The Mineral Industry of Finland

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A high level of activity was maintained in most branches of the Finnish mineral industry in 1968, despite early uncertainties resulting from devaluation of the markka in late 1967 and the persistence of strong inflationary trends in the nation's economy. In March, sweeping controls were established over wages, prices, rent, interest, and even taxes. These measures, which are scheduled to remain in force through 1969, were effective in stabilizing the economy, and with the added incentive of strong foreign demand, production and exports of many commodities matched or exceeded the levels of 1967. The construction industry was relatively depressed; however, building activity was increasing by year-end and a recovery was possible in 1969.

There were several significant individual developments in 1968. In mineral supply, the Luikonlahti copper mine was brought into production and another was under development near Outokumpu; deposits of talc were being developed near Kotkamo, to partially replace imported kaolin for the large paper industry; and additional deposits of apatite, discovered in Lapland, increased the known reserves of phosphate and associated rare-earth metals. In mineral processing, Finland became the only West European country to produce significant quantities of cobalt and ferrochromium from domestically mined ores; initial contracts were let for construction of the country's first zinc smelter; and the flash-smelting process developed by Outokumpu Oy. was adopted by several more foreign companies. In addition, an important expansion of rolling facilities was begun at the Raahe steelworks; crude oil refining capacity was doubled at Porvoo; and plans for construction of an atomic powerplant at Loviisa were temporarily abandoned.

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PRODUCTION

Production indices of major sectors of the mineral industry were as follows:

	(1959 =100)		
Industry sector	1966	1967	1968 [1]
Mines and quarries [2]	133	140	137
Primary metal plants [2]	217	220	251
Nonmetallic mineral product plants [2]	219	224	223
Petroleum refineries [3]	348	436	561
All industry [2]	167	171	176

[1] Average of monthly indices for 10 months (January–October).
[2] Source: Central Bureau of Statistics (Helsinki). Bulletin of Statistics (Tilastokatsauksia), No. 12, December 1968.
[3] Estimate based on annual refinery throughout reported by Neste Oy.

Table 1.—Finland: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1964	1965	1966	1967	1968
METALS					
Chromite concentrate, gross weight	-------	-------	NA	6,384	36,196
Cobalt:					
Mine output, metal content	[1] 1,684	[1] 1,493	[1] 1,438	e 1,800	e 1,700
Metal	-------	-------	--------	17	505
Copper:					
Mine output, metal content	r 32,557	r 30,160	r 26,723	29,336	e 29,800
Metal, electrolytic	33,177	30,522	31,912	r 34,173	35,895
Gold, metal ... troy ounces	r 22,049	r 18,027	r 15,471	20,281	21,380
Iron and steel:					
Iron ore and concentrate:					
Magnetite concentrate	r 477,000	658,000	r 638,000	642,000	e 510,000
Pelletized iron oxide (from pyrite)	204,000	227,000	324,000	299,000	341,000
Roasted pyrite (purple ore)	NA	NA	NA	39,421	100,720
Pig iron	592,000	934,000	934,000	r 1,017,000	1,039,000
Ferrochromium	-------	-------	--------	---------	7,830
Steel, crude	371,000	363,000	399,000	411,000	700,000
Steel semimanufactures	328,000	351,000	366,000	340,000	554,000
Lead, mine output, metal content	1,890	r 6,308	4,633	4,786	4,524
Nickel:					
Mine output, metal content	r 3,204	r 2,989	2,952	r 3,458	3,326
Metal, electrolytic	2,943	2,776	2,993	3,003	3,327
Sulfate, metal content e	147	163	185	160	177
Rare-earth metals:					
Lanthanide concentrates, gross weight	-------	-------	2,610	14,127	12,152
Mine output, oxide content e	-------	-------	70	500	402
Oxides	NA	NA	43	NA	NA
Selenium, metal ... kilograms	6,577	5,705	5,431	6,696	7,296
Silver, metal ... troy ounces	608,000	582,000	520,000	623,000	677,000
Titanium, ilmenite concentrate, gross weight	116,063	106,825	117,560	126,900	140,000
Vanadium:					
Mine output, metal content e	1,350	1,287	1,230	1,470	1,477
Pentoxide:					
Gross weight	1,756	1,721	1,733	2,093	2,139
Metal content	983	964	970	1,172	1,198
Zinc, mine output, metal content e	63,000	69,000	54,400	60,800	65,400
NONMETALS					
Asbestos	10,533	12,072	12,020	10,524	13,140
Cement, hydraulic ... thousand tons	1,572	1,770	r 1,575	1,514	e 1,480
Diatomite	2,170	950	1,200	1,619	1,980
Feldspar	14,900	11,872	26,317	35,025	e 50,000
Fertilizer materials, manufactured:					
Ammonia, primary, nitrogen content	e 61,000	72,000	77,000	83,000	NA
Phosphoric acid, P_2O_5 content	-------	-------	22,000	39,000	NA
Superphosphate, gross weight	514,300	437,400	r 571,300	395,100	e 320,000
Lime	240,000	245,000	227,000	230,000	210,000
Pyrite and pyrrhotite (including cupreous): [2]					
Gross weight	551,223	585,430	516,477	711,629	774,000
Sulfur content	264,000	283,700	249,200	341,000	371,000
Quartz	28,500	35,312	43,670	61,000	42,000
Stone, n.e.s.:					
Dimension stone (marble)	800	200	NA	---------	NA
Other, including limestone ... thousand tons	3,500	3,800	3,553	3,700	e 3,600
Sulfur, byproduct (recovered):					
Elemental	68,139	73,771	73,641	101,413	125,249
Gaseous (in SO_2)	e 119,900	e 126,200	159,396	181,891	205,088
Talc and soapstone:					
Talc	6,000	7,000	5,000	2,562	e 6,000
Soapstone ... cubic meters	150	e 125	125	150	e 200
Wollastonite	3,000	2,393	3,813	e 3,500	4,296
MINERAL FUELS AND RELATED MATERIALS					
Coke, all types	145,000	142,000	153,000	136,000	NA
Fuel briquets	17,000	28,000	25,000	25,500	26,000
Gas, manufactured ... thousand cubic meters	68,411	70,103	r 74,890	72,492	e 60,000
Peat, for fuel use	r 110,000	r 100,000	e r 100,000	e 100,000	e 100,000
Petroleum refinery products:					
Gasoline ... thousand tons	553	700	762	941	1,082
Kerosine and jet fuel ... do	[3] 13	33	45	42	66
Distillate fuel oil ... do	421	1,640	2,658	3,113	3,742
Residual fuel oil ... do	1,048				
Liquefied petroleum gases ... do	34	42	52	56	52
Lubricants ... do	NA	NA	NA	74	---------
Other, including bitumen ... do	292	211	189	221	221
Total refinery products ... do	2,361	2,626	3,706	4,447	5,163
Total crude oil processed ... do	2,554	2,772	3,714	4,657	5,990

e Estimate. r Revised. NA Not available.
[1] Source: United Nations (1964–66).
[2] Excluding pyrrhotite from Kotalahti mine.
[3] Kerosine only.

The slight decline in the index for mines and quarries was mostly due to reduced output of iron ore, which resulted from closing of the Jussarö mine in 1967 and the Kärväsvaara mine in 1968, and partly due to reduced output of construction materials. Actually, production at most of the country's mines increased with gains of about 25 percent at Vihanti, 10 percent at Pyhäsalmi, and a severalfold increase in output of chromite from the new mine near Kemi. Record quantities of cobalt, pelletized iron oxide, and sulfur were recovered from pyrite at Kokkola, and ferrochromium production was started at Tornio.

The rise in index for primary metals resulted largely from increased production of steel at Raahe, where the new plate mill was operated for the first full year. The continued rise of the index for petroleum refineries was due to increasing production from the Porvoo refinery, which reportedly became the largest in Scandinavia at the end of October.

TRADE

The 1967 currency devaluation, together with the stabilization measures introduced in 1968, helped to shift Finland's balance of trade into the surplus column for the first time since 1958. The dollar value of exports exceeded that of imports by approximately $44 million, as compared with a deficit of $176 million in 1967.

In mineral commodity trade, the deficit remained close to $300 million but it was reduced by $22 million compared with that of the previous year. The improvement was principally due to increased domestic production of steel at Raahe, which led to a reduction of 100,000 tons in imports of steelplate. The gain in steel trade was partially offset by increased imports of crude oil.

The value of total trade and mineral commodity trade for the last 3 years is shown in the following tabulation:

	Value (million dollars)	
	Mineral commodity trade	Total trade
Exports:		
1966 r	123	1,505
1967	123	1,635
1968	121	1,636
Imports:		
1966	r 404	1,726
1967	429	1,811
1968	405	1,592

Metals and metallic ores continued to be the principal items in mineral commodity trade in 1968, accounting for 80 percent of the value of exports and nearly 40 percent of the value of imports. The share of fuels in the value of imports rose to 51 percent in 1968, as compared with 39 percent in 1965.

The values of major items in Finland's mineral commodity trade in 1967 and 1968 are tabulated as follows:

	Value (million dollars)[1]	
	1967	1968
EXPORTS		
Iron and steel [2]	45.6	44.5
Copper	30.5	29.2
Zinc ore	8.3	7.4
Titanium [3]	2.3	1.9
Nickel	7.4	8.7
Vanadium	5.2	4.0
IMPORTS		
Iron and steel [2]	133.6	113.5
Aluminum	21.0	18.1
Copper	14.2	15.2
Lead and zinc	4.9	4.3
Fertilizer materials	18.6	18.4
Crude petroleum	79.7	86.9
Solid fuels	36.7	32.3
Petroleum products	86.7	86.5

[1] Converted from values in Finnmarks as follows: 1967, Fmk. 3.2 =$1; 1968, Fmk. 4.2 =$1.
[2] Includes iron ore and scrap.
[3] Includes ilmenite and titania.
Source: Official Statistics of Finland (Helsinki). Ulkomaankauppa (Foreign Trade). December 1968.

In mineral commodities, Sweden remained the principal buyer of Finnish exports, accounting for approximately 25 percent of the total value, followed by West Germany and the United Kingdom with 17 percent each. These countries also supplied about one-third of Finland's imports, in terms of value. The Soviet Union continued to supply most of Finland's fuel, and the Soviet share of the value of Finland's mineral commodity imports rose to nearly 50 percent in 1968. In contrast, less than 2 percent of the value of Finnish exports was destined for the U.S.S.R.

Table 2.—Finland: Exports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1966	1967
METALS		
Aluminum metal, including alloys, all forms	2,205	2,648
Copper:		
Matte	---------	215
Metal, including alloys:		
Unwrought	13,444	11,922
Semimanufactures	11,263	12,200
Iron and steel:		
Ore and concentrate, except roasted pyrite	142,163	121,501
Roasted pyrite	70,008	5,619
Metal:		
Scrap	3,608	4,906
Pig iron, including cast iron	783,798	791,918
Steel, primary forms	12,514	2,448
Semimanufactures	21,382	57,300
Lead ore and concentrate	10,449	7,545
Nickel metal, including alloys:		
Unwrought	2,626	2,648
Semimanufactures	190	21
Platinum-group metals and silver: Metal, including alloys value, thousands	$461	$343
Selenium, elemental	5	5
Tin metal, including alloys, all forms long tons	70	11
Titanium:		
Ore and concentrate	50,665	40,431
Dioxide	21,448	5,123
Vanadium oxides	2,130	2,491
Zinc:		
Ore and concentrate	112,542	115,327
Metal scrap	---------	134
Other:		
Ashes and residues containing nonferrous metals	8,834	1,222
Oxides, hydroxides, and peroxides of metals, n.e.s	5,167	1,993
Metals, including alloys, all forms:		
Alkali and rare earth metals	9	53
Base metals, n.e.s	31	169
NONMETALS		
Asbestos	8,528	8,849
Cement	27,738	12,303
Clay products value, thousands	$268	$307
Diatomite and other infusorial earths	137	98
Feldspar	20,896	31,135
Fertilizer materials, manufactured	100,276	16,864
Lime	502	1,505
Mica, all forms	25	25
Precious and semi-precious stones, except diamond value, thousands	$18	$21
Pyrite	51,230	31,311
Stone, sand and gravel:		
Dimension stone	7,830	9,887
Limestone (except dimension)	4,357	6,465
Sand, gravel, and other crushed rock	430	
Quartz and quartzite	1,214	NA
Sulfur:		
Elemental, all forms	1,230	7,710
Sulfuric acid	---------	15,828
Other nonmetals, n.e.s.:		
Slag, dross and similar waste, not metal bearing	10,050	NA
Other	---------	67
MINERAL FUELS AND RELATED MATERIALS		
Coal, all grades, including briquets	10,467	13,203
Coke and semicoke	8,913	6,710
Gas, hydrocarbon	1,614	9,502
Peat and peat briquets	347	502
Petroleum refinery products:		
Gasoline	e 19,647	e 171,304
Kerosine	---------	---------
Distillate fuel oil	9	24,953
Residual fuel oil	---------	104,708
Lubricants	75	94
Other	177	NA

e Estimate. r Revised. NA Not available.

Table 3.—Finland: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1966	1967	Principal sources, 1967
METALS			
Aluminum:			
Ore and concentrate	35	7,786	France 3,358; Greece 3,300.
Oxide and hydroxide	13,740	16,726	West Germany 6,648; Hungary 5,365.
Metal, including alloys, all forms:			
Unwrought	11,977	14,461	U.S.S.R. 8,512; Norway 2,682.
Semimanufactures	13,922	13,782	U.S.S.R. 5,523; Sweden 5,323.
Antimony metal	67	50	China (mainland) 35.
Arsenic trioxide, pentoxide, and acids	447	422	Sweden 417.
Chromium:			
Chromite	76	455	Republic of South Africa 435.
Oxide and hydroxide	583	319	West Germany 205.
Cobalt:			
Oxide and hydroxide	4	3	Mainly from United Kingdom.
Metal, including alloys, all forms	NA	NA	
Copper metal, including alloys:			
Scrap	302	2	NA.
Unwrought	11,446	6,628	Zambia 2,499; Chile 2,182.
Semimanufactures	4,457	4,335	United Kingdom 2,023.
Gold, unworked or partly worked troy ounces	7,359	96,227	U.S.S.R. 80,216; West Germany 6,752.
Iron and steel:			
Ore and concentrate, except roasted pyrite	837,310	637,895	Norway 416,295; Sweden 221,600.
Roasted pyrite	4	3,192	Norway 2,398; Rumania 794.
Metal:			
Scrap	122,551	111,861	U.S.S.R. 105,638.
Pig iron, including cast iron	2,773	4,797	Norway 4,736.
Sponge iron, powder and shot	2,232	1,979	Sweden 1,057.
Ferroalloys	9,475	10,914	U.S.S.R. 4,547; Norway 3,889.
Steel, primary forms	62,814	51,210	United Kingdom 21,915; U.S.S.R. 18,727.
Semimanufactures:			
Bars, rods, angles, shapes, sections	141,052	120,952	Sweden 29,501; West Germany 25,458; U.S.S.R. 18,213; Poland 15,651.
Universals, plates, sheet	380,913	411,020	U.S.S.R. 93,687; United Kingdom 81,454; Sweden 51,602; Common Market 134,921.
Hoop and strip	30,975	24,747	West Germany 9,767; United Kingdom 6,703.
Rails and accessories	1,161	1,296	West Germany 988.
Wire	16,577	15,591	Sweden 3,624; United Kingdom 3,508.
Tubes, pipes, fittings	80,704	83,142	West Germany 35,039; Czechoslovakia 10,295.
Castings and forgings, rough	299	289	NA.
Lead:			
Oxides	641	533	Sweden 371.
Metal, including alloys:			
Unwrought	14,392	8,529	U.S.S.R. 5,523; Sweden 1,422.
Semimanufactures	1,233	840	West Germany 598.
Magnesium metal, including alloys, all forms	17	36	Norway 35.
Manganese:			
Ore and concentrate	59,006	11,859	Belgium-Luxembourg 10,020.
Oxides	574	580	Netherlands 268; Republic of South Africa 203.
Mercury 76-pound flasks	1,015	638	Netherlands 290.
Molybdenum metal, including alloys, all forms	4	2	NA.
Nickel:			
Ore and concentrate	r 9	540	Norway 538.
Metal, including alloys:			
Scrap	395	80	United States 45; West Germany 24.
Unwrought	253	242	United Kingdom 110; U.S.S.R. 100.
Semimanufactures	186	236	Switzerland 100; United Kingdom 49.
Platinum group metals thousand troy ounces	6	2,750	West Germany e 1,540; U.S.S.R.e 825.
Silver, including alloys do	1,838		
Silicon, elemental	130	143	Sweden 132.
Tin:			
Oxides long tons	19	16	Mainly from United Kingdom.
Metal, including alloys:			
Unwrought do	361	237	United Kingdom 70; China (mainland) 56.
Semimanufactures do	44	32	Mainly from United Kingdom.
Titanium oxides	768	10	NA.
Tungsten metal, including alloys, all forms	5	3	NA.
Zinc:			
Oxides	318	331	East Germany 93; United Kingdom 61.
Metal, including alloys:			
Blue powder	153	222	West Germany 115; Norway 90.

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

(Metric tons unless otherwise specified)

Commodity	1966	1967	Principal sources, 1967
METALS—Continued			
Zinc—Continued			
Unwrought	7,097	6,741	Belgium-Luxembourg 2,946; U.S.S.R. 2,391.
Semimanufactures	408	388	West Germany 220.
Other:			
Ore and concentrate:			
Of titanium, vanadium, tantalum, and zirconium.	1	57,019	United Kingdom 56,998.
Of base metals, n.e.s	319	35	Argentina 30.
Ash and residue containing nonferrous metals.	1,030	489	West Germany 487.
Metals, including alloys, all forms:			
Metalloids, n.e.s	62	42	West Germany 20; Sweden 19.
Pyrophoric alloys	2	2	Austria 1.
Base metals, n.e.s	83	108	Sweden 48; United Kingdom 33.
NONMETALS			
Abrasives, natural, n.e.s value, thousands	$177	$212	United States $115.
Asbestos	6,393	6,431	U.S.S.R. 3,889; Canada 1,581.
Barite and witherite	516	646	West Germany 565.
Borates, natural, crude	2,428	2,539	United States 2,507.
Cement	8,334	7,475	United Kingdom 3,241; Denmark 3,142.
Chalk	11,398	10,209	France 4,006; Denmark 3,105; Sweden 2,665.
Clay and clay products:			
Crude clays	239,272	245,377	United Kingdom 225,515.
Clay products:			
Refractory (including brick)	20,857	46,067	U.S.S.R. 19,696; Sweden 8,541.
Nonrefractory value, thousands	$916	$637	Sweden $300.
Cryolite and chiolite, natural	47	62	All from Denmark.
Diamond:			
Gem, not set or strung value, thousands	$215	$190	Belgium-Luxembourg $72; United Kingdom $37.
Industrial do	$162	$143	Belgium-Luxembourg $96.
Feldspar	1,040	1,264	Sweden 643; Norway 616.
Fertilizer materials:			
Crude, phosphatic	387,149	351,834	U.S.S.R. 245,009; Morocco 106,825.
Manufactured:			
Nitrogenous	121,981	77,215	Norway 49,085; West Germany 27,922.
Phosphatic:			
Thomas (basic) slag	11,349	13,686	Sweden 13,384.
Other	1,598		
Potassic	188,269	180,579	East Germany 61, 545; U.S.S.R. 56,630.
Other, including mixed	3,293	1,145	Belgium-Luxembourg 1,106.
Ammonia	13,409	20,260	Trinidad and Tobago 12,487.
Fluorspar	4,917	4,356	France 1,240; United Kingdom 940.
Graphite, natural	393	346	Poland 200.
Gypsum and plasters	109,190	114,739	Poland 74,888; U.S.S.R. 19,109.
Lime	30	16	NA.
Magnesite	2,038	2,059	West Germany 1,651.
Mica, all forms	764	521	United Kingdom 367.
Pigments, mineral:			
Natural, crude	115	600	Belgium-Luxembourg 475.
Iron oxides, processed	1,142	1,253	West Germany 972.
Precious and semiprecious stone, except diamond:			
Natural value, thousands	$272	$239	West Germany $137.
Manufactured do	$169	$195	West Germany $133.
Pyrite	800	-------	
Salt (excluding brines)	376,010	352,344	Netherlands 169,142; East Germany 74,239.
Sodium and potassium compounds, n.e.s.:			
Caustic soda	2,293	5,403	United Kingdom 2,100.
Caustic potash	354	296	West Germany 128.
Stone, sand and gravel:			
Dimension stone	2,042	2,164	Sweden 645; Italy 482.
Dolomite, chiefly refractory grade	6,307	3,778	Belgium-Luxembourg 3,000.
Gravel and crushed rock	1,367	4,226	Sweden 3,306.
Limestone, except dimension	184,671	224,919	Mainly from Sweden.
Quartz and quartzite	4,767	1,699	Sweden 1,465.
Sand, excluding metal-bearing	98,104	84,640	Belgium-Luxembourg 58,038.
Sulfur:			
Elemental, all forms	78,952	51,235	United States 23,480; France 18,950.
Sulfuric acid	19,856	30	NA.
Talc and steatite	4,994	4,919	China (mainland) 1,695; Norway 1,680.
Other nonmetals, n.e.s.:			
Slag, dross and similar waste, not metal-bearing:			
From manufacture of iron and steel	48,738	5,925	Belgium-Luxembourg 4,350; Sweden 1,575.
Slag and ash, n.e.s	100	2,300	Switzerland 2,100.

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

Commodity	1966	1967	Principal sources, 1967
NONMETALS—Continued			
Other mineral materials	4,643	1,231	Republic of South Africa 470; United Kingdom 340.
Oxides and hydroxides of magnesium, strontium, and barium.	4,874	6,812	Norway 4,711.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	310	315	United Kingdom 143; United States 135.
Carbon black	3,451	3,172	Netherlands 1,465; United Kingdom 998.
Coal, all grades, including briquets. thousand tons	2,048	2,059	Poland 1,633; U.S.S.R. 418.
Coke and semicoke do	727	736	U.S.S.R. 616.
Gas, hydrocarbon, liquefied do	2	6	Netherlands 3.
Petroleum:			
Crude and partly refined do	2,901	4,970	U.S.S.R. 3,788; Iran 1,182.
Refinery products:			
Gasoline do	19	102	Sweden 27; Netherlands 25.
Kerosine do	32	26	Mainly from U.S.S.R. and Netherlands Antilles.
Distillate fuel oil do	2,314	1,861	U.S.S.R. 1,763.
Residual fuel oil do	1,617	978	U.S.S.R. 874; Rumania 104.
Lubricants do	80	68	United Kingdom 32; Sweden 15.
Other do	151	223	Venezuela 177.
Mineral tar and other crude chemicals derived from coal, petroleum or gas.	63	17	U.S.S.R. 9.

• Estimate. r Revised. NA Not available.

COMMODITY REVIEW

METALS

Chromite.—The sharp rise in output of chromite in 1968 was apparently due to requirements of the new ferrochromium plant at Tornio. (See Ferroalloys.) Crude ore production was 107,000 tons (30,000 tons in 1967). Average chromic oxide content in the crude ore was 25 percent (22 percent in 1967) and 41.3 percent in the concentrates (44.1 percent in 1967).

Cobalt.—The new plant at Kokkola for recovering cobalt from pyrite was operated for the first year in 1968. Metal production was approximately 40 percent of plant capacity, and amounted to an estimated 4 percent of world output. A metallurgical process developed by Sherritt Gordon Mines, Ltd., of Canada, was used to recover the metal, which was obtained mainly from pyrite produced at the Outokumpu mine.

Explorations for cobaltous pyrite were reportedly conducted in the Kuusamo area, about 150 miles northeast of Oulu, by Suomen Malmi Oy. A 90,000-ton deposit of pyrite and pyrrhotite, containing approximately 0.3 percent of cobalt and small quantities of copper and gold, was found in the area 10 years ago but the cobalt values were considered insignificant until the Kokkola plant was built.

Copper.—Ore production at the new Luikonlahti mine, 25 miles northwest of Outokumpu, began in 1968 and 4,000 tons of concentrates was reportedly produced. Operated by a private company, Malmikaivos Oy., the mine is expected to produce about 450,000 tons of ore annually. Ore reserves reportedly total 8 million tons containing 1.5 percent copper and 1 percent zinc.

Near Outokumpu, development of the Vuonos deposit was continued and production was scheduled to begin by 1971 at the rate of at least 300,000 tons annually. The Vuonos orebody reportedly contains approximately 3 percent copper. Elsewhere, exploration of the Säviä deposit was continued at Pielavesi.

The increased output of mine copper in 1968 was partly the result of increased production of byproduct concentrates at the Vihanti and Pyhäsalmi mines. Copper concentrate was produced by seven mines in 1968, as shown by the accompanying tabulation:

Mine	Principal product	Copper concentrate, metric tons	
		1967	1968
Outokumpu	Copper	89,433	86,496
Pyhäsalmi	Pyrite	25,497	27,489
Vihanti	Zinc	9,350	12,153
Virtasalmi	Copper	5,718	6,062
Kotalahti	Nickel	3,069	3,729
Luikonlahti	Copper	-------	4,000
Aijala	Zinc	245	970
Total		133,312	140,899

A Honeywell DDP–516 computer was ordered by Outokumpu Oy. for control of copper flotation at the Pyhäsalmi plant. The system was scheduled for installation in mid-1969. In other developments, the Outokumpu flash-smelting process for copper sulfide was licensed to three more Japanese firms and to one firm in Turkey. The process was also sold to a Brazilian company, for treatment of pyrite cleaned from coal.

Iron and Steel.—*Iron Ore.*—Closing of the Jussarő and Kärväsvaara mines reduced the output of magnetite concentrates in 1968, but the loss in volume was largely made up by a 100,000-ton increase in byproduct iron ore obtained from processing of pyrite at Kokkola. The overall supply position, including imports and exports, did not appear significantly changed from 1967.

The Jussarő mine, which normally produced about 110,000 tons of concentrate annually, apparently became uneconomic and was closed by Vuoksenniska Oy. in late 1967. The Kärväsvaara mine, with a normal production of 50,000 to 70,000 tons of concentrate, became depleted and was closed by Otanmäki Oy., probably in 1968. The latter company continued to operate the Raajärvi and Otanmäki mines which produced 262,000 tons and 246,000 tons, respectively, in 1968. Both mines are now underground operations, as openpit mining ceased at Raajärvi in mid-1968.

Otanmäki Oy. was officially merged with Rautaruukki Oy. on December 31 and all operations are now carried on under the name of the latter company. About 1 year previously, Vuoksenniska Oy., which operates blast furnaces at Koverhar (Hanko) and Turku and a steelworks at Imatra, was taken over by a Finnish bank, Pohjoismaiden Yhdyspankki Oy.

Ferroalloys.—Production of ferrochromium began in 1968 at Tornio, on the Gulf of Bothnia near the Swedish border. The plant, which is the only one in Finland, was built by Outokumpu Oy. to utilize chromite mined from deposits near Kemi. Production capacity of the plant was reported to be 30,000 tons annually.

Imports of ferroalloys rose 36 percent to nearly 15,000 tons in 1968, owing to increased steel production. Imports of ferrochromium continued to comprise about 9 percent of the total, but were expected to decrease in 1969 as domestic production increases.

Pig Iron.—Rautaruukki Oy. produced 610,000 tons of pig iron at Raahe, mostly from domestic iron concentrates. Vuoksenniska Oy., using imported ore, produced 289,000 tons of iron at Koverhar and 140,000 tons at Turku. About half the output at Raahe and three-fourths of the Vuoksenniska production was probably exported.

Exports of pig iron were 100,000 tons less than in 1967. The difference was probably due to increased consumption for steelmaking at Raahe.

Steel.—The sharp increase in output of crude and rolled steel in 1968 was due to the first year's operation of the oxygen-steelworks at Raahe, which was commissioned by Rautaruukki Oy. in late 1967. Although production figures were not available, it appeared likely that output at Raahe was at least 50 percent of rated annual capacity which was 600,000 tons of crude steel and 300,000 tons of heavy plate. Production of steel at the Imatra works, in electric furnaces, was reported to be 224,000 tons in 1968.

There were marked changes in exports and imports of plates and sheets in 1968. As compared with 1967 figures, exports increased by 75,000 tons and imports were reduced by 100,000 tons. There was also a reduction of 30,000 tons in imports of ingots and other crude forms.

Plans were announced by Rautaruukki to construct a rolling mill for steel sheet, adjacent to the plate mill at Raahe. The mill, to be completed by 1971, will have a production capacity of 230,000 tons annually. Cost of the plant was estimated at approximately $60 million.

Rare-Earth Metals.—A new source of rare-earth metals was indicated in the

deposits of apatite discovered in Lapland near Savukoski. (See section on Fertilizer Materials.) No figures were available, but the apatite reportedly contains appreciable quantities of rare-earth metals and the deposits were said to be similar to those mined in the Kola Pensinsula of the U.S.S.R.

Rare-earth oxides have been produced in Finland for a number of years, apparently from Kola apatite processed by Typpi Oy., a State-owned fertilizer company. In 1967 the company increased its production capacity for rare-earth oxides to 400 or 500 tons annually in order to process lanthanide concentrates obtained as by-products of lead ore produced at the Korsnas mine. The concentrates contain 2.5 to 3.5 percent rare-earth oxides and 300 grams of europium per ton.

Vanadium.—Exports of vanadium pentoxide from Finland were valued at $1.2 million less than in 1967, even though the quantity shipped increased. This reflected a fall in world prices for vanadium and drew attention to the competition faced by Otanmäki Oy., the Finnish producer, due to increasing supplies of vanadium from the Republic of South Africa and the United States.

Zinc.—A Finnish firm, Rauma-Repola Oy., was awarded a $1.4 million contract to supply leaching and purification equipment for the zinc refinery to be built at Kokkola by Outokumpu Oy. Production capacity of the plant will be 70,000 tons of zinc annually.

NONMETALS

Cement and Other Construction Materials.—The construction industry was generally depressed through the first 9 months of 1968. Although building starts began to increase in the latter part of the year, building production was expected to be 10 percent less than in 1967. Output of lime and cement was the lowest in 5 years, and cement production was only about 60 percent of the total capacity. Trade in construction-related commodities was static, except for exports of asbestos and feldspar which increased considerably. Although general conditions were definitely improving by yearend, the strength of the revival depended primarily on private rather than government expenditures and this factor was uncertain.

Fertilizer Materials.—Discovery of large but low-grade deposits of apatite was reported in 1968 in the Savukoski area of Lapland, northeast of Kemijärvi. The deposits, occurring in a carbonatite complex, contain only about 11 percent phosphorus pentoxide but the apatite reportedly contains appreciable quantities of rare-earth metals which would increase its value. Exploration of the area was being continued by Otanmäki Oy.

Another deposit of apatite, at Siilinjärvi in the Kuopio region of central Finland, was being developed by Apatiiti Oy., a State company formed by Typpi Oy. and the chemicals company, Rikkihappo Oy. The deposit reportedly contains 30 percent apatite, and potential reserves are extremely large.

Successful exploitation of either deposit would be advantageous to Finland since all raw phosphate is now imported. Annual consumption of phosphate rock is approximately 400,000 tons, and imports, mostly from the Soviet Union and Morocco, were valued at $8.4 million in 1968.

Consumption of fertilizer materials in Finland for the agricultural years 1966–67 and 1967–68 is tabulated as follows:

Fertilizer type	Thousand metric tons	
	1966–67	1967–68
Nitrogen:		
Compound fertilizer	61.7	73.5
Calcium nitrate [1]	38.1	42.0
Other	-----	0.1
Total	99.8	115.6
Phosphorus (P_2O_5):		
Compound fertilizer	109.6	134.5
Superphosphate	14.2	14.0
Other	8.6	4.6
Total	132.4	153.1
Potassium (K_2O):		
Compound fertilizer	88.7	104.1
Potassium chloride	9.1	8.2
Other	7.5	1.4
Total	105.3	113.7

[1] Including calcium ammonium nitrate.

Source: British Sulphur Corporation. Nitrogen, No. 57, Phosphorus and Potassium, No. 89. (January–February 1969).

Pyrite and Sulfur.—Increased output of pyrite from the Vihanti and Pyhäsalmi mines was responsible for the record production of recovered sulfur in 1968. Additional production was likely in 1969,

especially from the Luikonlahti copper mine where the ore is reported to contain more than 50 percent of pyrrhotite and pyrite. Sulfur concentrates from the latter mine may be used for manufacture of fertilizer in southeast Finland.

The present mine sources of pyrite concentrate are shown in the following tabulation:

Mine	Pyrite concentrates, metric tons	
	1967	1968
Pyhäsalmi	446,728	472,881
Outokumpu:		
Mine	169,572	158,428
Old tailings	56,240	55,977
Vihanti	33,889	81,679
Otanmäki	5,200	• 5,000
Total	711,629	773,965

The increased recovery of gaseous and elemental sulfur from pyrite at Kokkola has made possible a 45,000-ton reduction in annual imports of sulfur since 1966.

Talc.—Since 1962, talc from deposits near Sotkamo, central Finland, has been investigated as a substitute for imported kaolin in the Finnish paper industry. The investigation appeared to be successful, as an open-pit mine was being developed in 1968 by Suomen Talkki Oy. Production was scheduled to begin in mid-1969, at an initial rate of 200,000 tons of crude ore and 70,000 tons of concentrate annually. The open-pit ore reserves were reported to be 15 million tons. The deposit contains about 50 percent magnesite and is said to closely resemble deposits at Johnson, Vt.

Initially, three filler grades of talc will be produced from a basic flotation concentrate containing 95 percent talc. Later, production will include three grades of micronized talc.

MINERAL FUELS

Atomic Energy.—In late July, the Government's plans to build Finland's first nuclear powerplant were temporarily abandoned. Bids had been received from Sweden, the United Kingdom, and the Soviet Union, with each proposing a different type of reactor. Apparently, the plans were abandoned because of unresolved questions including safety, supply of fuel, and the extent of participation of Finnish industries. Until these questions can be resolved, additional supplies of electricity will be furnished by conventional hydro and thermal plants or from imported power.

Coal and Coke.—Finland continued to import almost all solid fuels from the Soviet Union (coke) and Poland (coal). Value of imports of solid fuels in 1968 was $16.3 million from the U.S.S.R. and $14 million from Poland. Total imports included 2,094,000 tons of coal and briquets and 662,000 tons of coke.

A trade agreement between Finland and the U.S.S.R. in November 1968 provided that Soviet exports of coal and coke to Finland would continue at about the same level during 1969.

The approximate consumption of coal and coke in Finland in 1967 and 1968 is shown in the following tabulation, in thousand metric tons:

	1967	1968
Coal:		
Electric power generation	415	854
Locomotive fuel	114	82
Paper and wood industry	593	780
Other industries	412	423
Gas and coke manufacturing	193	161
Space heating	74	58
Total	1,801	2,358
Coke:		
Metals reduction	734	732
Other industries	9	4
Space heating	136	65
Total	879	801

Petroleum.—Imports of crude oil in 1968 continued to be supplied by the Soviet Union and Iran, but there was a marked change in relative volume in favor of the U.S.S.R. Of the total import of 5.8 million tons, the Soviet share was almost 90 percent, as compared with 75 percent in 1967.

The expansion of annual processing capacity at the Porvoo refinery to 5.5 million tons was completed in October. Combined processing capacity of the refineries at Porvoo and Naantali was between 8.0 and 8.5 million tons annually at yearend.

Apparent consumption of petroleum products was 8.3 million tons. This indicated an increase of about 10 percent in 1968, compared with 5 percent in 1967 and 19 percent in 1966. The quantity of imports of petroleum products was almost unchanged from 1967, while exports fell to 131,000 tons and refinery production rose by 716,000 tons.