Nickel

By Horace T. Reno [1]

Nickel supply came into closer balance with demand in 1972 because some of the lower grade, high-cost mines were shut down and nickel consumption in the United States, Western European countries, and Japan increased rapidly. Nevertheless, a large surplus nickel supply remained in the producers' inventory that built up in 1970 and 1971.

Canadian nickel producers raised the quoted base price for pure nickel by approximately 15% the first of September. Producers in other countries except the United States followed the Canadian lead.

The U.S. nickel industry was little affected by the worldwide imbalance between supply and demand. The domestic price was not changed until late in the year when the price of domestically produced ferronickel was raised approximately 7%. Domestic consumers used 25% more nickel in 1972 than in 1971 and more than doubled their use of ferronickel.

The President approved legislation on July 26, 1972, that authorized disposal of all nickel held in the national stockpile. Stockpile nickel did not reach the open market during the year.

Table 1.—Salient nickel statistics

(Short tons)

	1968	1969	1970	1971	1972
United States:					
Mine production	17,294	17,056	15,933	17,036	16,864
Plant production:					
Primary	15,241	15,810	15,558	15,654	15,731
Secondary	14,061	18,775	23,159	29,657	35,926
Exports	33,681	34,758	31,456	26,143	21,671
Imports for consumption	147,950	129,332	156,252	142,183	173,870
Consumption	159,306	141,737	155,719	128,802	159,286
Stocks Dec. 31: Consumer	27,466	16,574	24,708	16,005	26,205
Price—cents per pound	94–103	103–128	128–133	133	133–153
World: Mine production	547,960	536,608	692,710	699,906	698,007

DOMESTIC PRODUCTION

The Hanna Mining Co. at Riddle, Oreg., was the sole producer of primary nickel in the United States. Byproduct nickel salts were produced at copper and other metal refineries. Part of the byproduct nickel originated from scrap.

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Table 2.—Primary nickel produced in the United States

(Short tons, nickel content)

	1968	1969	1970	1971	1972
Byproduct of metal refining	2,117	2,714	2,909	2,581	2,505
Domestic ore	13,124	13,096	12,649	13,073	13,226

Table 3.—Nickel recovered from nonferrous scrap processed in the United States, by kind of scrap and form of recovery

(Short tons)

Kind of scrap	1971	1972	Form of recovery	1971	1972
New scrap:					
Nickel-base	r 1,247	3,038	As metal	854	1,166
Copper-base	r 3,357	1,948	In nickel-base alloys	r 2,093	2,694
Aluminum-base	465	500	In copper-base alloys	r 5,332	6,738
			In aluminum-base alloys	774	1,056
Total	r 5,069	5,486	In ferrous and high-temperature alloys [1]	17,586	24,003
			In chemical compounds	197	269
Old scrap:					
Nickel-base	20,832	29,440	Total	r 26,836	35,926
Copper-base	577	600			
Aluminum-base	358	400			
Total	21,767	30,440			
Grand total	r 26,836	35,926			

r Revised.
[1] Includes only nonferrous nickel scrap added to ferrous and high-temperature alloys.

CONSUMPTION AND USES

The domestic nickel industry used more than twice as much nickel in the form of ferronickel in 1972 than it used in 1971. Essentially all of it was used in stainless and alloy steels. The pattern of nickel consumption in 1972 was changed little from that of 1971; 28% of the total consumed was used to make stainless steels, 12% was used in alloy steels, 18% was used in nickel plating, 26% was used to make high-nickel alloys and superalloys, and 3% was used in iron castings. International Nickel Co. of Canada, Ltd. (INCO), which in the past has reported statistics on the end-use consumption pattern, did not do so for 1972 because of the growing markets in Eastern Europe, the U.S.S.R., and Asia, areas for which accurate statistics are unavailable. Nevertheless, INCO reported little alteration in consumption either as to end use or geographical area. End-use market information available to the Bureau of Mines did not indicate any substantial change in the worldwide pattern of nickel usage.

Table 4.—Stocks and consumption of new and old nickel scrap in the United States in 1972

(Gross weight, short tons)

Class of consumer and type of scrap	Stocks, beginning of year	Receipts	Consumption			Stocks, end of year
			New	Old	Total	
Smelters and refiners:						
Nickel and nickel alloys	502	9,632	729	6,543	7,272	2,862
Monel metal	998	4,938	611	2,308	2,919	3,017
Nickel silver [1]	441	2,897	815	2,067	2,882	456
Cupronickel [1]	78	587	--	525	525	140
Nickel residues	5,816	1,621	5,501	--	5,501	1,936
Total	7,316	16,191	6,841	8,851	15,692	7,815
Foundries and plants of other manufacturers:						
Nickel and nickel alloys	14,672	17,023	1	27,934	27,935	3,760
Monel metal	19	136	10	136	146	9
Nickel silver [1]	2,397	12,112	11,990	--	11,990	2,519
Cupronickel [1]	1,253	16,589	16,120	100	16,220	1,622
Nickel residues	184	80	--	155	155	109
Total	14,875	17,239	11	28,225	28,236	3,878
Grand total:						
Nickel and nickel alloys	15,174	26,655	730	34,477	35,207	6,622
Monel metal	1,017	5,074	621	2,444	3,065	3,026
Nickel silver [1]	2,838	15,009	12,805	2,067	14,872	2,975
Cupronickel [1]	1,331	17,176	16,120	625	16,745	1,762
Nickel residues	6,000	1,701	5,501	155	5,656	2,045
Total	22,191	33,430	6,852	37,076	43,928	11,693

[1] Excluded from totals because it is copper-base scrap, although containing considerable nickel.

Table 5.—Nickel (exclusive of scrap) consumed in the United States, by form

(Short tons)

Form	1968 [1]	1969 [1]	1970 [1]	1971 [1]	1972 [1]
Metal	115,839	99,096	112,825	95,639	110,422
Ferronickel	15,170	17,804	15,230	r 11,515	22,806
Oxide powder and oxide sinter	24,362	19,133	21,369	r 16,554	19,315
Salts	3,935	2,647	3,792	2,376	3,939
Other	--	3,057	2,503	2,718	2,804
Total	159,306	141,737	155,719	r 128,802	159,286

r Revised.
[1] Metallic nickel salts consumed by plating industry are estimated.

Table 6.—U.S. consumption of nickel (exclusive of scrap), by use and form, 1972

(Short tons)

Use	Commercially pure unwrought nickel	Ferro-nickel	Nickel oxide	Nickel sulfate and other nickel salts	Other forms	Total of figures shown
Steel:						
Stainless and heat-resisting	17,155	16,788	11,196	--	227	45,366
Alloys (excludes stainless)	7,930	5,004	6,408	--	213	19,555
Superalloys	11,536	251	49	--	436	12,272
Nickel-copper and copper-nickel alloys	8,307	--	36	--	199	8,542
Permanent magnet alloys	3,925	221	54	--	--	4,200
Other nickel and nickel alloys	27,873	269	698	5	49	28,894
Cast irons	2,825	272	401	--	938	4,436
Electroplating [1]	25,351	--	31	3,547	107	29,036
Chemicals and chemical uses	906	--	71	204	--	1,181
Other uses [2]	4,614	1	371	183	635	5,804
Total reported by companies canvassed and estimated	110,422	22,806	19,315	3,939	2,804	159,286

[1] Based on monthly estimated sales to platers.
[2] Includes batteries, ceramics, and other alloys containing nickel.

Table 7.—Nickel (exclusive of scrap) in consumer stocks in the United States, by form

(Short tons)

Form	1970	1971 r	1972
Metal	17,944	11,499	18,174
Ferronickel	2,249	2,589	3,990
Oxide powder and oxide sinter	3,304	970	2,794
Salts	498	381	446
Other	713	616	801
Total	24,708	16,005	26,205

r Revised.

PRICES

The producers' price for electrolytic nickel was increased from $1.33 to $1.53 per pound the first of September. Prices were unchanged for domestically produced nickel in ferronickel until December 14 when the quoted price was raised from $1.28 to $1.38 per pound. The price changes for nickel produced in foreign countries widened the differential between prices quoted for pure nickel and that quoted for nickel in ferronickel and in other forms of nickel especially suited for steelmaking. The top grade of ferronickel produced in New Caledonia was quoted at $1.42 per pound of contained nickel, an increase of 12 cents per pound effective September 25.

FOREIGN TRADE

The gross weight of U.S. exports of nickel, nickel alloys, and nickel catalysts was 34% less in 1972 than that in 1971. Export of nickel scrap increased 14% over that of 1971.

U.S. foreign trade in nickel in 1972 was marked by greatly increased imports of nickel in ferronickel, 76% more than was imported in 1971. Most of the ferronickel imported originated in New Caledonia. Nickel-bearing ore was imported from Colombia, the Philippines, and Canada for use in pilot plant research operations. The total of nickel in all forms imported for consumption in 1972 was 21% more than was imported in 1971. Canada continued as the principal supplier but with 8 percentage points less of the total than in 1971. Imports of nickel from the U.S.S.R. increased more than fourfold compared with that imported in 1971.

Table 8.—U.S. exports of nickel and nickel alloy products, by class

Class	1970		1971		1972	
	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)
Unwrought	6,103	$13,450	4,287	$8,614	2,178	$6,469
Bars, rods, angles, shapes, sections	5,311	16,047	4,904	16,828	2,140	9,038
Plates, sheets, strip	4,653	21,893	3,351	14,675	3,455	16,625
Anodes	160	600	334	1,147	481	1,490
Wire	870	5,642	643	3,269	553	2,638
Powder and flakes	281	2,405	696	2,754	341	2,800
Foil	18	76	7	41	11	28
Catalysts	2,524	6,451	3,740	10,018	2,573	6,794
Tubes, pipes, blanks, fittings therefore, hollow bars	1,756	6,520	2,134	9,985	1,499	8,831
Waste and scrap	9,780	12,840	6,047	7,239	8,440	9,055
Total	31,456	85,924	26,143	74,570	21,671	63,768

Table 9.—U.S. imports for consumption of nickel products, by class

Class	1970		1971		1972	
	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)
Ore	21	$251	13,173	$297	258	$6
Unwrought	117,334	302,578	r 100,531	259,931	125,364	330,825
Oxide and oxide sinter	6,423	12,611	5,769	11,604	5,988	12,038
Slurry [1]	35,114	82,643	32,944	73,656	28,222	57,085
Bars, plates, sheets, anodes	177	773	79	302	198	683
Rods and wire	544	2,630	768	3,642	694	2,964
Shapes, sections, angles	2	12	[2]	1	1	7
Pipes, tubes, fittings	22	97	10	47	63	314
Powder	3,050	10,416	1	3	4,499	14,109
Flakes	76	207	2,708	8,234	331	909
Waste and scrap	2,149	4,485	1,336	1,896	2,306	3,517
Ferronickel	14,251	9,834	26,233	16,986	51,741	35,857
Total (gross weight)	179,163	426,537	183,552	376,599	219,665	458,314
Nickel content (estimated)	156,252	XX	142,183	XX	173,870	XX

r Revised. XX Not applicable.
[1] Nickel-containing material in slurry, or any form derived from ore by chemical, physical, or any other means, and requiring further processing to recover nickel or other metals.
[2] Less than ½ unit.

Table 10.—U.S. imports for consumption of new nickel products [1] by country

(Short tons)

Country	Metal		Powder and flakes		Oxide and oxide sinter		Slurry and other [2]			
	1971	1972	1971	1972	1971	1972	1971		1972	
	(Gross weight)		(Gross weight)		(Gross weight)		Gross weight	Nickel content	Gross weight	Nickel content
Australia	457	487	297	195	--	--	r 145	r 39	--	--
Canada	87,040	97,250	694	1,487	5,728	5,967	r 29,752	r 24,428	28,188	22,792
Finland	21	55	--	2	--	--	--	--	--	--
France	181	558	45	249	28	15	--	--	(3)	(3)
Germany, West	50	561	8	11	--	--	r 44	r 10	--	--
Mozambique	--	67	--	--	--	--	--	--	--	--
Netherlands	408	166	--	--	--	--	--	--	11	3
Norway	11,067	17,295	43	--	--	--	--	--	--	--
Rhodesia, Southern	--	1,801	--	--	--	--	--	--	--	--
South Africa, Republic of	929	2,791	122	215	13	--	r 2,977	r 1,349	--	--
Sweden	25	(3)	--	--	--	--	--	--	--	--
U.S.S.R.	22	94	--	6	--	--	--	--	--	--
United Kingdom	329	4,135	1,499	2,645	(3)	--	r 26	r 3	23	21
Uruguay	--	70	--	--	--	--	--	--	--	--
Other	2	34	1	20	--	6	--	--	--	--
Total	100,531	125,364	2,709	4,830	5,769	5,988	r 32,944	r 25,829	28,222	22,816

r Revised.

[1] Ore: 1971, 13,173 short tons: Australia 2,196, French Pacific Islands 5,566, Colombia 4,314, Philippines 1,097, Canada less than 1 short ton; 1972, 258 short tons: Canada 52, Colombia 70, Philippines 136.

[2] Nickel-containing material in slurry, or any form derived from ore by chemical, physical, or any other means, and requiring further processing to recover nickel or other metals.

[3] Less than ½ unit.

WORLD REVIEW

Australia.—Western Australia's nickel boom of the last 4 years was moderated somewhat by the oversupply of nickel around the world; however, nickel production increased 10% compared with that of 1971. Western Mining Corp., Ltd., again increased its reserves, and by the end of the year, the corporation had essentially completed a new flash smelter at Kalgoorlie. The Kalgoorlie smelter has a designed capacity of 25 tons of nickel concentrate per hour. It utilizes the Outokumpu Oy smelting process. Western Mining Corp.'s progress is a good measure of the rapidity with which the nickel industry of Western Australia has developed into a significant worldwide supplier. Just 5 years after first nickel production, Western Mining was the world's fourth largest producer of nickel and opened a sales office in the United States at Pittsburgh, Pa., to market nickel to North American consumers.

Construction of the mining plant and infrastructure for the Greenvale nickeliferous laterite deposits in Queensland was started, and the work proceeded as scheduled.

Poseidon Ltd.'s joint venture with Homestake Mining Co. and Hanna Mining Co. to exploit the Windarra deposit in Western Australia was disbanded, and Poseidon entered an agreement with Western Mining Corp. and Sherritt Gordon Mines Ltd. of Canada for sale of concentrates produced from the Windarra deposit. Reportedly, the Poseidon company will have some support on the project from the Australian Government.

The Agnew nickel prospect, 200 miles northwest of Kalgoorlie, discovered in 1971 by Selcast Exploration Ltd., a subsidiary of Selection Trust Ltd. of London, was proved a significant find. By yearend it was reported that the Agnew deposit contained 33 million tons of ore averaging 2.2% nickel at a cutoff grade of 1%.[2]

The Western Australian Government considered providing support in building infrastructure that serves the developing nickel and other mineral industries of the state. Reportedly, the most likely aid would be help in building a railway to Kalgoorlie continuing west to the Port of Geralton.

[2] Northern Miner. Major Nickel Orebody Shaping From Agnew Find in Australia. V. 58, No. 41, Dec. 28, 1972, p. 14.

Botswana.—The way was cleared for development of the Pikwe-Selebi copper-nickel deposits when agreements for financing the project were signed at Gaborone in March.

Canada.—Canadian nickel production in 1972 was 13% less than in 1971 because INCO cut back its mining operations 10% early in the year to adjust output to market conditions. At yearend INCO had 14 mines operating, 11 in Ontario and 3 in Manitoba. INCO's Maclennan mine in the Sudbury district was depleted, and its Shebandoan mining and milling complex in Northern Ontario was brought into production as planned.

Prospecting and exploration of nickel and copper-nickel properties continued at a high level of activity, little influenced by the worldwide imbalance between supply and demand. INCO and Falconbridge Nickel Mines Ltd. were active in exploration in Quebec, Ontario, and Manitoba. INCO did not report developments at specific properties in its annual report for the year. Falconbridge reported that underground drilling at its Onaping mine indicated a new significant sulfide zone and that diamond drilling from a drift on the 1,000-foot level at the Bucko Lake property of Bowden Lake Nickel Mines Ltd. was in nickel mineralization. Falconbridge had a 60% interest in the property.

Great Lakes Nickel Ltd. of Toronto, Ontario, and Boliden AB of Stockholm, Sweden, announced an agreement under which the Swedish company will study the feasibility of producing copper and nickel concentrates from the large low-grade copper-nickel property on which Great Lakes Nickel has indicated 106 million tons of 0.4% copper, 0.2% nickel ore. A feasibility study made for the Ontario Government indicated that a copper smelter-refinery in northern Ontario would not be economically viable unless large copper ore bodies are discovered. The study cited the Great Lakes Nickel Ltd. project as a possibility.

The principal Canadian nickel producers and their 1972 production, sales, or deliveries to customers as given in their annual report to stockholders were as follows:

Company	Type of operation	Thousand pounds
The International Nickel Co. of Canada, Ltd	Delivery	425,080
Falconbridge Nickel Mines Ltd	Delivery	89,665
Sherritt Gordon Mines Ltd	Sales	20,414

Environmental improvement in the Sudbury district was a major element in the operations of both INCO and Falconbridge. INCO commissioned a 1,250-foot chimney and a gas cleaning system and capped the three chimneys that it replaced. Falconbridge shut down its pyrrhotite processing plant until a process is developed to eliminate sulfur dioxide (SO_2) emissions. Both companies recycled processing waters and seeded barren land in the vicinity of their plants.

Falconbridge closed its nickel-iron refinery after 2 years of operation failed to achieve continuous production of specification products. Reports to the Bureau of Mines from U.S. consumers of the Falconbridge nickel-iron indicated that the material that reached the market was a satisfactory source of nickel for use in steelmaking.

Colombia.—Colombian Nickel Co. (CONICOL) and the Industrial Development Institute of Colombia (IFI) were renegotiating portions of their concession agreement to exploit nickel deposits at Cerro Matoso in the Department of Córdoba.

Cuba.—The Government of the Republic of Cuba announced that it had reached agreement with the Government of the U.S.S.R. for credits to finance general repair and reconstruction of the existing nickel plants at Moa Bay and Nicaro and to expand the mining base at both plants. Moreover, it announced that Cuban and Soviet organizations will collaborate on construction of the first phase of a mining-metallurgical complex with an annual output capacity of 30,000 tons of nickel and cobalt at Punta Gorda. The approximate distribution of credits for the projects was 52 million rubles (US$63.18 million) for rehabilitation of Nicaro and Moa Bay and 15 million rubles (US$18.225 million) for the Punta Gorda complex. The ultimate investment needed to raise Cuban production to 90,000 tons of nickel annually was estimated at $600 million, not including the funds required for the infrastructure, housing, and energy.

Dominican Republic.—The ferronickel plant of Falconbridge Dominicana C. por A. was officially inaugurated by His Excellency Dr. Waukeen Balenguer, President of the Republic. The plant produced about 46,000 tons of ferronickel during the year,

approximately 70% of its rated annual capacity.

Greece.—Société Minière et Métallurgique de Larymna S.A. (LARCO), the only active nickel producer in Greece, engaged in an expansion program designed to increase its nickel productive capacity from 1,100 to 1,750 tons per month.

Indonesia.—Indonesian production of nickel in 1972 was stimulated by a pricing dispute between Japanese consumers and the nickel producers in other areas of the Pacific. With Japanese help, PN Aneka Tambang (Aneka), the state mining corporation, was building a smelter at Pomalaa to process low-grade (1.8% nickel) laterite to 22% ferronickel. P.T. International Nickel Indonesia, a wholly owned subsidiary of INCO, announced agreement with six Japanese companies for equity participation in its planned nickeliferous laterite mining and processing facilities on the island of Sulawesi. The Japanese companies are to provide sales of the ferrous laterite mining and processing facilities project output over a 15-year period. It is expected that INCO's equity in the project will be 60% and that of the Japanese participants 20%; the remainder will be held by Indonesians.

New Caledonia.—Nickel ore production in New Caledonia in 1972 was 2% less than that produced in 1971 because a disagreement on prices with Japanese consumers shut down a large segment of the independent nickel mining industry. However, ore mining by that segment of the industry producing for processing in New Caledonia increased. Overall nickel production was down 4% compared with that in 1971, but ferronickel and matte production increased 28% and 25% respectively. Nickel ore exports to Japan were 42% less than exports in 1971.

The high level of production of nickel products in New Caledonia was maintained with the help of a group of consumers in France that, under French Government guidance, established a nickel stockpile of 38 million pounds.

The worldwide imbalance between nickel supply and demand delayed some planned nickel projects in New Caledonia and caused revision of others. The agreement

Table 11.—Nickel: World production [1] by country

(Short tons)

Country [2]	1970	1971	1972 [p]
Australia (content of concentrate)	[r] 32,810	35,866	39,442
Brazil (content of ore) [e]	3,200	3,500	3,500
Burma (content of speiss)	23	26	29
Canada [3]	305,881	294,342	256,467
Cuba:			
Content of oxide [e]	20,400	[r] 39,000	40,000
Content of sulfide [e]	18,400		
Dominican Republic	--	220	19,800
Finland:			
Content of concentrates	5,634	3,867	5,700
Content of nickel sulfate	165	136	[e] 165
Greece (recoverable content of ore)	9,526	[p] 11,800	[e] 12,100
Indonesia (content of ore) [4]	[r] 17,200	21,800	24,738
Mexico (content of ore)	49	[e] 55	[e] 55
Morocco (content of nickel ore and cobalt ore)	152	[e] 220	254
New Caledonia (recoverable) [5]	116,164	112,751	110,424
Norway (content of concentrate)	234	[e] 220	[e] 220
Poland (content of ore) [e]	2,200	[r] 2,200	2,200
Rhodesia, Southern (content of concentrate) [e]	12,000	[r] 12,800	13,200
South Africa, Republic of [6]	12,739	14,067	12,849
U.S.S.R. (content of ore) [e]	120,000	130,000	140,000
United States	15,933	17,036	16,864
Total	[r] 692,710	699,906	698,007

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

[1] Insofar as possible, this table represents mine production of nickel. Where data relate to some more highly processed form, the figures given are used in lieu of actual reported mine output as a measure of mine output. The following table gives metallurgical plant output, including data for countries that mine no nickel, but that process imported ores, concentrates, and/or other crude materials.

[2] In addition to the countries listed, Albania and East Germany also produce nickel from mines, but available information is inadequate to make reliable estimates of output levels.

[3] Refined nickel and nickel content of oxides and salts produced, plus recoverable nickel in matte and concentrates exported.

[4] Includes a small amount of cobalt not recovered separately.

[5] Nickel-cobalt content of metallurgical plant products, plus recoverable nickel-cobalt in exported ores.

[6] Reported erroneously as refined metal in previous editions.

Table 12.—Nickel: World smelter production [1] by country

(Short tons)

Country [2]	1970	1971	1972 [p]
Australia	1,100	15,400	17,600
Brazil [3]	2,900	2,900	3,100
Canada [3]	208,700	182,500	145,200
Cuba [e] [4]	40,000	35,000	37,000
Czechoslovakia [e]	900	900	900
Dominican Republic [4]	--	374	19,800
Finland	4,419	4,288	[3] 6,100
France	11,360	9,486	[3] 14,440
Germany, West	622	220	220
Greece	9,526	[p] 11,800	[e] 12,100
Japan [5]	99,100	112,400	119,000
New Caledonia [6]	48,304	50,728	65,384
Norway	42,415	46,058	47,739
Poland [e]	2,200	2,200	2,200
Rhodesia, Southern [e] [3]	5,500	7,700	8,800
South Africa, Republic of [3]	9,900	9,900	9,700
United Kingdom	40,500	42,700	[3] 35,200
U.S.S.R. [e]	120,000	130,000	140,000
United States: [7]			
Byproduct of metal refining	2,909	2,581	2,505
Recovery from domestic ore	12,649	13,073	13,226
Total	663,004	680,208	700,214

[e] Estimate. [p] Preliminary.

[1] Refined nickel plus nickel content of ferronickel produced from concentrates unless otherwise specified.

[2] In addition to the countries listed, East Germany and North Korea are believed to produce metallic nickel and/or ferronickel, but information is inadequate to make reliable estimates of output levels.

[3] Includes nickel content of nickel oxide and nickel fonte.

[4] Nickel-cobalt content of ferronickel only (no refined nickel is produced).

[5] Includes electrolytic nickel as follows 1970—14,763; 1971—17,077; 1972—18,189; the difference between these figures and the listed total is the nickel content of ferronickel, nickel oxide and nickel fonte.

[6] Nickel content of ferronickel and matte.

[7] Electrolytic nickel only.

between Société Le Nickel, S.A. and Patiño Mining Corp. to build a powerplant, erect a town, develop a harbor and port, and build a smelter in Poum on the northern tip of the island was allowed to lapse. However, Patiño entered an agreement to continue the project with Pechiney Ugine Kuhlmann (PUK) of France and the Gränges Co. of Sweden. The three concerns formed Société Metallurgique de Nickel Patiño Pechiney Gränges (SOMMONI), a new company that will manage the work. The Patiño subsidiary Compagnie Française d'Entreprises Minères, Métallurgiques et d'Investessiments (COFREMMI) was to own 42% of SOMMONI: PUK, 38%; and Gränges, 20%.

The French Government negotiated with three other concerns for mining lateritic nickel ores of New Caledonia: (1) International Nickel Co. of Canada, Ltd., which was attempting to organize a project for the production of 45 million pounds of nickel and 3 million pounds of cobalt annually, (2) Penamax, formed by American Metal Climax, Inc., and (3) Société Nationale des Pétroles d'Aquitaine of France and Freeport Minerals Corp. of the United States. At yearend none of the three potential projects were approved.

Philippines.—Marinduque Mining and Industrial Corp. (MMIC) announced that it was selling $3 million worth of its stock to raise the money needed to complete its equity share of the capital required to construct a laterite mining plant on the Surigao mineral reservation. Apparently the project was still viable despite numerous delays and the dampening effect of the world imbalance between supply and demand.

Atlas Consolidated Mining and Development Corp. began testing a 1,000-ton, bulk sample of Palawan ore preliminary to exercising its right of first refusal to exploit the properties. Reportedly, Soriano and Co. has proved reserves of 284 million tons containing 1.29 to 1.42% nickel at Palawan. Japanese companies negotiated for 1,000 tons of nickel concentrate per year from the Palawan deposits.

TECHNOLOGY

The pattern of nickel research and development in 1972 was little changed from that of the last 2 years. Scientists at Bureau of Mines laboratories researched methods of recovering nickel and copper from the Duluth gabbro of Minnesota. One element of the overall investigation was a study looking to pressure leaching of nickel-bearing gabbro in situ. The plan was to fracture the gabbro with nuclear explosives.

In the oxide ore phase of the Bureau's extractive research program, metallurgists studied segregation and chloridization processes. They reported a simple, low-cost roasting modification for improving nickel and cobalt extraction from relatively refractory, low-grade, weathered serpentine. The process was described in a Bureau of Mines Technical Progress Report.[3]

Apparently the pattern of research in the U.S.S.R. has followed that of the free world. It was reported that nickel production had been increased 37% in the 5-year plan period between 1966 and 1970. The increase was due to introduction of new technology, automation, mechanization, improvements in processes, and modernization of mining and metallurgical equipment. Oxygen-enriched airblast into a shaft smelting furnace, autoclave leaching to increase production of nickel hydroxide, and replacement of multiple hearth roasters by closed-system fluo-solids furnaces were among the technical improvements.[4]

The Division of Mineralogy of the Australian Commonwealth Scientific and Industrial Research Organization (CSIRO) began a comprehensive investigation on the nature of deposition and mode of origin of the nickel sulfide ores of Australia. The program was designed to develop a genetic model that is consistent and adequately understood. The initial work was an interpretive study of nickel-iron sulfide ore in the Lunnon shoot at Kambalda, Western Australia.[5] A magmatic model for the formation of the shoot was developed as a result of study of one intersection of the ore body. The data suggested that at temperatures above 1,140° C, the ore and its host ultramafic rock consisted of a crystal mush containing olivine and chromite crystals, sulfide droplets, and silicate magma.

CSIRO researchers also began collecting representative samples of nickeliferous oxide ores from various Australian deposits to determine their response to known hydrometallurgical procedures.[6]

Mining engineers of INCO, reported on more than 10 years of progress in raise boring at the Sudbury district nickel mines.[7] Improved safety in ground control, lower resistance to air flow, and reduced cost were cited as the advantages in raise boring.

The Republic Steel Corp. of Cleveland, Ohio, reported a new hydrometallurgical process for recovering nickel.[8] Metallurgists of the company worked with the Colorado School of Mines Research Institute on a feasibility study and pilot plant operation to test a number of lateritic ores. They reported that using hydrometallurgical techniques at elevated temperatures with additives of sulfur, oxygen, and metallic iron, the new process achieved 92% nickel recovery.

Informal reports from industrial research laboratories indicated a high level of activity in the search for new nickel applications, but as in 1971, the intensified research was not reflected in the published literature. Armco Steel Corp. described a new 5% nickel alloy to compete with ferritic and austentic nickel stainless steel.[9] The 5% nickel steel was said to increase the versatility of the nickel steels in handling and storage of liquified gases with special emphasis on liquid natural gas (LNG). Most LNG facilities have been built of alloy steels containing 9% nickel.

[3] Brooks, P. T., and G. M. Potter. Improving Nickel Extraction from Oxide Nickel Ores. Bu-Mines TPR 57, September 1972, 4 pp.

[4] Murashov, V. D. Improvements in Nickel Technology. Intermet Bull., v. 1, No. 4, April 1972, p. 41.

[5] Ewers, W. E., and D. R. Hudson. An Interpretive Study of a Nickel-Iron Sulfide Ore Intersection, Lunnon Shoot, Kambalda, Western Australia. Econ. Geol., v. 67, No. 8, December 1972, pp. 1075–1092.

[6] CSIRO Minerals Research Laboratories Annual Report, 1971–72, p. 20.

[7] Parris, T. D., and W. J. Taylor. Raise Boring at the International Nickel Company of Canada, Limited, Ontario Division. Can. Min. and Met. Bull., v. 65, No. 723, July 1972, pp. 25–30.

[8] Canadian Mining and Metallurgical Bulletin. Hydrometallurgical Recovery of Nickel. V. 66, No. 729, January 1973, p. 140.

[9] Wood, J. Armco Details Cost Advantage, Toughness of Nickell Alloy. Am. Metal Market, v. 79, No. 180, Oct. 2, 1972, p. 27.