,035; Canada $82.
Cement		16,003	19,104	559	Barbados 14,753; Trinidad and Tobago 2,700.
Chalk		13	40	(2)	France 18; West Germany 16; United Kingdom 6.
Clays, crude		384	636	459	Mexico 172; United Kingdom 4.
Diamond:					
Gem, not set or strung	thousand carats	—	80	73	Belgium-Luxembourg 6; Israel 1.
Industrial stones	value	$3,762	—	—	
Diatomite and other infusorial earth		104	23	23	
Feldspar, fluorspar, related materials		13	13	13	
Fertilizer materials:					
Crude, n.e.s.		465	—	—	

See footnotes at end of table.

TABLE 11—Continued

JAMAICA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
INDUSTRIAL MINERALS—Continued					
Fertilizer materials—Continued					
Manufactured:					
Ammonia		148	107	63	Japan 35; Trinidad and Tobago 8.
Nitrogenous		21,842	882	273	Dominican Republic 531; Sweden 50.
Phosphatic		312	108	8	Romania 100.
Potassic		3,096	391	26	Japan 360; West Germany 5.
Unspecified and mixed		11,892	5,057	328	Canada 4,727; West Germany 2.
Graphite, natural	value	$2,248	$1,221	$1,221	
Gypsum and plaster		62	65	59	United Kingdom 6.
Lime	value	$956	$3,693	$3,693	
Magnesium compounds:					
Oxides and hydroxides	do.	$14	—	—	
Other		17	49	4	United Kingdom 25; West Germany 20.
Mica:					
Crude including splittings and waste		103	162	5	Norway 154; Argentina 3.
Worked including agglomerated splittings	kilograms	180	341	310	United Kingdom 31.
Nitrates, crude	value	$258	—	—	
Phosphates, crude		283	94	94	
Pigments, mineral:					
Natural, crude		24	15	([2])	Mainly from West Germany.
Iron oxides and hydroxides, processed		27	154	11	West Germany 115; Spain 14; United Kingdom 12.
Potassium salts, crude		—	2	2	
Precious and semiprecious stones other than diamond:					
Natural	value	—	$1,157	$1,157	
Synthetic	do.	—	$9,246	—	All from United Kingdom.
Salt and brine		20,542	23,667	23,440	Canada 210; United Kingdom 17.
Sodium compounds, n.e.s.:					
Carbonate, manufactured		6,016	4,502	4,089	France 379; United Kingdom 17.
Sulfate, manufactured		970	1,656	375	Mexico 749; Belgium-Luxembourg 333.
Stone, sand and gravel:					
Dimension stone:					
Crude and partly worked		124	116	1	Italy 115.
Worked		3	15	15	
Gravel and crushed rock		23	32,772	22	Canada 32,750.

See footnotes at end of table.

TABLE 11—Continued

JAMAICA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
INDUSTRIAL MINERALS—Continued					
Stone, sand and gravel—Continued					
Limestone other than dimension	value	$604	$43	$43	
Quartz and quartzite		26	3	3	
Sand other than metal-bearing		20	294	273	Canada 19; United Kingdom 2.
Sulfur:					
Elemental:					
Crude including native and byproduct		68	57	20	Belgium-Luxembourg 36; India 1.
Colloidal, precipitated, sublimed		302	3,005	3,005	
Dioxide	kilograms	—	375	250	United Kingdom 100; Canada 25.
Sulfuric acid	do.	4,396	8,266	8,046	United Kingdom 220.
Talc, steatite, soapstone, pyrophyllite		1,170	449	290	Norway 115; Colombia 18.
Other: Crude		14	12	12	
MINERAL FUELS AND RELATED MATERIALS					
Asphalt and bitumen, natural		736	21	21	
Carbon including carbon black		740	773	100	Venezuela 672; United Kingdom 1.
Coal:					
Anthracite	value	$810	—	—	
All grades including briquets		5,090	—	—	
Coke and semicoke		55	114	89	United Kingdom 15; West Germany 10.
Peat including briquets and litter		22	55	55	
Petroleum:					
Crude	42-gallon barrels	31	44	38	United Kingdom 6.
Refinery products:					
Liquefied petroleum gas	thousand 42-gallon barrels	601	565	331	Venezuela 90; Mexico 74.
Gasoline	do.	788	876	524	Trinidad and Tobago 255; Venezuela 71.
Mineral jelly and wax	do.	14	16	9	United Kingdom 4; West Germany 2.
Kerosene and jet fuel	do.	607	1,154	119	Mexico 648; Trinidad and Tobago 321.
Distillate fuel oil	do.	399	641	327	Trinidad and Tobago 174; Sweden 77.
Lubricants	do.	27	36	15	Netherlands Antilles 18; Trinidad and Tobago 2.
Residual fuel oil	do.	20,689	9,850	4,193	Venezuela 2,345; Mexico 1,995.
Bitumen and other residues	do.	137	69	57	Venezuela 11.
Bituminous mixtures	do.	1	1	([2])	Mainly from Venezuela.
Petroleum coke	value	$37	—	—	

[1] Table prepared by Linda Williams.
[2] Less than 1/2 unit.

TABLE 12

TRINIDAD AND TOBAGO: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Destinations, 1987	
				United States	Other (principal)
METALS					
Aluminum: Metal including alloys:					
Scrap		24	198	140	United Kingdom 29; West Germany 27.
Unwrought		25	109	109	
Semimanufactures		53	26	13	Guyana 5; St. Christopher and Nevis 5.
Copper:					
Matte and speiss including cement copper		—	13	13	
Metal including alloys:					
Scrap		691	271	123	United Kingdom 148.
Unwrought		27	108	—	All to United Kingdom.
Semimanufactures		167	1,066	1,016	United Kingdom 42; St. Vincent and the Grenadines 3.
Iron and steel:					
Iron ore and concentrate excluding roasted pyrite		—	16,200	—	All to Venezuela.
Metal:					
Scrap		87	311	281	St. Lucia 30.
Pig iron, cast iron, related materials		54,371	90,477	—	Mainly to Venezuela.
Steel, primary forms		28,280	17,708	3,900	Jamaica 7,805; Venezuela 6,000.
Semimanufactures:					
Bars, rods, angles, shapes, sections		227,471	302,817	91,881	Canada 47,538; West Germany 42,097; Jamaica 19,702.
Universals, plates, sheets		539	1,423	—	United Kingdom 1,190; Barbados 41; St. Vincent and the Grenadines 30.
Hoop and strip	value	$78	—	—	
Rails and accessories	do.	$167	$3,485	—	Grenada $3,208; St. Vincent and the Grenadines $193.
Wire		161	201	—	Jamaica 120; St. Vincent and the Grenadines 52; Grenada 22.
Tubes, pipes, fittings		4,511	548	507	Grenada 12; Dominica 7.
Castings and forgings, rough	kilograms	1,490	—	—	
Lead:					
Oxides		40	88	—	All to Barbados.
Metal including alloys:					
Scrap		—	348	19	Brazil 160; United Kingdom 110; West Germany 58.
Unwrought		210	—	—	

See footnote at end of table.

TABLE 12—Continued

TRINIDAD AND TOBAGO: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
METALS—Continued					
Lead—Continued					
Metal including alloys—Continued					
Semimanufactures	kilograms	601	NA	—	
Nickel: Metal including alloys:					
Scrap		75	25	—	All to Netherlands.
Semimanufactures	kilograms	75	—	—	
Platinum-group metals: Metals including alloys, unwrought and partly wrought	troy ounces	32	—	—	
Silver:					
Waste and sweepings[2]	kilograms	218	10	—	All to Canada.
Metal including alloys, unwrought and partly wrought	troy ounces	2,958	—	—	
Tin: Metal including alloys:					
Scrap		199	—	—	
Semimanufactures	value	$1,973	$81	—	Grenada $56; bunkers $25.
Titanium: Oxides		2	—	—	
Tungsten: Metal including alloys, unwrought	kilograms	116	—	—	
Zinc: Metal including alloys:					
Scrap	value	—	$33	—	All to bunkers.
Semimanufactures	kilograms	100	4,100	—	Dominica 3,800; Guyana 300.
Other:					
Oxides and hydroxides	do.	400	12,591	12,591	
Ashes and residues	value	—	$3	—	All to Canada.
INDUSTRIAL MINERALS					
Abrasives, n.e.s.: Grinding and polishing wheels and stones	kilograms	234	1,369	—	St. Vincent and the Grenadines 649; Grenada 300; Guyana 277.
Asbestos, crude	value	—	$125	—	All to bunkers.
Barite and witherite	do.	$135	—		
Cement		9,632	67,973	—	Haiti 19,549; Grenada 12,092; St. Lucia 10,465.
Chalk		—	2	—	Grenada 1; St. Christopher and Nevis 1.
Clays, crude		1,121	—	—	
Diamond: Industrial stones	value	$2,897	—	—	
Fertilizer materials:					
Crude, n.e.s.	do.	$56.	$56	—	All to Barbados.
Manufactured:					
Ammonia	thousand tons	1,121	1,076	478	Belgium-Luxembourg 136; Denmark 128.
Nitrogenous		506,894	465,306	242,454	Dominican Republic 48,916; France 34,490.
Phosphatic	value	$97	—	—	

See footnotes at end of table.

TABLE 12—Continued

TRINIDAD AND TOBAGO: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Destinations, 1987	
				United States	Other (principal)
INDUSTRIAL MINERALS—Continued					
Fertilizer materials—Continued					
Manufactured—Continued					
Potassic	do.	$344	$1,657	—	Guyana $1,111; Grenada $546.
Unspecified and mixed		8	NA	—	
Gypsum and plaster	value	$340	$646	—	All to St. Lucia.
Lime		1	31	—	St. Lucia 26; Guyana 5.
Pigments, mineral: Iron oxides and hydroxides, processed	kilograms	—	50	—	All to St. Lucia.
Pyrite, unroasted	value	$33	—	—	
Salt and brine		18	1,566	—	Grenada 1,502; St. Vincent and the Grenadines 31; Dominica 30.
Sodium compounds, n.e.s.:					
Carbonate, manufactured	kilograms	3	1	—	NA.
Sulfate, manufactured	do.	20	—	—	
Stone, sand and gravel:					
Dimension stone:					
Crude and partly worked	value	$639	$700	—	All to Grenada.
Worked	do.	$316	—	—	
Gravel and crushed rock		32	4,421	—	St. Vincent and the Grenadines 3,316; Anguilla 1,100; Guyana 3.
Limestone other than dimension		13	—	—	
Sand other than metal-bearing		82	1,655	—	Anguilla 1,500; St. Vincent and the Grenadines 120; Antigua and Barbuda 21.
Sulfur: Sulfuric acid	kilograms	143	47	—	All to Guyana.
Talc, steatite, soapstone, pyrophyllite	value	$411	$858	—	All to Barbados.
Other: Crude		27	31	—	All to Guyana.
MINERAL FUELS AND RELATED MATERIALS					
Asphalt and bitumen, natural		30,512	33,908	289	West Germany 14,458; United Kingdom 4,954; Martinique 3,388.
Coal: Briquets of anthracite and bituminous coal		60	—	—	
Peat including briquets and litter		1	—	—	
Petroleum:					
Crude	thousand 42-gallon barrels	32,867	28,370	27,816	United Kingdom 554.
Refinery products:					
Liquefied petroleum gas	do.	197	179	—	Barbados 42; Guadeloupe 24; French Guiana 23.
Gasoline	do.	2,896	3,854	457	Japan 978; Suriname 337.
Mineral jelly and wax	do.	([3])	9	—	Mainly to Bermuda.
Kerosene and jet fuel	do.	2,145	2,692	430	Barbados 766; Jamaica 276.

See footnotes at end of table.

TABLE 12—Continued

TRINIDAD AND TOBAGO: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Destinations, 1987	
				United States	Other (principal)
MINERAL FUELS AND RELATED MATERIALS—Continued					
Petroleum—Continued					
Refinery products—Continued					
Distillate fuel oil	thousand 42-gallon barrels	3,955	4,334	1,509	Suriname 371; Grenada 321.
Lubricants	do.	13	10	(3)	Jamaica 2; Grenada 1; St. Lucia 1.
Residual fuel oil	do.	15,319	15,971	9,204	Netherlands 1,613; Italy 1,458.
Bitumen and other residues	do.	912	—	—	
Bituminous mixtures	do.	25	297	—	Grenada 220; Dominican Republic 24; Guatemala 23.
Petroleum coke	do.	—	(3)	—	All to Grenada.

NA Not available.
[1] Table prepared by Linda Williams.
[2] May include other precious metals.
[3] Less than 1/2 unit.

TABLE 13

TRINIDAD AND TOBAGO: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987 United States	Sources, 1987 Other (principal)
METALS				
Aluminum:				
Ore and concentrate	450	412	140	Jamaica 272.
Oxides and hydroxides	29	46	2	United Kingdom 44.
Metal including alloys:				
Scrap	20	(2)	—	All from St. Vincent and the Grenadines.
Unwrought	60	144	48	Venezuela 75; Canada 20.
Semimanufactures	1,714	1,887	1,157	Austria 185; United Kingdom 139; Jamaica 130.
Chromium:				
Ore and concentrate	3	—	—	
Oxides and hydroxides	5	21	10	Denmark 8; Canada 2.
Copper:				
Ore and concentrate value	$315	—	—	
Matte and speiss including cement copper do.	$222	—	—	
Sulfate	5	7	2	United Kingdom 5.
Metal including alloys:				
Scrap	120	1,469	1,461	St. Vincent and the Grenadines 5; Grenada 3.
Unwrought	112	6	(2)	Mainly from United Kingdom.
Semimanufactures	797	810	221	Canada 295; United Kingdom 101.
Iron and steel:				
Iron ore and concentrate excluding roasted pyrite	400,061	614,986	—	Brazil 592,563; Venezuela 22,423.
Metal:				
Scrap	2,200	(2)	—	All from Grenada.
Pig iron, cast iron, related materials	3	53	34	Netherlands 14; United Kingdom 4.
Ferroalloys:				
Ferromanganese	158	184	—	All from Norway.
Ferrosilicon	1,225	695	—	Do.
Unspecified	1,060	30	—	Austria 15; West Germany 15.
Steel, primary forms	4,348	1,457	—	West Germany 1,144; Japan 313.
Semimanufactures:				
Bars, rods, angles, shapes, sections	69,466	6,554	1,185	United Kingdom 3,416; Taiwan 1,102.
Universals, plates, sheets	26,284	42,370	303	France 15,727; United Kingdom 14,965; Belgium-Luxembourg 3,155.

See footnotes at end of table.

TABLE 13—Continued

TRINIDAD AND TOBAGO: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987 United States	Sources, 1987 Other (principal)
METALS—Continued					
Iron and steel—Continued					
Metal—Continued					
Semimanufactures—Continued					
Hoop and strip		349	75	52	United Kingdom 23.
Rails and accessories		5	(2)	—	All from United Kingdom.
Wire		2,489	10,810	44	Netherlands 9,045; Venezuela 706; Brazil 415.
Tubes, pipes, fittings		76,689	26,250	9,765	Japan 4,820; Argentina 3,111.
Castings and forgings, rough		6	(2)	(2)	
Lead:					
Oxides		25	74	(2)	Venezuela 54; United Kingdom 16; India 2.
Metal including alloys:					
Scrap		81	241	180	Barbados 60; Grenada 1.
Unwrought		(2)	39	36	Italy 3.
Semimanufactures		3	1,629	1,233	United Kingdom 396.
Magnesium: Metal including alloys, all forms		4	1,855	1,855	
Manganese: Ore and concentrate		4,040	3,158	80	Norway 2,478; Venezuela 600.
Nickel: Metal including alloys, semimanufactures	kilograms	711	2,071	468	United Kingdom 917; Canada 686.
Platinum-group metals: Metals including alloys, unwrought and partly wrought	value	$10,431	$4,960	$3,333	United Kingdom $1,627.
Silver: Metal including alloys, unwrought and partly wrought	do.	$97,271	$146,819	$9,944	Canada $133,608; West Germany $1,635.
Tin: Metal including alloys:					
Unwrought		3	3	—	United Kingdom 2; Singapore 1.
Semimanufactures		65	77	(2)	Japan 75; Taiwan 1; United Kingdom 1.
Titanium: Oxides		1,043	684	141	United Kingdom 311; Finland 228.
Tungsten: Metal including alloys:					
Unwrought	kilograms	201	237	237	
Semimanufactures	do.	341	382	359	Japan 23.
Zinc:					
Ore and concentrate		17	—	—	
Oxides		98	80	(2)	United Kingdom 30; Venezuela 17; Belgium-Luxembourg 16.
Blue powder		53	17	6	Norway 6; Canada 4.
Metal including alloys:					
Scrap		49	19	—	All from Canada.
Unwrought		401	298	—	Canada 297; United Kingdom 1.
Semimanufactures		4,257	82	42	Canada 40.

See footnotes at end of table.

TABLE 13—Continued

TRINIDAD AND TOBAGO: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987 United States	Sources, 1987 Other (principal)
METALS—Continued					
Other:					
Ores and concentrates		7,278	5	—	All from West Germany.
Oxides and hydroxides		r280	215	67	Austria 90; Sweden 36.
Base metals including alloys, all forms		3	5	4	United Kingdom 1.
INDUSTRIAL MINERALS					
Abrasives, n.e.s.:					
Natural: Corundum, emery, pumice, etc.	value	$2,549	$35,572	$20,925	Guatemala $12,635; Dominica $1,869.
Dust and powder of precious and semi-precious stones	do.	$26	$354	—	All from West Germany.
Grinding and polishing wheels and stones		3,523	4,246	4,196	United Kingdom 13; Venezuela 8.
Asbestos, crude		5	37	—	All from Canada.
Barite and witherite		19,081	18,027	5,839	Morocco 12,150; West Germany 15.
Boron materials: Crude natural borates		2	2	—	All from United Kingdom.
Cement		10,853	46,165	5	Denmark 44,533; West Germany 1,324; Republic of Korea 282.
Chalk		942	340	93	United Kingdom 101; France 88.
Clays, crude		3,742	1,447	1,168	United Kingdom 234; Canada 15.
Diamond: Gem, not set or strung	carats	825	395	(2)	India 162; Canada 133; Malaysia 98.
Diatomite and other infusorial earth		75	41	—	Netherlands 37; United Kingdom 4.
Feldspar, fluorspar, related materials		107	131	—	United Kingdom 77; Netherlands 30; Mexico 20.
Fertilizer materials:					
Crude, n.e.s.		88	51	51	
Manufactured:					
Ammonia		17,508	13	5	West Germany 8.
Nitrogenous		1,782	1,386	71	Dominican Republic 1,147; West Germany 100.
Phosphatic		2,327	292	223	Martinique 50; Canada 13.
Potassic		3,125	1,281	262	Dominican Republic 503; West Germany 241.
Unspecified and mixed		13,022	12,728	9,620	West Germany 1,600; Belgium-Luxembourg 940.

See footnotes at end of table.

TABLE 13—Continued

TRINIDAD AND TOBAGO: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987	
				United States	Other (principal)
INDUSTRIAL MINERALS—Continued					
Graphite, natural		2	12	12	
Gypsum and plaster		10,973	6,815	98	Jamaica 6,678; United Kingdom 39.
Lime		4,210	9,674	—	United Kingdom 8,777; Venezuela 897.
Magnesium compounds: Magnesite, crude	value	$15,733	$323	—	United Kingdom $202; West Germany $121.
Mica:					
Crude including splittings and waste		129	67	—	Norway 49; United Kingdom 18.
Worked including agglomerated splittings		3	74	7	Netherlands 66; United Kingdom 1.
Phosphates, crude		168	79	39	United Kingdom 40.
Pigments, mineral: Iron oxides and hydroxides, processed		304	74	5	West Germany 26; Netherlands 20; Canada 18.
Potassium salts, crude		82	—	—	
Precious and semiprecious stones other than diamond:					
Natural	value, thousands	$862	$1,227	$224	Canada $683; India $197.
Synthetic	do.	$44	$32	$8	India $22; France $2.
Pyrite, unroasted		5	—	—	
Salt and brine		86,841	23,453	20	Netherlands Antilles 21,289; Venezuela 1,301; Jamaica 779.
Sodium compounds, n.e.s.:					
Carbonate, manufactured		9,451	8,241	8,152	United Kingdom 64; Belgium-Luxembourg 25.
Sulfate, manufactured		2,438	1,954	128	Belgium-Luxembourg 1,238; United Kingdom 399; Venezuela 143.
Stone, sand and gravel:					
Dimension stone:					
Crude and partly worked		94	1	(2)	Mainly from United Kingdom.
Worked		35	45	8	Italy 17; Barbados 14.
Dolomite, chiefly refractory-grade		(2)	812	(2)	Austria 612; West Germany 200.
Gravel and crushed rock		3,054	1,164	720	China 426; Italy 18.
Limestone other than dimension		11,586	35,887	803	Netherlands Antilles 12,814; Curacao 12,481; Barbados 6,346.
Quartz and quartzite		36	83	(2)	Mainly from United Kingdom.
Sand other than metal-bearing		715	65,121	65,102	Japan 17; United Kingdom 2.

See footnotes at end of table.

TABLE 13—Continued

TRINIDAD AND TOBAGO: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987	
				United States	Other (principal)
INDUSTRIAL MINERALS—Continued					
Sulfur:					
Elemental:					
Crude including native and byproduct		37	26	(2)	Mainly from United Kingdom.
Colloidal, precipitated, sublimed	kilograms	618	2,232	5	Netherlands 2,217; West Germany 10.
Dioxide	do.	40,715	1	—	All from United Kingdom.
Sulfuric acid		5,800	2,651	749	Spain 1,500; Italy 210.
Talc, steatite, soapstone, pyrophyllite		507	592	452	Norway 100; Canada 20.
Other:					
Crude		590	550	550	
Slag and dross, not metal-bearing		127	1,037	1,037	
MINERAL FUELS AND RELATED MATERIALS					
Asphalt and bitumen, natural		2	2	2	
Carbon black		790	864	50	Venezuela 807; United Kingdom 6.
Coal: All grades including briquets		1,564	861	816	Canada 28; United Kingdom 13.
Coke and semicoke		253	259	225	United Kingdom 34.
Peat including briquets and litter		1,304	141	43	Canada 41; United Kingdom 24.
Petroleum:					
Crude	thousand 42-gallon barrels	(2)	1,739	(2)	Colombia 1,244; Saudi Arabia 495.
Refinery products:					
Liquefied petroleum gas	42-gallon barrels	95	37,857	47	Curacao 37,692; Italy 117.
Gasoline	do.	31	13	(2)	Mainly from United Kingdom.
Mineral jelly and wax	do.	5,107	4,332	1,111	United Kingdom 1,444; West Germany 815.
Kerosene and jet fuel	do.	80,396	22,801	—	All from Barbados.
Distillate fuel oil	do.	893,021	816,216	—	Curacao 344,493; Venezuela 239,057; Bahamas 141,495.
Lubricants including nonlubricating oils	do.	82,799	40,082	8,213	Curacao 27,879; Jamaica 1,530.
Residual fuel oil	do.	667,638	(2)	(2)	
Bitumen and other residues	do.	91	182	139	United Kingdom 42.
Bituminous mixtures	do.	479	6,927	6,763	United Kingdom 85; Canada 79.
Petroleum coke	do.	3,036	258	258	

[r] Revised.
[1] Table prepared by Linda Williams.
[2] Less than 1/2 unit.

THE MINERAL INDUSTRY OF

MEXICO

By Jerome F. Machamer[1]

Mexico is one of the major mineral-producing countries in the world, continuing in 1988 a role that the nation had assumed since the first European settlement of the Western Hemisphere. With respect to nonfuel minerals, Mexico was the world's leading producer of bismuth and silver; was among the top 5 producers of barite, fluorspar, graphite, molybdenum, and strontium; and was among the top 10 producers of antimony, white arsenic, cadmium, copper, lead, manganese, mercury, salt, selenium, sulfur, and zinc. In the mineral fuels sector, Mexico was the sixth largest producer of crude oil and ranked eighth in terms of proven oil reserves. In addition, Mexico was the largest foreign supplier of crude oil and cement to the United States. Within the Western Hemisphere, Mexico was second only to the United States as a producer of crude oil and was, along with Brazil, the only significant primary source of manganese ore and/or manganese alloys.

The year 1988 was one of austerity for the Mexican economy, as fiscal authorities struggled to contain inflation and other problems brought on by the foreign debt crisis that affected many countries in Latin America and other regions, and the mineral industry reflected that austerity. Gross domestic product (GDP) grew just over 1% relative to 1987 and reached a level of $193 billion at current prices.[2] Progress was made in decreasing the rate of inflation to 52%, which was about one-third the rate of the previous year. Overall growth in the industrial sector was 1.3%. Within this sector, the value of nonfuel minerals grew by 1.1%, while petroleum was unchanged from 1987 levels.

The total indicated value of production in 1988 of those minerals and mineral-derived products for which data are available was $19.8 billion in current 1988 dollars. Of this total, $12 billion, or 61%, was attributed to domestic and foreign sales by Petróleos Mexicanos (PEMEX), the State-owned petroleum company; $6.2 billion, or 31%, was attributed to metals including steel and aluminum; and $1.6 billion, or 3%, was attributed to industrial or nonmetallic minerals.[3] A very small fraction of 1% was attributed to the value of steam coal mined in the Río Escondido area of northern Coahuila. Although these figures were distorted by arbitrary low values ascribed to captive mineral production and steam coal and to the lack of value attributed to some industrial minerals, they nevertheless reflected the overwhelming importance of petroleum to the Mexican economy.

Certain long-term trends that may portend fundamental changes in the Mexican mineral economy were evident in 1988. Copper displaced silver as the most important nonferrous, nonfuel mineral produced in Mexico. Production of lead, silver, and zinc, metals for which Mexico is famous and which Mexico has traditionally supplied to world markets, continued a decline that began several years ago. On the other hand, production of aluminum, copper, and steel, all of which are industrial metals destined either for fabrication into value-added products or for export into competitive international markets, increased. Production of industrial minerals and derived products such as barite, cement, fluorspar, graphite, and salt also increased. This trend reflected both a drive to increase exports of Mexican mineral products and an increasing sophistication of Mexican industry. Finally, the volume and value of crude oil exports decreased while both volume and value of exports of refinery products and petrochemicals increased sharply. This change also mirrored the changing Mexican role as the country shifts from a supplier of raw materials to a supplier of value-added products to world markets.

GOVERNMENT POLICIES AND PROGRAMS

The privatization program, under which the Mexican Government has been selling some of its industrial interests, continued. In the mineral sector the most significant sale was that of the State interest in Mexicana de Cobre S.A., operator of the La Caridad mine and smelter complex, to a group led by Industriál Minera México S.A. Sale of the State interest in Ciá. Minera de Cananea S.A., the country's most important copper mining complex, was delayed by the absence of acceptable offers.

Another event of potentially major significance was the relocation of the major Government agencies dealing with minerals from Mexico City to Pachuca in the nearby State of Hidalgo. The relocation of these agencies, which included the Comisión de Fomento Minero, the Consejo de Recursos Minerales, and the Fideicomiso de Minerales No-Metalicos Mexicanos, was expected to streamline minerals-related activities and contribute in a small way to reducing the population pressure in Mexico City.

PRODUCTION

In 1988, the energy sector of the Mexican mineral industry generally showed both a decrease in gross production and an increase in recovered net production. While metallurgical coal production decreased, coke production was essentially unchanged. Similarly, natural gas production decreased, but recovery of marketable gas increased; also, crude oil production dropped, but production of refined products increased. Steam coal production increased marginally over that of 1987.

In the metallic minerals sector, copper production rose to a record high as the expansion at Cananea and construction of the smelter at the La Caridad complex (both in Sonora State) of Mexicana de Cobre were completed. Aluminum output rose, as did that of ferrous minerals and steel. Production of cadmium, mercury, molybdenum, and selenium also increased. On the other hand,

TABLE 1

MEXICO: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1984	1985	1986	1987	1988[p]
METALS						
Aluminum:						
Primary		43,988	[r]42,743	[r]37,016	60,200	68,337
Secondary		[r]19,556	[r]22,305	[r]16,432	8,765	4,474
Antimony:						
Mine output, Sb content[3]		3,064	4,266	3,337	2,839	2,185
Metal (in mixed bars and refined)		1,907	[r]2,715	1,955	1,602	1,207
Arsenic, white[4]		[r]4,164	[r]4,782	[r]5,315	5,304	5,164
Bismuth[5]		433	925	749	1,012	958
Cadmium:						
Mine output, Cd content		1,135	1,140	1,183	1,249	1,726
Metal, refined		[r]571	[r]734	1,016	935	1,117
Copper:						
Mine output, Cu content[6]		[r]189,720	[r]177,124	[r]189,146	253,693	[e]280,201
Metal:						
Blister (primary only)		70,339	68,182	74,662	127,576	151,772
Refined:						
Primary[e 7]		[r]78,263	[r]104,156	[r]75,811	109,816	110,313
Secondary[e 8]		13,900	[r]19,409	[r]13,686	20,223	19,976
Total		**[r]92,163**	**[r]123,565**	**[r]89,497**	**130,039**	**[e]130,289**
Gold:						
Mine output, Au content	troy ounces	[r]226,922	[r]241,904	[r]250,617	256,820	292,510
Metal, refined	do.	177,118	198,723	189,207	205,507	204,770
Iron and steel:						
Iron ore, mine output:						
Gross weight[9]	thousand tons	8,317	7,820	7,298	7,523	8,431
Fe content	do.	5,489	5,161	4,817	4,965	5,564
Metal:						
Pig iron	do.	3,926	3,595	[r]3,737	3,712	3,639
Sponge iron	do.	1,448	1,500	[r]1,420	1,551	1,648
Total	**do.**	**5,374**	**5,095**	**[r]5,157**	**5,263**	**5,287**
Ferroalloys:						
Ferromanganese	do.	[r]161	154	156	161	166
Silicomanganese	do.	42	39	61	80	80
Ferrosilicon	do.	23	28	18	18	17
Ferrochromium	do.	7	6	3	6	9
Other	do.	2	3	1	1	1
Total	**do.**	**[r]235**	**230**	**239**	**266**	**273**
Steel, crude	do.	7,560	[r]7,399	[r]7,225	7,642	7,789
Rolled products	do.	[r]6,004	[r]6,013	[r]5,589	5,954	6,140
Forgings and castings		[r]43	[r]33	26	38	40

See footnotes at end of table.

TABLE 1—Continued

MEXICO: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]	1984	1985	1986	1987	1988[p]
METALS—Continued					
Lead:					
Mine output, Pb content	[r]183,314	[r]206,732	[r]182,672	177,161	171,337
Metal:					
Smelter:					
Primary	[r]174,835	203,036	[r]182,021	176,986	171,087
Secondary (refined)[e]	30,000	31,000	33,000	35,000	35,000
Total[e]	**[r]204,835**	**234,036**	**[r]215,021**	**211,986**	**206,087**
Refined:					
Primary (including lead content of antimonial lead)	163,205	193,525	178,860	173,830	168,093
Secondary[e]	30,000	31,000	33,000	35,000	35,000
Total	**193,205**	**224,525**	**211,860**	**208,830**	**203,093**
Manganese ore:					
Gross weight					
Metallurgical, run-of-mine[e 10]	[r]668,400	[r]630,000	[r]660,400	581,700	680,300
Oxide, nodules	431,300	337,400	394,300	336,000	394,100
Battery grade[e]	[r]19,200	[r]30,300	38,700	41,300	40,000
Mn content	180,940	150,647	174,416	146,407	168,573
Mercury, mine output, Hg content 76-pound flasks	11,139	11,429	5,336	3,597	10,008
Molybdenum, mine output, Mo content	4,054	3,761	[r]3,350	4,400	4,456
Selenium, mine output, Se content	44	42	23	29	13
Silver:					
Mine output, Ag content thousand troy ounces	[r]63,874	[r]69,220	[r]74,048	77,643	75,841
Metallurgical products, Ag content do.	60,022	66,061	71,670	75,651	74,482
Metal, refined, primary do.	53,023	61,651	62,261	68,876	63,530
Tin:					
Mine output, Sn content	416	380	[r]385	369	24
Metal, smelter, primary	[r]1,595	[r]1,533	[r]1,488	1,730	250
Tungsten, mine output, W content	274	282	294	213	206
Zinc:					
Mine output, Zn content	[r]290,236	[r]275,412	[r]271,351	271,480	262,228
Metal:					
Smelter, primary	167,034	175,353	173,700	—	—
Refined, primary	162,912	171,388	172,489	184,755	192,529
INDUSTRIAL MINERALS					
Abrasives, natural[11]	609	248	1,458	12,390	[e]10,000
Barite	426,095	467,693	321,186	401,336	534,954
Cement, hydraulic thousand tons	18,436	20,680	19,751	22,347	22,872
Clays:					
Bentonite	267,348	267,695	136,478	129,596	133,037
Common	212,758	254,606	248,351	178,347	195,553
Fuller's earth	45,697	58,000	52,200	49,112	49,317
Kaolin	130,296	282,337	276,427	151,104	213,766
Diatomite	44,634	45,781	36,022	34,708	35,365
Feldspar	[r]395,046	432,031	85,019	106,490	95,755

See footnotes at end of table.

TABLE 1—Continued

MEXICO: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1984	1985	1986	1987	1988[p]
INDUSTRIAL MINERALS—Continued						
Fluorspar:[12]						
Acid-grade	thousand tons	344	379	424	291	338
Ceramic-grade	do.	37	27	14	—	27
Metallurgical-grade	do.	213	270	263	244	253
Submetallurgical-grade	do.	105	53	66	189	138
Total	**do.**	**[r]699**	**[r]729**	**[r]767**	**724**	**756**
Graphite, natural:						
Amorphous		39,846	33,468	36,018	36,674	42,096
Crystalline		1,683	1,910	1,838	1,787	1,735
Gypsum and anhydrite, crude (yeso)		4,260,022	4,602,796	4,232,805	4,575,416	4,125,825
Lime, hydrated and quicklime	thousand tons	5,440	5,093	5,545	[r e]6,250	3,738
Magnesium compounds:						
Magnesia[13]		105,701	121,698	99,965	118,332	141,014
Magnesite		30,424	19,299	7,530	7,351	7,531
Mica, all grades[12]		1,676	1,446	1,748	3,419	2,584
Nitrogen: N content of ammonia[14]		[r]1,820,632	[r]1,906,235	1,652,051	1,794,306	2,129,720
Perlite		31,515	37,261	46,170	39,428	39,150
Phosphate rock[15]		652,651	786,500	746,863	688,973	732,005
Salt, all types	thousand tons	6,167	6,467	6,205	6,199	6,965
Sodium compounds, n.e.s.:						
Carbonate (soda ash):						
Natural		192,000	200,185	[e]200,000	[e]180,000	[e]180,000
Synthetic		231,008	257,223	[e]250,000	[e]250,000	[e]250,000
Sulfate, natural (bloedite)[16]		413,238	394,074	455,360	488,642	[e]430,000
Stone, sand and gravel:						
Calcite, common		480,986	400,516	437,118	486,740	430,031
Dolomite		392,877	330,711	453,861	411,601	340,671
Limestone[17]	thousand tons	29,055	30,840	28,919	23,735	24,741
Marble		149,220	263,100	258,000	261,000	468,000
Quartz, quartzite, glass sand (silica)		1,462,158	1,479,100	886,411	965,921	926,166
Sand and gravel:						
Sand	thousand cubic meters	52,031	54,350	50,064	52,513	51,904
Gravel[e]	do.	33,694	35,196	32,420	34,007	33,600
Strontium minerals: Celestite		31,991	32,320	24,042	47,739	[e]60,000
Sulfur, elemental:						
Frasch process	thousand tons	1,364	1,551	1,588	1,806	1,628
Byproduct:						
Of metallurgy[e]	do.	[r]120	[r]120	[r]134	[r]154	240
Of petroleum and natural gas	do.	462	469	462	498	510
Total[e]	**do.**	**[r]1,946**	**[r]2,140**	**[r]2,184**	**[r]2,458**	**2,378**
Talc		8,900	29,900	24,301	17,469	18,320
Vermiculite		505	350	220	161	191
Wollastonite		9,251	13,512	9,356	10,993	10,779

See footnotes at end of table.

TABLE 1—Continued

MEXICO: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1984	1985	1986	1987	1988[p]
MINERAL FUELS AND RELATED MATERIALS						
Carbon black (materia prima negro de humo)		277,197	264,317	[r]543,693	748,124	943,987
Coal:						
Run-of-mine:						
Metallurgical	thousand tons	7,173	[r]7,331	[r]7,108	7,014	6,375
Steam	do.	2,215	[r]2,440	[r]3,050	4,122	4,211
Total	**do.**	**9,388**	**9,771**	**10,158**	**11,136**	**10,586**
Washed metallurgical coal	do.	3,455	3,442	[r]3,027	3,026	2,340
Coke:[18]						
Metallurgical	do.	2,885	2,890	2,594	2,330	2,322
Imperial	do.	35	6	6	6	5
Breeze	do.	8	5	4	4	5
Total	**do.**	**2,928**	**2,901**	**2,604**	**2,340**	**2,332**
Gas, natural:						
Gross	million cubic feet	1,373,457	1,315,337	1,252,352	1,276,926	1,273,061
Marketable	do.	1,242,905	1,197,127	1,175,191	1,194,217	1,218,783
Natural gas liquids: Field condensate	thousand 42-gallon barrels	41,824	26,583	26,547	27,657	27,925
Petroleum:						
Crude	do.	982,517	960,114	886,092	927,333	917,431
Refinery products:						
Gasoline:						
Aviation	do.	436	406	419	418	430
Motor, leaded and unleaded	do.	131,516	130,084	129,296	134,291	137,044
Liquefied petroleum gas	do.	56,781	60,981	66,912	70,306	75,704
Jet fuel	do.	12,370	12,379	12,625	15,141	16,495
Kerosene	do.	11,654	11,286	9,798	11,009	9,961
Distillate fuel oil (diesel)	do.	85,358	89,726	88,521	84,817	75,465
Lubricants	do.	2,573	2,504	2,386	2,602	2,842
Residual fuel oil	do.	137,210	145,253	147,974	154,939	154,003
Asphalt	do.	8,292	8,360	6,054	6,655	5,463
Unfinished crude oil[19]	do.	14,577	16,954	950	660	—
Unspecified	do.	24,414	26,208	28,736	31,283	36,150
Refinery fuel and losses	do.	16,591	14,763	10,903	7,560	8,517
Total	**do.**	**501,772**	**518,904**	**504,574**	**519,681**	**522,074**

[e]Estimated. [p]Preliminary. [r]Revised.
[1]Table includes data available through Dec. 1, 1989.
[2]In addition to the commodities listed, additional types of crude construction materials are produced, but output is not reported and available information is inadequate to make reliable estimates of output levels.
[3]Sb content of ores for export plus Sb content of antimonial and impure bars plus refined metals.
[4]Gross weight of white and black (impure) arsenic trioxide.
[5]Refined metal plus Bi content of impure smelter products.
[6]Mine output is estimated based upon reported concentrate production plus reported smelter output adjusted for 2.5% metal loss to slag.
[7]Includes cathode copper from the Cía. Minera de Cananea S.A. electrowinning plant in metric tons as follows: 1984-9,289; 1985-8,034; 1986-8,033; 1987-9,662 and 1988-11,380.
[8]Secondary refined copper production is estimated to be 16.8% of the total refined copper produced by Cobre de México SA.
[9]Calculated from reported Fe content on the basis of concentrate and pellets containing 66% iron. Total run-of-mine output in 1986 was just under 15 million tons.
[10]Calculated from reported production of Mn carbonate ore and oxide nodules by Cía. Minera Autlán S.A. and reported Mn content of mine production.
[11]Based on exports, comprised mostly of pumice stone and emery (a granular, impure variety of corundum).
[12]Instituto Mexicana de la Fluorita A.C. through 1986; Consejo de Recursos Minerales for 1987 and 1988.
[13]Reported by Industrias Peñoles S.A. de C.V. as the only major producer.
[14]For 1986-88; nitrogen content of ammonia produced by PEMEX plus liquid nitrogen.
[15]Includes only output used to manufacture fertilizers.
[16]Series reflects output reported by Industrias Peñoles plus an additional 30,000 tons estimated production by smaller producers.
[17]Excludes that for cement production.
[18]Includes coke made from imported metallurgical coal.
[19]Specified by PEMEX as "virgin stock-28" and processed at its refineries primarily for export.

production of Mexico's traditional metals, lead, silver, and zinc, along with production of most of their associated by-products (except cadmium) declined. Gold production rose to more than 9,000 kilograms (293,000 troy ounces), a level last achieved in 1960.

In the industrial minerals sector, production of barite, bentonite, cement, fluorspar, graphite, nitrogen, phosphate rock, salt, and strontium rose. Sulfur production, including that in sulfuric acid, rose, although Frasch sulfur production decreased. Production of feldspar (used in glass), gypsum, kaolin, and mica all declined.

Although employment data for the mineral industry in 1988 were not available, the lack of significant industry growth suggests that employment levels did not change materially. Several mining companies have noted that their mines cannot meet the wage rates paid by some other industries, and that they are having difficulty maintaining their work forces.

TRADE

The value of Mexican mineral and petroleum exports in 1988 was $7.39 billion, a drop of $1.8 billion, or nearly 20%, compared with those of 1987. The total exports of $20.66 billion were virtually unchanged relative to 1987. Thus, the contribution of mineral-related items to total exports fell from 46% in 1987 to 36% in 1988. The value of nonpetroleum mineral exports rose from $576 million in 1987 to $680 million in 1988, an increase of about 15%. The value of refined and derived petroleum product exports rose from $753 million in 1987 to $826 million in 1988; that of crude oil exports, on the other hand, dropped from $7.88 billion in 1987 to $5.85 billion in 1988, a decrease of almost 26%. These latter declines more than offset the gain in export revenue resulting from (1) the increase in the physical volume of refined and derived petroleum-product exports and (2) the increases in both physical volume and unit value of nonpetroleum mineral exports.

Although Mexico was a net exporter of the majority of both fuel and nonfuel minerals, the country did depend upon imports for some of its raw material requirements. In 1988, the Mexican steel industry imported 289,000 tons of iron ore pellets, 125,000 tons of lump iron ore, 287,000 tons of sinter fines, and 231,000 tons of metallurgical coal, whereas in 1987 the industry imported 45,000 tons of pellets, 101,000 tons of lump ore, 344,000 tons of sinter fines and no coal. Other industries that imported all or part of their raw material requirements or major commodity inputs included the aluminum industry, which imported all of its alumina and part of its secondary materials; the fertilizer industry, which imported all of its potash and about two-thirds of its phosphate requirements; and the steel industry, which imported iron and steel scrap and specialty alloying metals such as chromium and nickel. Mexico also imported asbestos, specialty clays, talc and titanium; the country may also have been a net importer of gold.

In 1988, Mexico was a net exporter of steel, although the balance of its steel exports over imports decreased from 1.044 million tons valued at $254 million in 1987 to 742,000 tons valued at $124 million in 1988. Mexico also imported manganese ore, sulfur, and other commodities of which it was a substantial producer in cases where it was economically attractive to use imported rather than domestic materials or where imported material was required for blending purposes.

Mexico was a major exporter of copper, lead, silver, zinc, and several of the lesser metals; manganese ore and ferroalloys; and cement, fluorspar, graphite, gypsum, salt, sodium sulfate, and sulfur. The value of exports of copper concentrate and matte in 1988 was $200 million while the export value of refined copper increased 200% to $145 million. These values reflected increases in both physical volume and prices over those of 1987. Exports of silver in bar form decreased by 12% to $318 million, again reflecting lower world prices. Demand for sulfur was met by a drawdown in stocks, as sulfur exports rose in both physical volume and value.

Mexico was a major mineral trading partner of the United States. In 1988, Mexico exported about 246 million barrels of crude oil to the United States. This amount was more than 13% of total U.S. imports of crude oil and over 52% of Mexican crude oil exports. Mexico was thus second only to Saudi Arabia as a supplier of crude oil to the United States and was fourth, behind Saudi Arabia, Canada and Venezuela as a supplier of all petroleum products to the United States. Mexico also exported to the United States more than 10% of U.S. imports of antimony, lead, silver, tungsten, and zinc; and cement, fluorspar, graphite, lime, strontium, and sulfur, among other mineral products. It imported from the United States a significant part of its national requirement for aluminum feedstock, scrap iron, kaolin, phosphate and potash, sodium carbonate (trona), and talc.

COMMODITY REVIEW

Metals

Aluminum.—Grupo Aluminio S.A. de C.V., a Mexican company affiliated with Aluminum Company of America, completed the expansion of its smelter in Veracruz and achieved record production of 72,811 tons of primary and secondary aluminum ingot in 1988. Imports of aluminum in all forms decreased from 55,123 tons in 1987 to 51,433 tons in 1988; exports rose from 21,248 tons to 30,018 tons. Apparent consumption of aluminum in 1988 decreased to 94,226 tons. This level was the lowest since 1983, and significantly lower than the 10 year average of 132,100 tons per year.

TABLE 2

MEXICO: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
METALS				
Alkali and alkaline-earth metals	—	(2)	—	All to Guatemala.
Aluminum:				
Oxides and hydroxides	203	313	284	Guatemala 27.
Metal including alloys:				
Scrap	5,291	6,727	6,727	
Unwrought	2,672	3,058	3,013	Guatemala 45.
Semimanufactures	1,125	5,231	3,638	Costa Rica 335; Guatemala 193.
Antimony:				
Ore and concentrate	3,510	3,108	3,108	
Ash and residue containing antimony	—	1,340	1,222	China 79; Ivory Coast 39.
Metal including alloys, all forms	140	63	63	
Arsenic: Oxides and acids	4,330	4,559	4,478	Brazil 80.
Bismuth:				
Ore and concentrate	—	(2)	(2)	
Oxides and hydroxides	—	2	—	All to Brazil.
Metal including alloys, all forms	673	1,402	1,146	Belgium-Luxembourg 151; China 43.
Cadmium: Metal including alloys, all forms	549	800	522	Netherlands 171; Brazil 87.
Chromium: Oxides and hydroxides	13	2	(2)	Guatemala 2.
Cobalt: Oxides and hydroxides	—	18	—	All to Jamaica.
Columbium and tantalum: Metal including alloys, all forms: Tantalum	—	8	(2)	West Germany 8.
Copper:				
Ore and concentrate	298,709	367,403	9,023	West Germany 69,625; Spain 64,785; China 62,100
Matte and speiss including cement copper	—	3	3	
Oxides and hydroxides	261	258	258	
Sulfate	851	2,523	2,501	Canada 22.
Ash and residue containing copper	—	3,868	3,868	
Metal including alloys:				
Scrap	4,814	14,754	13,784	Republic of Korea 889.
Unwrought	19,117	18,233	13,639	Venezuela 3,973.
Semimanufactures	13,338	34,458	31,705	Spain 536.
Iron and steel:				
Iron ore and concentrate including roasted pyrite	r1,015	1,304	1,234	Costa Rica 70.
Metal:				
Scrap	21,747	44,052	25,961	China 16,948.
Pig iron, cast iron, related materials	67	1,306	1,203	Cuba 91; France 7.

See footnotes at end of table.

TABLE 2—Continued

MEXICO: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987	
			United States	Other (principal)
METALS—Continued				
Iron and steel—continued				
Ferroalloys:				
Ferromanganese	[r]42,077	26,613	14,894	Colombia 5,785; Canada 4,435.
Ferrosilicomanganese	19	40,007	29,864	Japan 6,721; Colombia 1,604.
Ferrosilicon	[r]51	52	20	Colombia 16; Panama 10.
Unspecified	[r]325	147	18	Japan 57; Brazil 31.
Steel, primary forms	153,274	193,569	67,793	Thailand 27,996; Ecuador 27,508.
Semimanufactures:				
Bars, rods, angles, shapes, sections	405,017	392,349	84,939	China 145,158; Honduras 57,412.
Universals, plates, sheets	363,798	357,783	125,149	Japan 77,415; Thailand 52,049.
Hoop and strip	2,939	5,312	5,037	Cuba 124.
Rails and accessories	70	36	36	
Wire	8,266	18,374	4,439	Canada 5,594; China 3,524.
Tubes, pipes, fittings	154,078	334,948	132,483	Argentina 87,965; India 39,628.
Castings and forgings, rough	23,223	70,075	68,494	Canada 797.
Lead:				
Ore and concentrate	5,618	15,770	15	Spain 8,295; Belgium-Luxembourg 7,375.
Oxides	25,130	30,375	17,396	Japan 7,500; Ecuador 956.
Metal including alloys:				
Scrap	1,852	3,099	3,099	
Unwrought	104,003	86,603	41,844	Italy 11,506; Brazil 11,204.
Semimanufactures	421	406	141	Spain 148; Japan 54.
Magnesium: Metal including alloys, all forms	289	284	244	Netherlands 40.
Manganese:				
Ore and concentrate:				
Battery-grade	31,023	30,543	15,071	Singapore 3,600; Japan 3,500.
Metallurgical-grade	83,877	134,762	6,052	Canada 30,625; Venezuela 30,380; Spain 29,400.
Oxides	6	118	15	Costa Rica 102.
Mercury 76-pound flasks	4,505	3,508	1	Brazil 2,085; Argentina 1,076; Uruguay 184.
Molybdenum:				
Ore and concentrate	2,875	4,238	201	Netherlands 1,834; United Kingdom 1,165; West Germany 982.
Metal including alloys, all forms	229	5	—	Belize 4; Brazil 1.

See footnotes at end of table.

TABLE 2—Continued

MEXICO: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
METALS—Continued				
Nickel:				
Ore and concentrate kilograms	15	—		
Matte and speiss	3	—		
Metal including alloys:				
Scrap	—	(2)	(2)	
Semimanufactures	15	6	5	Japan 1.
Platinum-group metals: Metals including alloys, unwrought and partly wrought troy ounces	1,447	31,469	31,347	West Germany 122.
Silver:				
Ore and concentrate value, thousands	—	$1	$1	
Metal including alloys, unwrought and partly wrought thousand troy ounces	55,596	52,169	41,363	Japan 7,317; United Kingdom 1,500.
Tin:				
Ore and concentrate	908	10,089	—	Belgium-Luxembourg 5,542; Japan 4,547.
Metal including alloys:				
Scrap	2	19	19	
Unwrought	171	910	910	
Semimanufactures	191	26	16	Cuba 5.
Titanium:				
Ore and concentrate kilograms	110	—		
Oxides	818	841	24	El Salvador 281; Honduras 269; Guatemala 260.
Tungsten:				
Ore and concentrate	772	633	633	
Metal including alloys:				
Unwrought	r44	6	5	Sweden 1.
Semimanufactures	8	39	—	West Germany 38; Brazil 1.
Vanadium:				
Ore and concentrate	—	40	40	
Ash and residue containing vanadium	1,360	1,070	1,070	
Zinc:				
Ore and concentrate	197,774	157,516	11,164	Belgium-Luxembourg 83,573; United Kingdom 27,126
Oxides	20,563	24,107	21,698	United Kingdom 1,719.
Blue powder	2,650	65	65	
Ash and residue containing zinc	1,446	2,599	1,930	Uruguay 649.
Metal including alloys:				
Unwrought	73,929	72,044	53,200	Japan 4,557; Costa Rica 3,618.
Semimanufactures	12,294	20,671	1,890	Brazil 11,446; Argentina 3,363.

See footnotes at end of table.

TABLE 2—Continued

MEXICO: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
METALS—Continued				
Other:				
Ores and concentrates	14	21	1	China 20.
Oxides and hydroxides	—	974	503	France 114; Brazil 105.
Ashes and residues	172	164	163	West Germany 1.
Base metals including alloys, all forms	36	4	3	Argentina 1.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	1,457	12,390	12,322	Spain 66.
Artificial: Silicon carbide	1,791	4,045	2,737	Japan 1,309.
Dust and powder of precious and semi-precious stones kilograms	12	187	187	
Grinding and polishing wheels and stones	165	172	165	Cuba 2.
Asbestos, crude	([2])	40	40	
Barite and witherite	29,792	65,794	65,649	Cyprus 145.
Boron materials:				
Crude natural borates	63	3	3	
Oxides and acids	1	([2])	—	All to El Salvador.
Cement thousand tons	3,717	4,371	4,160	Belize 51.
Chalk	475	2,250	2,250	
Clays, crude:				
Bentonite	11,488	11,846	1,310	Netherlands 10,500; Colombia 20.
Fuller's earth	22	22	22	
Kaolin	2,012	87	1	Colombia 53; Guatemala 30; El Salvador 2.
Unspecified	56	113	61	Colombia 16; Guatemala 12.
Cryolite and chiolite	263	51	51	
Diatomite and other infusorial earth	5,461	5,905	—	Belgium-Luxembourg 1,299; Argentina 1,256; Brazil 906.
Feldspar, fluorspar, related materials:				
Feldspar	688	3,845	3,845	
Fluorspar	437,526	474,781	280,383	Canada 90,673; Netherlands 51,928.
Fertilizer materials:				
Crude, n.e.s.	([2])	113	113	
Manufactured:				
Ammonia	96,592	144,886	318	Spain 80,305; Turkey 22,544; Spain 21,668.
Nitrogenous	81,933	175,907	88,852	Netherlands 19,914; Belgium-Luxembourg 19,742.
Phosphatic	25,244	723	314	Belize 332; Guatemala 55.

See footnotes at end of table.

TABLE 2—Continued

MEXICO: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
INDUSTRIAL MINERALS—Continued					
Fertilizer materials—continued					
Potassic		120	23	23	
Unspecified and mixed		528	633	292	West Germany 331.
Graphite, natural		18,919	19,599	18,959	Spain 610.
Gypsum and plaster	thousand tons	2,269	2,184	1,979	Canada 164; Japan 26.
Iodine		16	([2])	—	All to Ecuador.
Lime		18,578	53,662	52,840	Belize 417.
Magnesium compounds:					
Magnesite, crude		4	31	19	Cuba 7; Nicaragua 5.
Oxides and hydroxides		44,342	39,430	16,803	Argentina 6,251; Netherlands 4,199.
Meerschaum, amber, jet		([2])	20	20	
Mica:					
Crude including splittings and waste		29	22	21	El Salvador 1.
Worked including agglomerated splittings		2	58	6	Cuba 52.
Phosphates, crude		55	3	([2])	Belize 3.
Pigments, mineral: Iron oxides and hydroxides, processed		2,741	4,890	3,069	Japan 936; Canada 302.
Precious and semiprecious stones other than diamond:					
Natural	kilograms	834	3,006	417	Japan 2,431; Italy 150.
Synthetic	do.	46	—	—	
Salt and brine	thousand tons	4,435	4,841	1,435	Japan 2,829; Canada 317.
Sodium compounds, n.e.s.:					
Carbonate, manufactured		1,857	3,955	1	Cuba 2,579; Colombia 970; Honduras 350.
Sulfate, manufactured		157,283	137,901	86,303	Brazil 29,891; Ecuador 4,327.
Stone, sand and gravel:					
Dimension stone:					
Crude and partly worked		2,164	1,930	1,016	China 722; Guatemala 72.
Worked		14,602	16,957	16,577	Panama 93.
Dolomite, chiefly refractory-grade		1,461	2,165	1,663	Panama 381; El Salvador 120.
Gravel and crushed rock		r20,207	60,680	60,655	Guatemala 12.
Limestone other than dimension		104,636	6	6	
Quartz and quartzite		76	19	19	
Sand other than metal-bearing		28,986	10,691	10,634	El Salvador 21.
Sand and gravel		([3])	—	—	
Strontium minerals: Celestite		30,698	39,324	37,660	Japan 1,664.
Sulfur:					
Elemental: Crude including native and byproduct	thousand tons	1,031	1,435	813	Morocco 329; Romania 116.
Dioxide		110	107	—	All to Belize.
Sulfuric acid		321	845	40	Panama 456; Guatemala 317.

See footnotes at end of table.

TABLE 2—Continued

MEXICO: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
INDUSTRIAL MINERALS—Continued					
Talc, steatite, soapstone, pyrophyllite		20	116	115	El Salvador 1.
Vermiculite and perlite		66	295	172	Venezuela 88; Colombia 35.
Other:					
Crude		333	279	276	France 3.
Slag and dross, not metal-bearing		410	12,220	12,050	Venezuela 170.
MINERAL FUELS AND RELATED MATERIALS					
Asphalt and bitumen, natural		r77,581	200,292	200,289	Panama 3.
Carbon: Carbon black		36,433	63,468	22,654	Switzerland 19,066; Cuba 4,766.
Coal: All grades including briquets		831	46,643	46,550	El Salvador 80; Costa Rica 13.
Coke and semicoke		24,358	183	17	Cuba 166.
Peat including briquets and litter		25	26	26	
Petroleum:					
Crude	thousand 42-gallon barrels	r470,267	490,339	240,926	Spain 73,078; Japan 62,716.
Refinery products:					
Liquefied petroleum gas	do.	r6,769	6,094	3,938	Belize 567; Ecuador 530.
Gasoline, motor	do.	r3,896	3,649	179	Colombia 2,338; Ecuador 526; Bermuda 221.
Mineral jelly and wax	do.	75	82	82	
Kerosene and jet fuel	do.	r2,435	4,616	3,485	Jamaica 650; Peru 177.
Distillate fuel oil	do.	r19,716	7,409	2,989	Liberia 1,885; Panama 1,047.
Lubricants	do.	5	3	(2)	Mainly to Panama.
Residual fuel oil	do.	r16,140	13,652	4,962	Bahamas 7,022; Panama 2,575.
Asphalt	do.	(3)	—	—	
Bitumen and other residues	do.	390	90	90	
Bituminous mixtures	do.	128	408	404	Guatemala 2.
Petroleum coke	do.	—	442	442	
Unfinished crude oil	do.	950	1,266	1,266	
Unspecified	do.	3,326	2,026	1,593	Netherlands 306; China 126.

r Revised.
1 Table prepared by P. J. Roetzel.
2 Less than 1/2 unit.
3 Revised to zero.

TABLE 3

MEXICO: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS					
Aluminum:					
Ore and concentrate		35,086	40,225	37,128	Guyana 3,039; Brazil 16.
Oxides and hydroxides		88,121	165,698	155,580	West Germany 6,730; Japan 2,104.
Metal including alloys:					
Scrap		18,218	8,890	8,767	France 57; Japan 44.
Unwrought		16,085	11,017	7,580	Canada 3,048; Venezuela 361.
Semimanufactures		18,796	22,263	19,131	NA.
Antimony: Oxides		29	28	8	West Germany 20.
Arsenic: Metal including alloys, all forms		43	86	86	
Beryllium: Metal including alloys, all forms	kilograms	36	31	31	
Bismuth: Metal including alloys, all forms	do.	15	27	27	
Cadmium: Metal including alloys, all forms		42	132	90	Belgium-Luxembourg 42.
Chromium:					
Ore and concentrate		27,781	45,016	14,848	Zimbabwe 26,243; Cuba 3,925.
Oxides and hydroxides		63	194	183	Netherlands 10; Italy 1.
Cobalt:					
Oxides and hydroxides		151	158	67	Belgium-Luxembourg 76; United Kingdom 12.
Metal including alloys, all forms		71	63	9	Canada 21; Belgium-Luxembourg 20.
Columbium and tantalum: Metal including alloys, all forms: Tantalum	kilograms	184	986	982	West Germany 4.
Copper:					
Oxides		11	17	14	Peru 3.
Sulfate		47	10	10	
Metal including alloys:					
Scrap		7,451	20,537	20,537	
Unwrought		437	177	177	
Semimanufactures		2,963	3,016	2,321	NA.
Unspecified		8,121	4,624	3,851	Chile 673; West Germany 100.
Iron and steel:					
Iron ore and concentrate		208,617	44,803	44,646	Venezuela 150; West Germany 4.
Metal:					
Scrap		430,502	464,111	451,663	Japan 4,516; Panama 1,373.
Pig iron, cast iron, related materials		10,482	11,442	8,947	Canada 2,037; Brazil 299.

See footnotes at end of table.

TABLE 3—Continued

MEXICO: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS—Continued				
Iron and steel—continued				
Ferroalloys:				
Ferrochromium	25	766	600	Belgium-Luxembourg 163; West Germany 3.
Ferromanganese	108	42	25	Spain 17.
Ferromolybdenum	43	43	16	Netherlands 27.
Ferronickel	49	64	63	West Germany 1.
Ferrosilicomanganese	31	65	65	
Ferrosilicon	579	767	703	West Germany 36; Canada 28.
Ferrovanadium	18	26	26	
Silicon metal	1,744	2,073	1,693	Brazil 380.
Unspecified	r2,317	1,033	843	Brazil 110; United Kingdom 58.
Steel, primary forms[2]	153,029	NA		—
Semimanufactures:				
Bars, rods, angles, shapes, sections[2]	26,281	23,847	20,777	Japan 1,244; United Kingdom 513.
Universals, plates, sheets[2]	279,331	163,491	59,857	Japan 41,200; Spain 19,386.
Hoop and strip[2]	6,271	4,230	1,898	West Germany 1,235; Japan 493.
Rails and accessories	151,116	86,124	31,432	Canada 43,046; France 9,656.
Wire[2]	4,173	3,152	1,591	Japan 527; West Germany 504.
Tubes, pipes, fittings	63,832	25,287	11,906	NA.
Unspecified	60,515	16,664	12,772	NA.
Lead:				
Oxides	27	19	19	
Metal including alloys:				
Scrap	1,056	2,300	2,300	
Unwrought	28	44	44	
Semimanufactures	13	292	69	Canada 223.
Lithium: Oxides and hydroxides	156	217	117	Hong Kong 100.
Magnesium: Metal including alloys:				
Scrap	17	10	10	
Unwrought	965	693	673	Norway 20.
Semimanufactures	101	128	128	
Manganese:				
Ore and concentrate	112,353	44,670	32,253	Switzerland 10,688; France 1,000.
Oxides	1,826	1,722	764	Belgium-Luxembourg 642; West Germany 186.

See footnotes at end of table.

TABLE 3—Continued

MEXICO: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS—Continued					
Mercury	76-pound flasks	7	2	2	
Molybdenum:					
Ore and concentrate	kilograms	—	60	60	
Metal including alloys:					
Unwrought		19	35	30	Austria 4.
Unspecified		8	8	3	Netherlands 5.
Nickel:					
Matte and speiss		1,896	2,197	531	Canada 777; Netherlands 632.
Oxides and hydroxides		64	81	3	Canada 39; Cuba 39.
Metal including alloys, semimanufactures		2,662	1,191	367	NA.
Platinum-group metals: Metals including alloys, unwrought and partly wrought:					
Palladium	troy ounces	329	330	128	Switzerland 201; West Germany 1.
Platinum	do.	1,868	357	357	
Rhodium	do.	47	1	1	
Unspecified	do.	148	([3])	([3])	
Selenium, elemental		25	66	47	United Kingdom 12; Yugoslavia 3.
Silver: Metal including alloys, unwrought and partly wrought	troy ounces	r5,594	167,193	117,999	Switzerland 48,882; West Germany 161.
Tellurium, elemental	kilograms	95	636	635	Sweden 1.
Tin:					
Ore and concentrate		6,311	3,687	3,074	Chile 325; Canada 141.
Oxides		39	11	11	
Metal including alloys:					
Scrap		135	140	140	
Unwrought		67	44	44	
Semimanufactures		12	6	4	West Germany 1; United Kingdom 1.
Titanium:					
Ore and concentrate		47,129	44,562	43	Australia 44,519.
Oxides		1,405	1,197	311	West Germany 425; Japan 103.
Metal including alloys, all forms		42	2	1	West Germany 1.
Tungsten:					
Ore and concentrate	kilograms	45	155	155	
Metal including alloys, all forms		43	54	27	Austria 22; Netherlands 2.

See footnotes at end of table.

TABLE 3—Continued

MEXICO: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS—Continued				
Zinc:				
Oxides	96	100	83	Denmark 17.
Blue powder	239	272	254	Belgium-Luxembourg 18.
Metal including alloys:				
Scrap	1,376	1,205	1,205	
Unwrought	2	2	2	
Semimanufactures	184	211	171	Japan 31; Brazil 9.
Zirconium: Ore and concentrate	1,177	771	671	Austria 63; Spain 18.
Other:				
Ores and concentrates	426	296	244	United Kingdom 23; Netherlands 15.
Ashes and residues	2,304	4,991	4,990	Panama 1.
Base metals including alloys, all forms	308	315	283	Belgium-Luxembourg 14; Hong Kong 10.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	1,061	925	854	West Germany 61; Netherlands 8.
Artificial:				
Corundum	1,446	353	292	Brazil 42; Austria 18.
Silicon carbide	135	138	138	
Dust and powder of precious and semiprecious stones excluding diamond kilograms	127	827	822	Spain 5.
Grinding and polishing wheels and stones	345	387	302	West Germany 31; Canada 12.
Asbestos, crude	28,209	38,377	8,400	Canada 19,908; Republic of South Africa 4,012.
Barite and witherite	99	88	80	Switzerland 6; West Germany 2.
Boron materials:				
Crude natural borates	976	762	741	Argentina 18; West Germany 3.
Oxides and acids	2,085	2,733	2,612	Italy 106; West Germany 9.
Bromine	99	146	142	Israel 4.
Cement	8,438	9,978	7,545	France 1,624; Yugoslavia 671.
Chalk	1	3	3	
Clays, crude:				
Bentonite	509	1,318	1,312	United Kingdom 3; West Germany 2.
Kaolin	85,424	91,833	91,595	Spain 204; United Kingdom 30.
Unspecified	109,818	129,640	129,058	West Germany 417; Brazil 88.

See footnotes at end of table.

TABLE 3—Continued

MEXICO: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
INDUSTRIAL MINERALS—Continued					
Cryolite and chiolite		832	653	602	Denmark 49; Switzerland 2.
Diamond:					
Industrial stones	kilograms	139	856	506	Ireland 325; United Kingdom 18.
Dust and powder	do.	[r]537	7,760	1,726	West Germany 6,001; Belgium-Luxembourg 25.
Diatomite and other infusorial earth		513	422	422	
Feldspar, fluorspar, related materials		4,448	10,410	10,044	Canada 354; Switzerland 6.
Fertilizer materials:					
Crude, n.e.s.		791	298	298	
Manufactured:					
Ammonia		27,070	102,428	102,428	
Nitrogenous		184,321	138,986	5,387	U.S.S.R. 107,825; East Germany 20,637.
Phosphatic		249,732	24,301	24,301	
Potassic		29,181	81,807	59,778	Canada 22,000; Israel 26.
Unspecified and mixed		1,953	60,991	60,643	Belgium-Luxembourg 247; Spain 101.
Graphite, natural		48	399	202	Brazil 71; West Germany 22.
Gypsum and plaster		8,546	5,660	5,602	Italy 34; West Germany 24.
Iodine		141	207	167	Hungary 15; Japan 12.
Lime		729	1,771	1,771	
Magnesium compounds:					
Magnesite, crude		1,573	637	633	Netherlands 3; Switzerland 1.
Oxides and hydroxides		1,701	222	206	Netherlands 9; West Germany 6.
Sulfate		6	47	14	Denmark 25; United Kingdom 6.
Mica:					
Crude including splittings and waste		153	58	48	West Germany 7; Canada 2.
Worked including agglomerated splittings		94	43	36	Belgium-Luxembourg 2; Spain 2.
Phosphates, crude	thousand tons	1,097	1,345	324	Morocco 993; Israel 28.
Pigments, mineral: Iron oxides and hydroxides, processed		588	358	328	West Germany 27; Netherlands 2.
Potassium salts, crude		144,588	77,437	55,409	Canada 22,000; Israel 26.
Precious and semiprecious stones other than diamond:					
Natural		[r]56	905	876	West Germany 28.
Synthetic	kilograms	41,874	657	519	Switzerland 95; France 24.
Pyrite, unroasted		124	98	24	West Germany 74.
Quartz crystal, piezoelectric	kilograms	36	16	6	West Germany 10.
Salt and brine		660	538	508	West Germany 30.

See footnotes at end of table.

TABLE 3—Continued

MEXICO: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987	
				United States	Other (principal)
INDUSTRIAL MINERALS—Continued					
Sodium compounds, n.e.s.:					
Carbonate, manufactured		78,191	85,287	85,285	West Germany 2.
Sulfate, manufactured		50	14	14	
Stone, sand and gravel:					
Dimension stone:					
Crude and partly worked		1,667	1,851	177	Italy 925; Guatemala 402; Cuba 204.
Worked		9,781	8,789	8,524	Italy 141; Argentina 59.
Calcite, common		r1,519	1,339	1,236	Italy 54; United Kingdom 43.
Dolomite, chiefly refractory-grade		1,497	1,369	1,369	
Gravel and crushed rock		2,799	3,099	2,745	France 210; United Kingdom 57.
Quartz and quartzite		405	630	524	Sweden 100; Belgium-Luxembourg 5.
Sand other than metal-bearing		68,305	64,426	64,340	Panama 54; Belgium-Luxembourg 13.
Sulfur:					
Elemental:					
Crude including native and byproduct		239,342	448,566	219,388	Canada 229,033; Belgium-Luxembourg 145.
Colloidal, precipitated, sublimed		35	75	75	
Sulfuric acid		22,383	13,850	13,850	
Talc, steatite, soapstone, pyrophyllite		79,279	93,404	92,409	Italy 600; France 253.
Vermiculite		462	942	942	
Other: Crude		9,051	10,800	10,541	Spain 96; Italy 66.
MINERAL FUELS AND RELATED MATERIALS					
Asphalt and bitumen, natural		1,048	927	927	
Carbon:					
Carbon black		3,301	2,342	1,616	West Germany 465; United Kingdom 130.
Other		58	56	50	West Germany 6.
Coal:					
Briquets of anthracite and bituminous coal	thousand tons	240	20	15	Panama 5.
Lignite including briquets		3,592	3,180	3,177	France 3.
Coke and semicoke		r64,396	67,169	29,880	Panama 36,836; Singapore 453.
Gas, natural	million cubic feet	1,789	2,073	2,073	
Peat including briquets and litter		268	400	400	

See footnotes at end of table.

TABLE 3 Continued

MEXICO: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
MINERAL FUELS AND RELATED MATERIALS—Continued					
Petroleum refinery products:					
Liquefied petroleum gas	thousand 42-gallon barrels	8,987	5,866	5,681	NA.
Gasoline, motor	do.	14	1,872	1,446	NA.
Mineral jelly and wax	do.	236	273	238	Brazil 27; West Germany 3.
Kerosene and jet fuel	do.	504	557	487	NA.
Lubricants	do.	1,274	1,911	1,174	NA.
Residual fuel oil	do.	11,096	17,200	15,510	NA.
Petroleum coke	do.	880	424	424	

[r] Revised. NA Not available.
[1] Table prepared by H. D. Willis.
[2] Does not include high carbon or alloy steel.
[3] Less than 1/2 unit.

Cadmium.—Mine production of cadmium increased by nearly 40% in 1988, approaching the levels of the 1970–80 period, despite the decline in mine production of zinc, of which cadmium is a byproduct. On the other hand, refined cadmium production increased by only 20%. These data suggest that large quantites of cadmium-bearing waste materials were moved to market in 1988 under the influence of the abnormally high price for cadmium that prevailed during most of 1988.

Copper.—The year 1988 was a banner one for copper in Mexico, as the metal displaced silver as the country's most important nonfuel, nonferrous mineral product. Mine production rose to a record high, as did the production of blister copper. The high prices for copper that prevailed during 1988 also contributed to the increase in the value of copper production.

In 1988, Cía. Minera de Cananea S.A. (Cananea), with its mine and smelter in Cananea, Sonora, displaced Mexicana de Cobre S.A. as the largest copper producer in Mexico. Cananea completed its new 65,000-ton-per-day concentrator, resulting in a total milling capacity of 80,000 tons per day. Work continued on expansion of the solvent extraction/electrowinning facility, which will ultimately have an annual capacity of 30,000 tons of cathode copper. During 1988, the Cananea smelter operated at its effective capacity, producing 44,907 tons of copper in blister copper. In addition, 70,274 tons of copper in concentrates and 11,380 tons of cathode copper were produced, resulting in total mine production, after allowance for copper contained in purchased ores, of approximately 126,000 tons. Cananea was one of the State-owned companies scheduled for privatization. Although bids had been received, they either could not be financed or were not acceptable to the Government; thus, privatization was not completed.

Mexico's second largest copper producer was Mexicana de Cobre S.A. with its La Caridad mine and smelter complex at Nacozari de García, Sonora. The company continued to phase in its flash smelter, which will have a capacity of 180,000 tons per year. Production in 1988 was 76,227 tons of copper in anodes and 46,031 tons of copper in concentrates. The Government-owned interest in the company was sold to Fomento Industrial del Norte de México, an affiliate of Industrial Minera México S.A., (IMMSA), as majority owner, and the National Mine and Metallurgical Workers Union, as minority owner. A related company, Mexicana de Acido Sulfurico S.A., which produces sulfuric acid as a byproduct from the La Caridad smelter, was also acquired by the same organizations.

Copper concentrates from other mining operations in Mexico were smelted by IMMSA at its smelter in San Luis Potosí. The 30,030 tons of copper in blister copper produced by that smelter in 1988 were slightly less than the amount produced in 1987. Indicated production by Cobre de México S.A. of refined copper from primary and secondary sources was 118,909 tons, slightly less than the 1987 indicated production. Cobre de México was planning to relocate the smelting and anode casting facilities from Mexico to a new site in Celaya, Guanajuato. The move would enable the company to en-large its electrolytic refining facility in Mexico City, which is the only copper refinery in Mexico, and thus increase its annual capacity to 200,000 tons of refined copper.

Gold.—Reported gold production rose by almost 14% to the highest level achieved since 1960, although reported production of refined gold decreased slightly. Production increases were attributed to increased byproduct production, especially at Cananea; to mining of ores with a higher gold content at Guanajuato and other silver-gold producing districts, and to production from new mines.

One mine using heap-leaching technology to produce gold began operations in 1988, and several other prospective mines were being evaluated. The Amelia Mine of Cía. México Canterra S.A. in Sonora produced 7,000 troy ounces of gold in 1988, and was expected to produce 34,000 ounces in 1989.

Gold deposits which were undergoing exploration and evaluation as potential heap-leaching operations included the Santa Gertrudis project of Zapata Mining Co., an affiliate of Phelps Dodge Corp., near Magdalena, Sonora; the Paredones Amarillo project in Baja California, in which Imperial Metals Corp. of Vancouver, Canada holds an interest; and the Las Minitas, in Sonora, project of Industrias Peñoles S.A. de C.V. (Peñoles) and Terra Mines Limited of Edmonton, Canada.

Iron Ore.—Iron Ore production and shipments increased to record levels in 1988. Mine production was approximatly 16.4 million tons of crude ore. Reported shipments included about 1.5 million tons of screened ore and 8.5 million tons of pellets and sinter. In addition, 289,000 tons of pellets and 412,000 tons of lump ore and sinter fines were imported. Overall utilization of pelletizing capacity was over 84%. Peña Colorada and the pellet plant of Altos Hornos de México S.A., at Monclova, Coahuila, were the principal producers.

The most important iron ore development of the year was the opening of the Cerro Nahuatl Mine in Colima State by HYLSA de Mexico S.A. (HYLSA). This mine was to replace the El Encino Mine in Pihuamo, Jalisco, which was approaching depletion, and would enable HYLSA to continue operation of its Las Encinas pellet plant at Alzada, Colima.

Siderúrgica Mexicana (SIDERMEX), the agency holding the Government's equity interest in steel and steel-related industries, received a World Bank loan to modernize some of its operations. Part of the loan was to be used to continue rehabilitation of the Hercules Mine in Sierra Mojada, Coahuila.

Iron and Steel.—Steel production increased for the second consecutive year, surpassing by 126,000 tons the previous record production of 7.66 million tons of crude steel set in 1981. Production of finished products, including rolled products, castings, and forgings, rose to 6.2 million tons. Productivity, defined as the ratio of finished to crude steel, was 79.3%. This level was a 2% increase over that of 1987, but was below the record 84% established in 1981.

Production by company and product lines is shown in tables 4 and 5.

During 1988, steel production by the State-owned SIDERMEX Group declined modestly from 1987 levels, while that of the privately owned steel companies increased. Production of iron was virtually unchanged at 5.287 million tons versus 5.263 million tons in 1987. The production of direct-reduced iron increased by almost 100,000 tons to 1.648 million tons while the production of pig iron decreased by 73,000 tons to 3.634 million tons. Similarly, the production of steel in obsolete open-hearth furnaces decreased by 380,000 tons to 929,000 tons, while production in electric arc furnaces increased by 208,000 tons to 3.574 million tons, and production in basic oxygen converters increased by 319,000 tons to 3.286 million tons.

TABLE 4

MEXICO: PRODUCTION OF CRUDE STEEL, BY COMPANY

(Thousand metric tons)

Group and company	1986	1987	1988[p]
Government-owned companies:			
Siderúrgica Mexicana (SIDERMEX) Group:			
Altos Hornos de México S.A. (AHMSA)	2,868	3,086	3,083
Fundidora de Monterrey S.A. (FMSA)[1]	[r]254	—	—
Siderúrgica Lázaro Cárdenas-Las Truchas S.A. (SICARTSA)	1,192	1,190	1,131
Total	**[r]4,314**	**4,276**	**4,214**
Private Companies:			
Tubos de Acero de México S.A. (TAMSA)	233	485	540
Hylsa de México S.A. (HYLSA)	1,582	1,662	1,708
Others	[r]1,096	1,219	1,327
Total	**[r]2,911**	**3,366**	**3,575**
Grand total	**[r]7,367**	**7,642**	**7,789**

[p] Preliminary. [r] Revised.
[1] Permanently closed in 1986 after incomplete operating year.
Source: Cámara Nacional de la Industria del Hierro y del Acero, Informe Anual 1988, México, D.F.

TABLE 5

MEXICO: PRODUCTION OF FINISHED STEEL, BY PRODUCT TYPE

(Thousand metric tons)

Product type	1986	1987	1988p
Castings and forgings	26	38	40
Rolled products:			
Flat-rolled	r2,265	2,362	2,524
Non-flat products	3,116	3,310	3,276
Seamless tubes	208	282	340
Total	**r5,615**	**5,992**	**6,180**

p Preliminary. r Revised.

Source: Camara Nacional de la Industria del Hierro y del Acero, Informe Anual 1988. Mexico, D.F.

For the fifth time in 6 years, steel trade showed a positive balance. Exports of finished steel products amounted to 1.163 million tons valued at $643 million. Mexico's quota for steel exports to the United States was 401,000 tons in 1988. Other destinations for Mexican steel products included other Latin American countries, the European Community, the Soviet Union, China, and other Asian countries. Imports of finished steel products were 588,000 tons valued at $566 million. With respect to exports, the Mexican steel industry was expected to argue that its quota under the Voluntary Restraint Agreement for exports to the United States should be increased to reflect Mexico's basic shift from a net importer to an exporter. Also noteworthy with regard to exports was the increase in the volume of seamless pipe exports as Tubos de Acero de México S.A. (TAMSA) looked beyond PEMEX, its only domestic customer, for additional markets.

Apparent domestic consumption of steel increased for the third year in a row, reaching 7.22 million tons. Nevertheless consumption was below the annual average of 7.45 million tons for the 1982-88 period and well below the record 12.469 million tons set in 1981. A modest steel price increase was granted in January 1988, but prices were frozen for the remainder of the year as the Government of Mexico continued its austerity program.

Significant development events during the year included the formal opening of the first phase of the SICARTSA II expansion of the Siderúrgica Lázaro Cárdenas-Las Truchas S.A. (SICARTSA) works at Lázaro Cárdenas, Michoacán, the refinancing of HYLSA, the granting of a $400 million World Bank loan to modernize the steel industry, and the continued rationalization of SIDERMEX. The SICARTSA expansion, which was expected to be completed in 1991, included a 2-million-ton-per-year, direct-reduction-iron plant, an electric furnace, and a continuous caster. These additional facilities were expected to increase SICARTSA's capacity from about 1 million to 3 million tons of crude steel per year. HYLSA negotiated a reduction in its offshore debt from $1.2 billion to $574 million. In return, it granted its lenders a 21% equity interest in the company. About one-half of the World Bank loan was to go to Altos Hornos de México S.A. (AHMSA) for modernization of its Monclova works; $75 million was to go to HYLSA, and the balance was to go to SIDERMEX for upgrading of its iron ore and coal mines. None of the World Bank loan was to be used to fund the expansion of the SICARTSA works.

The rationalization of SIDERMEX, which started with the closing of the Fundidora Monterrey works in 1986, continued as several small firms were closed or consolidated, several nonintegrated specialty firms were sold to private sector investors, and several marketing and administrative functions were decentralized. SIDERMEX employment level had been reduced by an estimated 15,000 persons by the end of 1988; additional reductions were expected in 1989 and succeeding years.

Ferroalloys and Manganese.—Production of metallurgical manganese ore increased substantially in 1988, although the production of battery-grade manganese dioxide apparently declined modestly. Production of ferromanganese increased marginally, while the production of other ferroalloys was essentially unchanged. The principal producer of both manganese ore and ferroalloys continued to be Cía. Minera Autlán S.A. This company mined and calcined manganese carbonate ore at facilities near Molango, Hidalgo; produced ferroalloys at Tamós, in the State of Veracruz near Tampico and Teziutlan, in the State of Puebla; and mined battery-grade manganese ore at Nonoalco, Hidalgo.

Lead.—The indicated mine production of lead declined for the fifth year in a row, and production of primary lead from smelters and refineries declined for the fourth consecutive year. The progressive decline in lead production cannot be attributed to any single factor, but extends across the entire group of lead producers.

Silver.—Mine production of silver registered a slight decline from the 1987 level and was about 2.5% lower than the recent production high achieved in 1986. Nevertheless, the average annual production of 73.9 million troy ounces for the 1983-88 period was 70% greater than the average annual production of 43.4 million ounces achieved during the 32 years from 1951 to 1982. The relatively high level of silver production during 1983-88, when compared with declining lead and zinc production from 1984 onwards, indicates that Mexican mines, which are basically lead-zinc-silver mines, were forced to mine their highest grade ores to offset the prevailing low metal prices of the period. The decline in silver production since 1986 suggests that the quantities of high-grade ore available for mining were becoming limited, and further suggests that production might continue to decline in the absence of significant new mine development.

Principal silver developments in 1988 included the capacity expansions at the Tayoltita and San Antonio Mines of Corporacíon Industrial Sanluís S.A. in Durango and Sinaloa, respectively, and a capacity increase at Fresnillo, Zacatecas. Discovery of the relatively high-grade Santa Niño vein systems in what had been considered a barren area has revitalized the Fresnillo district and prompted the expansion of milling capacity to 50,000 tons per month. Milling capacity at Tayoltita was increased to 1 million tons per year, and at San Antonio to 170,000 tons per year. Banco Cremi, formerly the Banco de Crédito Minero, opened a precious metals refinery in Mexico with the capacity to refine 6 million troy ounces of silver annually. Minera Reál de Angeles S.A. added waste removal equipment during the year, in response to the deepening of the Reál de Angeles Mine with its concomitant increase in the waste-to-ore ratio. However, this new equipment was not expected to increase the capacity of the mine.

Late in the year, the Government announced plans to privatize its minority interests in the Lampazos Mine in Sinaloa and the Reál de Angeles Mine in Zacatecas. The State interest in Lampazos was to be acquired by Empresas Frisco S.A., the holder of the majority interest, and the State interest in Reál de Angeles was to be acquired pro rata by Empresas Frisco and Placer Dome Ltd. of Canada.

Zinc.—Zinc production in 1988 decreased again for the fifth consecutive year, similar to the production pattern for lead. However, refined zinc production increased. This increase reflected both price increases for zinc metal that occurred in 1988, and the improved operating performance at the zinc refineries of IMMSA at San Luis Potosí and of Peñoles at Torreón, Coahuila.

Industrial Minerals

Barite.—Barite production increased by more than 33% in 1988, reaching a new record high. This record followed a 25% increase in 1987. PEMEX statistics show only a 5% increase in meters drilled in 1988 over that of 1987, indicating that a significant proportion of the increased barite production may have been exported. The major producers continued to be Barita de Sonora S.A. and Peñoles from its La Minita Mine in Michoacán. During 1988, the State interest in Barita de Sonora, which had been financed by the Fideicomiso de Minerales No-Metalicos Mexicanos, was sold to private investors.

Cement.—Cement production, which in 1988 was essentially unchanged from that of 1987, reflected the general pattern of the national economy. Preliminary data suggest that exports may have increased over those of 1987 approximately 15% to about 4.2 million tons. Virtually all Mexican cement exports were destined for the United States. Mexico continued as the largest foreign supplier of cement to the United States.

Fluorspar.—Indicated fluorspar production increased slightly in 1988 over that of 1987, but remained significantly below the levels of 1 million tons or more achieved during the early 1970's. During 1988, the quasi-official Instituto Mexicano de la Fluorita A.C. was dissolved, and its reporting responsibilities assumed by the Cámara Minera de México. However, a discrepancy between production data reported by the Instituto and the Cámara Minera, on the one hand, and by the Consejo de Recursos Minerales, on the other, was not resolved. Production data in this report are those compiled by the Consejo.

Significant developments during the year included the opening of a new fluorspar mine near Taxco, Guerrero by Cía. Minera Las Cuevas S.A. de C.V., and the sale of the State interest in Química Fluor S.A. de C.V. The new mine, known as La Azul, was to have a capacity of 200,000 tons per year. Ore reserves were reported to be 1 million tons. Química Fluor, with a capacity of 60,000 tons per year at Matamoros, Tamaulipas, was Mexico's largest producer of hydrofluoric acid. The Company is affiliated with E.I. du Pont de Nemours & Co. of the United States.

Graphite.—Mexican graphite production increased for the fourth consecutive year, reflecting an increasing demand for graphite refractories and electrodes, as well as an aggressive export drive. The country reportedly supplied 40% of the graphite imported into the United States. Amorphous graphite was produced by several companies from metamorphosed coal seams near Hermosillo, Sonora. These companies included affiliates of Cummings-Moore Graphite Co. and Superior Graphite Co. of the United States. Crystalline graphite was produced by Grafito de México S.A. from deposits in Oaxaca. Grafito de México was increasing its capacity from 2,000 to 4,000 tons per year. The company, a unit of the Fideicomiso de Minerales No-Metalicos Mexicanos, was among the State-owned companies scheduled for privatization.

Gypsum.—Reported gypsum production decreased to the lowest level in at least 5 years, in accord with the general level of business and construction activity in 1988. The largest producer, Cía. Occidentál Mexicana S.A., an affiliate of DOMTAR Ltd. of Canada, quarried gypsum on San Marcos Island in the Gulf of California for markets in the western United States and the Far East. Gypsum for both domestic markets and export to the Eastern United States is mined in the States of Hidalgo, Nuevo León, Puebla, and San Luis Potosí.

Phosphate Rock.—Phosphate production increased by 6% over that of 1987, reflecting the rationalization and upgrading carried out by Roca Fosforica Mexicana S.A. (ROFOMEX) at its facilities at San Juan de la Costa in Baja California Sur. ROFOMEX continued to be the principal producer of phosphate in Mexico. Lesser quantites of phosphate are produced from mines in central Mexico. Indicated consumption of crude phosphate rock in Mexico was about 2 million tons annually. Approximately two-thirds of this amount was imported, principally from Morocco and the United States.

Salt.—After cement and sulfur, salt is the third most important industrial mineral product in Mexico. Moreover, Mexico is one of the leading exporters of salt in the world. In 1988, salt production increased by 12% over that of 1987. The principal source of salt for export is Exportadora de Sal S.A., owned 51% by the Comisión de Fomento Minero and 49% by Mitsubishi Corp. of Japan, which produces salt by evaporation of seawater from facilities in Baja California. Salt is also produced at a number of small operations throughout Mexico. In addition, salt is recovered as a byproduct of brine operations in central and northern Mexico.

Stone.—Stone, including marble for decorative building purposes, is a major mineral product in Mexico, although much of the production may not have been recorded. A major development announced in 1988 was a venture between the ICA Group of Mexico and Vulcan Materials Co. of the United States to develop a quarry and facilities to ship up to 7.5 million tons per year of crushed stone at Playa del Carmen, in the State of Quintana Roo. The stone, which was expected to meet all specifications for concrete aggregate, was to be shipped by barge to markets in the Gulf Coast and southeastern regions of the United States.

Strontium Minerals.—Mexican celestite production continued to increase. Estimated production in 1988 was 25% greater than in 1987; and this level was a record high. The principal producers again were Cía. Minera La Valenciana S.A., which operates mines near Torreón in Coahuila, and Sales y Oxidos S.A., an affiliate of Church and Dwight of the United States, which operates mines near Monterrey in Nuevo León. Both companies also convert celestite to strontium carbonate. The bulk of production is exported to the United States and Japan for use in cathode ray tubes.

Sulfur.—Mexican sulfur and sulfuric acid production reflected changes taking place in the sulfur industry. In the face of strong international markets, production of Frasch sulfur decreased by almost 10%, and inventories were drawn down to meet export sales objectives. Production of byproduct sulfur from oil refining and natural gas processing increased marginally, while the production of sulfuric acid from metallurgical operations increased substantially. Sulfuric acid produced from the smelting and refining operations of IMMSA at San Luis Potosí and Peñoles at Torreón increased. Mexicana de Acido Sulfurico, an affiliate of Mexicana de Cobre, began to recover sulfuric acid on a major scale from waste gases produced by the La Caridad smelter in Sonora. On a long-term basis, Frasch sulfur production can be expected to decline unless new deposits are brought into production, although sulfuric acid production can be expected to increase as the La Caridad smelter approaches capacity operation.

Mineral Fuels

Coal.—Production of steam coal did not change significantly during the year. However, production of metallurgical coal declined sharply in 1988 compared with that of 1987. This sharp drop was due to the planned rationalization of the SIDERMEX mines as well as the effects of an explosion at the Quatro y Medio Mine of SIDERMEX at Esperanzas, Coahuila. This mine disaster occurred on January 25, when a methane accumulation at the working face was ignited by an electrical spark. The resulting explosion and fire took the lives of 37 employees and resulted in closing of the mine.

On the positive side, SIDERMEX initiated operations at its new Mimosa IV Mine at Palau, Coahuila. Mimosa IV was the first of the new mines to be developed under the SIDERMEX modernization program. The mine was to operate one longwall section, with coal transported to the surface by conveyer belt. Production during the initial operation of the mine was projected to be 120,000 tons per month, rising to 150,000 tons per month as the mine reached full development. Several smaller mines where productivity is very low were expected to be closed when the Mimosa IV Mine comes into full production.

Petroleum and Natural Gas.—Petroleum and natural gas production were not significantly changed from that of 1987. Crude oil production decreased slightly, but condensate production rose. Similarly, gross natural gas production decreased, but production of marketable gas increased. Refinery production also increased. The number of wells drilled increased 40%, from 103 to 144; total meters drilled increased 50%, from 466,800 to 490,700. The discovery rate (productive wells) was unchanged at 66%. Total hydrocarbon reserves at yearend were equivalent to 67.6 billion barrels of oil, down from 69 billion barrels at yearend 1987.

All petroleum activities in Mexico, including both basic petrochemicals and refining and distribution, are reserved for PEMEX, the State-owned

TABLE 6

MEXICO: PROVEN HYDROCARBON RESERVES

(Million 42-gallon barrels unless otherwise specified)

Zone	Dry natural gas (billion cubic feet	Liquid hydrocarbons				
		Crude oil	Condensate	Dry natural gas-liquid equivalent	1987 total	1988 total
1987 total	**74,831**	**47,176**	**6,934**	**14,890**	**69,000**	**XX**
1988:						
Marine (Bay of Campeche)	11,724	26,156	3,018	2,335	32,249	31,509
Chicontepec	26,688	10,901	1,321	5,338	17,564	17,560
Southeastern	22,749	6,865	1,911	4,522	13,740	13,289
Southern	1,085	755	66	218	1,090	1,039
Central	3,445	1,078	249	642	1,988	1,969
Northern	446	418	31	89	539	538
Northeastern Frontier	7,219	18	225	1,444	1,830	1,687
Total	**73,356**	**46,191**	**6,821**	**14,588**	**XX**	**67,600**

XX Not applicable.

Source: Petróleos Mexicanos S.A., Memoria de Labores, 1987 and 1988, Mexico, D.F.

oil monopoly. PEMEX sales in 1988 were about $13 billion, or 7.4% of GDP for 1988. Cash flow, before taxes and reserves but after worker participation in profits, was $7.4 billion. This amount was about 12% of total public sector revenues or about one-third of public-sector finanical requirements as reported by the Banco de México.

Mexican petroleum production was from fields bordering on or in the Gulf of Mexico. These fields have been grouped into five zones for administrative and reporting purposes. In 1988, the most important producing area was the Bay of Campeche in the Marine Zone. It produced 67% of Mexican crude oil and 29% of natural gas. Other important areas were the Villahermosa Field in the Southeastern Zone, which produced 25% of Mexican crude oil and 51% of natural gas, and the Poza Rica Field in the Central Zone, which produced 2% of Mexican crude oil. Next to the Bay of Campeche and Villahermosa Fields, the most important source of natural gas in 1988 was the Northeastern District (the Rio Grande Valley) of the North Zone, which produced 7% of Mexican gas in 1988.

PEMEX operated 9 refineries, of which 7 had associated petrochemical plants, and 13 separate petrochemical plants. In addition, several of the refineries and/or petrochemical plants had associated natural gas processing facilities. A total of 437.2 million barrels of petroleum liquids (crude oil and condensate) was processed in refineries and petrochemical plants, and a total of 497 million barrels of refinery products and 15.5 million tons of basic petrochemicals was produced during the year.

During 1988, PEMEX exported 477 million barrels of crude oil, invoiced at $5.85 billion. This amount was down from 491 million barrels invoiced at $7.88 billion in 1987. PEMEX also exported 44 million barrels of refinery products and 517,500 tons of petrochemicals. Their total invoice value was $654 million, an increase over the 1987 total invoice value of $593 million. Exports of refinery products were evenly distributed in value between the several petroleum-based fuels. In general, both volumes and total value increased in 1988 over those of 1987, although unit values decreased marginally.

Petrochemical exports were dominated by ammonia, which accounted for 87% of the total volume and 60% of the value exported in 1988. Both the volume and value of ammonia exports were three times greater than in 1987.

Imports of refinery products, mostly fuels, increased slightly over those of 1987, although their value decreased. The volume and value of natural gas imports, although small, increased by about 20% over 1987 levels. On the other hand, the volume of petrochemical imports decreased from nearly 196,000 tons valued at $35 million in 1987 to about 34,000 tons valued at $17.4 million in 1988.

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[1] Economic geologist, Division of International Minerals.

[2] Where necessary, values have been converted from Mexican pesos (Mex$) to U.S. dollars at the rate of Mex $2262 = US$1.00.

[3] No value is assigned to iron ore, metallurgical coal, coke or pig iron because the value of these commodities is incorporated in the value of the steel produced from them.

TABLE 7

MEXICO: PETROLEUM AND NATURAL GAS PRODUCTION

Zone and District	Natural gas (million cubic feet)			Crude oil[1] (thousand 42-gallon barrels)		
	1986	1987	1988	1986	1987	1988
Marine Zone:						
Bay of Campeche	316,711	353,880	366,809	567,305	615,475	617,413
Southeastern Zone:						
Villahermosa[2]	643,532	642,963	644,787	241,449	238,243	230,724
Comalcalco District	8,395	5,789	4,573	6,120	5,003	4,596
Ciudad Pemex	71,686	59,624	60,133	10	24	64
Total[3]	**723,613**	**708,376**	**709,493**	**247,579**	**243,270**	**235,384**
Southern Zone:						
Agua Dulce District	15,950	24,306	26,236	14,470	14,825	15,305
El Plan District	17,812	19,989	17,546	10,159	10,416	9,772
Nanchital District	1,022	868	903	1,351	1,300	1,359
Total[3]	**34,784**	**45,163**	**44,685**	**25,980**	**26,542**	**26,435**
Central Zone:						
Poza Rica	26,755	24,840	19,412	26,480	23,966	20,933
Papaloapan Basin	20,805	20,645	20,855	2,463	2,364	1,749
Nueva Faja de Oro	1,350	—	—	—	—	—
Total[3]	**48,910**	**45,485**	**40,267**	**28,944**	**26,330**	**22,682**
Northern Zone:						
Northern District	16,534	16,971	16,673	9,312	9,006	8,875
Southern District	6,862	8,037	7,744	6,880	6,635	6,586
Northeastern Frontier District	104,938	99,014	87,390	92	76	56
Total[3]	**128,334**	**124,022**	**111,807**	**16,285**	**15,717**	**15,517**
Grand total	**1,252,352**	**1,276,926**	**1,273,061**	**886,092**	**927,333**	**917,431**

[1] Does not include condensate.
[2] Referred to as Mesozoic.
[3] Data may not add to totals shown because of independent rounding.

Source: Petróleos Mexicanos, Memoria de Labores, 1986, 1987, and 1988, Mexico, D.F.

TABLE 8

MEXICO: SALIENT CRUDE OIL TRADE STATISTICS

		1984	1985	1986	1987	1988
Exports:						
Quantity	thousand 42-gallon barrels	556,479	524,943	470,704	490,962	476,946
Value	millions	$14,968	$13,296	$5,582	$7,883	$5,855
Share of total Mexican exports	percent	62	61	35	41	28
To the United States:						
Total	thousand 42-gallon barrels	252,454	299,011	238,176	214,663	249,920
Share of total U.S. imports	percent	19	19	16	12	13

THE MINERAL INDUSTRIES OF

NORTHERN SOUTH AMERICA

By Henry R. Ensminger, Alfredo C. Gurmendi, and Jerome F. Machamer

INTRODUCTION[1]

In this group of four countries and a French overseas department, making up the northern part of South America, Colombia and Venezuela have the most important and most diversified mineral industries. Mineral output in both countries is dominated by the production of natural gas and petroleum. Venezuela is the second most important producer of crude oil in the Latin America region after Mexico, but Venezuela surpassed Mexico as a supplier of crude oil and petroleum products to the U.S. market. In 1988, Venezuela supplied a total of 291 million barrels to the United States compared with the supply of 273 million barrels by Mexico. Colombia, with 49 million barrels, was ranked third as a U.S. petroleum supplier and was the leading producer and exporter of steam coal in all of Latin America. Colombia also has the largest coal reserves in Latin America. Venezuela is also developing its sizable coal resources in Zulia State, which is across the border from the Colombian coal deposits.

As for nonfuel minerals, the most important commodities produced included bauxite and gold. Bauxite was produced by Guyana, Suriname, and Venezuela, but only Suriname and Venezuela have installed capacity to produce alumina and ingot aluminum. Venezuela has the bauxite reserves and enough low cost energy sources to become a significant exporter of aluminum in this decade. Some gold was produced in all five areas with Colombia as the second-ranked gold producer in Latin America after Brazil. Output of gold has been in an upward trend in Guyana and Venezuela. Colombia was the only producer of platinum. An iron and steel industry is well developed in Colombia and Venezuela, both of which had record high levels of crude steel in 1987. Output of iron ore in Venezuela was adequate to meet domestic demand and a significant level of exports. In Colombia, ferronickel exports were an important source of foreign exchange earnings after petroleum and steam coal.

Of the industrial minerals, the most important by far was cement. It was produced predominantly in Colombia and Venezuela at an equal level and with a surplus available for exports.

In terms of economic impact, the value of Colombia's mineral output was 3.6% of the country's gross domestic product (GDP) and exports of the major mineral commodities accounted for 29% of total exports. The importance of minerals in Colombia's export sector has been growing since the initiation of coal exports from El Cerrejón in early 1985 and the resumption of crude oil exports in 1986 following the discovery of important oilfields.

In the case of Venezuela, the value of petroleum output alone accounted for 13% of GDP and the leading mineral exports, including aluminum, gold, iron ore, and petroleum, represented 91% of total exports. Although Venezuela's crude oil output decreased, mining output increased 15% in 1988. Mineral commodities, particularly bauxite, are also important in the export sector of Guyana and Suriname.

COLOMBIA[2]

Introduction

Colombia's mineral production in 1988 was valued at 3.57% of the country's GDP, or approximately \$1.7 billion,[3] as compared with about 3.54% of GDP in 1987 and only 1.27% of GDP in 1980. During 1988, the value of mineral production increased by 5.2% over that of 1987, down from the spectacular double-digit growth rates of the preceding 5 years, but, nevertheless, greater than the 4.2% growth rate of the economy as a whole. The principal mineral products were petroleum, coal, and gold, in that order. The rapid growth in the value of mineral production that occurred in the mid-1980's was due to the wave of new production from the Caño Limón oilfield of northeastern Colombia and the Cerrejón Norte coal mine in the Guajira Peninsula; the reduced growth evident in 1988 reflects the stabilizing of production from those two areas.

The value of mineral exports in 1988 was \$1.7 billion, or more than 29% of the total value of all exports. The fact that total mineral exports were assigned a greater value than total mineral production suggests that the value assigned to crude oil refined in Colombia and the prices for refined products sold in Colombia were both less than the value of comparable products in world markets, whereas exported materials were valued at world price levels. Principal mineral exports during 1988, in order of decreasing value, were: crude oil and refined petroleum products, coal, ferronickel, and emeralds. The total value of mineral production is not broken down by specific mineral commodities; however, all of the foregoing commodities are heavily export oriented, and the rank and value of exports approximates that of overall production, excluding gold. An exception to this generalization is cement, of which more than 80% was consumed internally. Cement exports were valued at \$66 million. The total indicated value of cement production was about \$300 million, putting cement in fourth place in importance in Colombia's mineral production.

On a monetary basis, the most important factors affecting the performance of the mineral industry in 1988 were decreased oil production and lower prices for exported crude oil and refined products. This was offset to some extent by increased coal production and exports and by substantial increases in the price received for nickel.

Government Policies and Programs

Regulatory legislation of significance to future mineral production included the passage of a new Mining Code

(Código Minero), which was expected to come into effect late in 1989, and the beginning of a program to promote and encourage the further development of Colombia's large steam coal resources. The new mining act, which was designed to facilitate and encourage mineral exploration and development, particularly on the part of small- and medium-scale miners, contains provisions to facilitate and expedite the processing of claim applications, to improve the security of mineral occupancy and tenure, and to establish a fund to provide financial assistance to small- and medium-scale miners.

Several basins that contain Early Tertiary coals similar to those of the Cerrejón deposit occur in northern Colombia. One of these deposits, La Loma, in the Department of César, has been leased to Drummond Coal Co. of Birmingham, Alabama, and is scheduled to begin production by 1993. Feasibility studies regarding the development of other deposits were underway; the Government hopes to increase annual coal production to the level of 60 million tons per year by the end of the century.

Another project with major potential for the future of Colombia is the Guainía project in eastern Colombia. This project was established in 1987, as a venture between Empresa Colombiana de Petróleos (ECOPETROL) and Empresa Colombiana de Minas (ECOMINAS), to carry out a preliminary geological assessment of alluvial and bedrock gold occurrences in the Precambrian terrane of the Serranía de Naquén. Widespread indications of gold mineralization have reportedly been located. The Government was reported to be drawing up an invitation to qualified companies with expertise in large-scale gold mining to submit proposals for further exploration and evaluation of the area.

Production

Reported mineral production generally increased in 1988, with record production levels achieved in important commodities such as crude steel, cement, and coal. Production increases also were recorded for gold, platinum, and silver, and for several industrial minerals, including salt and sulfur. On the other hand, production of crude oil and natural gas declined, largely as a result of terrorist attacks against pipelines and pipeline stations. Terrorist activities in gold mining areas, late in the year, threatened to cause a major disruption in production of that commodity.

Trade

Exports of mineral products from Colombia in 1988, including refined petroleum products, were valued at $2.02 billion and were 38% of total exports. This was a decline of 7% from 1987, when mineral exports were valued at $2.17 billion and were 41% of total exports. The decline was due entirely to the decrease in volume and realized price for crude oil and refined petroleum products. With the exception of cement exports, which declined marginally in both volume and value, the value of all other mineral exports increased. Summary data on the value of mineral exports are shown in table 2.

Commodity Review

Metals.—**Gold.**—Gold production in 1988 increased by 9% over that of 1987, as a result of the relatively high prices for bullion that prevailed in the early part of the year and of increased artisanal activity in eastern Guainía Province. The principal gold-producing area is in the Department of Antioquía, where gold is recovered from both lode and placer deposits. Although the bulk of the gold is produced from artisanal placer workings, large-scale dredging operations are conducted by Mineros de Antioquía S.A. in the Río Nechi, and vein-type deposits are worked by Frontino Gold Mines Ltd. near Segovia. Gold is also recovered as a byproduct from alluvial platinum deposits in the Department of Chocó. Greenstone Resources Ltd. of Canada continued its exploration of the Oronorte lode deposits in the Segovia area. Data on gold production are shown in table 3.

A major gold exploration and evaluation program was carried out in the Caranacoa and Serranía de Naquén regions in the Department of Guainía in easternmost Colombia. Occurrences of placer gold in Pleistocene and Recent river sediments are widespread; bedrock occurrences in conglomerates and quartzites of the Precambrian Guainía formation also have been reported. Exploration work was conducted by Proyecto Minero del Guainía, a venture sponsored jointly by ECOMINAS and ECOPETROL. The most prospective area for major gold concentrations has been set aside as a national reserve, and an invitation to submit proposals for further exploration and development was expected in 1989.

Iron and Steel.—Colombia's only integrated steel producer, and largest private employer, Acerías Paz del Río, operates iron ore mines at Paz de Río and an integrated steelworks at Belencito, both in Department of Boyacá northeast of Bogotá. Acerías Paz del Río shipped about 260,000 tons of rolled steel products in 1988, accounting for more than 40% of steel shipments from Colombian mills. Nonintegrated steel producers, all of which produce steel in electric furnaces from scrap or pig iron, include Siderúrgica de Medellín S.A. and Hojalata y Laminados S.A. in Medellín; Siderúrgica del Pacífico S.A. in Cali; and Siderúrgica del Boyacá S.A. in Bogotá. Domestic capacity was effectively fully utilized, and several of the nonintegrated producers announced major expansion plans. Total demand for finished steel products in 1988 was about 1.1 million tons, of which 454,000 tons was imported.

Lead and Zinc.—Minor quantities of lead and zinc concentrates were pro-

TABLE 1

COLOMBIA: PRODUCTION OF MINERAL COMMODITIES

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987[p]	1988[p]
METALS						
Aluminum, bauxite		560	—	—	—	—
Copper, mine output, Cu content		234	—	—	—	—
Gold	troy ounces	730,670	1,142,385	1,285,878	853,468	932,824
Iron and steel:						
Iron ore and concentrate	thousand tons	441	439	523	615	615
Pig iron	do.	271	246	319	[r]326	309
Ferroalloys: Ferrosilicon		(2)	(2)	(2)	(2)	—
Steel, crude	thousand tons	[r]507	[r]530	631	689	754
Semimanufactures, hot-rolled	do.	[r]385	[r]431	457	532	597
Lead:						
Mine output, Pb content		51	82	202	158	31
Refined (secondary)[e]		3,000	3,000	4,000	4,000	4,000
Nickel:						
Mine output, Ni content		21,885	15,434	[e]22,600	[e]25,200	19,979
Ferronickel, Ni content		17,064	11,800	[e]18,600	[e]20,700	16,669
Platinum-group metals	troy ounces	10,106	11,650	14,368	20,528	26,200
Silver	do.	153,445	168,770	187,188	160,277	210,955
Zinc, mine output, Zn content		—	2,000	6,000	—	138
INDUSTRIAL MINERALS						
Asbestos		9,982	12,435	[e]13,000	[e]13,000	16,819
Barite		3,340	5,050	4,198	3,792	[e]4,000
Cement, hydraulic	thousand tons	5,215	5,394	6,011	5,965	[e]6,378
Clays: Kaolin		938,307	1,041,151	1,155,267	1,221,000	1,306,470
Diatomite[e]		(2)	(2)	(2)	(2)	—
Feldspar		32,000	34,308	35,722	33,760	[e]35,000
Gypsum	thousand tons	260	250	295	302	307
Lime, hydrated and quicklime[e]	do.	1,300	1,300	1,300	1,300	1,300
Magnesite[e]		1,600	1,600	[3]14,936	15,000	16,000
Nitrogen: N content of ammonia		93,700	99,400	93,440	88,900	84,300
Phosphate rock		11,480	24,249	28,626	[e]34,000	[e]29,800
Precious and semiprecious stones: Emerald[4]	carats	394,181	337,950	634,561	886,551	1,095,650
Salt:						
Rock	thousand tons	271	236	227	205	209
Marine	do.	664	494	501	450	473
Total	**do.**	**935**	**730**	**728**	**655**	**682**
Sodium compounds, n.e.s.: Sodium carbonate		129,440	113,209	112,920	116,864	114,087
Stone and sand:						
Calcite		4,575	3,107	5,334	5,334	[e]8,736
Dolomite	thousand tons	15	15	14	33	33
Limestone	do.	11,565	11,756	[e]12,000	[e]12,000	11,980
Marble		15,171	16,993	19,568	17,500	[e]17,500

See footnotes at end of table.

TABLE 1—Continued

COLOMBIA: PRODUCTION OF MINERAL COMMODITIES

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987[p]	1988[p]
INDUSTRIAL MINERALS—Continued						
Stone and sand—Continued						
Sand excluding metal-bearing		521,578	511,587	516,215	602,400	654,800
Sulfur:						
Native (from ore)		36,245	41,374	36,038	41,490	42,795
Byproduct, from petroleum		10,430	9,790	[e]10,000	[r e]10,200	8,200
Total		**46,675**	**51,164**	**[e]46,038**	**51,690**	**50,995**
Talc, soapstone, pyrophyllite		6,785	8,611	9,013	11,927	12,800
MINERAL FUELS AND RELATED MATERIALS						
Carbon black[e]		18,000	18,000	18,000	18,000	18,000
Coal:						
Metallurgical	thousand tons	603	618	630	759	585
Steam	do.	6,034	9,088	11,540	13,835	14,315
Total	**do.**	**6,637**	**9,706**	**12,170**	**14,594**	**14,900**
Coke, all types[e]	do.	550	550	550	600	550
Gas, natural:						
Gross	million cubic feet	182,100	182,700	[e]185,000	[e]190,000	177,573
Marketed	do.	([5])	([5])	([5])	([5])	143,445
Natural Gas Liquids	thousand 42-gallon barrels	[r]2,320	[r]2,297	2,216	1,717	1,384
Petroleum:						
Crude	do.	61,153	64,352	110,714	147,843	136,760
Refinery products:						
Gasoline:						
Aviation	do.	317	342	313	276	255
Motor	do.	22,916	21,432	24,589	28,603	27,281
Jet fuel	do.	3,487	3,651	3,829	3,888	3,685
Kerosene	do.	2,017	2,156	2,147	2,054	2,198
Distillate fuel oil	do.	10,507	11,150	11,152	14,502	14,080
Residual fuel oil	do.	20,027	19,825	21,017	23,776	23,319
Lubricants[e]	do.	657	657	730	750	733
Liquefied petroleum gas (propane)	do.	3,641	3,702	2,782	3,445	4,569
Asphalt and bitumen	do.	967	926	973	1,079	1,127
Refinery fuel and losses and unspecified products	do.	1,208	1,029	1,915	[e]1,986	3,779
Total	**do.**	**65,744**	**64,870**	**69,447**	**80,359**	**81,026**

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

[1]Table includes data available through Nov. 1989.

[2]Revised to zero.

[3]Reported figure.

[4]Based on registered exports by the Banco de la Republica.

[5]Comparable historical data were not available at the time of publication.

TABLE 2

COLOMBIA: VALUE OF MINERAL EXPORTS

(Millions of U.S. Dollars)

	1984	1985	1986	1987	1988[e]
Crude Oil and Refined Products	$455.0	$409.0	$619.0	$1,341.0	$952.7
Coal	37.8	124.8	190.4	359.6	424.5
Ferronickel	62.4	54.6	48.0	77.1	179.4
Emeralds	21.0	27.0	34.0	62.0	89.8
Cement	18.4	22.7	25.3	62.8	65.7
Total	**$594.6**	**$638.1**	**$916.7**	**$1,902.5**	**$1,712.1**
Total Exports	**$3,623**	**$3,782**	**$5,434**	**$5,638**	**$5,805**
Minerals as percent of total	16%	17%	17%	34%	29%

[e] Estimated.

duced by Frontino Gold Mines from its gold mining operations at Segovia, Department of Antioquía. Reported production in 1988 was 255 tons of lead concentrates containing 12% lead and 383 tons of zinc concentrates containing 36% zinc.

Nickel.—Colombian nickel production is in the form of ferronickel produced by Cerro Matoso S.A. from a nickeliferous laterite deposit at Monte Líbano, southeast of Montería in the Department of Córdoba. Ferronickel production in 1988 was 41,672 tons containing about 16,600 tons of nickel, a decrease of about 15% from 1987. Export earnings from ferronickel, however, increased from about $77 million in 1987 to $179 million in 1988, reflecting the much higher prices for nickel that prevailed during 1988. During the year, the company rescheduled its foreign bank debt of $262 million. Production was expected to decrease again in 1989 because of a planned shutdown for maintenance.

TABLE 3

COLOMBIA: PRODUCTION OF GOLD, BY COMPANY

(Thousand troy ounces)

Company	1988	Percent of total
Frontino Gold Mines Ltd.	45.9	4.9
Mineros de Antioquía S.A.	41.2	4.4
Cía. Mineros de Chocó	2.8	0.3
Small and Medium Producers	842.9	90.4
Total	**932.8**	**100.0**

Platinum.—Production of platinum group metals (PGM) in 1988 increased by 28% over 1987, probably in response to rising prices for those metals. Although Colombian production of PGM was minute on a global scale, the country was, nevertheless, the fifth most important primary source of PGM in the world. Production is derived entirely from placer deposits along the Río San Juan in the Department of Chocó. The source area for the placer deposits has not been identified.

Industrial Minerals.—Colombia is a producer of several industrial minerals, including asbestos, barite, cement, feldspar, gypsum, kaolin and other clays, lime, limestone and dolomite, magnesite, phosphate, salt, sodium carbonate, sulfur, and talc. Notable production increases were recorded for cement, emeralds, and talc. Cement production increased by 7% over that of 1987. Cement exports declined marginally but still exceeded one million tons or 15% of total production; export revenues from cement were $66 million. Reported emerald production and the value of emerald exports increased by 21% and 50%, respectively, over those of 1987; these compare with increases of 76% in volume and value from 1986 to 1987 and were a result of the Government's efforts to institutionalize and regularize the trade in emeralds. Nitrogen production declined for the fourth year in a row, and phosphate rock production declined by 12% from the record level achieved in 1987; reasons for these declines were not known.

Mineral Fuels.**—Coal.**—Coal production in Colombia increased by about 1.3 million tons or 9% in 1988 as compared to 1987. The most important mine is Cerrejón Norte, on the Guajira Peninsula. The mine, which is operated on a 50-50 joint venture basis by Carbones de Colombia S.A. (CARBOCOL), a State-owned corporation, and International Colombia Resources Corp. (INTERCOR), a subsidiary of Exxon Corp., produced about 9.6 million tons and shipped about 9.4 million tons in 1988. Production fell short of the 10.5-million-ton objective set for the year but nevertheless was 10% more than production in 1987. Nominal capacity of the Cerrejón Norte mine complex is 15 million tons per year. The price, f.o.b. port for spot sales of Cerrejón coal, increased by $10 per ton to $37 per ton; because of contract sales, however, the average price received for coal shipped was only $29.06 per ton. Gross revenue for the venture was $275 million on shipments of 9.36 million tons. During 1988, coal was shipped from Cerrejón Norte to more than 20 countries; Denmark, the Netherlands, and the United States were the three most important destinations.

CARBOCOL reopened the Cerrejón Centro Mine in mid-1988 with the objective of shipping 500,000 tons of coal using the Cerrejón Norte rail and port facilities. The mine was being operated by Pinski y Associates under contract to CARBOCOL. In 1988, production was reported to have been 60,000 tons.

Colombia was developing ambitious plans to become the world's largest coal exporting country. Three major coal developments were announced during the year, all involving coals in the La Loma-La Jagua syncline in the Department of César, about 200 kilometers southwest of the Cerrejón area. Coals in the La Loma-La Jagua Basin are similar to those at Cerrejón. Drummond Coal Co. of Birmingham, Alabama, entered into a 30-year agreement with CARBOCOL under which Drummond will develop and operate the La Loma deposit. Coal may be transported down the Río Magdalena by barge for shipment through either the Port of Cartagena or the Port of Barranquilla, or the railroad line to the Port of Santa Marta may be upgraded to enable the coal to be shipped through that port. Production rate may be as high as 6 million tons per year. Feasibility studies were initiated for two other projects in the same basin, El Descanso and La Jagua, each involving proposed production in the range of 3 to 5 million tons per year.

Other coal projects being studied included development of the Alto San Jorge coal basin in the Department of Córdoba and of metallurgical coal and anthracite in the Department of Norte de Santander. The Government entered into discussions with Mexico and Brazil, among other countries, to supply both steam and metallurgical coal, and continued its marketing efforts with respect to the Cerrejón coals. The country hopes to raise coal production to 60 million tons of coal annually by the year 2000.

Natural Gas.—Natural gas production in 1988 was 487.5 million cubic feet per day on a gross basis or 393 million cubic feet per day on a marketed basis, equivalent to marketable production of 143.4 billion cubic feet for the year. Production was essentially unchanged from 1987. Principal producing fields were the offshore Chuchupa Field and the onshore Ballena Field, both in the Guajira Peninsula area, and the Payoa and Provincia Fields in the Middle Magdalena River valley. A new State-owned corporation, Sociedad de Gas Natural, was established to distribute and sell natural gas throughout Colombia. Gas is currently distributed along the north coast of Colombia by pipeline. A new line from gasfields in the Meta River Basin to Villavicencio and Bogotá was nearing completion, and new pipelines to augment gas distribution along the north coast and to bring additional gas into the central part of the country were being planned. Measured reserves of natural gas stood at 4,360 billion cubic feet at yearend.

Petroleum.—Colombia is an important oil producing country, ranking seventh in the Western Hemisphere in terms of crude oil production and about eighth in terms of refining capacity. There are three major producing areas in the country: a belt along the eastern foothills of the Andes Mountains, which generally parallels and lies to the north of the Río Meta (part of the Orinoco drainage); an area around Barrancabermeja in the middle part of the Magdalena River Basin, which appears to be at the head of the ancestral delta of the Río Magdalena; and an area around Tibú in the northern portion of the Department of Norte de Santander, which extends into Venezuela and is part of the Maracaibo Basin. Lesser fields have been found along the upper course of the Río Magdalena and bordering the Río Putumayo in southern Colombia; this latter area extends into Ecuador and is also on the eastern flank of the Andes chain. A few oil and natural gasfields are found in the delta of the Río Magdalena, but the main sources of gas are the Chuchupa and Ballena Fields.

Major refineries in Colombia are located at Barrancabermeja, in the center of the country, and at Cartagena, on the Caribbean coastline, with capacities of 150,000 and 70,000 barrels per day (bbl/d), respectively. Smaller refineries to service local needs are located at Tibú; at El Guamo, southwest of Bogotá; and at Mocoa in southern Colombia. Crude oil loading facilities are located at Coveñas on the Caribbean Sea and at Tumaco in southern Colombia on the Pacific Ocean. Petroleum products are shipped through Buenaventura on the Pacific Coast and, probably, through Cartagena on the Caribbean.

Crude oil production in 1988 declined from 385,000 bbl/d in 1987 to 373,000 bbl/d in 1988, largely as a result of interruptions to production while damages to crude oil pipelines, caused by terrorist attacks, were being repaired. Of total production, 80,700 bbl/d or 22% was from fields operated by ECOPETROL; 59,880 bbl/d or 16% was produced by private sector companies; and the remaining 232,500 bbl/d were produced from fields operated jointly by ECOPETROL and private firms. The major oilfield in Colombia is the Caño Limón Field, near the Venezuelan frontier in the Department of Arauca. The field was discovered by Occidental Petroleum in 1983 and is operated by a consortium including Occidental, Shell International, and ECOPETROL. Production in 1988 was 182,875 bbl/d, or 49% of total Colombian crude oil production. A major project during the year was the completion of a power generation and distribution system to service the oil production and transportation facilities as well as the municipalities in the region.

A number of pipeline projects designed to increase production and export capacity to 620,000 and 360,000 bbl/d, respectively, were planned or underway. These included lines that will link the Upper Magdalena region, southwest of Bogotá, and the East Plains region, east of Bogotá along the Río Meta, with the main crude oil export system, as well as additional pipeline capacity for the oil from the Caño Limón area. During the year, the Porvenir-Velásquez segment of the East Plains line was completed, linking the fields of the Meta River Basin to the national system and the major refinery at Barrancabermeja.

The major refinery in Colombia, which is in the center of the country at Barrancabermeja, in the Department of Santander, had a capacity to process 150,000 bbl/d of crude oil. The other large refinery, which is at Cartagena, Department of Bolívar, had a capacity to process 70,000 bbl/d. Small refineries are at Tibú, Department of Norte de Santander; El Guamo, Department of Tolima; and at Orito, Department of Putumayo. The two large refineries operated near capacity in 1988, processing a total of 214,100 bbl/d of crude, while the three small refineries processed a total of 3,700 bbl/d. Total refinery throughput of 217,900 bbl/d was down 3% from the record level of 224,300 bbl/d achieved in 1987.

Crude oil exports in 1988 were 138,000 bbl/d or 37% of total production, a decrease of 5% from the 146,000 bbl/d export rate in 1987. Average price per barrel declined from $17.70 in 1987 to $13.50 in 1988, resulting in decline in the value of crude oil exports, from approximately $943 million in 1987 to approximately $680 million in 1988. Exports of refined petroleum products decreased in indicated value from $398 million in 1987 to $273 million in 1988, while gasoline imports increased in value from $101 million to $139 million. The net trade balance in refined petroleum products therefore decreased from $297 million in 1987 to $134 million in 1988.

The Government continued its policy of encouraging active and aggressive exploration and development of the nation's petroleum resources. Twenty-eight new association contracts or joint exploration agreements between ECOPETROL and private groups were signed during the year, including two contracts covering about 2.5 million hectares off the Pacific coast. Eighty-seven exploration wells with an aggregate length of 550,000 feet were drilled during the year; 23 of these wells were drilled by ECOPETROL, and 33 were reported as having positive results. In addition, 204 development wells were drilled, of which 109 were drilled by ECOPETROL, and 176 were described as positive. Proven reserves of crude oil were reported to be 1.9 billion barrels at December 31, 1988; 45% of these reserves are in the Cravo Norte area of the Department of Arauca, which includes the Caño Limón Field. Of the total proven reserve, ECOPETROL holds sole interest in 23% and, through association contracts, has interests in another 69%.

FRENCH GUIANA[4]

French Guiana's limited mining industry produced columbite-tantalite, gold, sand and gravel, and stone. However, mining continued to represent a small sector of the country's economy.

GUYANA[5]

Introduction

Guyana reported that economic performance in 1988 did not considerably differ from 1987 when a growth rate of 3% in GDP was recorded. Policies formulated to attract foreign investment in the mining sector seem to be paying off. Several companies started gold exploration and the Guyana Geology and Mines Commission (GMC), the agency authorized to negotiate agreements, held discussions with U.S., Canadian, and European firms. The Government acknowledged the need for foreign investment and technology to create a viable mining industry. Guyana reviewed its mining code to attract new foreign investment and no longer insists on equity participation in mining projects except where prior exploration had taken place.

Foreign mining companies are exploring for oxide deposits and placers. Bauxite, gold, and diamonds are extensively explored. Kaolin, feldspar, sand, clays, and shells are also actively explored.

Guyana's gold rush of 1987-88 was prompted by new governmental policies that are reflected in the revised mining and foreign investment codes.

Commodity Review

Metals.—**Bauxite.**—Bauxite is the most valuable mineral resource in Guyana. The Government-owned Guyana Mining Enterprise Ltd. (Guymine) produces high-grade bauxite ores at Linden, Ituni, and Kwakwani with proven reserves of 100 million tons. In 1988, mine production was about 1.9 million tons of ore. Guyana supplanted Jamaica as Canada's largest supplier of bauxite. The United States accounted for more than 25% of Guyana's bauxite exports, followed by Canada with 13%, Norway with 11%, and the Federal Republic of Germany with 5%.

The Guyana Government entered into a joint venture with Reynolds Metals Co. of the United States on a 50-50 basis to develop a new bauxite mine with a potential annual capacity of 2.6 million tons at Aroima in the Barbice River. Production was expected to start by late 1989 at this property.

Guyana's Bauxite Industry Development Corp. (Bidco) was planning to conduct a feasibility study to reopen the 300,000 tons per year refinery, which closed in 1982, at Linden. Bauxite feed was to come from the Ituni Mine in eastern Guyana.

Guymine agreed to supply 1.1 million tons of bauxite for 3 years to Interalumina of Venezuela. Bidco contracted the Venezuelan company Dayco S.A. to open a bauxite mine in Kwakwani in eastern Guyana. Output will be processed at Everton, Guymine's plant, prior to being shipped to Interalumina.

TABLE 4

FRENCH GUIANA, GUYANA, AND SURINAME: PRODUCTION OF MINERAL COMMODITIES[1]

Country and Commodity		1984	1985	1986	1987[p]	1988[e]
FRENCH GUIANA[2]						
Gold, mine output, Au content	troy ounces	10,127	8,005	10,481	11,000	11,000
Stone, sand and gravel[e]	metric tons	400,000	400,000	400,000	400,000	400,000
GUYANA[2]						
Aluminum:						
Bauxite, dry equivalent, gross weight	thousand metric tons	1,333	1,675	1,466	[3]2,200	[3]1,339
Diamond[e]:						
Gem	thousand carats	6	4	3	2	3
Industrial stones	do.	8	7	6	5	6
Total	**do.**	**14**	**11**	**[3]9**	**7**	**9**
Gold, mine output, Au content	troy ounces	11,131	10,323	14,035	[3]50,425	75,000
SURINAME[2]						
Aluminum:						
Bauxite, gross weight	thousand metric tons	3,454	3,000	3,847	1,200	2,000
Alumina	do.	1,208	1,000	1,471	1,370	1,400
Metal, primary[4]	do.	[r]29	29	30	29	30
Cement, hydraulic	do.	50	50	50	50	50
Clays: Common[e]	metric tons	100,000	100,000	110,000	110,000	110,000
Gold, mine output, Au content	troy ounces	322	500	600	[e]700	700
Sand and gravel[e]:						
Sand, common	thousand metric tons	150	155	160	160	160
Gravel	do.	20	25	25	25	25
Stone, crushed and broken	do.	46	[e]50	50	[e]50	50

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

[1] Includes data available through mid-June 1989.

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

[3] Reported figure.

[4] Data represent exports.

Gold.—Paranapanema S.A. of Brazil announced a production decision at the Tassawini property, about 110 kilometers northwest of Georgetown. The proven and probable ore reserves were expected to be in excess of 3 million tons grading 2.4 grams of gold per ton. Tentative production target was set at 25,000 troy ounces or 780 kilograms per year.

The Main Stock Zone of the Omai project, 120 kilometers south of Georgetown, was reported to contain, at yearend, minable reserves of 30.4 million tons grading 1.53 grams of gold per ton or 1.5 million troy ounces of gold. The joint venture of Placer Dome Inc. and Golden Star Resources Ltd., both Canadian firms, requested a 6-month extension of the original April 1989 feasibility deadline to evaluate additional drilling at the discovery at Wenot Lake, south of the Omai project. Golden Star Resources Ltd. is dedicating mining concessions efforts in the Potaro District. The Proto-Mahdia gravels contain a demonstrated 12 million cubic meters and a possible 32 million cubic meters of workable dry gravels, averaging near 0.4 gram of gold per ton. Homestake Co. of the United States and its partner, South American Goldfields Inc. of Toronto, Canada, commenced drilling at Peter Mine and the Tiger River and Dazier Creek properties in the Potaro District.

Denison Mines Ltd. of Canada signed concession agreements with the Government in October to explore jointly with its partner South American Goldfields Inc., in the Cuyuni and Mozaruni areas. The Aurora Mine, 200 kilometers west of Georgetown, produced more than 60,000 troy ounces of gold in the 1940–50 period from veins grading 0.5 to 1 ounce of gold per ton, from a small open pit in stockworked porphyry, and from the Quartz Hill property immediately west of Placer's Omai deposit.

Guyana is seeking partners to fund drilling of promising gold prospects, such as the Marudi Mountain property in the far south of Guayana, Kaburi, and the Bishop properties in the Potaro District.

Other Metals.—Small copper mineralization and occurrences are scattered over the northern half of Guyana. The most important occurrence is the Groete Creek prospect. Molybdenite occurrences also are present in the Potaro District, principally at the Eagle Mountain near the Mahdia goldfield.

Diamonds are associated with the Pakaraima Mountain formation in the west of the country. Most of the diamond-bearing areas are on the right bank of the Middle Mazaruni River. Several thousand carats of diamonds were exported annually. Diamond production decreased from more than 9,000 carats in 1986 to about 7,000 carats in 1987; no detailed information was available for the 1988 output.

Industrial Minerals.—Kaolin occurrences are coincident with bauxite. Guyana has large and widespread resources of kaolin and ball clay. Guyana was planning to install a kaolin milling plant to process the high quality Topaira deposit at Ituni, which has an estimated reserves of 3 million tons. Over 5,000 square miles of northeastern Guyana is covered with white sand suitable for glass manufacturing.

***Mineral Fuels.*—Oil and Gas.**—Guyana carried out prospecting for both mineral fuels on the Continental Shelf with only minimal success to date. The Takutu Basin, about 300 miles south-southwest of Georgetown is the only inland prospect. This basin is considered petroliferous because one of two exploratory wells by Home Oil Co. discovered crude of 42° API, which flow tested at 500 bbl/d.

SURINAME[6]

Introduction

Suriname's economy revolved around the bauxite industry. The mining and processing of bauxite into alumina and aluminum ingot accounted for 8% of the GDP and 70% of exports. Suriname was the third largest bauxite producer in the Latin American region after Brazil and Jamaica. Suriname was the fifth most important International Bauxite Association member country bauxite producer, accounting for about 3.5% of world output. Production of bauxite amounted to almost 3.4 million tons, an increase of 31% more than the previous year.

The Suriname Government drafted a revised mining code in order to attract new foreign investment.

Commodity Review

***Metals.*—Alumina, Aluminum, and Bauxite.**—Bauxite is mined by Suriname Aluminum Co. (Suralco), a subsidiary of the Aluminum Co. of America (Alcoa) and NV Billiton Maatschappij Suriname (Billiton), a Royal Dutch/Shell Group Subsidiary. Both companies experienced considerable setbacks as a result of guerrilla activities, strikes, and wage disputes. The rate of exchange received by the mining industry hindered investment. Billiton and Suralco were seeking concessions from the Government on reducing export levies as a precondition for investment to include new bauxite mines at Moengo, Accaribo, and Onoribo. Suralco is also committed to develop the kaolin deposits at Moengo.

Alumina production increased by almost 20% to about 1.6 million tons. Aluminum output increased to 5,300 tons following the reopening of the Paranam smelter and refinery complex at only 50% capacity because of guerrilla activity and the low level of water in the Brokopondo reservoir. Alumina and aluminum were produced by the joint venture of Suralco and Billiton.

Suriname's bauxite reserves occur in the Backhays Mountains in the southwest area of the country and were estimated at 490 million tons.

Gold.—Alluvial and primary gold mineralization are typical occurrences in Suriname. Placers are worked at Tibiti River, Litanie River, Platina Creek, Pete Creek, and Rosebel prospect. It was reported that the state mining company, Grassalco, has proven reserves of 5 million tons grading 2 grams of gold per ton at its Gross-Rosebel gold prospect in southeastern Suriname.

***Mineral Fuels.*—Oil and Gas.**—Production of oil in Suriname came from the Tambaredjo and Borneo fields east of Paramaribo where reserves are estimated at 200 million barrels. The Government oil firm, Staatsolie, reported a new oil find in the Saramacca District west of Paramaribo where reserves are estimated at 350 million barrels.

Suriname's oil production rose as a result of increased drilling and steam injection reaching a level of about 730,000 barrels by yearend. The target for 1990 was expected to be 5,000 bbl/d.

Surveys for other possible oil and natural gas deposits were underway. Staatsolie announced in October 1988 a \$35 million[7] refinery to produce diesel oil and propane gas, with construction to begin in 1989. Production was expected to increase to 3,000 bbl/d.

Energy.—Suriname's energy sector is closely linked to the bauxite industry with installed capacity of about 450 megawatts composed of 54% thermal and 46% hydroelectric. Staatsolie was planning a \$56 million, 13-megawatt power station in the Saramacca District in conjunction with the Suriname Electricity Co. The facility was expected to reduce by 33% Suralco's supply of power to the national grid. Completion of this project was set for 1990.

VENEZUELA[8]

Introduction

Venezuela's economy did well in 1988 with the GDP reaching $48.8 billion[9] in terms of current prices. This represented a real growth of 4.2% versus the 3.2% growth of 1987. The mining sector grew 14.6% (due to higher gold production), while oil improved by only 1% and agriculture and construction increased by 4.2% and 6.2%, respectively. Inflation recorded a record 6.8% increase in December and reached a total of 35.5% for the year. The 1988 inflation rate was the second highest in recent history, only trailing the 40.3% increase posted in 1987.

Since 1987, Japan had become the major source of financing in Venezuela. In 1988, the Export-Import Bank of Japan provided more than $400 million for the modernization of a bauxite mine and for the construction of a new hydroelectric complex. Mitsubishi Metal Corp., part of the Japanese consortium holding 20% of Industria Venezolana de Aluminio C.A. (VENALUM), agreed to finance part of an expansion program in the state aluminum industry. In April, the President visited Japan in an endeavor to secure loans from the Export-Import Bank for investments in projects ranging from aluminum and steel production to railway improvements, hydroelectric power, and petrochemicals.

Siderúrgica Venezolana S.A. (SIVENSA), an industrial holding company comprised of 40 companies, reported sales of $610 million up 25% from that of 1987. SIVENSA was the sixth largest company in Venezuela in 1988 and the largest private sector group in the steel sector. Its direct iron ore briquette reduction plant at Puerto Ordaz, Bolívar State, came on-stream at yearend.

CORIMON, a 26 company private sector conglomerate, announced its sales increased 84% in 1988 to $340 million. The group announced that it had planned investments of about $210 million concentrated on projects in the petrochemical sector. Among the planned projects was one with Petroquímica de Venezuela S.A. (PEQUIVEN), a subsidiary of Petróleos de Venezuela S.A. (PDVSA), to produce ethylene oxide, which was projected to save the country $40 million in imports, annually, when production begins in 1991.

Government Programs

State investment in industry development in Venezuela had concentrated particularly in the eastern Guayana region. While the oil industry had declined in recent years, the Guayana Project had played an increasingly dominant role in the country's economic development policy. A large part of the project had come under the aegis of the Corporación Venezolana de Guayana (CVG), the Guayana Development Corp.

Central to CVG's activities had been the project's aim to improve and initiate international trade, based upon development of Venezuela's natural resources in addition to stimulating downstream processing activities. While the oil boom in the early 1970's was responsible for considerable initial project investment, the sudden decline in oil income in the 1980's further encouraged this development in order to establish diverse income earnings as an alternative to an oil-based industry.

Production

Estimated aluminum production exceeded the figure for 1987 by approximately 6%. Planned production by 1992 is expected to be near 850,000 tons annually with projected annual production of 2 million tons by the year 2000. Production of alumina is expected to increase to 4 million tons annually by the year 2000. Plans were formulated to increase bauxite production to 6 million tons annually by the mid-1990's and to at least 8 million tons by the year 2000.

Coal production showed a dramatic increase in 1988, increasing approximately 900% over that of 1987 according to Carbones del Guasare S.A. Projected production figures for the mid-1990's are to attain or exceed 6.5 million tons annually. The great majority of the coal will be produced by the Guasare coal project in the State of Zulia, 100 kilometers northwest of Maracaibo.

The production of iron ore by C.V.G. Ferrominera Orinoco C.A. (FERROMINERA) increased by approximately 6% in 1988. Ferrominera began an expansion of its processing and storage facilities to meet increased demands of customers for high grade ore. It has scheduled an increase from its production capacity of 18 million tons in 1988 to 25 million tons in 1992.

Total crude petroleum production, including lease condensate and gas liquids, decreased approximately 4% in 1988. The lower production combined with the lower price for crude petroleum resulted in a decrease of revenue by approximately 7% to $7.1 billion.

Raw steel production decreased by 1.2% in 1988 while sponge and pig iron production was down by about 2%. Hot-rolled steel products declined by almost 3%. C.V.G. Siderúrgica del Orinoco C.A. (SIDOR), the state steel company, produced approximately 83% of the total steel production while SIVENSA, an independent producer, accounted for the remainder.

Trade

Venezuela's total exports decreased $2.35 billion below the figure for 1987. This resulted in a negative trade balance of $515 million compared to a positive trade balance of $2.27 billion for the previous year. The major contributor to the decline in the trade balance was petroleum exports, which was $702 million below the figure for 1987. The export values of aluminum, iron ore, and steel were up 22%, 39%, and 21%, respectively, for a total increase of $157 million.

Venezuela and Cuba were finalizing a

TABLE 5

VENEZUELA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987[p]	1988[e]
METALS						
Aluminum:						
Alumina		1,139,000	1,085,000	1,296,000	[e]1,347,000	350,000
Bauxite		—	—	—	[e]217,000	[2]700,000
Metal, unalloyed ingot		386,150	395,894	424,000	[e]428,000	[2]455,000
Gold, mine output, Au content	troy ounces	50,885	74,180	82,800	124,141	[2]118,091
Iron and steel:						
Iron ore and concentrate	thousand tons	13,371	14,754	17,396	17,780	[2]18,789
Metal:						
Pig iron	do.	326	441	491	473	[2]496
Sponge iron	do.	2,486	2,635	2,918	3,111	[2]3,157
Ferroalloys:						
Ferromanganese	do.	2	2	—	—	—
Ferrosilicomanganese	do.	9	22	29	[e]28	30
Ferrosilicon[3]	do.	44	61	51	[e]50	55
Total	**do.**	**55**	**85**	**80**	**[e]78**	**85**
Steel, crude	do.	2,777	3,055	3,467	3,722	[2]3,677
Semimanufactures, hot-rolled	do.	1,973	2,060	2,315	3,081	[2]2,994
Lead, secondary, smelter[e]		17,000	18,000	16,000	17,000	18,000
INDUSTRIAL MINERALS						
Amphybolite		169,081	183,296	315,833	241,000	[2]179,200
Cement, hydraulic		4,783,000	5,294,000	5,747,000	6,110,000	[2]6,199,000
Clays:						
Kaolin		12,540	13,906	14,906	25,598	[2]24,800
Other	thousand tons	1,868	1,928	1,648	1,794	[2]1,967
Diamond:						
Gem	carats	40,739	47,400	45,000	[e]35,000	[2]55,200
Industrial	do.	232,183	167,900	188,500	[e]63,000	[2]52,500
Total	**do.**	**272,922**	**215,300**	**233,500**	**[e]98,000**	**[2]107,700**
Feldspar		40,497	42,440	34,900	43,546	[2]96,500
Gypsum		142,386	188,754	250,230	246,324	[2]250,900
Nitrogen, N content of ammonia		[r]518,000	[r]452,000	530,000	577,000	[2]481,000
Phosphate rock		3,265	8,567	194,221	212,779	100,000
Pyrophyllite		15,500	18,700	25,000	[e]32,000	32,000
Salt, evaporated		280,700	338,889	511,421	[e]500,000	500,000
Serpentinite, crushed		345,225	517,117	553,550	[e]580,000	580,000
Stone, sand and gravel:						
Stone:						
Dolomite	thousand tons	87	274.00	271	257	[2]276
Granite		335,726	655,587	568,300	[e]287,000	[2]561,400
Limestone	thousand tons	11,561	13,906	14,907	15,458	[2]17,999
Marble	cubic meters	169	272	549	671	675

See footnotes at end of table.

TABLE 5—Continued

VENEZUELA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987[p]	1988[e]
INDUSTRIAL MINERALS—Continued						
Stone, sand and gravel—Continued						
Sand and gravel	thousand tons	5,989	6,879	7,030	7,645	[2]7,565
Sand, glass	do.	334	297	335	548	[2]441
Sulfur, byproduct of petroleum and natural gas[e]		86,000	35,100	99,380	[r]125,000	[2]125,000
MINERAL FUELS AND RELATED MATERIALS						
Carbon black[e]	thousand tons	51	51	41	61	60
Coal, bituminous		50,870	41,427	67,641	117,000	1,000,000
Gas, natural:						
Gross	million cubic feet	[r]1,147,925	[r]1,173,110	[r]1,291,005	[r]1,276,040	[2]1,340,280
Marketable	do.	517,664	498,159	576,390	[e]465,300	450,000
Natural gas liquids:[4]						
Natural gasoline	thousand 42-gallon barrels	4,708	6,885	6,687	[e]6,500	6,500
Liquefied petroleum gas	do.	13,945	15,849	15,007	[e]15,000	15,000
Total	**do.**	**18,653**	**22,734**	**21,694**	**[e]21,500**	**21,500**
Petroleum:						
Crude[5]	do.	658,279	613,583	664,125	664,125	[2]625,995
Refinery products: Gasoline:						
Aviation	do.	539	373	277	286	260
Motor	do.	46,100	59,994	88,470	76,884	85,000
Jet fuel	do.	14,486	18,263	20,770	21,229	20,000
Kerosene	do.	4,277	21,648	32,060	32,640	30,000
Distillate fuel oil	do.	69,744	92,870	87,470	76,884	85,000
Residual fuel oil	do.	117,466	107,987	96,620	89,760	[2]102,565
Lubricants	do.	2,340	2,343	2,453	2,566	2,000
Liquefied petroleum gas	do.	1,868	15,848	2,824	2,768	[2]3,285
Asphalt and bitumen	do.	8,930	10,215	11,980	11,983	10,000
Naphtha	do.	19,800	21,249	15,750	18,760	15,000
Refinery gas[6]	do.	12,020	7,844	9,862	7,400	8,000
Unspecified	do.	27,813	20,754	22,330	22,640	20,000
Total	**do.**	**325,383**	**379,388**	**390,866**	**363,800**	**[e]381,110**

[e] Estimated. [p] Preliminary. [r] Revised.
[1] Table includes data available through Aug. 18, 1989.
[2] Reported figure.
[3] Figure represents combined 45% silicon content and 75% silicon content production.
[4] From nonassociated natural gas only.
[5] Includes associated natural gas lease condensate and natural gasoline. Lease condensate is included as follows, in thousand 42-gallon barrels: 1984-39,785 (revised); 1985-43,435; 1986-51,830; 1987-60,225; and 1988-68,620. Natural gasoline is included as follows, in thousand 42-gallon barrels: 1984-20,805 (revised); 1985-22,995 (revised); 1986-35,405; 1987-34,310; and 1988-35,770.
[6] Liquid equivalent.

3-year trade agreement at yearend. Under the proposed agreement, Cuba would receive tariff preferences in export goods such as rum, tobacco, and nickel oxide among others, and Venezuela would have tariff preferences in oils, greases, lubricants, pipe connections, aluminum plates and sheets, and industrial valves.

The Mines and Energy Ministry reported that Venezuela would be able to increase its petroleum exports in 1989. Based on an increase in crude petroleum prices, the export sales would generate in excess of $9 billion. This would exceed the 1988 export income by about $2 billion.

Mexico and Venezuela renewed the San José Agreement, initially signed in 1980, to supply petroleum to Caribbean and Central American countries. The volume sold, originally 160,000 bbl/d, now is 130,000 bbl/d. Ten countries were to receive petroleum including Nicaragua, which had been previously excluded.

Commodity Review

Metals.—**Aluminum and Bauxite.**—In 1988, Venezuela produced an estimated 455,000 tons of unalloyed aluminum, an increase of about 6% from that of 1987. A portion of a new potline was inaugurated in midyear at VENALUM, which increased its annual capacity 50,000 tons to 330,000 tons per year. The other State-owned company, Aluminio del Caroni S.A. (ALCASA), increased its production to 127,000 tons in 1988.

Work on the 360,000-ton smelter for Aluminio Guayana (ALUYANA) in Puerto Ordaz, Bolívar State, began in October. CVG had a 51% share with two Italian companies, Cía. Técnica International (a private company) and Italimplanti (a state-owned company) sharing the remaining 49%. The first phase of the smelter, 195,000 tons per year, is to be operational in 1991 while the final phase, 175,000 tons per year, will be completed in 1993. In addition to ALUYANA, five new primary aluminum smelters were planned, all to be completed between 1991 to yearend 1993. They are as follows: ALAMSA (180,000 tons in 1991), ALISA (60,000 tons by yearend 1993), Aluminios de Angostura (190,000 tons prior to 1993), ALUQUAY (180,000 by yearend 1993), and ALUSUR (120,000 tons in 1992). In 1988, VENALUM announced plans to increase the plant's smelting capacity by 145,000 tons by 1998, while ALCASA announced plans to expand its smelting capacity by 180,000 tons by 1990. The Government announced a projected total capacity for aluminum production of 1.8 million tons by 1996. Also announced were projections of 3 million tons of alumina and 6 million tons of bauxite by 1996. Plans were made to expand Interamericana de Alumina C.A.'s (INTERALUMINA) alumina capacity from 1 million to 2 million tons per year by 1996. INTERALUMINA exceeded its designed capacity by 30% in 1988 as it produced 1.3 million tons of alumina.

In 1987, the first year that C.V.G Bauxita Venezolana C.A.'s (BAUXIVEN) Los Pijiguaos Mine was in operation, 217,000 tons of bauxite was produced. In 1988, the mine's production rose to an estimated 700,000 tons. In the coming decade, rapid expansion in production had been planned to complement corresponding growth in aluminum and alumina over this period. With its proven reserves assessed at over 200 million tons of aluminum, planned production was to reach 1.6 million tons in 1990 and 8 million tons by 1995.

In the past, bauxite for the aluminum industry was obtained primarily from foreign sources. By contrast, indigenous reserves are expected to become the major source of bauxite by the mid-1990's. Savings to the alumina industry have been projected to be $150 million, or 13% of current production costs, compared with the present import policy.

Gold.—After successive gold production increases from 1984–87, production decreased by 5% in 1988 to 118,100 troy ounces. CVG reported that new plans were under way to place Venezuela among the top gold producers in the world. The President of CVG had envisaged the exporting of up to 250 tons of gold per year by the year 2000. Surveys have suggested that the Guayana region south of the Orinoco River could contain 10,000 tons of gold. In addition, CVG claimed that the El Callao region, about 800 kilometers southeast of Caracas, contains 8,000 tons of proven reserves, 5,000 tons of which were extractable by open pit operations. CVG's mineral exploration subsidiary, Técnicos Mineros (TECMIN) had carried out studies revealing that Venezuela may possess anywhere from 5% to 10% of the world's gold reserves.

Steps were taken in the southern Guayana region to reduce the amount of gold being smuggled out of the country. The measures taken included setting aside areas for small-scale mining, authorizing the central bank to buy gold from miners at world daily prices, and giving the industry a $2 million income tax allowance.

At yearend, Promiven Mining Co., a Spanish-Venezuelan venture, and Vencemos, a private mining group in Venezuela, reported plans to start up an alluvial gold mine located in the southern part of Venezuela. They also secured four adjacent concessions. Detailed exploration, mine planning, and development were expected to be completed by June 1989, with production to begin shortly thereafter. Promiven also signed a joint-venture agreement with CVG founding a company called PMG, which will develop several large areas in the Bochinche and Chocó areas (El Callao gold district) in northeast Bolívar State.

Iron Ore.—Venezuela's iron ore production rose to 18.8 million tons in 1988, which was almost a 6% increase from that of 1987. The Piar Div.'s San Isidro and Cerro Bolívar Mines collectively produced approximately 87% of the total while Pao's El Pao Mine produced the remainder. The San Isidro Mine produced 58% of the Piar division's total for 1988.

FERROMINERA had planned increased production in the San Isidro and Cerro Bolívar Mines and the startup of the Los Barrancos Mine, adjacent to San Isidro, to more then compensate for the total depletion of the El Pao Mine by 1993.

FERROMINERA had drawn up plans to increase its mining and export capacity and to boost productivity. The main goals were: an increase in production of the Piar Div. to 25 million tons per year by 1992; construction of a pelletization plant with a capacity of 3.3 million tons; a floating transshipment station on the Orinoco River to allow loading onto bulk carriers of up to 200,000 deadweight tons; and to increase productivity to 3 tons per employee.

Venezuela continued to look toward Japan as a vital source of foreign capital for investment in mining projects and as a valuable export destination. Iron ore exports to Japan were begun in 1986. In 1988, exports totaled approximately 800,000 tons with plans for 2 million tons for 1989. China, the Republic of Korea, and other Asian countries have been targeted as possible export outlets.

Japan's Kobe Steel Ltd. was to invest $12 million in the rehabilitation of the Minerales Ordaz C.A. (MINORCA) direct-reduction iron briquet plant at Puerto Ordaz, Bolívar State.

Iron and Steel.—Steel production decreased by slightly more than 1% to 3.7 million tons in 1988 while manufactured steel production decreased slightly to 3 million tons. Pig and sponge iron recorded small increases in 1988 production.

Feasibility studies were completed at yearend on a new slab steel project, Complejo Siderúrgico de Guayana (COMSIGUA). The project, involving Venezuela's CVG and Japan's Kobe Steel, was expected to have a 950,000-ton-per-year slab capacity.

C.V.G. Siderúrgica del Orinoco C.A. (SIDOR) announced plans to expand its seamless steel tube plant in 3 stages to a total capacity of 335,000 tons per year.

Other Metals.—Production of ferroalloys was approximately near the level for 1987. C.V.G. Ferrosilicón de Venezolana C.A. (FESILVEN) announced plans for expansion and modernization of its facilities. The plans included construction of two additional furnaces, increased capacity of ferrosilicon 75% by 25,000 tons per year, and increased capacity of 13,500 tons per year of silicon metal.

Strategic Minerals Corp. (STRATCOR) of the United States announced an agreement with Procesadora Paraguana C.A. (PROPACA) whereby the Venezuelan company would provide 25% to 30% of the feed to STATCOR's vanadium processing plant in Hot Springs, Arkansas, United States. PROPACA was to begin operations in early 1989. PROPACA, which was founded in 1986, will process all of the vanadium-bearing petroleum coke produced by LAGOVEN S.A., a subsidiary of PDVSA.

***Industrial Minerals.*—Cement.**—In 1988, total cement production was 6.2 million tons, which was 93% of the total capacity. The largest company, Venezolana de Cementos C.A. (VENCEMOS), produced approximately 50% of the total production. Cementos Caribe, one of two cement producers in Venezuela that export cement, produced 900,000 tons in 1988 of which about 405,000 tons was exported.

Other Industrial Minerals.—PEQUIVEN announced an agreement with Norsk Hydro of Norway to build an ammonia plant in José, near Puerto La Cruz in eastern Venezuela. The $207 million project will include a 500,000 tons per year liquid ammonia plant. PEQUIVEN holds a majority 49% stake in the venture, Norsk Hydro a 30% share, national investors a 15% share, and 6% is offered on the Caracas stock exchange.

***Mineral Fuels.*—Coal.**—Venezuela's coal production increased from about 117,000 tons in 1987 to an estimated 1 million tons in 1988. Total production has been planned to reach 6.5 million tons per year at a cost of $550 million by 1996. Coal exports totaled 773,000 tons in 1988. Europe received 74% of the exports, the United States received 21%, and the Caribbean region 5%.

In 1988, there were three major coal projects in various stages of development. The Tachira project, having proven reserves of 375 million tons of coking coal when fully developed, will produce 320,000 tons per year for shipment downriver to Ciudad Guayana for use by the aluminum and steel industries there. The Fila Maestra project in Anzoategui State, a joint Spanish-Venezuelan venture begun in 1982, was in the process of increasing its production of steam coal from 300,000 tons to 700,000 tons over the next 5 years. Carbones del Zulia C.A. (CARBOZULIA) reported production of about 500,000 tons from the Paso Diablo project in 1988.

CARBOZULIA was reported to have abandoned the idea for the development of a new deepwater port near Paraguaipoa, Zulia State, because of the high cost and has tentatively chosen to expand the existing facilities at Santa Cruc de Mara north of Maracaibo City.

Natural Gas and Petroleum.—Crude petroleum production decreased by about 4% to an estimated 637 million barrels in 1988. Venezuela came under criticism by the Organization of Petroleum Exporting Countries (OPEC) for excluding condensate and natural gas liquids from its total natural gas and petroleum production figures. In addition, a controversy was developing with some members of OPEC over the marketing of "orimulsion," a mixture of extra heavy crude petroleum and water that can be burned like coal or fuel oil.

CORPOVEN S.A., a subsidiary of PDVSA, found a very productive crude petroleum-bearing zone at a depth of 5,182 meters on the El Furrial trend. This Oligocene age strike was north of the Musipan and El Carito oil and gas strikes in northern Monagas State. The El Furrial find had added 6 billion barrels of light and medium crude petroleum to the existing 58 billion barrels of proven reserves and added 21 trillion feet of natural gas to the existing 102 trillion feet of proven reserves. In 1988, PDVSA became the first wholly state-owned company to become sole owner of a major United States refinery. It purchased the remaining 50% of Champlin Refining Co. from the parent company, Union Pacific Corp. The primary asset was the 160,000-bbl/d refinery in Corpus Christi, Texas. In addition, Venezuela Petroleum Holdings Inc., a United States subsidiary of PDVSA, was negotiating with Unocal Corp. over formation of a partnership and the transfer of Unocal's Chicago, Illinois, refinery along with certain marketing and other assets to the partnership.

Two United States banks, Bank America Corp. and Salomón Bros., agreed to lend $1 billion against future crude petroleum sales to the two United States refineries in which Venezuela holds a stake. The agreement essentially amounted to the immediate availability of cash in exchange for accounts receivable for the sale of 300,000 to 325,000 bbl/d of crude petroleum. The proceeds were to be drawn in December by the Venezuelan Central Bank to help make interest payments on the foreign debt. Repayment was structured so that the loan would be repaid by 1995.

CORPOVEN, operator of the Eastern Venezuela Cryogenic Complex in Anzoategui State, began preliminary engineering studies for a 50% increase of its design capacity of 800 million cubic feet per day. The plan was pushed by PDVSA in order to find new ways to utilize abundant natural gas supplies.

PEQUIVEN and Ecofuel, a subsidiary of Italy's national hydrocarbon company Ente Nazionale Idrocarburi, signed an agreement to form a joint petrochemical venture. The new company, Super Octanos C.A., will produce 500,000 tons per year, of a nonlead additive that raises the gasoline octane level. Each company will hold 49% of the new firm's shares with the remaining 2% being sold to private Venezuelan investors. The project's cost was projected to be $145 million with the start up scheduled for late 1989.

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[1] By Orlando Martino, physical scientist, Division of International Minerals.

[2] By Jerome F. Machamer, economic geologist, Division of International Minerals.

[3] Where necessary, values have been converted from Colombian pesos (Col $) to U.S. dollars at the rate of Col$340 = US$1.00.

[4] By Alfredo C. Gurmendi, physical scientist, Division of International Minerals.

[5] By Alfredo C. Gurmendi, physical scientist, Division of International Minerals.

[6] By Alfredo C. Gurmendi, physical scientist, Division of International Minerals.

[7] Where necessary, values have been converted from Suriname guilder (SG) to U.S. dollars at the official rate of SG1.77 = US$1.00.

[8] By H. Robert Ensminger, physical scientist, Division of International Minerals.

[9] Unless otherwise specified, values have been converted from Venezuelan bolivars (Bs) to U.S. dollars at the rate of Bs14.50 = US$1.00.

TABLE 6

FRENCH GUIANA: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
Iron and steel: Metal:				
Scrap	31	6	—	All to Brazil.
Semimanufactures:				
Bars, rods, angles, shapes, sections	—	10	—	All to Suriname.
Universals, plates, sheets	3	—		
Molybdenum: Metal including alloys, all forms	—	2	—	All to Martinique.
Petroleum refinery products:				
Gasoline 42-gallon barrels	4,692	—		
Distillate fuel oil do.	6,901	358	NA	NA.
Residual fuel oil do.	5,501	—		
Salt and brine	—	1	—	All to Guadeloupe.
Stone, sand and gravel: Gravel and crushed rock	—	2	—	All to France.

NA Not available.
[1] Table prepared by H. D. Willis.

TABLE 7

FRENCH GUIANA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS				
Aluminum:				
Oxides and hydroxides	1	2	—	All from France.
Metal including alloys, semimanufactures	52	81	10	France 60; West Germany 10.
Chromium: Oxides and hydroxides value, thousands	—	$1	—	All from France.
Cobalt: Oxides and hydroxides do.	—	$3	—	Do.
Copper: Metal including alloys, semimanufactures	57	64	([2])	Mainly from France.
Iron and steel: Metal:				
Scrap value, thousands	$1	—		
Ferroalloys	3	—		
Steel, primary forms	—	8	—	Mainly from West Germany.
Semimanufactures:				
Bars, rods, angles, shapes, sections	3,747	3,708	1	France 2,658; Belgium-Luxembourg 297; Spain 244.
Universals, plates, sheets	2,498	2,918	—	France 2,599; Martinique 173; Belgium-Luxembourg 142.
Hoop and strip	2	4	—	All from France.
Rails and accessories	4	NA		
Wire	26	43	—	France 40; Netherlands 2; Italy 1.
Tubes, pipes, fittings	955	950	1	France 783; Spain 120; Belgium-Luxembourg 25.
Castings and forgings, rough	38	43	—	France 37; West Germany 6.
Lead:				
Oxides value, thousands	$1	$1	—	All from France.
Metal including alloys, semimanufactures	2	2	—	Do.
Mercury do.	$6	$8	—	France $7; West Germany $1.
Nickel: Metal including alloys, semimanufactures	—	1	—	All from France.
Tin: Metal including alloys, semimanufactures value, thousands	$2	$5	—	Do.
Titanium: Oxides	2	1	—	Do.
Zinc: Metal including alloys, semimanufactures	1	—		
Other:				
Ashes and residues	41	202	—	Do.
Base metals including alloys, all forms value, thousands	$4	$2	—	Do.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	31	—		
Grinding and polishing wheels and stones	9	9	—	France 5; Italy 3.
Boron materials: Oxides and acids	1	—		

See footnotes at end of table.

TABLE 7—Continued

FRENCH GUIANA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
INDUSTRIAL MINERALS—Continued					
Cement		42,816	47,950	—	France 15,275; Martinique 11,511; Guadeloupe 6,936.
Chalk		11	—		
Clays, crude		7	20	—	All from France.
Diamond, natural:					
Gem, not set or strung	value, thousands	$13	$13	—	Do.
Industrial stones	do.	—	$4	—	Do.
Diatomite and other infusorial earth		—	1	—	Do.
Fertilizer materials:					
Crude, n.e.s.		1	1	—	Do.
Manufactured:					
Ammonia		4	5	—	Mainly from France.
Nitrogenous		749	882	—	France 500; Netherlands 370; Belgium-Luxembourg 12.
Phosphatic		144	228	—	Belgium-Luxembourg 165; France 63.
Potassic		102	68	—	France 64; Belgium-Luxembourg 4.
Unspecified and mixed		1,160	994	80	France 818; Belgium-Luxembourg 89.
Gypsum and plaster		50	108	—	All from France.
Lime		557	238	—	France 138; Martinique 100.
Mica: Worked including agglomerated splittings		7	—		
Pigments, mineral: Iron oxides and hydroxides, processed	value, thousands	—	$1	—	All from France.
Precious and semiprecious stones other than diamond:					
Natural	do.	$85	$39	$1	Brazil $35; France $3.
Synthetic	do.	—	$1	—	All from France.
Salt and brine		376	429	—	France 189; West Germany 170; Spain 59.
Sodium compounds, n.e.s.:					
Carbonate, manufactured		1	(2)	—	All from France.
Sulfate, manufactured		107	203	—	Do.
Stone, sand and gravel:					
Dimension stone:					
Crude and partly worked		260	21	—	All from Italy.
Worked		34	49	(2)	Italy 21; France 20; Brazil 7.
Dolomite, chiefly refractory-grade		58	124	—	France 104; Belgium-Luxembourg 20.
Gravel and crushed rock		13	—		
Quartz and quartzite		NA	2	—	All from West Germany.
Sand other than metal-bearing		195	114	20	France 74; Canada 15.

See footnotes at end of table.

TABLE 7—Continued

FRENCH GUIANA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
INDUSTRIAL MINERALS—Continued					
Sulfur:					
Elemental, crude including native and byproduct		1	18	—	All from France.
Sulfuric acid		5	15	—	France 10; Guadeloupe 5.
Other:					
Crude		69	98	—	France 93; West Germany 5.
Slag and dross, not metal-bearing		—	42	—	All from France.
MINERAL FUELS AND RELATED MATERIALS					
Coal excluding briquets		23	—		
Coke and semicoke	value, thousands	—	$1	—	All from Martinique.
Peat including briquets and litter		20	9	—	All from France.
Petroleum refinery products:					
Liquefied petroleum gas	42-gallon barrels	21,425	32,062	—	Trinidad and Tobago 29,476; Netherlands Antilles 2,216; France 360.
Gasoline, motor	do.	147,586	229,475	—	Trinidad and Tobago 228,880; France 595.
Mineral jelly and wax	do.	8	346	—	All from France.
Kerosene and jet fuel	do.	90,001	106,772	—	Mainly from Trinidad and Tobago.
Distillate fuel oil	do.	300,548	315,305	3,529	Trinidad and Tobago 301,004; Netherlands Antilles 7,102; Venezuela 3,670.
Lubricants	do.	8,477	13,489	7	France 9,569; Belgium-Luxembourg 2,891; Jamaica 581.
Residual fuel oil	do.	124,509	232,414	—	All from Trinidad and Tobago.
Bitumen and other residues	do.	14,502	11,399	—	Trinidad and Tobago 11,326; France 73.
Bituminous mixtures	do.	18	36	—	All from France.

NA Not available.
[1] Table prepared by H. D. Willis.
[2] Less than 1/2 unit.

2THE MINERAL INDUSTRIES OF

SOUTHERN SOUTH AMERICA

By Pablo Velasco and Alfredo C. Gurmendi

INTRODUCTION[1]

Argentina, Chile, Paraguay, and Uruguay make up the southern part of South America and are commonly called "southern cone" countries. As the second largest country in Latin America with a population of 32 million, Argentina's value of mineral fuels and other minerals production was at the approximate level of that of Chile, a country one-third the size of Argentina with a population of 13 million. However, Chile is a more diversified mineral producer where nonfuel mineral output is more important relative to petroleum—the mineral commodity that dominates Argentina's mineral economy.

Mineral commodities played a dominant role only in the export sector of Chile where they accounted for 61% or $4.4 billion of total merchandise exports in 1988. In Argentina, total mineral exports represented only 3% of total exports with a value of $243 million consisting primarily of crude oil and refinery products. Mineral exports are insignificant in Paraguay and Uruguay.

In terms of the world mineral economy, Chile is significant as a supplier of copper, lithium, molybdenum, rhenium, and iodine; Argentina as a supplier of borates. In 1988, Chile was the world's leading producer and exporter of copper and in second place after the United States as a supplier of molybdenum. Chile was the second largest producer of iodine after Japan.

Argentina and Chile produced a diversity of mineral fuels—crude oil, natural gas, and coal—but only Argentina was relatively self-sufficient in oil with a small surplus for export. In 1988, Argentina was a modest supplier of petroleum to the United States involving 1.3 million barrels of crude oil and 3.9 million barrels of refinery products, mostly residual fuel oil. Argentina's output of crude oil has been in a downtrend since 1981, and, by 1985, it was replaced by Brazil as the third place oil producer, after Mexico and Venezuela in the Latin American region. Paraguay exported energy to Brazil from its share of the output of the Itaipú hydroelectric complex. Argentina has entered into a number of joint hydroelectric development projects with Paraguay and Uruguay.

Argentina was the first country in the Latin American region to develop an integrated nuclear power industry involving uranium mining, milling and enrichment plants, and the installation of a 374-megawatt nuclear powerplant (Atucha I) in 1974. Argentina has also played an important role in the region as an exporter of nuclear technology to Bolivia, Brazil, Chile, Mexico, Peru, and Uruguay.

Argentina and Chile were involved with efforts to restructure their mining industries whose past development has had the strong intervention of Government. Chile demonstrated the greatest advance in its policy to privatize its mining industries and was successful in using debt-equity swaps to attract mining investment. In the near term, Chile evidenced the best prospects in the group for expanded domestic and foreign investment in the mining sector because of political stability, favorable investment climate, and good mineral potential.

The southern cone countries are all members of the Latin American Integration Association (LAIA) headquartered in Buenos Aires, Argentina, and the Latin American Energy Association (OLADE) headquartered in Quito, Ecuador. Chile is an influential member of the Intergovernmental Council of Copper Exporting Countries (CIPEC). Chile has been a proponent of the proposed International Copper Study Group under review by producer and consumer countries.

Argentina and Chile are signatories of the 1961 Antarctica Treaty and are among the seven countries making claims on Antarctica territories. In October 1985, Uruguay achieved Consultative Party status within the treaty. Argentina and Chile maintain research stations on Antarctica. Of all the claimant nations, Argentina has had the longest presence on Antarctica dating back to 1904. Argentina and Chile have signed the agreement called the Convention on the Regulation of Antarctic Mineral Resources Activities (CRAMRA) negotiated by the Antarctica Treaty nations during the period 1982–88.

ARGENTINA[2]

Introduction

Argentina, the second largest country in Latin America, has a well-diversified natural resource base and great mineral potential. During almost three decades, the Government has directly or indirectly expended a considerable effort on exploration, generating the discovery of a number of mineral deposits, most of them small and medium size and polymetallic. But no followup investments have been made to develop these deposits. Mineral production and trade remain almost negligible in terms of the contribution to the gross domestic product (GDP) and to total exports. Total mineral exports, excluding hydrocarbons, were estimated at approximately 0.5%, and including hydrocarbons at about 3% of total exports.

The El Aguilar Mine in Jujuy Province, the largest lead, zinc, and silver mine in the country and the most significant privately owned mine in Argentina, was sold in February by Fluor Corp. (St. Joe Minerals Corp.) to the Bolivian Consortium Cía. Minera del Sur (COMSUR) for an undisclosed amount. This ended the only U.S. mining venture of any significance in the country. El Aguilar employed about 1,700 workers who operated a 2,000-ton-per-day underground mine and a flotation-type concentrator producing about 30,000 tons of zinc, 24,000 tons of lead in concentrates, and 1.6 million troy ounces of silver per year.

According to economic advisors, the

Argentine economy was considered to be overregulated, with the consequent presence of an underground economy. However, instead of deregulating the economy, the authorities appeared intent on more regulations. Although the Government has yet to release yearend figures, economic growth was slightly negative through the middle of the year, compared with 1987, when the growth rate was 1.6%. The World Bank has estimated that Argentine private deposits held outside of the country amounted to nearly $21 billion[3]. The Government has imposed several new economic programs since 1986, incorporating various elements of the original Plan Austral. The most recent program, the Plan Primavera, announced in August was designed to significantly lower the inflation rate. Although initial results have been favorable, critics argued that the program did not represent a basis for improved economic performance over the medium or long term and caused further distortions of the economy.

Government Policies and Programs

Argentine foreign investment laws were considered to be among the most open and liberal in Latin America. In general, foreign investors enjoy all the rights given to domestic investors. The Argentine Government initiated programs to attract and increase private investment in petroleum (Plan Houston, Plan Olivos, and Petroplán). Such programs, coupled with better management by Yacimientos Petrolíferos Fiscales (YPF), was expected to result in increased petroleum production.

The Argentine Government, through its Secretariat of Mining, has designed and implemented a strategy known as the Mining Expansion Plan (Plan de Expanción Minera P.E.M). The plan's main objective was to improve the investment climate in the mineral sector by applying the Mining Promotion Law responsibly and generously to attract and encourage domestic and foreign investment in the mineral sector. The plan includes the establishment of a data bank to be used to evaluate new and potential ore bodies for development and to assist the owners of mining projects in contacting prospective investors outside of the sector. The Mining Promotion Law (Law 22,095), passed in November 1979, treats domestic and foreign investors equally. Beneficiaries are duly registered persons or legal entities qualified to act in Argentina. Benefits and incentives are in no way linked to the origin of ownership or percentage of equity. Tax incentives may be granted to national and international companies. Benefits will be based on the nature of the project and its compliance with the purposes of the Plan de Expanción Minera. Benefits to promote mining activities fall into three categories. One category involves exploration, development, preparation, and extraction of minerals. A second category involves crushing, grinding, processing, pelletizing, sintering, briqueting, roasting, smelting, refining, and other steps in ore treatment. The third category involves manufacture of primary products. A regional integration criterion is applied to all processing operations. In order to qualify for these incentives, a firm must integrate processing with the mining development phase. The law permits a 100% income tax deduction for expenses related to investments made in research, prospecting, and exploration, as well as mining license fees. The law also permits the same deduction for construction of roads, railroad siding, housing for personnel, and other infrastructure. Expenses for technical consultants are also included in this deduction. The Government introduced major changes in administering mining sector incentives. These incentives for investment, stated in the Mining Promotion Law, called for deferred taxation and tax breaks. The Law also formed the Fondo de Fomento Minero, a mining finance fund administrated by the Secretaría de Estado de Minería, (S.E.M.).

Production

Argentina continued to be one of the world's largest producers and exporters of borax. Also produced were modest quantities of base metals such as lead and zinc, industrial minerals such as bentonite, gypsum, and kaolin, and mineral fuels such as coal, coke, and crude oil. Production of precious metals was limited. The Secretariat of Mining reported a 4.7% decrease in production of gold to over 30,000 troy ounces in 1988 and an increase of 24% in silver to 2.4 million troy ounces compared with output of 1987. Production of internationally traded industrial minerals showed a sustained growth. Domestic demand remained stagnant. Production of construction materials, which included sand and gravel, granite, marble, and other building stones, was sensitive to investment in construction and remained fairly depressed. Cement output declined slightly. Yacimientos Carboníferos Fiscales (YCF) reported a 34% coal production increase. The production of crude oil and natural gas increased 4.3% and 16.6%, respectively.

Trade

The National Customs Administration and the National Institute of Statistics and Census reported the value of exported nonfuel minerals, mineral-related products, and metals to be approximately $38.4 million, an increase of 18% compared with that of 1987. The export value of crude oil and refinery products increased 98.0% to $205 million. The principal nonfuel mineral exports were lead concentrates, polymetallic concentrates containing gold and silver, borax, boric acid, granite, sodium borate, ulexite, and zinc concentrate. Other significant mineral products exported included bentonite, borates, celestite, portland cement, gypsum, and dimensional forms of granite and marble.

There were 200 different minerals and mineral-related products exported. Marble and granite showed promising

TABLE 1

ARGENTINA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1984	1985	1986	1987[p]	1988[e]
METALS						
Aluminum:						
Primary		[r]133,700	[r]135,700	[r]147,600	[3]155,800	[3]157,400
Secondary		7,500	[r]8,000	[r]6,500	[3]7,500	7,500
Beryllium: Beryl concentrate:						
Gross weight		[r]72	31	50	46	40
BeO content		[r]7	3	5	5	4
Cadmium: Smelter		46	46	47	46	46
Columbium (Cb_2O_5)	kilograms	—	—	—	—	[3]51
Copper: Mine output, Cu content		223	391	317	379	[3]475
Gold: Mine output, Au content	troy ounces	22,120	28,357	30,350	[3]31,829	[3]30,318
Iron and steel:						
Iron ore and concentrate:						
Gross weight	thousand tons	572	639	810	[r]567	[3]583
Fe content	do.	346	389	514	[r]360	[3]370
Metal:						
Pig iron and sponge iron	do.	1,799	2,999	2,600	[3]2,785	[3]2,755
Ferroalloys, electric-furnace:						
Ferromanganese		23,976	23,663	19,782	[3]21,407	[3]18,940
Ferrosilicomanganese		13,336	7,493	12,977	[3]11,746	[3]12,766
Ferrosilicon		19,932	18,790	22,979	[3]23,998	[3]25,983
Other		3,939	4,892	5,272	[3]6,790	[3]7,803
Total		**61,183**	**54,838**	**61,010**	**[r]63,941**	**[3]65,492**
Steel, crude	thousand tons	2,647	2,942	3,235	[3]3,633	[3]3,662
Semimanufactures[4]	do.	2,456	2,269	2,977	[r]3,912	[3]3,012
Lead:						
Mine output, Pb content		28,542	28,582	[r]26,868	[r]26,069	[3]28,721
Metal:						
Smelter, primary		16,300	15,088	[r]15,700	[r]16,200	[3]19,000
Refined:						
Primary		16,300	15,088	[r]15,700	[r]16,200	16,000
Secondary		15,000	13,575	[r]15,000	[r]16,000	16,000
Total		**31,300**	**28,663**	**[r]30,700**	**[r]32,200**	**32,000**
Manganese ore and concentrate:						
Gross weight		[r]5,888	7,276	9,886	[3]6,393	[3]9,657
Mn content		[r]1,443	1,728	2,458	[3]1,324	[3]2,000
Silver, mine output, Ag content	thousand troy ounces	1,984	2,170	2,134	[3]1,918	[3]2,382
Tin:						
Mine output, Sn content		274	451	379	[3]186	[3]446
Metal, smelter		292	135	365	[e]350	280
Tungsten, mine output, W content		37	17	20	15	20

See footnotes at end of table.

TABLE 1—Continued

ARGENTINA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1984	1985	1986	1987[p]	1988[e]
METALS—Continued						
Uranium, mine output, U_3O_8 content	kilograms	94,430	[r]148,956	[r]203,753	[3]112,499	155,000
Zinc:						
Mine output, Zn content		34,909	35,713	39,540	35,648	[3]36,297
Metal:						
Smelter:						
Primary		27,725	30,377	29,123	[3]31,900	29,000
Secondary		2,200	2,500	3,000	[r]2,600	2,400
Total		**29,925**	**32,877**	**32,123**	**34,500**	**31,400**
INDUSTRIAL MINERALS						
Asbestos		1,093	1,244	1,697	332	[3]294
Barite		44,170	55,753	58,617	29,300	[3]45,000
Boron materials, crude		142,880	158,252	191,871	184,786	[3]196,000
Cement, hydraulic	thousand tons	[r]5,224	[r]4,630	[r]5,553	[r]6,302	[3]6,048
Clays:						
Ball clay (plastic clay), n.e.s.	do.	1,870	1,595	1,580	644	[3]815
Bentonite		[r]125,703	147,065	146,191	108,595	110,000
Foundry earth		124,023	96,821	102,551	107,000	100,000
Fuller's earth (decolorizing clay)		3,611	1,743	[e]2,000	[e]2,000	2,000
Kaolin		90,545	73,802	117,378	128,500	[3]56,130
Laterite (aluminous)		31,902	32,086	38,816	44,548	[3]53,000
Refractory		70,250	38,388	72,185	47,834	45,000
Other[5]		665,615	524,267	1,596,852	2,275,826	1,400,000
Diatomite		5,227	9,929	14,362	4,586	10,000
Feldspar		17,948	27,066	24,087	29,282	25,000
Fluorspar		23,157	30,612	39,076	73,788	42,000
Graphite		15	32	40	216	100
Gypsum, crude		566,943	460,816	462,195	561,073	500,000
Lithium: Spodumene, amblygonite, gross weight		[r]25	35	184	178	[3]28
Mica:						
Sheet		12	347	234	340	[3]330
Waste and scrap		278	374	317	451	[3]450
Nitrogen: N content of ammonia		49,300	64,900	62,879	[r]71,829	[3]86,668
Phosphates: Thomas slag[6]		500	500	228	110	[3]55
Pigments, mineral, natural: Ocher		757	4,020	1,027	92	[3]850
Precious and semiprecious stones: Amethyst	kilograms	NA	NA	NA	NA	NA
Pumice and related volcanic materials		54,257	44,350	22,957	[3]195,526	80,000
Salt:						
Rock	thousand tons	1	1	1	1	1
Solar	do.	937	1,447	1,218	950	[3]835
Total	**do.**	**938**	**1,448**	**1,219**	**951**	**836**

See footnotes at end of table.

TABLE 1—Continued

ARGENTINA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1984	1985	1986	1987[p]	1988[e]
INDUSTRIAL MINERALS—Continued						
Sand and gravel:						
Sand:						
Construction	thousand tons	11,399	11,352	10,389	9,048	10,000
Ferruginous-titaniferous		NA	NA	NA	NA	NA
Silica sand (glass sand)	thousand tons	306	275	292	283	[3]285
Gravel	do.	4,301	3,745	5,552	3,574	3,500
Stone:						
Basalt	do.	[r]3,354	3,020	2,802	2,542	2,500
Calcareous:						
Calcite, nonoptical		7,100	8,220	7,687	2,800	3,500
Calcium carbonate (chalk)		8,585	12,629	13,448	7,200	7,600
Dolomite		211,270	97,146	254,966	379,473	[3]438,000
Limestone	thousand tons	11,167	10,064	10,166	13,910	13,000
Marble:						
Aragonite, broken		2,603	1,032	513	1,740	[3]2,220
Onyx, in blocks and broken		[r]13,592	11,041	9,351	9,020	9,000
Travertine, in blocks and broken		4,447	6,007	4,423	5,925	[3]11,117
Unspecified, in blocks and broken		92,282	71,042	98,227	72,179	[3]38,200
Flagstone		41,180	61,425	53,943	64,945	60,000
Granite:						
In blocks		25,359	32,948	30,424	43,934	[3]53,700
Crushed	thousand tons	4,144	3,653	3,747	3,548	[3]4,600
Quartz, crushed		96,420	81,213	126,255	133,517	110,000
Quartzite, crushed	thousand tons	996	1,105	580	2,128	2,000
Rhodochrosite		23	6	13	10	10
Sandstone		200	282	346	608	600
Serpentine, crushed		5,146	12,551	23,010	28,689	29,000
Shell, marl		556,949	431,990	320,898	618,536	500,000
Tuff and tufa	thousand tons	458	1,876	1,306	12,146	10,000
Strontium minerals: Celestite		400	983	1,133	1,010	1,000
Sulfates, natural:						
Aluminum (alum)		11,583	24,513	30,489	64,655	[3]65,000
Magnesium (epsomite)		[r]697	904	762	2,500	1,500
Sodium (mirabilite)		32,626	20,865	31,789	27,481	[3]11,344
Talc and related materials:						
Pyrophyllite		5,012	2,785	2,812	1,260	1,200
Steatite		NA	280	[e]300	[e]300	250
Talc		22,774	15,944	22,353	24,138	[3]25,400
Total		**27,786**	**19,009**	**25,465**	**25,698**	**26,850**
Vermiculite		4,451	4,887	5,207	952	20,200
Water, mineral-containing		85,436	100,720	151,998	177,544	173,150
Zeolite		90	103	120	110	100

See footnotes at end of table.

TABLE 1—Continued

ARGENTINA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1984	1985	1986	1987[p]	1988[e]
MINERAL FUELS AND RELATED MATERIALS						
Asphalt and bitumen, natural		994	3,235	3,702	[r]3,350	3,000
Coal, bituminous	thousand tons	509	400	[1]370	[r]380	[3]508
Coke, all types, including breeze	do.	[r]422	625	840	[3]700	700
Gas, natural:						
Gross	million cubic feet	675,757	658,605	677,407	[3]675,482	801,453
Marketed[7]	do.	[r]509,520	[r]525,059	[r]506,180	[r]521,552	629,686
Natural gas liquids:						
Butane	thousand 42-gallon barrels	2,605	3,132	3,170	[3]3,306	3,887
Propane	do.	3,497	2,996	3,030	[3]4,967	5,283
Total	**do.**	**6,102**	**6,128**	**6,200**	**[3]8,273**	**9,170**
Peat, agricultural (Turba)		2,308	3,917	3,166	[3]3,786	3,000
Petroleum:						
Crude	thousand 42-gallon barrels	175,097	167,781	158,467	[r]156,348	164,418
Refinery products:						
Gasoline	do.	43,817	34,785	31,351	[r]31,246	28,041
Kerosene	do.	3,549	3,449	3,675	[r]3,778	3,503
Jet fuel	do.	5,143	4,685	5,028	[r]5,384	5,176
Distillate fuel oil	do.	57,265	48,801	51,429	[r]54,172	53,997
Residual fuel oil	do.	38,448	17,485	21,447	[r]25,734	27,790
Lubricants	do.	1,883	1,593	1,792	[r]1,868	1,781
Other	do.	8,565	10,417	16,148	[r]16,445	16,499
Refinery fuel and losses	do.	11,766	43,982	25,337	[r]14,205	21,400
Total	**do.**	**170,436**	**165,197**	**156,207**	**[r]152,832**	**158,187**

[e]Estimated. [p]Preliminary. [r]Revised. NA Not available.
[1]Table includes data available through Nov. 30, 1989.
[2]In addition to the commodities listed, bismuth, carbon black, columbite, lime, natural gasoline, perlite, and potassium sulfate (Kalinite) are believed to be produced, but output is not reported quantitatively, and available information is inadequate to make reliable estimates of output levels.
[3]Reported figure.
[4]Hot-rolled semimanufactures only; excludes castings and cold-rolled semimanufactures produced from imported hot-rolled semimanufacturers.
[5]Includes plastic, semiplastic, and/or ferruginous clays used totally in the manufacture of portland cement.
[6]Thomas slag production was estimated from the Thomas crude steel reported in La Siderurgia Argentina annual published by the Instituto Argentino de Siderurgia.
[7]Includes 78,692 million cubic feet of natural gas imported from Bolivia.

trends in foreign markets. Brazil remained the single largest importer of Argentine minerals, accounting for approximately 60% of the total. Other important mineral markets included the United States, Japan, Eastern Europe, and the U.S.S.R.

According to Government import figures, the value of imports of minerals and basic manufactured items derived from mineral substances amounted to nearly $840 million. Mineral imports accounted for almost 20% of total imports, of which industrial minerals, namely asbestos, kaolin, magnesium, and sulfur, accounted for almost 80%. Iron ore and manganese were imported for the steel industry. Imports of natural gas from Bolivia increased 5% to 79 billion cubic feet with an estimated value of $215 million. Imports of metallurgical coal from the United States and other countries increased 4% to an estimated 1.1 million tons.

Commodity Review

Metals.—**Aluminum.**—Primary aluminum in Argentina was produced by Aluminios Argentinos S.A.I.C. (ALUAR). ALUAR'S refinery in Puerto Madryn, Chubút Province, was 52.1% owned by the state and 47.9% by private investors. The refinery has an installed capacity of 160,000 tons per year of primary aluminum and employs more than 1,200 workers. Sev-

TABLE 2

ARGENTINA: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Destinations, 1987 United States	Destinations, 1987 Other (principal)
METALS					
Aluminum:					
Oxides and hydroxides		1	1	—	Mainly to Uruguay.
Metal including alloys:					
Unwrought		74,000	73,009	18,517	Japan 32,400; Netherlands 6,239.
Semimanufactures		13,469	17,995	4,810	Netherlands 9,195; Japan 1,643.
Chromium: Oxides and hydroxides		13	38	—	Chile 29; Venezuela 5; Uruguay 4.
Copper: Metal including alloys:					
Unwrought		1	2	—	Mainly to Uruguay.
Semimanufactures		3,144	3,217	2,441	Iran 484; Israel 131.
Iron and steel: Metal:					
Scrap		9	—		
Pig iron, cast iron, related materials		45	715	—	Uruguay 481; Brazil 100; Italy 80.
Ferroalloys		9,840	16,511	12,516	Japan 3,199; United Kingdom 432.
Steel, primary forms		369,796	132,360	26,787	China 50,345; India 17,505.
Semimanufactures:					
Bars, rods, angles, shapes, sections		249,578	193,648	43,084	China 46,938; Chile 28,032.
Universals, plates, sheets		315,539	379,387	208,976	Japan 51,115; Thailand 45,958.
Hoop and strip		178	9	—	Uruguay 8; Bolivia 1.
Rails and accessories		NA	530	—	Paraguay 405; Colombia 116; Bolivia 9.
Wire		3,795	4,410	1,630	Bolivia 1,108; Uruguay 702.
Tubes, pipes, fittings		228,217	330,833	110,079	China 89,090; U.S.S.R. 54,665.
Castings and forgings, rough		196	39	—	Bolivia 25; Uruguay 9; Chile 5.
Lead:					
Ore and concentrate		17,080	19,727	—	Brazil 6,807; France 5,001; U.S.S.R. 4,200.
Oxides		83	49	—	All to Uruguay.
Metal including alloys:					
Unwrought		50	400	—	Do.
Semimanufactures	value, thousands	1	$6	—	All to Libya.
Magnesium: Metal including alloys, semimanufactures		—	1	—	All to Uruguay.
Manganese: Oxides		—	2	—	All to Bolivia.
Nickel: Metal including alloys, semimanufactures	value, thousands	$15	$2	—	All to Libya.
Platinum-group metals: Metals including alloys, unwrought and partly wrought:					
Platinum	do.	$1	—		
Silver: Waste and sweepings	do.	—	$10	—	Italy $9; West Germany $1.
Tin:					
Ore and concentrate		3	190	—	Netherlands 185; Paraguay 5.
Metal including alloys, semimanufactures		1	1	—	Mainly to Uruguay.
Titanium: Oxides	value, thousands	—	$1	—	All to Chile.
Tungsten: Metal including alloys, all forms	do.	$11	—		

See footnotes at end of table.

TABLE 2—Continued

ARGENTINA: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
METALS—Continued				
Zinc:				
Ore and concentrate	7,602	7,679	—	All to Brazil.
Oxides	341	278	—	Brazil 200; Chile 47; Uruguay 30.
Metal including alloys:				
Unwrought	762	—		
Semimanufactures	11	2	—	All to Uruguay.
Other:				
Ores and concentrates	50	—		
Ashes and residues	—	10	10	
Base metals including alloys, all forms	NA	89	—	Mainly to Brazil.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	62	754	—	Uruguay 518; Spain 193; Paraguay 23.
Artificial: Corundum	—	1	—	All to Uruguay.
Grinding and polishing wheels and stones	4	13	—	Brazil 8; Uruguay 3; Chile 1.
Asbestos, crude	15	38	—	All to Uruguay.
Barite and witherite	530	676	—	Bolivia 500; Paraguay 100; Uruguay 76.
Boron materials:				
Crude natural borates	12,682	17,351	—	Brazil 16,739; Uruguay 12.
Oxides and acids	6,912	6,738	—	Brazil 4,776; Italy 773; Netherlands 632.
Cement	48,727	33,054	—	Bolivia 14,478; Brazil 9,530; Chile 8,943.
Chalk	—	5	—	All to Uruguay.
Clays, crude	19,310	11,539	4	Brazil 7,977; Chile 1,776; Uruguay 1,083.
Diatomite and other infusorial earth	42	50	—	Uruguay 40; Paraguay 10.
Feldspar, fluorspar, related materials	93	319	—	Chile 180; Uruguay 84; Paraguay 55.
Fertilizer materials: Manufactured:				
Ammonia	397	458	—	Uruguay 456; Paraguay 2.
Nitrogenous	3,279	360	—	Bolivia 170; Paraguay 100; Uruguay 90.
Phosphatic	20	—		
Potassic	6	—		
Unspecified and mixed	940	2,159	—	Paraguay 1,760; Bolivia 390; Dominican Republic 7.
Gypsum and plaster	10,065	12,350	—	Paraguay 11,155; Uruguay 1,189; Nicaragua 3.
Lime	8,216	5,430	—	Chile 5,149; Bolivia 281.
Magnesium compounds: Magnesite, crude	26	100	—	All to Chile.
Mica:				
Crude including splittings and waste	43	16	—	Chile 9; Bolivia 7.
Worked including agglomerated splittings value, thousands	—	$8	—	Uruguay $5; Bolivia $3.
Pigments, mineral: Iron oxides and hydroxides, processed	121	362	—	Uruguay 122; Colombia 71; Singapore 65.
Precious and semiprecious stones other than diamond, natural value, thousands	$152	$201	$2	West Germany $114; Hong Kong $49; Japan $22.

See footnotes at end of table.

TABLE 2—Continued

ARGENTINA: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
INDUSTRIAL MINERALS—Continued				
Salt and brine	12,738	130,608	3	Brazil 126,108; Uruguay 2,380; Paraguay 2,117.
Sodium compounds, n.e.s.: Carbonate, manufactured	100	46	—	Uruguay 43; Paraguay 3.
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked	2,406	3,083	28	Italy 1,825; Japan 598; Spain 306.
Worked	1,940	2,045	1,165	New Zealand 212; Japan 208.
Dolomite, chiefly refractory-grade	473	948	—	Chile 733; Brazil 150; Italy 46.
Gravel and crushed rock	13	5	—	All to Uruguay.
Quartz and quartzite	2	145	—	Bolivia 98; Uruguay 40; Paraguay 2.
Sand other than metal-bearing	20	—		
Sulfur:				
Elemental, crude including native and byproduct	41	195	—	Paraguay 165; Uruguay 30.
Sulfuric acid	2,955	2,136	2,112	Bolivia 23; Uruguay 1.
Talc, steatite, soapstone, pyrophyllite	98	30	—	All to Chile.
Other:				
Crude	9,375	11,226	—	Brazil 11,173; Chile 50; Uruguay 3.
Slag and dross, not metal-bearing	86	59	—	All to Belgium-Luxembourg.
MINERAL FUELS AND RELATED MATERIALS				
Asphalt and bitumen, natural	513	532	—	Chile 400; Brazil 132.
Carbon black	153,056	88,898	—	Brazil 45,671; U.S.S.R. 16,347; Netherlands 13,928.
Coal: All grades excluding briquets	3	9	—	All to Uruguay.
Coke and semicoke	82,707	53,032	—	Belgium-Luxembourg 52,618; Paraguay 407; Uruguay 7.
Peat including briquets and litter	13	—		
Petroleum:				
Crude thousand 42-gallon barrels	948	599	599	
Refinery products:				
Liquefied petroleum gas do.	234	7	—	All to Paraguay.
Gasoline, motor do.	674	268	7	Paraguay 209; Chile 33; Uruguay 16.
Mineral jelly and wax do.	55	66	—	Chile 21; Peru 16; Netherlands 13.
Kerosene and jet fuel do.	149	293	205	Paraguay 88.
Distillate fuel oil do.	1,320	526	([2])	Paraguay 524; West Germany 1.
Lubricants do.	81	101	—	Uruguay 86; Paraguay 8; Bolivia 2.
Residual fuel oil do.	4,743	2,231	2,119	Paraguay 80; Iran 6.
Bitumen and other residues do.	78	75	—	Paraguay 43; Chile 23; Uruguay 9.
Bituminous mixtures do.	3	1	—	Mainly to Paraguay.
Petroleum coke do.	555	307	—	Canada 182; Netherlands 117; Uruguay 7.

NA Not available.
[1] Table prepared by H.D. Willis.
[2] Less than 1/2 unit.

TABLE 3

ARGENTINA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS					
Alkali and rare-earth metals		21	19	8	Canada 4; France 4.
Aluminum:					
Ore and concentrate		25,739	31,325	33	China 18,870; Brazil 9,123; Guyana 3,145.
Oxides and hydroxides		356,839	239,225	995	Australia 223,989; Brazil 12,280.
Metal including alloys:					
Unwrought		11	21	—	Brazil 15; West Germany 5; Italy 1.
Semimanufactures		1,108	8,814	155	Brazil 8,041; Uruguay 121.
Antimony: Oxides[2]		1	12	NA	NA.
Cadmium: Oxides and hydroxides[2]		64	59	NA	NA.
Chromium:					
Ore and concentrate		15,572	27,558	2	Republic of South Africa 25,546; Cuba 2,008.
Oxides and hydroxides	value, thousands	$1	$13	$11	West Germany $1; Italy $1.
Cobalt: Oxides and hydroxides		11	29	21	Netherlands 4; Republic of South Africa 2.
Columbium and tantalum: Metal including alloys, all forms: Tantalum	value, thousands	$22	$27	$19	West Germany $8.
Copper:					
Ore and concentrate		—	1	—	All from Switzerland.
Oxides and hydroxides[2]		1	—		
Metal including alloys:					
Scrap		80	106	—	All from Israel.
Unwrought		48,222	50,987	96	Chile 45,712; Peru 5,138.
Semimanufactures		1,042	1,420	129	Japan 394; West Germany 326; Brazil 293.
Iron and steel:					
Iron ore and concentrate:					
Excluding roasted pyrite	thousand tons	3,128	3,342	([3])	Brazil 2,919; Venezuela 236; Peru 181.
Pyrite, roasted		5,567	4,203	—	All from Brazil.
Metal:					
Scrap		1,068	671	41	Japan 265; Belgium-Luxembourg 155; Italy 89.
Pig iron, cast iron, related materials		1,470	17,800	782	Venezuela 16,255; Brazil 476.
Ferroalloys:					
Ferromanganese		1,302	2,913	—	Brazil 2,168; Netherlands 340; Sweden 240.
Unspecified		2,536	4,079	246	Republic of South Africa 2,708; Brazil 591.
Steel, primary forms		421,094	401,000	12	Brazil 118,930; Italy 80,123; Republic of South Africa 62,248.

See footnotes at end of table.

TABLE 3—Continued

ARGENTINA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987	
				United States	Other (principal)
METALS—Continued					
Iron and steel—Continued					
Metal—Continued					
Semimanufactures:					
Bars, rods, angles, shapes, sections		17,277	18,100	290	West Germany 5,456; Uruguay 4,097; Brazil 3,999.
Universals, plates, sheets		97,045	257,948	4,476	Japan 125,090; Brazil 53,026; Belgium-Luxembourg 26,071.
Hoop and strip		4,153	5,782	385	Belgium-Luxembourg 1,522; Japan 916; Brazil 782.
Rails and accessories		437	436	153	Belgium-Luxembourg 253; West Germany 14.
Wire		4,528	4,657	14	Uruguay 2,404; Brazil 1,237; France 205.
Tubes, pipes, fittings		8,290	72,870	445	Mexico 61,992; Italy 4,317; Sweden 2,239.
Castings and forgings, rough		33	34	2	Brazil 12; Japan 12; West Germany 6.
Lead:					
Oxides		—	180	10	Peru 110; Mexico 60,
Metal including alloys:					
Scrap		—	35	—	All from Chile.
Unwrought		10	172	—	Uruguay 160; Belgium-Luxembourg 12.
Semimanufactures		3	1	([3])	Mainly from Netherlands.
Lithium: Oxides and hydroxides[2]		170	124	NA	NA.
Magnesium: Metal including alloys:					
Unwrought		840	746	426	West Germany 151; Norway 142.
Semimanufactures		63	67	60	West Germany 5; Uruguay 2.
Manganese:					
Ore and concentrate		50,578	60,353	93	Brazil 39,218; Congo 21,000.
Oxides		790	631	154	Brazil 455; Netherlands 20.
Mercury	76-pound flasks	6,150	1,305	—	Mexico 870; Netherlands 290; Spain 145.
Molybdenum: Metal including alloys, all forms		5	4	1	Austria 2; West Germany 1.
Nickel:					
Matte and speiss		29	17	([3])	Mainly from Cuba.
Oxides and hydroxides[2]		110	24	NA	NA.
Metal including alloys:					
Unwrought		538	844	148	Netherlands 488; Canada 75.
Semimanufactures		150	256	82	West Germany 41; Netherlands 35.
Platinum-group metals: Metals including alloys, unwrought and partly wrought:					
Platinum	value, thousands	$532	$340	$40	West Germany $213; Spain $72.
Silver: Metal including alloys, unwrought and partly wrought	do.	$2,924	$2,884	$1	Belgium-Luxembourg $2,714; West Germany $82; Peru $45.

See footnotes at end of table.

TABLE 3—Continued

ARGENTINA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS—Continued				
Tin:				
Ore and concentrate	131	161	—	All from Bolivia.
Metal including alloys:				
Unwrought	1,344	727	—	Brazil 669; Bolivia 58.
Semimanufactures	15	24	23	West Germany 1.
Titanium: Oxides	1,037	1,085	37	Belgium-Luxembourg 595; West Germany 216; Netherlands 91.
Tungsten:				
Ore and concentrate	10	97	—	Bolivia 79; Netherlands 18.
Metal including alloys, all forms	30	9	5	West Germany 2; Brazil 1.
Zinc:				
Oxides	35	29	1	Uruguay 17; West Germany 11.
Metal including alloys:				
Scrap	—	34	—	All from Peru.
Unwrought	4,457	5,867	—	Mexico 3,296; Spain 1,299; Peru 552.
Semimanufactures	77	46	1	Mexico 34; Italy 10.
Other:				
Ores and concentrates	2,541	2,659	65	Republic of South Africa 1,887; Bolivia 680.
Oxides and hydroxides	57	75	26	West Germany 31; Italy 13.
Ashes and residues	—	24	—	All from Chile.
Base metals including alloys, all forms	234	339	228	Republic of South Africa 31; Belgium-Luxembourg 21.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	185	290	290	
Artificial: Corundum	6,931	6,961	85	Brazil 6,503; France 177; West Germany 111.
Dust and powder of precious and semiprecious stones value, thousands	$558	$750	$667	Belgium-Luxembourg $65; Norway $11.
Grinding and polishing wheels and stones	188	209	9	Italy 130; Brazil 44; West Germany 21.
Asbestos, crude	12,701	14,324	235	Brazil 6,568; Canada 3,958; Republic of South Africa 3,116.
Barite and witherite	259	1,577	62	Bolivia 1,510; West Germany 5.
Bromine[2]	19	24	NA	NA.
Cement	1,048	1,176	91	France 427; Brazil 408; Netherlands 115.
Chalk	2	1	—	All from West Germany.
Clays, crude	25,056	34,118	14,698	Brazil 16,182; Italy 3,001.
Cryolite and chiolite	11	28	—	Denmark 25; Belgium-Luxembourg 3.

See footnotes at end of table.

TABLE 3—Continued

ARGENTINA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
INDUSTRIAL MINERALS—Continued				
Diamond:				
Gem, not set or strung value, thousands	$2	—		
Industrial stones do.	$375	$468	$81	Belgium-Luxembourg $317; Switzerland $35.
Diatomite and other infusorial earth	2,300	1,822	173	Mexico 986; Chile 663.
Fertilizer materials:				
Crude, n.e.s.	15	—		
Manufactured:				
Nitrogenous	49,165	59,470	9,568	Bulgaria 16,975; U.S.S.R. 10,996.
Phosphatic	29,348	34,911	12,531	Turkey 13,000; Brazil 3,880.
Potassic	19,518	20,651	5,914	Canada 5,500; East Germany 3,731.
Unspecified and mixed	93,894	65,421	60,348	Chile 2,025; Belgium-Luxembourg 1,728.
Graphite, natural	392	435	38	Brazil 241; Austria 40.
Gypsum and plaster	11	6	4	Japan 2.
Iodine[2]	20	16	NA	NA.
Lime	105	—		
Magnesium compounds: Magnesite, crude	15,812	20,179	54	Brazil 10,687; Mexico 6,469; China 2,046.
Mica:				
Crude including splittings and waste	2	2	2	
Worked including agglomerated splittings	6	13	3	France 3; Brazil 2.
Nitrates, crude	2,575	3,900	—	All from Chile.
Pigments, mineral: Iron oxides and hydroxides, processed	68	83	45	West Germany 30; Belgium-Luxembourg 6.
Precious and semiprecious stones other than diamond:				
Natural value, thousands	$44	$21	—	Brazil $19; Uruguay $2.
Synthetic do.	$8	$89	$71	Switzerland $10; Belgium-Luxembourg $6.
Pyrite, unroasted	3	40	—	All from West Germany.
Salt and brine	44	33	10	Belgium-Luxembourg 11; Netherlands 4.
Sodium compounds, n.e.s.:				
Carbonate, natural and manufactured	197,847	199,572	66,825	Belgium-Luxembourg 68,068; Romania 27,370.
Sulfate, natural and manufactured[2]	[r]2,727	2,384	NA	NA.
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked	3,347	1,453	—	Brazil 842; Uruguay 451; Italy 139.
Worked	575	659	—	Italy 250; Uruguay 200; Spain 198.
Dolomite, chiefly refractory-grade	463	350	—	All from Brazil.
Gravel and crushed rock	71,415	160,654	—	Paraguay 95,699; Uruguay 64,950; France 5.
Quartz and quartzite	127	281	—	Sweden 238; Belgium-Luxembourg 33; Brazil 10.

See footnotes at end of table.

TABLE 3—Continued

ARGENTINA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987	
				United States	Other (principal)
INDUSTRIAL MINERALS—Continued					
Stone, sand and gravel—Continued					
Sand other than metal-bearing		(4)	211,024	9,127	Uruguay 199,944; Brazil 1,952.
Sulfur:					
Elemental:					
Crude including native and byproduct		110,571	105,896	11,990	Canada 89,905; Colombia 4,000.
Colloidal, precipitated, sublimed		23	22	21	West Germany 1.
Sulfuric acid		5,174	2,287	—	Mainly from Uruguay.
Talc, steatite, soapstone, pyrophyllite		382	1,049	31	China 782; Uruguay 94; Brazil 84.
Other:					
Crude		5,609	7,637	364	Brazil 4,388; Belgium-Luxembourg 910; Republic of South Africa 848.
Slag and dross, not metal-bearing		365	368	2	Brazil 216; Uruguay 150.
MINERAL FUELS AND RELATED MATERIALS					
Asphalt and bitumen, natural		133	77	77	
Carbon black		767	617	378	West Germany 81; Belgium-Luxembourg 73.
Coal:					
Anthracite and bituminous excluding briquets	thousand tons	1,092	1,110	663	Poland 212; Australia 181.
Lignite including briquets		100	100	100	
Gas, natural	million cubic feet	78,204	74,906	—	All from Bolivia.
Peat excluding briquets and litter[2]		20	100	NA	NA.
Petroleum:					
Crude	42-gallon barrels	7	—		
Refinery products:					
Liquefied petroleum gas	do.	12	1,467,608	—	Algeria 509,971; Saudi Arabia 309,662; United Arab Emirates 98,565.
Gasoline, motor	do.	6,621	1,126,539	2,661	Netherlands 747,558; Brazil 237,226; Tunisia 138,490.
Mineral jelly and wax	do.	6,390	7,114	2,330	Brazil 3,038; Spain 897.
Kerosene and jet fuel	do.	39	1,461,774	8	Italy 360,600; Spain 350,726; Brazil 333,932.
Distillate fuel oil	do.	—	4,003,752	485,862	Saudi Arabia 836,259; U.S.S.R. 553,741.
Lubricants	do.	28,553	477,722	6,972	Brazil 191,338; Spain 183,925; Italy 43,085.
Residual fuel oil	do.	—	5,126,955	751,275	U.S.S.R. 1,393,239; Trinidad and Tobago 808,064.
Bitumen and other residues	do.	—	109	—	All from West Germany.
Bituminous mixtures	do.	61	—		
Petroleum coke	do.	28	847	847	

[r] Revised. NA Not available.
[1] Table prepared by H. D. Willis.
[2] Estadistica Minera de la Republica Argentina, 1988.
[3] Less than 1/2 unit.
[4] Quantity not available, valued at $627,000.

eral firms were involved in converting primary aluminum ingots into different aluminum products. These firms included Camea S.A., Uboldi S.A., and Kicsa. Kicsa, which was the most important in the production of aluminum products, employed more than 600 workers. In 1987, Kisca spent $7 million to expand its rolling mill. In 1988, Kicsa planned to introduce more modern equipment, for a total investment of $22 million, to double aluminum foil output and to produce aluminum cans for beverages. The company expected that the domestic demand for primary aluminum would increase by an estimated 10,000 tons per year.

Copper.—By yearend, the Provincial government of Mendoza planned to auction the Paramillos Sur copper deposit. Bids, which were open to both national and foreign companies, were to be presented to the Dirección de Minería in Mendoza by October 31. The winner would have to pay 25% of the value immediately and the balance within 24 months. The Paramillos Sur deposit, 75 kilometers north of the Provincial capital, Mendoza, has not been mined since the 1960's. Studies, during the 1964–68 period, under the "Plan Cordillerano," indicated 186 million tons of ore reserves with an average grade of 0.58% copper with economically recoverable gold and molybdenum values.

The Paramillos Sur copper deposit consists of nine concessions of 100 hectares each. Development of the El Pachón copper project also has been delayed several times. In 1984, El Pachón S.A. invited several firms to study the feasibility of producing copper through the application of bacterial leaching. The results indicated that El Pachón ore would be amenable to this method of processing. At yearend, the company was updating estimated investment costs for the El Pachón project. The proposed project would consist of an open pit mine, a modular pad complex to leach the copper, and a solvent extraction electrowinning plant to produce metallic copper for domestic consumption. Plans were to operate at an annual rate of 30,000 tons of metallic copper. According to the current measured ore reserves, the mine would have a life of 80 years. The total cost for the El Pachón project, using the bacterial leaching process, was estimated at $140 million, including preproduction expenditures, initial working capital, miscellaneous items, and inflated costs up to the year 1989.

Gold and Silver.—The Farallón Negro Mine in Catamarca Province and the Angela Mine in Chubút Province were the main sources of gold output. Silver output increased 24.3% to 2.4 million troy ounces. The Farallón Negro Mine and other properties in the mining district are owned by Yacimientos Mineros Agua de Dionisio (YMAD), a state enterprise that is controlled by the Provincial governments of Catamarca and Tucumán. The district, in addition to the Farallón Negro Mine, includes the large Bajo de la Alumbrera copper-gold-silver-molybdenum deposit, the Alto de la Blenda lead-zinc-silver deposit, the Cerro Atajo, and the La Josefa gold-copper deposits. In 1987–88, YMAD built a 9,000-square-meter heap-leaching pad at the Farallón Negro Mine to process low-grade ores, previously discarded as waste. YMAD also continued to study the Bajo de la Alumbrera polymetallic deposit, 4 miles southeast of Farallón Negro to recover gold on a pilot basis using the heap-leaching facilities available at Farallón Negro Mine.

Cerro Castillo S.A., an operator in Río Negro Province, projected that the company would increase the country's gold output by one-third in 1989. The gold is a byproduct of its beneficiation process which also produces lead, zinc, copper, and silver concentrate. The company mines about 80,000 tons of ore per year, recovers 3,000 tons of polymetallic concentrates and 7,000 tons of zinc concentrate, and earned more than $6 million in exports in 1988.

BHP-Utah International Minerals, based in San Francisco, California, United States, presented an investment and exploration proposal to the mining authorities of Córdoba Province. BHP-Utah proposed to finance a precious metals exploration program in the Cruz del Eje region in Córdoba Province, where the Mining Secretariat discovered promising occurrences. The Mining Secretariat, through a technical and legal commission, is currently studying BHP-Utah's proposal.

The Provincial government of Neuquén, in south-central Argentina, and the Dirección General de Fabricaciones Militares (DGFM), a state enterprise, announced a public tender for a feasibility study, with an option for exploitation and beneficiation of gold deposits, in reserve areas of the Andacollo District, Minas Chos Malal in Neuquén Province. The Corporación Minera de Neuquén Sociedad del Estado Provincial (CORMINE S.E.P), holders of the mining concession, announced that the bid packages would be opened on January 10, 1989. The area to be studied covers more than 100,000 hectares in the districts of Las Ovejas, Narvarco, Las Lagunas, and Cerro Mayal.

Compañía Minera Tea S.A. and Unión Transitoria de Empresas, a partnership formed by Cía. Minera Aguilar S.A. and Kantek S.A., invested $7 million to explore a gold deposit in the Andacollo district, in west-central Argentina near the Chilean border.

Several domestic and international firms showed an interest in exploring the Cerro Vanguardia gold deposit located 110 kilometers northeast of the port of San Julian in southern Argentina. This gold deposit was discovered by the Provincial government of Santa Cruz, and according to preliminary studies, it assays 12 grams per ton. Fomento Minero de Santa Cruz (FORMICRUZ) was set up to coordinate all exploration and development programs in the deposit area. Canadian and South African firms reportedly had expressed an interest in the Cerro Vanguardia gold deposit.

The Swedish state mining agency Sveriges Geologiska and Yacimientos Mineros Riojanos-Sociedad de Economía Mixta (YAMIRI-SEM) signed an agreement with the government of La Rioja Province, in northern Argentina, to carry out a feasibility study on the gold-bearing deposits at Sierra de las Minas, Rosario Vera Peñaloza, and Ulapes in the Department of San Martin. This is the second agreement signed between the two firms and the state; the first was for the exploration and development of the La Mejicana gold deposit in La Rioja Province in 1987.

The French agency Bureau de Recherches Geologiques et Minieres (BRGM) concluded the first stage of a lead-silver-nickel deposit study in La Rioja Province. Future efforts will concentrate on prospecting for gold, silver, lead, platinum, and zinc deposits in the northeastern, northwestern, and western regions of Argentina. The French technicians will be assisted by specialists from the Mining Secretariat and from each region taking part in the study. The program will span an 18-month period.

A technical group of geologists and mining engineers from the Federal Republic of Germany's agency for technical cooperation collected data for an analysis of the Hualilál gold deposit in San Juan Province and La Florida tungsten deposit in San Luís. The group will prepare a feasibility study for both projects.

Iron Ore.—The primary sources of iron ore included Zapla deposit in Jujuy Province and Sierra Grande deposit in Río Negro Province. The iron ore extracted in Zapla was fed to the Altos Hornos Zapla steel plant, and the ore from Sierra Grande was transformed into iron ore pellets for the Sociedad Mixta Siderurgia Argentina (SOMISA) steel plant. The balance of output was used for the elaboration of high density drilling mud and cement. However, the national production of iron ore concentrate and pellets was not sufficient to satisfy the increasing demand from the production of primary iron (pig iron and sponge iron). As a result, the country had to import iron ore from Brazil, Venezuela, and Peru. According to the Instituto Argentino de Siderurgia, the national consumption of iron ore in different forms was over 2 million tons, of which 23% was imported in the form of pellets and 38% was in the form of sinter and 38% was in the form of iron ore, with a total value of $85 million.

Iron and Steel.—Steel production appeared to have been affected during the first semester by the shutdown of one of SOMISA's blast furnaces for almost 4 months. Sales of steel products declined from 2.1 million tons in 1987 to 1.9 million tons in 1988, and steel exports increased from 980,000 tons in 1987 to 1.4 million tons in 1988. The principal iron and steel producers in Argentina were SOMISA, Industria Argentina de Aceros S.A. (ACINDAR S.A.), SIDERCA (Formerly Dálmine Siderca) Propulsora Siderúrgica S.A.I.C., Establecimientos Altos Hornos Zapla (DGFM), Aceros Bragado S.A.C.I.F., Hierro Patagónico de Sierra Grande S.A.M. (HIPASAM), La Cantábrica S.A. Metalúrgica Industrial y Comercial, and La Basconia S.A. During the past decade, the Argentine steel industry experienced transformation and technological improvements that have enabled it to compete economically in international markets. Output has been adequate to satisfy domestic demand with a great variety of high-quality products, as well as to substitute for imported steel products.

Faced with the likelihood of a continuing decline in domestic steel demand in 1988, Argentine steel producers were seeking to increase exports in order to maintain production rates. The producers export annually more than 1 million tons of steel products or about one-third of the country's total output.

Domestic steel consumption declined in 1988 because the Government's new economic program, introduced in October 1987, continues to depress the economy through a price and wage freeze. Restrictions on iron and steel imports were ended and replaced with a 20% ad valorem tax on the f.o.b. price.

Steel has become the leading export commodity from the industrial sector. From export revenues of $150 million in 1980, the total reached nearly $700 million in 1988; 1989 figures were expected to be around the $900 million level. In 1988, SOMISA and SIDERCA were the two leading steel producers in the country with exports valued at $122 and $120 million, respectively, followed by Propulsora Siderúrgica with $60 million and ACINDAR with $50 million.

A sales contract for $380 million was signed between SIDERCA and China National Metals and Minerals Imports and Export Corp. (MINMETALS) as part of a trade agreement reached between the two countries. Under the agreement, Argentina will supply China with 380,000 tons of oil transport pipeline over 3 years, to be distributed as follows: 100,000 tons in 1989; 130,000 tons in 1990; and 150,000 tons in 1991.

***Industrial Minerals.*—Bentonite.**—Argentina is the only country in Latin America that exports natural sodium bentonite. Minarmco S.A., owned by ARMCO of the United States, is the largest and most modern producer of bentonite in Argentina. Competing with Minarmco are four major companies based in Neuquén and Río Negro Provinces, plus several smaller companies in San Juan and Mendoza Provinces. Minarmco began to produce bentonite in 1982, and initiated exports in 1986. In 1988, Minarmco produced 30,000 tons of bentonite of which 3,000 tons was exported. National production of bentonite declined 25% from the peak year of 1985. Total domestic demand for bentonite was approximately 80,000 tons per year. Argentina's exports of bentonite went primarily to Brazil and, to a lesser extent, to Chile, Uruguay, and others. Exports to Brazil are exclusively for metal casting because Petroleos Brasileiros purchases activated calcium bentonite produced in Brazil. Minarmco and other producers are expected to begin exporting bentonite to the Middle East petroleum producing countries.

Boron.—According to estimates, Argentina ranked fourth in the world as a boron producer after the United States, Turkey, and the U.S.S.R. Production of boron minerals increased by 6% compared with that of 1987. In terms of foreign exchange generated, this industry ranked first among all mining industries in the country. More than 90% of the boron minerals and derivatives produced in Argentina, mainly sodium borate, and 67% of the boric acid output were exported. Brazil was the largest importer of Argentine borates; smaller amounts went to Uruguay, Chile, Mexico, Bolivia, the Netherlands, Venezuela, the Republic of South Africa, Italy, and the Federal Republic of Germany. The largest boron mineral producer in Argentina was Cía. Boroquímica S.A.M.I.C.A.F., owned by Río Tinto Zinc Corp. Ltd. and Industrias Químicas Baradero S.A. Boroquímica has an installed annual capacity of 37,000 tons at its plants in Campo Quijano and Tincalayu in the Province of Salta. Exports from Argentina reached 26,500 tons in 1988. Borates were produced from hydrous borocite (magnesium borate), tinkal (sodium borate), colemanite or borocalcite (calcium borate), and ulexite (sodium and calcium borate). The largest boron deposits in Argentina are in the Andean region in the Provinces of Catamarca, Jujuy, and Salta. Studies of these minerals indicate that there are similarities between the boron deposits in Kirka, Turkey, and the Argentine Tincalayu deposit, and between the Birgadic and Emet, Turkey, deposits and those of pastos Grandes in Argentina. The Kramer deposit in the United States is also similar to the Kirka and Tincalayu deposits.

Granite.—Production of granite blocks and in crushed form increased 22% and 30%, respectively, compared with that of 1987. The production of granite in blocks takes place in quarry operations located in Buenos Aires, Córdoba, Río Negro, La Rioja, and San Luis Provinces. The largest granite block producers are: Cía., Carlos Campolonghi S.A., in Buenos Aires and San Luis Provinces; Leme A. Mena y Cía. and Corp. Cementera Argentina, in Córdoba; and Alessandrini Hnos., in Río Negro Province.

Approximately 90% of the crushed granite comes from the Provinces of Buenos Aires, Córdoba, and Santiago del Estero.

Exports of granite, generally in the form of blocks approximately 3 by 1.30 by 0.80 meters, are mostly to Italy, Japan, France, Spain, Israel, the Federal Republic of Germany, and Singapore. Granite manufactures are exported as polished sheets or plates and floor tile, paving tile, or flagstone to Japan, the United States, Saudi Arabia, Canada, Australia, and the United Arab Emirates. The value of these exports was $1.4 million in 1988.

Four technicians from the Italian firm Technostone have been in Córdoba Province putting together a plan for a survey of the granite resources in the Province. Work will take place in the Cruz del Eje Department, where the second stage of the project will begin with the installation of a granite pilot plant in Villa de Soto. It was expected that the volume of high-quality granite reserves in the area will be higher than previously thought and could turn the province into a leading national producer. Relevant construction and infrastructure will be extended by Argentine companies, with the exception of a 5,000-square-meter storehouse, which Technostone will ship from Italy.

Mineral Fuels.—**Coal.**—Production of bituminous coal rebounded from the depressed levels of prior years. Yacimientos Carboníferos Fiscal (YCF), the country's coal producer, mines coal from the Río Turbio Mine, which is in the southwest corner of Santa Cruz Province, 16 kilometers east of the Chilean Port of Puerto Natales. Under a 5-year plan for the exploration of Argentine coal reserves in the Patagonia region, YCF planned to increase annual coal production to 650,000 tons by 1988 and to 1.6 million tons by 1992. Thus, 1988 production fell short of the level expected by the company. Argentina's potential coal reserves were estimated in 1988 at more than 5 billion tons of probable steam coal. This was in addition to the proven reserves currently under exploitation in Río Turbio.

By yearend, the Secretariat of Energy reported that proven steam coal reserves in the Río Turbio Mine increased by 32% to 182 million tons. The 5-year exploration program, which ended in August, was financed by a $10 million loan from the World Bank and additional assistance of $10 million from the National Energy Fund. The exploration program included the coalbeds in an area known as the Cancha Carrera in Río Turbio. The program also included a feasibility study of mining the coking coal reserves with financial assistance from the National Energy Fund and from the Argentine Steel Institute. The goal of the project was to eliminate imports of coking coal, which reached a level of more than 1,000,000 tons at a cost of over $50 million.

Natural Gas.—Natural gas production increased almost 19% to a record high. To supplement domestic natural gas production, Argentina imported an estimated 78,700 million cubic feet of gas from Bolivia, 5.1% more than in 1987, for an estimated value of $215 million. Natural gas was imported under a bilateral agreement between Argentina and Bolivia, due to expire in 1992.

Of the total production of natural gas during the year, 16% was used by home consumers, 15% in thermoelectric plants, 32% in industrial plants (including petrochemical plants), 4% was consumed at the production site, 14% was flared or vented, 8% was reinjected into the reservoirs for repressuring, and 11% represented losses. Proven recoverable resources of natural gas now stand at 700 billion cubic meters (24.7 trillion cubic feet), most of which is in the Neuquén Basin. The most important project underway during the year was the construction of the NEUBA II natural gas pipeline, which, together with the extension to the northern gas pipeline, was scheduled to start operating in 1989. Construction of this gas pipeline, per agreement signed in early February, will enable delivery of natural gas from Loma de La Lata and other nearby gasfields in Neuquén Province at a flow rate of up to 918 million cubic feet per day. The NEUBA II pipeline will run through the Provinces of Neuquén, Río Negro, La Pampa, and Buenos Aires to the federal capital and will consist of 667,000 meters of 36-inch-diameter pipe, 686,000 meters of 30-inch-diameter pipe, and 4,700 meters of 24-inch-diameter pipe, for a total length of 1,358 kilometers. Pipeline construction was by a joint venture of the Argentine group TECHINT and the Mexican firm PROTEXA, for a total cost of approximately $460 million.

Expansion of the northern gas pipeline will increase its delivery capacity by 42%, from 360 to 512 million cubic feet per day. Investment costs are estimated at $200 million, of which the International Development Bank will contribute $60 million for the acquisition of equipment and imported steel plate for the local pipe manufacture.

The Progas consortium, composed of Sofregas (France), Montreal Engenharia (Brazil), and Ecofisa-Calix (Argentina), presented to the Secretariat of Energy a gas recovery project estimated to cost $290 million. The project included the provision of equipment as well as the construction and installation of facilities in Neuquén, which would allow the extraction of the richest fraction of the natural gas delivered by existing gas pipelines, to be mixed with the natural gas delivered by the Neuquén-Bahía Blanca-Buenos Aires gas pipeline currently under construction. The Neuba gas enriched in this manner would be reprocessed at Bahía Blanca, where the richest fractions would be extracted.

At the third meeting of Governors from the northern provinces, construction of a gas pipeline from Salta Province to the northeastern provinces of the country and into Brazil was proposed. The project was expected to earn $1.2 billion yearly from the exploitation of gas reserves in the northern fields. These fields have estimated reserves of 140 million cubic meters (4.9 billion cubic feet). The provincial Governors pledged technical and financial support for this regional project.

Petroleum.—Crude oil production increased 5.2% compared with that of 1987 reversing the recent downtrend. Argentina, an exporter of crude oil and oil products from 1981 to 1986, became an importer again in 1987 requiring $260 million in foreign exchange. In 1988, however, the situation was beginning to reverse because the country required $84 million for imports. In 1988, there were limited exports of crude oil and oil products. Argentina's energy sector remained dominated by the state-owned Yacimientos Petrolíferos Fiscales (YPF). YPF contracts 32% of national oil production to the private sector while accounting for 66% of the total; the remainder is produced by concessions. Nationalistic forces have fought to keep the dominant part of petroleum production as a state-controlled operation claiming that petroleum resources are a vital part of the national patrimony. At the same time, the Government's inability to adequately develop petroleum resources to meet domestic demand have resulted in costly oil imports. Therefore, the Government has turned increasingly to the private sector to boost the country's petroleum production. In 1985, the Government developed the Houston Plan, designed to attract private investment for high-risk areas. To date, three international tenders have been issued under the Houston Plan, and a fourth was to be launched later in 1989. In 1987, in response to the continued fall in production levels, the Government developed the Olivos Plan to provide higher price incentives for private operators under concessions. The Olivos Plan was not implemented until May 1988. At yearend, the Government was planning another production plan, the Petroplan, for 1989, which was designed to attract private capital into areas previously reserved for YPF.

Uranium.—Production of yellowcake (U_3O_8) increased 38% to an estimated 155 tons compared with that of 1987. Approximately 25% of the total was produced from two private operations, the largest of which was the Los Gigantes deposit in Córdoba Province. The rest was produced from several deposits operated by the Atomic Energy Commission (CNEA). A feasibility study was completed in 1988 to activate the Sierra Pintada deposit in San Rafael, Mendoza Province. During 1988, exploratory work was carried out in the Provinces of Córdoba and Salta.

Argentina continued efforts to market its nuclear technology to developing nations. In December, the Government inaugurated a nuclear power reactor in Huarangal, Perú, 38 kilometers from Lima. The 10-megawatt reactor, built by the CNEA, was estimated to cost $110 million. The reactor uses 20% enriched uranium, and is designed for the production of radioisotopes for export to the South American market. As part of the 1984 bilateral nuclear cooperation agreement with Algeria, a contract was signed in May 1985 for Argentina to construct a 1-megawatt research reactor to be called NUR (Arabic for brightness) in Dradi, 10 kilometers from Algiers. Construction began in 1987, and installation of the reactor was scheduled for the summer of 1988. The NUR reactor will use 20% enriched uranium shipped from Argentina. Argentina provided on-site technicians to supervise the construction, and trained Algerian technicians in Bariloche, Argentina. To keep the export program alive, the Government was considering future agreements with Iran, India, Saudi Arabia, Egypt, Syria, Turkey, Romania, Albania, and the U.S.S.R.

CHILE[4]

Introduction

Chile retained its dominant role as the leading producer and exporter of copper, accounting for 22% of the output of the market economy copper countries. Chile is also the world's largest producer and exporter of potassium and sodium nitrate. Chile ranked second in world output of iodine, lithium, molybdenum, and rhenium; fifth in boron; seventh in selenium; eighth in silver; and ninth in gold. In addition, Chile possesses approximately 23% of the world's copper reserves, as well as important reserves of lithium, 58%; rhenium, 40%; iodine, 23%; selenium, 21%; and molybdenum, 20%. Chile's production of copper reached a new historical level in 1988. The mining sector's contribution to the total export value was $4.1 billion[5] or 58% of the total. Corporación Nacional del Cobre de Chile (CODELCO-Chile) is the largest copper producer in the world, contributing about 74% of the total Chilean copper output and about 14% of the Western World's needs. Despite the various problems that beset CODELCO-Chile, 1988 was a profitable year for the company. The net profit of $587 million represented an increase of $320.2 million over that of the previous year. CODELCO-Chile contributed $1.5 billion to the Chilean Treasury in terms of profit sharing and taxes, compared with almost $600 million in 1987. A significant part of the higher profit was attributed to the substantial increase of the price of copper. The average copper price on the London Metal Exchange was $1.18 per pound, almost 37% higher than the average price in 1987.

Preliminary data of the Central Bank of Chile indicated the GDP grew 7.4%, to just above $22.1 billion. In terms of current dollars, this was the second highest rise in the GDP in Latin America. After a slight growth in 1987, output in the mining sector grew 4.2% in 1988, compared with 7.4% for the economy as a whole. This slower growth rate was due to production problems in CODELCO-Chile.

Government Policies and Programs

Most of the legal provisions concerning mining activities in Chile have been developed since 1980 and are still relatively new. The use of chapter 19 debt-to-equity swaps for foreign investment in the mining sector had been growing during the past 2 years and was expected to increase in 1989. However, the availability of the chapter 19 debt-to-equity swap program after March 1990 will depend on political developments. The chapter 19 provisions in Chile's foreign exchange regulations were instituted by the Central Bank of Chile as a mechanism for reducing the country's external debt.

Several large foreign mining companies have used or were planning to use chapter 19 provisions to finance specific portions of their large projects. Utah International Inc. used it to finance a small part of its $200 to $250 million Cía. Minera Salar de Atacama's (MINSAL) potassium chloride, potassium sulfate, boric acid, and lithium carbonate project. There were indications that chapter 19 may also be used in the development of Empresa Nacional de Minería (ENAMI) Quebrada Blanca gold project and the expansion of Placer Dome Inc. of Canada's La Coipa gold project. Although chapter 19 is not the most attractive mechanism for most large mining projects, it is an attractive alternative for specific non-profit-generating portions of the same projects. This is because chapter 19 debt-to-equity regulations require a 10-year waiting period prior to repatriation of capital. A 4-year waiting period is required for the repatriation of profits in percentages that do not exceed 25% of the original investment in any year.

Foreign banks have a strong incentive to use chapter 19 to diversify their portfolios by using the debt swap mechanism. The recent rise in precious and base metals and iodine prices in the world markets has caused mining projects to be among the most attractive investment opportunities in Chile. The use of chapter 19 has given great support to the development of mining activity in Chile, primarily in allowing medium-size investments to be made in high-potential deposits. Since 1985, approximately $100 million has been invested according to chapter 19 regulations specifically in the mining sector, which corresponds to more than 7% of the total chapter 19 investments in all sectors of the economy.

According to Chile's Foreign Investment Committee, total authorized investment rose to $1.95 billion, compared with $563 million in 1987. Mining was the sector that attracted the largest investment with $1.33 billion; followed by services, $490 million; and industry, $91 million.

Actual investment rose to $787 million, compared to $497 million in 1987. Of this total investment, $358 million went to the mining sector, $323 million to services, and $102 million to industry.

Production

The 16 leading minerals produced in Chile were coal, copper, gold, iodine, iron ore, lead, lithium carbonate, manganese, molybdenum, sodium and potassium nitrates, natural gas, crude oil, petroleum products, silver, sodium sulfate, and zinc. Output of 5 of these minerals decreased while production for the other 11 increased. The production of fine copper increased 4.2% to 1.47 million tons, a record high. Molybdenum, doré metal, and sulfuric acid were produced as byproducts of copper. CODELCO-Chile accounted for 74% of the country's total copper output and all of the output of molybdenum. The small- and medium-size mining sector produced the remaining 26% of the copper.

Trade

Mineral exports accounted for 58% of Chile's total exports, followed by the industrial sector with 30% and the agricultural sector with 12%. The latest figures from the Central Bank of Chile reveal that the nation's total mineral export earnings were up 49%, to $4.1 billion, mainly due to a bullish copper market. Copper exports were valued at $3.4 billion, up almost 61% accounting for 82% of the total minerals exported. Increases in export value of other commodities were as follows: Nitrates and iodine, 23%; gold, 14.4%; iron ore and pellets, 8.7%; molybdenum, 8%; silver, 3%; and other minerals, 12%. Of the copper exported, 59% was electrolytic copper in the form of wire bars and cathodes, 15% was fire-refined copper, 15% was blister copper, and the remaining 11% was copper contained in concentrates. Of the total copper exported, 1.1 million tons was produced and shipped by CODELCO-Chile, and the remainder was sold by private companies. Earnings by CODELCO-Chile from copper exports totaled $2.9 billion, about $983 million more than in 1987. CODELCO-Chile's shipments of molybdenum amounted to about 16,300 tons of contained molybdenum for a value of about $148 million. Shipments by CODELCO-Chile of other byproducts included doré metal and rhenium.

Commodity Review

Metals.—**Copper.**—Chile continued as the leading producer and exporter of copper in the world, and contributed 82% of the value of mineral exports. Most of the increase in Chile's export revenue can be attributed to a 61% rise in copper prices. The f.o.b. value of the copper exports was approximately $3.4 billion, a 61% increase compared with that of 1987. CODELCO-Chile, the largest copper producer in the world, produced 74% of the total national output. The small- and medium-size mining sectors, which produced 24% and 2%, respectively, accounted for the rest of the output. The output of 1.1 million tons of fine copper attained by CODELCO-Chile was slightly larger than the level achieved in 1987. In addition, CODELCO-Chile produced 63,802 tons of copper cathodes through custom electrolytic refining. In all, 98.2 million tons of sulfide and oxide ores was processed during the year. CODELCO began the year with a production target of 1.2 million tons, a figure that was ultimately reduced to 1.1 million tons. The reduction was due to a number of factors including rock bursts in one of the operating levels of the El Teniente Mine in December 1987, rapidly declining ore grades in the El Salvador Div., a fire in the Andina Div., and the startup problems and a subsequent explosion in the new flash oven at the Chuquicamata Div.

ENAMI, Chile's national mining company, produced 109,000 tons of copper, a decrease of 4.5%. This decrease was caused by fewer deliveries and declining ore grades from Chile's small- and medium-size mining companies. Minera Disputada de las Condes S.A. (a subsidiary of Exxon Minerals Chile Inc.) increased its production to 125,100 tons of copper during its first full year of production from its recently expanded El Soldado Mine.

Because of declining copper ore grades, Anglo-American Corp.'s Empressa Minera de Mantos Blanco's production declined to 79,000 tons, and the Sociedad Minera Pudahuel S.A.'s production declined to 13,000 tons. Chile's gold producers, principally Bond International Gold's Compañía Minera El Indio, increased production to 30,100 tons from a heap-leaching process of lower grade ores.

There was considerable activity in exploration and evaluation of major investments in large copper mines. The best known is the La Escondida copper project, which was well advanced and expected to add 320,000 tons per year to Chile's copper production. By 1993–94, when CODELCO-Chile's expansion projects come on-stream, Chile's copper production is estimated to reach 2.8 million tons per year. Phelps Dodge Corp. (Ojos del Salado Mine) and Exxon (Los Bronces Mine) are studying expansion methods to increase production at their mines to 90,000 tons each. Cerro Colorado, a property that was found to be marginal as a flotation beneficiation project, has been revived by Río Algom Ltd. of Canada as a possible bacterial leach operation to produce 40,000 tons per year of copper cathodes. Los Pelambres, owned by the LUKSIC Group, was being evaluated for application of an electrowining process at a 40,000-ton-per-year level. Both of these leach projects have a competitive advantage over other locations in the world because of the large surplus of sulfuric acid generated in Chile by the pollution-control programs. The LUKSIC Group, owned by the Chilean-Yugoslav LUKSIC Group through Dolberg Finance Corp., is the largest of the domestic operations in Chile, with copper production of about 30,000 tons per year. The group has controlling interest in Cía. Minera Carolina de Michilla, Anaconda South America Inc., and Cía. Minera Cerro Centinela S.A. The latter, an operating company, holds controlling interest in Cía. Minera Cerro Negro, Santa Margarita de Astillas, Combarbalá, and Illapel Mines.

TABLE 4

CHILE: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1984	1985	1986	1987[p]	1988[p]
METALS						
Arsenic trioxide[e]		3,500	4,000	4,000	[3]3,616	[3]3,207
Copper:						
Mine output, Cu content[4]		1,307,503	1,359,840	1,395,781	1,412,936	1,472,041
Metal:						
Smelter, primary[5]		1,098,300	[r]1,088,400	1,123,900	1,106,900	1,189,400
Refined:[6]						
Fire, primary refined[e]		183,000	180,900	[r]185,100	[r]180,300	[e]200,902
Electrolytic[e]		696,700	703,400	757,200	[r]790,000	[e]811,898
Total		**879,700**	**884,300**	**942,300**	**970,300**	**1,012,800**
Gold, mine output, Au content	troy ounces	541,064	554,278	576,719	547,678	662,755
Iron and steel:						
Iron ore and concentrate:						
Gross weight	thousand tons	6,685	6,534	6,981	6,690	7,866
Fe content[e]	do.	3,991	3,967	[3]4,197	4,078	4,801
Metal:						
Pig iron	do.	594	580	591	617	776
Ferroalloys:						
Ferromanganese		4,890	6,330	6,277	6,614	6,899
Ferrosilicomanganese		—	755	1,706	1,232	681
Ferrosilicon		6,365	4,501	3,732	4,258	5,685
Ferromolybdenum		2,211	671	1,397	885	1,190
Other		—	—	247	502	2,211
Total		**13,466**	**12,257**	**13,359**	**13,491**	**16,666**
Steel, crude[7]	thousand tons	692	689	706	726	899
Semimanufactures (hot-rolled)	do.	473	442	481	502	659
Lead, mine output, Pb content		4,284	2,473	1,501	829	1,359
Manganese ore and concentrate:						
Gross weight		26,807	35,631	31,631	31,803	43,655
Mn content		8,680	11,865	11,097	10,821	14,511
Molybdenum, mine output, Mo content		16,861	18,389	16,581	16,941	15,527
Rhenium, mine output, Re content	pounds	14,198	12,266	18,609	14,471	[e]15,300
Selenium	kilograms	25,450	50,037	47,000	45,909	44,051
Silver	thousand troy ounces	15,766	16,633	16,078	16,068	16,284
Zinc, mine output, Zn content		19,168	22,288	10,504	19,618	19,182
INDUSTRIAL MINERALS						
Barite		21,722	54,494	53,121	52,109	43,135
Borates, crude, natural (ulexite)		3,985	4,773	6,440	13,438	32,122
Cement, hydraulic	thousand tons	[r]1,400	[r]1,424	1,434	1,594	1,833
Calcite	do.	—	—	2,757	2,972	2,900

See footnotes at end of table.

TABLE 4—Continued

CHILE: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1984	1985	1986	1987[p]	1988[p]
Clays:						
Kaolin		48,608	48,537	42,170	44,533	54,129
Other (unspecified)		[r]18,543	9,177	14,215	15,975	21,067
Diatomite		1,712	2,317	2,684	3,218	2,919
Feldspar		3,026	2,565	2,275	705	4,453
Gypsum:						
Crude		167,477	195,911	192,848	235,173	315,798
Calcined		44,818	57,222	60,452	92,441	92,135
Iodine, elemental		2,661	3,020	3,076	3,115	4,035
Lapis lazuli	kilograms	9,000	8,500	[e]8,000	—	—
Lime, hydraulic[e]	thousand tons	778	800	800	750	750
Lithium carbonate		2,110	4,508	4,458	6,139	7,332
Nitrogen: Natural crude nitrates:						
Sodium		595,360	621,330	617,010	556,240	546,560
Potassium		132,100	150,000	147,100	165,070	181,020
Total		**727,460**	**771,330**	**764,110**	**721,310**	**727,580**
Phosphates:						
Guano		NA	3,150	7,546	5,605	4,052
Rock		4606	7,110	6,684	10,389	9,161
Total		**4,606**	**10,260**	**14,230**	**15,994**	**13,213**
Pigments, mineral, natural: Iron oxide		16,113	8,224	4,404	8,145	8,542
Potash, K_2O equivalent		18,494	21,000	20,000	23,110	25,343
Pumice (includes pozzolan)		172,150	206,333	222,080	242,453	277,179
Quartz, common		293,465	267,510	293,218	350,488	420,797
Salt, all types		625,760	753,427	1,032,373	865,168	1,042,466
Sodium compounds, n.e.s.: Sulfate[8]		56,770	52,700	58,700	60,406	79,079
Stone:						
Limestone	thousand tons	2,326	2,470	2,757	3,017	3,647
Marble		1,440	1,300	NA	NA	1,152
Sulfur:						
Native, other than Frasch:						
Refined		13,685	14,755	13,297	14,917	16,924
Caliche		40,279	63,992	43,826	22,131	20,725
Byproduct, (from smelters and oil refining)		32,135	30,073	41,142	335,116	416,266
Total		**86,099**	**108,820**	**98,265**	**372,164**	**453,915**
Talc		422	1,299	2,257	980	1,070
MINERAL FUELS AND RELATED MATERIALS						
Coal, bituminous and lignite	thousand tons	1,323	1,384	1,454	1,750	2,122
Coke: Coke oven	do.	278	291	294	297	287
Gas, natural:						
Gross	million cubic feet	172,971	163,790	153,866	153,709	151,110
Marketed	do.	53,431	50,535	42,342	37,215	42,631

See footnotes at end of table.

TABLE 4—Continued

CHILE: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1984	1985	1986	1987[p]	1988[p]
MINERAL FUELS AND RELATED MATERIALS—Continued						
Natural gas liquids:						
Natural gasoline	thousand 42-gallon barrels	962	945	893	898	893
Liquefied petroleum gas	do.	2,956	2,916	2,716	2,767	2,662
Total	**do.**	**3,918**	**3,861**	**3,609**	**3,665**	**3,555**
Petroleum:						
Crude	do.	14,069	13,048	12,204	10,922	8,934
Refinery products:						
Gasoline:						
Aviation	do.	56	25	82	50	53
Motor	do.	8,233	8,246	7,793	9,438	10,374
Jet fuel	do.	1,264	1,195	1,372	1,632	1,659
Kerosene	do.	855	755	969	1,323	1,439
Distillate fuel oil	do.	8,064	8,749	9,661	11,653	13,154
Residual fuel oil	do.	5,982	5,566	5,642	5,983	6,595
Liquefied petroleum gas	do.	5,114	4,831	5,044	5,335	5,878
Unspecified	do.	1,453	1,554	1,566	1,185	1,394
Total	**do.**	**31,021**	**30,921**	**32,129**	**36,559**	**40,546**

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

[1] Table includes data available through Aug. 1989.

[2] In addition to the commodities listed, pyrite is also produced, but available information is inadequate to make reliable estimates of output levels.

[3] Reported figure.

[4] Figures are the nonduplicate copper content of ore, concentrates, cemented copper, slags and minerals, copper as a byproduct of gold and silver precipitate, and other copper-bearing products measured at the last stage of processing as reported in available sources.

[5] Figures are total blister, fire-refined, electrolytic, and equivalent copper output including that blister subsequently refined in Chile and copper produced by electrowinning. Detailed statistics on electrowinning are not available; although based on current plant capacities, electrowon copper production is estimated to be approximately 55 metric tons per year.

[6] Figures are total refined copper distributed into two classes according to method of refining, fire-refined and electrolytic, which includes electrowon copper refined in Chile.

[7] Excludes castings.

[8] Includes natural sodium sulfate and anhydrous sodium sulfate, coproducts of the nitrate industry.

Gold and Silver.—Chile's Servicio Nacional de Geologia y Mineria reported that gold production increased 21% to 663,000 troy ounces, and silver production increased 1.4% to 16.3 million ounces.

Gold was produced by several small, medium, and large lode and placer mines and as a byproduct of metallic copper, silver, lead, and zinc mines. The small- and medium-size gold mines produced 73% of the total production, followed by the copper mines with 23%, and the silver, lead, and zinc mines with the remainder. The largest gold-producing companies were Minera El Indio, Cía. Minera El Bronce de Petorca, Sociedad Contractual Minera Vilacollo, and the Homestake Mining Co.

Minera El Indio was recently acquired from St. Joe Gold Corp. by Bond international Gold of the Cayman Islands, a subsidiary of the Bond Corp. of Australia. Minera El Indio operates an open pit and an underground mine at El Indio, and an open pit heap-leach operation at El Tambo, 8 kilometers southeast of El Indio. In addition to the $24 million expansion of its concentration plant, the company invested $12 million in a second concentrate toaster and $4.5 million in a pressure tailings filtering plant to recover scarce processed water. The company is investing $24 million in the expansion of both mines and $6 million in exploration in the surrounding area. The company produced 209,000 ounces of gold, 1.13 million ounces of silver, and 20,000 tons of copper. The company also produces arsenic trioxide. According to the company, total reserves are in excess of 10 million tons. The second largest gold producer, Minera El Bronce de Petorca operates the El Bronce Mine at Petorca in the north of Santiago Province. Production averages 113,000 ounces of gold, 96,000 ounces of silver, and about 1,250 tons of copper per year. The next most important gold and silver producer in Chile is CODELCO-Chile. ENAMI, a major purchaser of gold concentrates and ores, smelted 225,000 ounces of gold bars in 1988. Two recently expanded projects are the Choquelimpie gold-silver mine purchased in August from Cía. C.P.A. PROMEL by Minera Vilacollo (owned by Citibank-Chile, Shell Chile, and Westfield Minerals of Canada) and the El Hueso open pit gold operation, which Minera Homestake Chile leased from CODELCO-Chile.

The most promising new gold-silver projects are La Coipa and Marte. ENAMI and Consolidated TVX of Canada purchased La Coipa for $58 million in July 1987. La Coipa was purchased from Cía. Sierra Morena (a subsidiary of Consolidated Goldfields of the United Kingdom), Banco Nacional, Banco Concepción, and a number of individuals. The La Coipa Norte Mine, with a potential third stage, is still being explored. The principal advantages of the project include low-cost open pit mining, an agitation leaching method, high-grade ores, and the flexibility of development. Proven ore reserves contain 60 tons of gold and 7,500 tons of silver. Given the size of these reserves, the La Coipa project has the potential of becoming one of Latin America's richest gold and silver deposits. There are also a large number of companies developing other gold mines that could increase production in the near future. These companies include ENAMI, Minera Anglo-American Chile, Cominor, Anaconda Chile, Minera LAC Chile S.A., Chevron Minera Corp., Inversiones Mineras del Inca, Cía. Minera Horus, Freeport Chile Exploration Co., Cía. Minera Millantum de Traiguen, Cía. Minera Doña Inez, and Falconbridge Chile S.A.

The presence in Chile of Canadian mining companies is growing every year. Placer Dome Inc. was the fifth

TABLE 5

CHILE: EXPORTS OF COPPER AND MOLYBDENUM ORE, BY DESTINATION[1]

Destination	Copper (thousand metric tons)			Molybdenum (metric tons)
	Ore and concentrate, Cu content[2]	Blister	Refined	Ore and concentrate, Mo content
1987:				
Argentina	—	—	50.5	—
Belgium-Luxembourg	—	—	—	608
Brazil	77.7	13.1	81.6	—
Canada	19.8	—	—	—
China	—	8.9	18.2	—
Finland	8.6	—	—	—
France	—	—	90.8	—
German Democratic Republic	—	.5	7.5	—
Germany, Federal Republic of	2.5	23.6	105.3	—
Greece	—	—	13.8	—
Hungary	—	6.9	—	—
Indonesia	—	—	16.7	—
Italy	(3)	7.9	122.3	—
Japan	84.2	—	94.0	—
Korea, Republic of	27.3	—	48.0	—
Malaysia	—	—	11.5	—
Netherlands	(3)	1.5	4.3	1,041
Portugal	—	—	6.2	—
Saudi Arabia	—	—	4.0	—
Spain	41.3	—	5.4	—
Sweden	5.3	—	9.4	309
Taiwan	5.6	—	53.2	—
Turkey	—	14.9	.2	—
United Kingdom	—	17.0	31.3	—
United States	.1	31.7	150.6	—
Venezuela	—	—	9.4	—
Yugoslavia	—	11.3	3.5	—
Other	.1	2.6	4.9	—
Total	**272.5**	**139.9**	**942.6**	**[4]1,957**
1988:				
Argentina	—	—	32.4	—
Belgium-Luxembourg	(3)	14.7	6.0	—
Brazil	65.5	14.1	24.8	—
Canada	5.8	—	—	—
China	4.1	3.0	16.8	—
Finland	16.9	—	—	—
France	—	1.6	120.5	—
German Democratic Republic	—	—	6.0	—

See footnotes at end of table.

TABLE 5—Continued

CHILE: EXPORTS OF COPPER AND MOLYBDENUM ORE, BY DESTINATION[1]

Destination	Copper (thousand metric tons)			Molybdenum (metric tons)
	Ore and concentrate, Cu content[2]	Blister	Refined	Ore and concentrate, Mo content
1988—Continued				
Germany, Federal Republic of	8.3	18.7	142.7	—
Greece	—	—	9.8	—
Hungary	—	1.5	3.0	—
Indonesia	—	—	11.0	—
Italy	—	3.0	145.7	—
Japan	52.4	1.0	111.5	—
Korea, Republic of	16.8	3.0	41.1	—
Malaysia	—	—	8.9	—
Netherlands	—	3.0	12.9	782
Portugal	.3	—	6.6	—
Saudi Arabia	—	—	4.0	—
Spain	31.1	—	4.3	—
Sweden	1.6	—	15.8	—
Taiwan	3.0	—	66.7	—
Turkey	—	11.3	—	—
United Kingdom	1.0	10.4	50.4	239
United States	10.8	63.8	106.9	—
Venezuela	—	—	15.0	—
Yugoslavia	3.9	11.7	5.0	—
Other	4.5	3.2	7.6	—
Total	**226.0**	**164.0**	**975.4**	**1,021**

[1] Table prepared by H. D. Willis.
[2] Includes cement copper and secondary copper.
[3] Less than 50 tons.
[4] Data do not add to total shown because of independent rounding.

Source: Estadisticas del Cobre, 1987 and 1988 monthly editions, Comision Chilena del Cobre.

Canadian mining company to establish operations in Chile during the past 2 years. In December, Placer Dome acquired 51% of La Coipa and formed a new operating company, Cía. Minera Mantos de Oro. This firm plans to invest $190 million to develop the Ladera-Farellón open pit as a second stage of this project. The Farellón open pit mine, a large low-grade operation, was planned for startup in 1991. Ore processing capacity was expected to be 15,000 tons per day with production of 8 tons of gold per year for 10 years.

Anglo-American Chile, a consortium of Anglo-American, Cominco Resources International Ltd. of Canada, and the Chemical Bank of New York, is developing the Marte project. The group has invested $30 million in exploration and in the construction of 429 kilometers of roads. It is planning an additional $47 million to develop an open pit mine by March 1989. In October, Glamis Gold Ltd. of Canada purchased 51% of the San Cristobal gold deposit from Inversiones Mineras del Inca S.A. for $3 million, with an option on the remaining 49% for $6 million.

Echo Bay Mines Ltd. of Canada acquired 100% of Minera Orión Chile Ltd. from Tenneco in late 1986, one-half of which was later transferred to Coeur d' Alene Mines of the United States. In August 1987, LAC Minerals Ltd. of Canada purchased 85% of the bankrupt Sociedad Contractual Minera El Toqui Ltda. (SCMT) and expanded the SCMT zinc mine in the 11th region in the south of Chile. In December 1987, LAC signed an option to purchase 85% of the group Cía. Minera Anita Apolinario gold mine in the fourth region and an option to purchase 85% of the Huantajalla silver mine in the first region. Cominco was participating in joint ventures with Anglo-American Chile to develop the Marte and El Lobo gold projects in the third region. It also purchased 25% of the equity of Minera de Mantos Blancos, which operated the Mantos Blancos copper project in the second region.

Falconbridge Chile, a subsidiary of Falconbridge Ltd. of Canada, owns a small portion of Minera de Mantos Blancos. Falconbridge also recently purchased Mobil Oil Corp.'s 80% interest in the Collahuasi copper project in the first region and now owns 100% of the project. Glamis Gold Ltd. purchased 51% of the Inversiones Mineras del Inca S.A. and the San Cristobal gold project in the second region. The Rayrock Mining Co. is developing the Ivan copper project in the second region. Finally, Río Algom Ltd. of Canada, a subsidiary of Río Tinto Zinc Corp. Ltd. of the United Kingdom, is reevaluating the Cerro Colorado copper project in the first region. As a result of these activities, Canada will soon have the third largest foreign mining presence in Chile, after the United States and Australia.

There were a large number of new silver projects that were expected to raise Chile's silver production to over 27.3 million ounces per year in the near term. Currently CODELCO-Chile and other large copper producers provide nearly 70% of all the silver produced. ENAMI smelted 8 million ounces of silver in 1988. The two largest independent silver producers were Procesadora de Metales Ltda. and PROMEL, with two plants. The PROMEL plant near the Peruvian border has a leach capacity of 680 tons per day while the Pucara plant has an 1,800-ton-per-day-capacity. Both are supplied with ore from Choquelimpie Mine. The second producer, Compañía Minera Flomax S.A. near Chuquicamata, operated a 200-ton-per-day heap-leaching facility, supplied with ores from the old Caracoles Mine waste dumps, producing about 480,000 ounces of silver per year. PROMEL sold its Choquelimpie Mine to the Shell consortium, which is now focused on the gold values in the deposit instead of silver.

Iron Ore.—Production of iron ore increased almost 18% to nearly 8 million tons. Cía. Minera del Pacífico S.A. (CMP), a subsidiary of the Cía. de Acero del Pacífico S.A. de Inversiones (CAP), operated three iron ore mines in the northern part of the country: El Romeral and El Algarrobo in the third region and El Laco in the second. The El Algarrobo Mine supplies 4.2 million tons annually of concentrate with 59% to 60% iron content to the Huasco pellet plant at Huasco Valley in La Serena. The plant has been expanded to a capacity of 4.5 million tons per year of self-fluxing pellets. The El Laco Mine in the mountains in the Atacama Province has been reopened to supply a high-grade (low-sulfur) ore to the Zapla steel plant in Jujuy, Argentina. Because of the altitude, the mine only operates in the summer. Production of iron ore pellets reached 4.2 million tons in 1988. Exports were 3 million tons of ore at $10.66 per ton and 3.6 million tons of pellets at $21.39 per ton.

CMP succeeded in opening up Australia as another market for its output. CMP's El Romeral Mine in Coquimbo will supply 68,000 tons of iron ore to The Broken Hill Pty. Co. Ltd.'s New South Wales plant. It was hailed as something of a coup for the Chilean company, since Australia is one of the leading iron ore exporters in the world. The first shipments were scheduled for early Janauay 1989 under a contract worth $1 million. CMP has opened several other new markets for its products, in China, Qatar, the Republic of Korea, and Yugoslavia in addition to sales to Australia and Argentina. According to company sources, the most important market penetration was the sale to China, which could establish the beginning of a long and prosperous business relationship. The first shipment of 55,000 tons of iron ore to China was worth $1.3 million.

Iron and Steel.—Production of ferroalloys, pig iron, and crude steel increased 24%, 26%, and 24%, respectively; semimanufactured (hot-rolled) products increased 38% in response to increased domestic and international demand. The country was practically self-sufficient in steel, importing a small amount from Brazil. A small percentage of the country's steel production was exported in the form of steel pipes for the U.S. petroleum industry. More than 95% of Chilean steel is produced by the Cía. Siderúrgica de Huachipato (CSH), a subsidiary of CAP. The remainder is produced by three small companies. In keeping with increased production plans, CSH has embarked on an ambitious expansion plan to increase its ingot production to 850,000 tons per year. A 500,000-ton coke plant, under construction in Talcahuano Province, should be completed by the second half of 1990. The new plant, aimed at increasing ingot production, will increase consumption of domestic coal by 300,000 tons per year. A continuous casting line and rolling mill purchased in 1975 were to be installed as part of the project. The company plans to modernize and expand the hot and cold bar rolling mills.

Lead and Zinc.—Chile's lead and zinc production increased 64% and declined 2%, respectively. Chile's three traditional zinc and lead producers include the SCMT in the 11th region, the Compañía Minera Catemu Ltda. in the 5th region, and the Empresa Minera de Aysén Ltda. in the 11th region. SCMT's El Toqui Mine in Aysén Province, southern Chile, was the largest producer of lead and zinc. Under the new ownership of Minera LAC Chile S.A., a subsidiary of LAC Minerals of Canada established in December 1987, $19 million was invested under the Central Bank of Chile's chapter 19 debt-to-equity swap program to obtain $30 million worth of Chilean currency. Of this amount, the equivalent of $25 to $26 million was used to liquidate SCMT's outstanding debt. The remainder was used to purchase an 85% interest in SCMT and two affiliated gold mining companies, Sociedad Minera Katterfeld and Sociedad Minera Condor. Minera LAC Chile is 99% owned by LAC Minerals of Canada and 1% owned by LAC's U.S. subsidiary LAC Minerals Inc. Since December 1987, LAC of Canada has invested additional capital in the determination of additional ore reserves, the purchase of new mining equipment, the expansion of the capacity of the concentration plant, and the expansion of SCMT's hydroelectric powerplant.

SCMT produced approximately 32,000 tons of zinc concentrate with a value of approximately $8 to $9 million. SCMT expects to produce as much as 50,000 tons of zinc concentrate in 1989 after the expansion of the El Toqui concentration plant and the transfer of mining operations to the Mallín Alto deposit. In June 1989, Minera LAC Chile was scheduled to begin a prefeasibility study on the possibility of increasing production to 200,000 tons of zinc concentrate per year and the possible construction of a zinc refinery. Almost all of SCMT's zinc concentrate was sold c.i.f. to Brazil, where SCMT took advantage of lower freight and insurance costs. SCMT's iron and silver concentrate was stored in Puerto Chacabuco, from where it will eventually be sold in public auction.

Manganese.—Manganese production increased 37% to almost 44,000 tons. All of Chile's manganese was produced by Manganesos de Atacama S.A. (MASA), a CAP subsidiary. MASA operated the Corral Quemado and Los Loros manganese mines in the fourth region and also leased other deposits in the same region. The company also produced ferromanganese, silicomanganese, and manganese dioxide at its ferroalloy plant in Coquimbo. CSH purchased all of MASA's manganese ore and the majority of its ferromanganese and silicomanganese. MASA produced 6,899 tons of ferromanganese and 681 tons of silicomanganese. MASA was developing a high-grade manganese ore deposit in the fourth region, which was believed to be an extension of the existing mines. Production should begin in 1989. The company plans to install a second ferroalloy plant at Coquimbo.

Vanadium.—CMP was studying the possibility of producing and exporting vanadium from CMP's El Romeral Mine where the iron ore has an average grade of 0.5% to 0.7% vanadium. According to CMP officials, the reserves of vanadium at El Romeral Mine represent about 6% of world reserves or 20% of the reserves of market economy countries. Three studies have been completed including a laboratory study, a pilot plant study, and an economic evaluation. An engineering study to optimize the proposed production process and determine the type of equipment to be used remained to be completed. Based on the studies already completed, the vanadium would be produced as a byproduct from the concentration of 1,500 tons of iron ore per day at the El Romeral Mine. The commercial products obtained from this process would include ammonium metavanadate and 98.5%-pure vanadium pentoxide with an estimated export value of $25 million per year.

Industrial Minerals.—**Lithium and Potassium.**—Sociedad Chilena de Litio Ltda. (SCL), jointly owned by Foote Mineral Co. (55%) of the United States (a subsidiary of Cyprus Minerals) and CORFO (45%), produced 7,332 tons of lithium carbonate, an increase of 19% relative to 1987. Although the company was capable of increasing production, the output was intentionally limited to avoid depressing the world price. In June, CORFO sold 25% of SCL shares to Cyprus Minerals for $6.5 million, thereby increasing Cyprus ownership to 80%. In late 1988, CORFO planned to sell the remaining 20% of its equity to Cyprus Minerals for $7.5 million. SCL's Government-authorized monopoly for the production of lithium in Chile expired at yearend. SCL was in the process of completing a potassium chloride plant capable of producing at least 35,000 tons and possibly 45,000 tons per year of 95%-pure potassium chloride. The plant will utilize the large amounts of sylvite discarded at the solar evaporation ponds. According to an agreement signed with Sociedad Química y Minera de Chile S.A. (SOQUIMICH) in 1987, the plant's entire production will be sold to SOQUIMICH to replace imported potassium nitrate. The plant was expected to go into operation in July at an estimated cost of $3 million.

Although installed lithium production capacity exceeded the 1988 demand by over 40%, Sociedad Minera Salar de Atacama Ltda. (MINSAL), a consortium of AMAX Inc., 63.75%; CORFO, 25%; and Molibdenos y Metales S.A. (Molymet), 11.25%, was close to making a final decision to establish a competing potassium chloride, potassium sulfide, boric acid, and lithium carbonate production operation in an adjacent area of the Salar de Atacama. In another effort to avoid flooding the world market, CORFO has limited initial lithium production of the MINSAL project to 16,500 tons of lithium carbonate per year, but MINSAL will still be able to increase this amount by 7% per year during the life of the project.

Nitrates and Iodine.—Chile's iodine production increased by 30% to just over 4,000 tons, strengthening Chile's position as the world's second largest producer of iodine after Japan. Most of this increase was produced by SOQUIMICH, the recently privatized state nitrate company, which increased its production to 3,600 tons. The remainder was produced by the newly established Amsterdam Chemical Pharmaceutical Minera (APC Minera) a consortium of the Sociedad Contractual Minera Lagunas, the Amsterdam Pharmaceutical Co. (ACF) of the Netherlands, the Compañía de Salitre y Yodo de Chile (COSAYACH), and the Compañía Minera del Alba. Production of iodine has helped revitalize Chile's traditional nitrate industry. Iodine production in Chile is obtained as a by-product of nitrate production or as the primary product of a newly developed process to extract iodine from abandoned nitrate tailings in Chile's first and second regions. Increased byproduct output has been associated with a 13% increase in Chile's nitrate production.

Chile exported nitrates to 67 countries on 5 continents; iodine was exported primarily to Europe and the United States. Over 80% of the nitrate production was exported; the remainder was consumed in Chile's growing agricultural sector. Because of increased byproduct and primary iodine production, iodine has replaced nitrates as SOQUIMICH's largest source of operating income, increasing from close to zero in 1983 to a total of over $52 million in 1988. Although the increase in iodine production was the most important factor in this increase in income, other factors included higher prices for iodine and increased production of potassium nitrate, which was more profitable than SOQUIMICH's sodium nitrate production.

SOQUIMICH was planning to invest $3.75 million in a joint venture with ISE Chemicals and the Mitsubishi Corp. of Japan. A 6-month feasibility study was underway, and the final decision was to be made before the end of 1989. Production was expected to begin in 1990 with a capacity of 500 tons of iodine per year. Further into the future, SOQUIMICH was also planning to invest $100 million in the Pissis, Nebraska, and Perdiz nitrate and iodine projects in the first region. The project was aimed at production rates of 300,000 tons of nitrate and 1,000 tons of iodine per year.

Sulfur.—Chile has been an importer and producer of sulfur for many years. In 1988, Chile imported over 70,000 tons of sulfur mostly from Canada.

Chile's native sulfur production derived from caliche decreased 6.4%. Chile also produced nearly 17,000 tons of refined sulfur, an increase of 13.5%. Chile's total production of sulfur, including sulfur derived from smelters and oil refineries, increased 22% in 1988.

Although imports and the production of refined sulfur has remained fairly constant over the past 5 years, the domestic production of caliche has been declining. This is because the caliche once purchased by CODELCO-Chile's Chuquicamata Div. for the production of sulfuric acid is gradually being replaced by the sulfuric acid produced by the Chuguicamata Div.'s new sulfuric acid plant.

Despite the decline in the domestic demand for sulfur, a number of foreign mining companies have expressed interest in the production of Chilean sulfur for export to the United States and other markets. Because of Chile's many volcanoes, it has over 100 identified sulfur prospects. All are at an altitude in excess of 4,000 meters, and all contain ores with 35% to 50% sulfur.

***Mineral Fuels.*—Coal.**—Coal output increased 21% to 2.1 million tons in 1988. The Chilean Government has encouraged greater domestic coal production as a means of reducing Chile's dependence upon imported petroleum. This effort resulted in the opening of the Cía. de Carbones de Chile S.A. COCAR Pecket coal mine in region 12 and COCAR's signing of a 10-year contract to supply coal to CODELCO's Tocopilla electric power division in the second region. Coal provides almost 70% of the electricity for Chile's Northern Electric Power Grid, which supplies the first and second regions. Coal production, however, has not kept up with demand. It was estimated that Chile may have to import 500,000 tons of steam coal per year for at least the next 3 years. Coal production costs at the Pecket Mine were estimated by Chile's Power Institute to be about $26 per ton, compared with $60 per ton for underground coal produced by Empresa Nacional del Carbón S.A. (ENACAR) in the Concepción area.

COCAR's bulk coal shipments to CODELCO-Chile in Tocopilla started in the last quarter of 1987. CODELCO-Chile's Chuquicamata Div. powerplant was converted from fuel oil to coal because of lower operating costs. ENACAR operates the Lota, Colico, Trongol, and Lebú underground coal mines in region eight and is Chile's largest coal producer. ENACAR is 98.9% owned by CORFO. ENACAR produced almost 791,000 tons of bituminous coal with a heating value ranging from 6,100 to 7,100 kilocalories.

Natural Gas.—Gross output of natural gas decreased slightly, continuing the declining trend since 1982. Of total production, 68% was reinjected; 4% was flared; and 28% was used in the field, lost during transmission, or marketed internally. Chile has been producing petroleum in the 12th region since 1945, but it has not been able to find a way to effectively use the associated natural gas.

In an effort to attract foreign investors for several gas-related projects, Chile called for international bids. Chile chose the Henley Group of the United States to develop a methanol project and Combustion Engineering of the United States to develop an ammonia urea project. Once these two projects are in place, the necessary raw material will be available for a variety of downstream projects based on hydrocarbons.

Natural gas was also used to provide heat and electricity for the principal cities of the 12th region. With the completion of the Cape Horn methanol plant in 1988, a greater percentage of the annual production of natural gas was being consumed than in previous years, thereby reducing the amount available for reinjection.

In March, state-owned Empresa Nacional del Petróleo (ENAP) completed the construction of 178 kilometers of an 18-inch natural gas pipeline between Posesión and Punta Arenas. The pipeline can transport 212 million cubic feet of gas per day to the methanol and ammonia-urea plants in Cabo Negro and the city of Punta Arenas. The total cost of the gas pipeline was $20 million.

Petroleum.—ENAP was Chile's only producer of crude oil and natural gas. ENAP reported that Chile's production of crude oil was about 8.9 million barrels, an 18% decrease from that of 1987. This continued the decline that started in 1983. Offshore production represented 63% of the annual total. Production wells on Tierra del Fuego Island accounted for almost 21%, while mainland production dropped sharply and, in 1988, supplied only 16% of the total. ENAP's production has declined from a peak of 54% of national consumption in 1982 to a 30% share in 1988. The declining trend in output of crude oil in the Magellan region prompted Chile's ENAP to extend its exploration efforts to other areas of the country. In 1988, a contract for a joint exploration project was signed with Hunt Oil Co. of the United

States. Similar negotiations have been initiated with Eurocan Ventures Ltd. of Canada, Shell Oil-Pecten International of the United States, and Maxus Energy of the United States, the former Shamrock Co. During the first quarter of 1989, ENAP and Hunt Oil Co. were scheduled to start a drilling operation in the Atacama salt flats in northern Chile, estimated to cost $10 million. Hunt is a majority partner with 65% interest in the project. Additionally, Hunt presented another proposal to the Government to join ENAP in exploring 5,000 square kilometers in the highlands of Parinacota in northern Chile.

Eurocan Bermuda Ltd., a subsidiary of Eurocan Ventures Ltd., was negotiating an agreement with ENAP to search for oil in a 5,000-square-kilometer area in the Pedernales and Maricunga salt flats. Pecten International has shown interest in exploring the Imilac salt flats and the San Pedro de Atacama area. Another firm interested in the area, Maxus Energy, was considering the Punta Negra salt flat zone. ENAP signed an agreement in April with PETRO-CANADA to jointly explore for oil in Ecuador.

PARAGUAY[6]

Introduction

Paraguay's economic performance continued improving, and the GDP grew by 4% compared with 4.3% in 1987 and negligible growth in 1986. The industrial sector also grew by 5.3% compared with 3.5% in 1987. The country's task is to become competitive by modernizing the industrial base and cutting costs. The Government expected to benefit from joining the regional economic integration efforts of Argentina, Brazil, and Uruguay. The existing legislation stipulates that export taxes be abolished and that a free fluctuating exchange rate be adopted for trade, services, and investment. Foreign debt is to be renegotiated and prices set according to the open market system.

Paraguay is predominantly an agricultural economy. Increased export revenues were derived from the sale of hydroelectric power to Argentina and Brazil. Mining made slow progress, although concessions and tax incentives encouraged national and foreign companies to undertake limited exploration.

Paraguay's mineral resources remained partially explored because of inadequate infrastructure, inflation, and limited private investment. Studies commissioned by the Dirección General de Recursos Minerales (DGRM) concluded that opportunities exist for the commercial development of marble, pyrophyllite, granite, talc, gypsum, and lignite.

Commodity Review

Metals.—Shortages of raw materials in the steel industry forced the 60% Government-owned, Aceros del Paraguay S.A. (Acepar), to produce at the 10% capacity of 150,000 tons per year of laminated steel products. The $290 million[7] Acepar plant at Villa Hayes, about 13 miles north of Asunción, is a joint venture of Paraguay and Brazil, and depends on iron ore and coal produced in Brazil. Discussions were held with the Bolivian Government to import 500,000 tons per year of iron ore from the Mutun Mine near the Paraguay border. The Mutun iron ore source is remote, but ore produced could be hauled by barge along the Paraguay River.

Industrial Minerals.—Industrial minerals such as limestone, gypsum, kaolin and other clays, glass sand, and stone were limitedly produced.

Paraguay's other mineral occurrences included soapstone, mica, pyrite, barites, copper in malachite and azurite, manganese in pyrolusite, and uranium. At yearend, reserves of lateritic iron ore on the Paraná River near Encarnación were estimated at 250 to 3,000 million tons with 35% iron.

The Government-owned Industria Nacional del Cemento (INC) operates two cement plants at Puerto Vallemí in Concepción and Itapucumi in Villeta, each having rated capacities of 400,000 tons per year and 600,000 tons per year, respectively.

Mineral Fuels and Energy.—Paraguay's total energy requirements continued to be heavily dependent upon oil and natural gas imports. Paraguay's Petróleos Paraguayos S.A. (Petropar) imported about 2.4 million barrels of crude oil from Algeria. The limited oil exploration in Paraguay was disappointing, although Piper Oil Co. delineated undetermined reserves of oil and natural gas in the Cuenca Curupayty District. Occidental Petroleum Co. of the United States identified an oil and natural gas bearing structure in Boquerón, Chaco Boreal of western Paraguay. Texaco Co. of the United States is to carry out geophysical surveys in a concession close to the border with Argentina, where substantial oil resources were discovered in 1984.

Paraguay's economy was expected to improve following the commissioning of additional 700-megawatt turbines at Itaipú hydroelectric plant on the Paraná River. When fully operational, the $18.5 billion Itaipú complex, a joint venture with Brazil, is expected to generate 12,600 megawatts, with revenues estimated to be at least $200 million per year.

The Yacyretá hydroelectric project, 200 miles downstream from Itaipú, a joint venture of Argentina and Paraguay, had been behind schedule because of Argentina's growing financial difficulties. The first group of turbines was not expected to be in operation until 1993. Yacyretá's installed capacity was expected to be 2,760 megawatts at a cost of about $5.6 billion.

TABLE 6

PARAGUAY: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Country and Commodity		1984	1985	1986	1987[p]	1988[e]
PARAGUAY[2]						
Cement, hydraulic	thousand metric tons	109	46	179	[3]261	[3]321
Clays:						
Kaolin		50,000	60,000	60,000	[3]72,000	76,000
Other	thousand metric tons	1,700	1,750	1,650	[3]1,898	1,910
Gypsum		6,000	2,500	2,800	[3]3,100	[3]3,600
Iron and steel:						
Pig iron		—	—	—	[3]33,500	[3]62,700
Steel, crude		—	—	—	[3]9,700	[3]62,300
Lime		85,000	80,270	88,290	92,500	96,000
Petroleum refinery products:						
Gasoline	thousand 42-gallon barrels	327	506	672	646	650
Jet fuel	do.	18	115	162	160	150
Kerosene	do.	88	58	21	23	20
Distillate fuel oil	do.	512	623	640	656	650
Residual fuel oil	do.	149	223	254	200	200
Liquefied petroleum gas	do.	35	47	40	35	35
Refinery fuel and losses	do.	167	229	22	77	50
Total	**do.**	**1,296**	**1,801**	**1,811**	**1,797**	**1,755**
Pigments, mineral: Natural, ocher		250	260	250	285	250
Sand including glass sand	thousand metric tons	1,654	1,741	1,659	1,893	1,900
Stone:						
Dimension	do.	62	65	65	60	60
Crushed and broken:						
Limestone (for cement and lime)	do.	175	180	387	507	500
Other	do.	1,730	1,850	1,720	1,990	2,000
Marble		300	400	450	600	750
Talc, soapstone, pyrophyllite		150	120	130	180	210

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

[1] Includes data available through mid-June 1989.

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

[3] Reported figure.

[4] Data represent exports.

URUGUAY[8]

Introduction

Uruguay's economy continued in a period of slow growth, and the GDP reached almost 2% compared with 4% in 1987 and a robust growth of 6% in 1986. Uruguay remains a relatively free market economy, especially in trade, services, and investment, which are attractive to foreign investors.

Uruguay has limited mineral resources and a relatively undeveloped mineral industry. The country is endowed with small known reserves of gold, copper, lead, manganese, and zinc, mainly in Rivera, Soriano, Flores, and Colonia Departments; therefore, there was limited interest in mining investment, except for gold.

Commodity Review

Metals.—Low grade iron ore deposits are found at Valentines, in the southeastern part of Uruguay, with proven reserves of 45 million tons grading 40% iron, and at Zapucay, in the northern part of Uruguay, with 400 million tons grading 40% iron. The pending decision for a $140 million[9] iron and steel complex at Valentines, was not finalized at yearend.

Gold Standard Co. of Salt Lake City, Utah, signed a joint venture for exploring the San Juan Hills gold prospect with Compañía Minera San José, a 100% subsidiary of Bond International Gold Co. of the United States. Minera San José will be the project operator having 60% equity and being responsible for 100% of the exploration activity.

Industrial Minerals.—Uruguay's main quarrying activity continued on construction minerals such as dimension stone, limestone, dolomite, marble, and aggregates; however, lack of enough investment hampered the full potential of these industries. Lavalleja, an old dolomite deposit about 160 miles east of Montevideo, has a potential of 230,000 tons per year operation. Uruguay produced corundum as a natural abrasive, a commodity which has been largely replaced by synthetic abrasives. Corundum was used by glassmakers for grinding optical lenses; consumption remained volatile and in decline.

Mineral Fuels.—**Oil, Gas, and Energy.**—Uruguay is heavily dependent on imports of crude oil, and no known oilfields are existent. Natural gas reservoirs in the northwestern region of the country continued unexplored and the known coal deposits were considered subeconomic.

The 1988 drought affected the water levels in the Río Negro hydroelectric system and in the Uruguay River, which is the main water source for the Salto Grande Dam. The thermal plants were not able to meet the demand for electricity. The Uruguayan Government imposed rotating blackouts of 3 hours 1 day per week to balance electricity production and consumption.

The state-owned electric power agency, Administración Nacional de Usinas y Transmisiones Eléctricas (UTE), was overhauling its hydroelectric generating plant in Paso de los Toros, with World Bank financial assistance of $45.2 million. This first of four power dams was expected to be overhauled completely, during a 4-year program, at a cost of $138 million. UTE was concerned with the blackouts and the projected higher demands for electricity by 1995. One option was to build a coal- or oil-fired powerplant, in Punta Pedregal on the outskirts of Montevideo, at an estimated cost of $200 million. This project is a feasible cogenerating electrical facility and a backup system to the hydrogenerating grid.

The World Bank provided a $24 million loan to Administración Nacional de Conbustibles, Alcohol y Portland (ANCAP) to modernize its oil refinery and improve capacity to refine various grades of crude oil and reduce operational costs. Total project cost was estimated at $30 million; $6 million was to be supplied by the Government. Project engineering was underway; equipment was to be purchased in 1989. The project was expected to be completed by late 1990.

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[1] Prepared by Orlando Martino, supervisory physical scientist, Chief, Branch of Latin America and Canada.

[2] Prepared by Pablo Velasco, physical scientist, Division of International Minerals.

[3] Where necessary, values have been converted from Argentine australes to U.S. dollars at the rate of australes5.8 = US$1.00, the average exchange rate in 1988.

[4] Prepared by Pablo Velasco, physical scientist, Division of International Minerals.

[5] Where necessary, values have been converted from Chilean pesos (Ch$) to U.S. dollars at the rate of Ch$245 = US$1.00, the average exchange rate for 1988.

[6] By Alfredo C. Gurmendi, physical scientist, Division of International Minerals.

[7] Where necessary, values have been converted from Paraguayan guaraníes (Gs) to U.S. dollars at the average market rate of Gs910 = US$1.00 for 1988.

[8] By Alfredo C. Gurmendi, physical scientist, Division of International Minerals.

[9] Where necessary, values have been converted from Uruguayan new pesos (N$) to U.S. dollars at the rate of N$358 = US$1.00.

TABLE 7

URUGUAY: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1984	1985	1986	1987[p]	1988[e]
Aluminum, secondary		31	20	51	56	[3]65
Barite		10	15	15	[e]15	15
Cement, hydraulic	thousand metric tons	334	314	340	401	[3]434
Clays, unspecified		70,936	150,000	[e]150,000	[e]150,000	150,000
Coke, gashouse[e]		10,000	8,000	8,000	8,000	8,000
Corundum[e]		50	40	40	40	40
Feldspar[e]		[3]1,950	1,000	1,000	1,000	1,000
Gem stones, semiprecious:						
Agate		108	90	[e]90	[e]90	90
Amethyst		21	20	[e]20	[e]20	20
Gypsum[e]		[3]74,091	100,000	100,000	100,000	100,000
Iron and steel:						
Ferroalloys: Electric-furnace ferrosilicon crust		162	250	[e]250	[e]250	250
Steel, crude		40,763	38,964	30,987	30,200	[3]28,700
Semimanufactures		35,789	31,773	34,348	43,500	[3]18,000
Lime	thousand metric tons	8	9	10	13	10
Petroleum refinery products:						
Gasoline	thousand 42-gallon barrels	1,643	1,649	1,660	1,540	1,550
Jet fuel	do.	152	184	182	264	300
Kerosene	do.	572	452	415	457	500
Distillate fuel oil	do.	3,348	2,992	2,324	3,290	3,300
Residual fuel oil	do.	2,725	2,301	2,434	2,418	2,500
Lubricants	do.	46	[r]49	[r]49	56	60
Liquefied petroleum gas	do.	482	498	459	580	600
Unspecified	do.	251	189	225	826	800
Refinery fuel and losses	do.	-151	-386	22	[e]20	20
Total	**do.**	**9,068**	**[r]7,928**	**[r]7,770**	**9,451**	**9,630**
Sand and gravel:						
Sand, common	thousand metric tons	1,391	1,500	[e]1,500	[e]1,500	1,500
Gravel	do.	237	500	[e]500	[e]500	500
Stone:						
Dimension	do.	10	8	[e]8	[e]10	10
Crushed and broken:						
Alum schist		9,977	8,000	[e]8,000	[e]8,000	8,000
Dolomite	thousand metric tons	4	3	[e]3	[e]3	3
Limestone	do.	666	700	[e]700	[e]700	700
Marble	do.	4	4	[e]4	[e]5	5
Marl		4,257	7,000	[e]7,000	[e]7,000	7,000
Quartz		150	300	[e]300	[e]300	300
Other, including ballast	thousand metric tons	1,969	1,900	[e]1,900	[e]2,000	2,000

See footnotes at end of table.

TABLE 7—Continued

URUGUAY: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]	1984	1985	1986	1987[p]	1988[e]
Sulfur, elemental, byproduct[e]	2,000	2,000	2,000	2,000	2,000
Talc, soapstone, pyrophyllite	1,658	1,500	[e]1,500	[e]1,500	1,500
Tuff: Tufa	4,347	3,500	[e]3,500	[e]3,500	3,500

[e]Estimated. [p]Preliminary. [r]Revised.
[1] Includes data available through mid-June 1989.
[2] In addition to the commodities listed, a variety of crude construction materials (common clays, sand and gravel, and stone) undoubtedly were also produced, but output was not reported, and available information was inadequate to make reliable estimates of output levels.
[3] Reported figure.

TABLE 8

URUGUAY: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
METALS				
Aluminum:				
Oxides and hydroxides	9	6	—	All to Paraguay.
Metal including alloys, semimanufactures	199	275	—	Argentina 130; Paraguay 40; Peru 25.
Copper: Metal including alloys, semimanu factures	28	6	—	All to West Germany.
Iron and steel: Metal:				
Steel, primary forms	323	—		
Semimanufactures:				
Bars, rods, angles, shapes, sections	9,087	4,103	—	All to Argentina.
Universals, plates, sheets	705	1,136	917	Bolivia 150; Argentina 67.
Hoop and strip	133	354	—	All to Argentina.
Wire	2,549	3,565	—	Argentina 2,746; Brazil 771; Bolivia 30.
Tubes, pipes, fittings	575	1,063	—	Argentina 603; Brazil 416; Chile 44.
Castings and forgings, rough value, thousands	—	$5	—	All to Argentina.
Lead: Metal including alloys, unwrought	60	164	—	Do.
Zinc: Oxides	223	747	—	Brazil 730; Argentina 17.
Other: Ashes and residues	—	650	—	All to Brazil.
INDUSTRIAL MINERALS				
Cement	3,060	6,960	—	Brazil 6,940; Argentina 20.
Clays, crude	—	2	—	All to Argentina.
Fertilizer materials: Manufactured:				
Nitrogenous	—	240	—	All to Paraguay.
Phosphatic	27,366	48,694	—	Brazil 45,193; Argentina 3,501.
Potassic	60	—		
Unspecified and mixed	3,950	37,609	—	Brazil 34,034; Paraguay 3,408.

See footnote at end of table.

TABLE 8—Continued

URUGUAY: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
INDUSTRIAL MINERALS—Continued				
Lime	105	—		
Precious and semiprecious stones other than diamond, natural value, thousands	$348	$768	$367	West Germany $267; France $35.
Sodium compounds, n.e.s.:				
Carbonate, manufactured	30	153	NA	NA.
Sulfate, manufactured	4,495	5,421	—	Argentina 1,401; Brazil 1,080; Peru 918.
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked value, thousands	$920	$1,268	—	Japan $695; Italy $479; Argentina $87.
Worked	535	10	—	All to Spain.
Gravel and crushed rock	34,640	33,550	—	All to Argentina.
Sand other than metal-bearing	195,288	206,897	—	Do.
Sulfur				
Elemental: Crude including native and byproduct	388	202	—	All to Paraguay.
Sulfuric acid	13,505	5,922	—	Brazil 3,400; Argentina 2,390; Paraguay 132.
Talc, steatite, soapstone, pyrophyllite	50	104	—	All to Argentina.
Other: Slag and dross, not metal-bearing	20	150	—	Do.
MINERAL FUELS AND RELATED MATERIALS				
Petroleum refinery products:				
Gasoline, motor 42-gallon barrels	85,179	—		
Distillate fuel oil do.	—	68,341	—	All to Argentina.
Lubricants do.	273	1,309	—	Argentina 455; Brazil 105; Peru 49.
Bituminous mixtures do.	230	242	—	All to Brazil.

NA Not available.
[1] Table prepared by H. D. Willis.

TABLE 9

URUGUAY: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS				
Aluminum:				
Ore and concentrate	3,951	8,455	—	All from Brazil.
Oxides and hydroxides	1,203	1,102	2	Brazil 564; West Germany 495; United Kingdom 30.
Metal including alloys:				
Unwrought	1,991	2,693	—	Argentina 2,628; Brazil 60; United Kingdom 5.
Semimanufactures	371	958	([2])	Argentina 803; Brazil 63; France 56.
Chromium:				
Ore and concentrate	4	4	—	All from Brazil.
Oxides and hydroxides	1,013	15	—	West Germany 8; Argentina 4; Brazil 3.
Cobalt: Oxides and hydroxides value, thousands	$2	$5	—	West Germany $3; Republic of Korea $1.
Copper: Metal including alloys:				
Unwrought	10	54	—	Peru 30; Chile 22; Argentina 2.
Semimanufactures	1,733	2,514	8	Chile 1,630; Brazil 432; Peru 249.
Iron and steel: Metal:				
Pig iron, cast iron, related materials	570	594	9	Paraguay 300; Brazil 245; Argentina 36.
Ferroalloys:				
Ferromanganese	299	194	—	Brazil 192; West Germany 2.
Unspecified	518	450	—	Brazil 427; West Germany 13; Republic of South Africa 5.
Steel, primary forms	12,520	19,507	—	Argentina 15,365; Venezuela 2,992; Brazil 1,150.
Semimanufactures:				
Bars, rods, angles, shapes, sections	11,285	18,313	([2])	Argentina 9,194; Brazil 6,807; Poland 970.
Universals, plates, sheets	15,707	56,932	221	Brazil 26,960; Argentina 24,162; Republic of South Africa 2,205.
Hoop and strip	924	1,431	68	Brazil 763; West Germany 351; Australia 117.
Rails and accessories	98	12	—	All from Japan.
Wire	1,441	1,366	1	Argentina 631; Brazil 572; Republic of South Africa 79.
Tubes, pipes, fittings	269	2,127	2	Brazil 1,343; Argentina 324; Venezuela 170.
Castings and forgings, rough	—	6	—	Argentina 5; Peru 1.
Lead:				
Oxides	3,107	145	—	Argentina 89; Mexico 56.
Metal including alloys, unwrought	1,312	1,927	—	Mexico 1,526; Argentina 400; Brazil 1.
Magnesium: Metal including alloys:				
Unwrought	1	12	12	
Semimanufactures	9	11	4	Italy 5; Canada 2.
Manganese: Oxides	12	22	—	West Germany 15; Brazil 7.

See footnotes at end of table.

TABLE 9—Continued

URUGUAY: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS—Continued				
Mercury 76-pound flasks	145	986	(2)	Mexico 957; West Germany 29.
Molybdenum: Metal including alloys, all forms value, thousands	$8	$15	—	Austria $9; Netherlands $5.
Nickel: Metal including alloys:				
Unwrought	8	15	—	Canada 13; Norway 2.
Semimanufactures	15	37	(2)	West Germany 32; Canada 3; France 1.
Platinum-group metals: Metals including alloys, unwrought and partly wrought:				
Platinum value, thousands	—	$10	—	All from West Germany.
Silver: Metal including alloys, unwrought and partly wrought do.	$1	$6	—	All from Chile.
Tin: Metal including alloys:				
Scrap	1	—		
Unwrought	29	25	—	All from Brazil.
Semimanufactures	2	2	—	Mainly from Brazil.
Titanium: Oxides	30	120	(2)	United Kingdom 116; Italy 4.
Tungsten: Metal including alloys, all forms value, thousands	$6	$10	$1	Japan $4; United Kingdom $4.
Zinc:				
Oxides	121	40	1	Argentina 32; France 7.
Metal including alloys:				
Unwrought	1,497	1,950	—	Mexico 1,883; Austria 20; Peru 20.
Semimanufactures	41	70	2	West Germany 29; Belgium-Luxembourg 17; Netherlands 11.
Other:				
Ores and concentrates	10	24	19	Netherlands 5.
Oxides and hydroxides	11	6	3	West Germany 3.
Ashes and residues	—	960	—	Mexico 776; Chile 154; Cuba 30.
Base metals including alloys, all forms	4	10	—	Netherlands 6; U.S.S.R. 3.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	111	548	11	Argentina 518; Netherlands 10.
Artificial: Corundum	85	110	(2)	Brazil 109; Argentina 1.
Grinding and polishing wheels and stones value, thousands	$306	$479	$26	Brazil $127; West Germany $61; Italy $45.
Asbestos, crude	1,003	1,193	—	Brazil 910; Republic of South Africa 140.
Barite and witherite	22	65	1	Argentina 64.
Boron materials:				
Crude natural borates	306	—		
Oxides and acids	227	250	5	Argentina 242; Brazil 2.
Cement	646	49	—	France 42; Brazil 4.

See footnotes at end of table.

TABLE 9—Continued

URUGUAY: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
INDUSTRIAL MINERALS—Continued					
Chalk		12	31	12	France 19.
Clays, crude		4,686	7,207	907	Brazil 3,787; Argentina 2,513.
Diamond: Industrial stones	value, thousands	—	$1	—	All from Argentina.
Diatomite and other infusorial earth		62	74	—	Argentina 40; Brazil 34.
Feldspar, fluorspar, related materials		31	93	—	Argentina 83; United Kingdom 10.
Fertilizer materials: Manufactured:					
Ammonia		543	671	—	Argentina 549; Brazil 116; Netherlands 3.
Nitrogenous		53,219	36,478	—	East Germany 17,747; Mexico 7,644; Brazil 6,426.
Phosphatic		20,835	31,800	13,850	Brazil 12,250; Morocco 5,700.
Potassic		6,536	5,310	—	West Germany 4,009; Brazil 1,300; Switzerland 1.
Unspecified and mixed		42,648	40,034	33,902	Morocco 2,400; Brazil 2,047; Belgium-Luxembourg 1,506.
Graphite, natural		29	49	—	Brazil 36; West Germany 9; Argentina 3.
Gypsum and plaster		960	1,247	—	Argentina 797; West Germany 450.
Magnesium compounds: Magnesite, crude		46	62	1	Brazil 36; Netherlands 11; West Germany 9.
Mica:					
Crude including splittings and waste		39	69	14	Brazil 50; Norway 5.
Worked including agglomerated splittings		2	2	—	All from Spain.
Nitrates, crude		312	266	—	All from Chile.
Phosphates, crude		35,422	89,700	—	Tunisia 44,000; Togo 25,000; Senegal 20,700.
Pigments, mineral: Iron oxides and hydroxides, processed		171	244	4	Argentina 125; West Germany 97; Spain 9.
Precious and semiprecious stones other than diamond:					
Natural	value, thousands	$12	$6	$6	
Synthetic	do.	$16	$14	$10	Switzerland $4.
Pyrite, unroasted		2	—		
Salt and brine		76,801	63,841	17	Chile 61,940; Argentina 1,732; West Germany 147.
Sodium compounds, n.e.s.:					
Carbonate, manufactured		11,648	14,773	—	Spain 12,863; Poland 1,117; France 747.
Sulfate, manufactured		2,196	1,970	7	Mexico 1,080; Chile 535; West Germany 123.
Stone, sand and gravel:					
Dimension stone:					
Crude and partly worked		21,264	948	—	Brazil 589; Argentina 359.
Worked		14	28	—	Brazil 22; Argentina 6.
Dolomite, chiefly refractory-grade		105	227	—	Brazil 182; Argentina 45.

See footnotes at end of table.

TABLE 9—Continued

URUGUAY: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987	
				United States	Other (principal)
INDUSTRIAL MINERALS—Continued					
Stone, sand and gravel—Continued					
Quartz and quartzite		—	62	—	All from Argentina.
Sand other than metal-bearing		20	6	1	Belgium-Luxembourg 5.
Sulfur:					
Elemental:					
Crude including native and byproduct		24,684	15,350	15,350	
Colloidal, precipitated, sublimed		8	8	3	West Germany 2; United Kingdom 2.
Sulfuric acid	value, thousands	$2	$2	—	All from West Germany.
Talc, steatite, soapstone, pyrophyllite		63	21	4	Brazil 13; West Germany 4.
Other: Crude		194	598	—	United Kingdom 305; Mexico 110; Netherlands
MINERAL FUELS AND RELATED MATERIALS					
Asphalt and bitumen, natural		1	1	1	
Carbon black		2,363	2,808	17	Argentina 2,054; Mexico 606; Brazil 93.
Coal:					
Briquets of anthracite and bituminous coal		4	8	—	All from Argentina.
All grades excluding briquets		500	502	—	Poland 500; Austria 2.
Coke and semicoke		2	11	—	All from Argentina.
Peat including briquets and litter		18	—		
Petroleum:					
Crude	thousand 42-gallon barrels	9,917	8,251	—	Mexico 3,386; Nigeria 2,810; United Arab Emirates 1,037.
Refinery products:					
Liquefied petroleum gas[3]	do.	25	90	—	All from Brazil.
Gasoline, motor	do.	162	92	([2])	Brazil 61; Netherlands 16; Argentina 15.
Mineral jelly and wax	do.	6	4	([2])	Argentina 3; Brazil 1.
Kerosene and jet fuel	do.	26	155	—	Mainly from Argentina.
Distillate fuel oil	do.	476	318	—	Saudi Arabia 212; Brazil 106.
Lubricants	do.	153	119	13	Argentina 75; Chile 8.
Residual fuel oil	do.	217	—		
Bituminous mixtures	do.	([2])	2	—	Mainly from West Germany.
Petroleum coke	do.	18	22	—	Mainly from Argentina.

[1] Table prepared by H. D. Willis.
[2] Less than 1/2 unit.
[3] May include natural gas.