

NICKEL

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SUMMARY OUTLINE

	Page		Page
Summary.....	519	Other countries.....	523
Uses and consumption.....	520	New Caledonia.....	523
World production.....	521	Japan.....	523
United States.....	521	India.....	524
Imports and exports.....	522	Brazil.....	524
Canada.....	522	U. S. S. R. (Russia).....	524
Falconbridge Nickel Mines, Ltd.....	522	Germany.....	524
International Nickel Co.....	523	Italy.....	524
Other Canadian mines.....	523	Norway and Greece.....	524
		Finland.....	524

Nickel production and consumption reached an all-time high in 1935, although the year was marked by no major technologic discoveries. Estimated world deliveries of nickel metal in all forms from all sources during 1935 were 80,000 short tons compared with 61,000 tons in 1934 and 68,000 tons in 1929. The automotive industry continued to be the largest consumer.¹ Material increase in production indicated that mines and plants were being run to full capacity.

Efforts to achieve economic autarchy, or national self-sufficiency, prevalent in many countries during recent years, may account in part for the efforts made in Italy, Germany, Japan, and Soviet Russia to locate domestic reserves of nickel. The development of deposits in Brazil, Finland, and Netherland India is significant. Normal commercial development continued in Norway, Greece, New Caledonia, and Canada, the last-mentioned country maintaining its position as the world's principal source of both crude and refined nickel. During 1935 the quoted price of nickel and nickel semi-manufactures continued steady at the level prevailing since 1929. Electrolytic nickel was quoted throughout the year at 35 cents a pound.

Salient statistics for nickel, 1933-35

	1933	1934	1935
World:			
Production ¹short tons..	50,989	77,753	(?)
United States:			
Production, byproduct of copper refining.....do.....	126	157	160
Secondary production.....do.....	1,650	1,850	1,950
Imports ²do.....	26,430	29,298	37,848
Exports ³do.....	1,051	2,727	2,193
Price per pound ⁴cents..	35	35	35
Canada:			
Production.....short tons..	41,632	64,344	69,044
Exports.....do.....	44,041	59,076	71,363
Imports.....do.....	496	345	286

¹ Approximate.

² Adequate information not available.

³ Excludes "All other manufactures of nickel"; weight not recorded.

⁴ Excludes "Manufactures"; weight not recorded.

⁵ Price quoted by International Nickel Co. of Canada, Ltd., for electrolytic nickel at New York, in 2-ton minimum lots.

¹ Annual Report, International Nickel Co. of Canada, Ltd., Dec. 31, 1935.

Uses and consumption.—During the World War consumption of nickel reached a record height. At that time its use in the manufacture of alloys was developed to an unprecedented degree. Immediately after the cessation of hostilities large stocks of metallic nickel as well as surplus plant equipment threatened the industry. Technical research, directed toward increasing consumption through extending its use, has broadened the market for the metal to such a degree that maximum production has been necessary to satisfy industrial demands.

The demand for stainless steels and such alloys as 18-8 (chromium 18 percent, nickel 8 percent) has increased materially the consumption of the metal. Likewise, the use of corrosion-resisting light-weight steels and intermediate alloys, particularly in railway transportation, is a significant factor in the progress of the nickel industry. In transportation, nickel-bearing aluminum alloys and low-cost nickel-manganese cast steels are in greater demand. To meet the competition of other alloys, gray cast iron has been improved and hardened by the addition of nickel. Structural grades of bronzes have been improved mechanically and their cost decreased by the addition of nickel and tin. Welding rods are a recent development in the use of nickel-steel and monel metal. An outstanding development in the field of electrical plating is the perfection of the bright-plating process, by which nickel is deposited at a high rate of speed. Materials so plated require less grinding and buffing. By this process irregular shapes can be plated satisfactorily.²

Technical research has developed an outlet for nickel alloys in the food and beverage-manufacturing industries, where resistance to corrosion and the nontoxic qualities of the metal are major requirements. In the manufacture of chemicals, which requires equipment having a high degree of resistance to corrosion, the market for nickel and its alloys is ever increasing. Modern methods for the manufacture of phenol, caustic soda, and noncombustible synthetic solvents depend in part upon the use of nickel. Nickel and monel metal fabricates are being put to new use in the textile industries, especially where dyes come in contact with metal parts. The ever increasing demand for high-speed, heavy-duty machinery indicates an expanding market for nickel and its alloys, based upon the ability of this metal to resist heavy strains.

A large part of the nickel consumed annually is required in the manufacture of stainless steels, which are being used widely in automobile, railway car, and airplane manufacture. In marine transportation, in which corrosion resulting from contact with salt water is a serious problem, nickel alloys are considered essential. The corrosion-resisting properties of nickel are responsible for the extensive use for decorative purposes of nickel alloys in the building industry. The variety and extent of public-work projects and soil-conservation programs during the past few years, to which an increase in the use of excavating and road-building machinery is due, account for part of the greater consumption of nickel. Nickel is used in the production of crushers, cars, pumps, drills, etc.—equipment that must withstand corrosion, shocks, abrasion, and severe temperature changes and that is essential in the extractive industries. In the petroleum industry,

² Stanley, R. C., *The Nickel Industry in 1935*. International Nickel Co., New York, Dec. 26, 1935, 35 pp. Mathewson, C. H., *Modern Uses of Nonferrous Metals*, New York, 1935, pp. 229-269.

nickel and its alloys play a prominent part in both production and refining. Nickel coinage continued to expand in 1935, and it is estimated that over 4 billion nickel pieces, representing 77 denominations and issued by 28 countries, are now in use. As an ornamental and decorative material, nickel and its alloys continue to find a widening outlet in the jewelry industry.³

WORLD PRODUCTION

World production of nickel (content of ore) in 1931-35, by countries, in metric tons

	1931	1932	1933	1934	1935
Australia (Tasmania).....	(¹)	1	9	(²)	(²)
Brazil.....			31	39	5
Canada (Ontario).....	29,786	13,756	37,768	58,371	62,830
Greece.....	649	953	1,377	(²)	(²)
India, British.....	817	945	989	1,188	(²)
New Caledonia.....	5,500	5,000	5,000	8,600	(²)
Norway.....	531	975	969	1,334	(²)
Southern Rhodesia.....					(³)
U. S. S. R. (Russia).....				863	(²)
United States.....	338	177	114	142	145
	37,621	21,807	46,257	(²)	(²)

¹ Production was less than 1 metric ton.

² Data not available.

³ Production of nickel ore, 58 metric tons; nickel content not stated.

UNITED STATES

The domestic supply of nickel is obtained from secondary sources, chiefly from scrap metal, although a small amount is recovered as a by-product in the refining of copper. No new discoveries of nickel ore were reported during 1935.

Since early colonial times nickel mines have been operated for relatively short periods in Pennsylvania and Missouri. Nickel-bearing ores have been reported in Arizona, Arkansas, California, Colorado, Connecticut, Idaho, Iowa, Maine, Massachusetts, Nevada, New Mexico, North Carolina, Oregon, Virginia, and Washington. Developmental work was done at two properties in Montana during 1935, and an analysis of the sulphide material indicates the presence of 1.85 percent copper and 0.55 percent nickel.⁴

Nickel content of nickel salts and metallic nickel produced in the United States as a byproduct in the electrolytic refining of copper, 1926-35

Year	Short tons	Value	Year	Short tons	Value
1926-30 (average).....	471	\$285,642	1933.....	126	\$62,913
1931.....	373	202,406	1934.....	157	108,414
1932.....	195	88,515	1935.....	160	129,500

Secondary nickel recovered as metal and in nonferrous alloys and salts in the United States, 1926-35

Year	Short tons	Value	Year	Short tons	Value
1926-30 (average).....	3,636	\$2,545,200	1933.....	1,650	\$1,155,000
1931.....	2,070	1,449,000	1934.....	1,850	1,295,000
1932.....	1,450	1,015,000	1935.....	1,950	1,365,000

³ *Manufacturing Jeweler*, vol. 94, no. 14, Providence, R. I., July 18, 1935, p. 16.

⁴ Howland, A. L., Peoples, J. W., and Sampson, E., *The Stillwater igneous complex and associated occurrences of nickel and platinum group metals: Montana Bureau of Mines and Geol., Misc. Contrib. 7, Butte, Mont., April 1936, 15 pp.*

Imports and exports.—The value of nickel imports in 1935 was \$17,181,538 compared with \$13,431,333 in 1934. Exports of nickel were valued at \$2,747,751 compared with \$2,712,263 in 1934.⁵

Value of nickel imported into and exported from the United States, 1925-35

Year	Imports for consumption			Exports				
	Nickel, nickel ore and matte, nickel oxide, and alloys of nickel with copper, etc.	Manufactures and nickel sheets and strips	Total	Nickel, Monel metal and other alloys	Manufactures	Nickel silver or German silver in bars, rods, or sheets	Nickel-chrome electric resistance wire	Total
1925-29 (average)---	\$11,830,285	\$177,747	\$12,008,032	\$772,008	\$846,292	\$296,272	(1)	\$1,920,972
1930-----	12,750,721	128,106	12,878,827	1,207,612	923,547	243,528	(1)	2,429,964
1931-----	7,565,824	48,010	7,613,834	648,026	438,333	72,350	\$253,107	1,411,816
1932-----	4,660,489	33,941	4,694,430	635,399	432,173	43,219	250,681	1,361,472
1933-----	10,746,721	15,696	10,762,417	546,878	504,760	57,645	285,033	1,394,316
1934-----	13,409,338	21,995	13,431,333	1,505,286	738,515	95,562	372,900	2,712,263
1935-----	17,128,213	53,325	17,181,538	1,207,048	1,101,476	114,218	325,009	2,747,751

¹ Not separately recorded.

² Includes nickel salts valued at \$6,400 in 1929 and \$55,277 in 1930; not separately recorded for other years.

Nickel imported for consumption in the United States, 1933-35, by classes

Class	1933		1934		1935	
	Pounds	Value	Pounds	Value	Pounds	Value
Unmanufactured:						
Nickel ore and matte-----	19,220,399	\$2,522,682	11,845,865	\$1,608,515	15,924,300	\$2,087,259
Nickel alloys, pigs, bars, etc-----	31,621,203	7,850,443	45,799,511	11,616,100	58,858,720	14,877,182
Nickel oxide-----	2,019,155	373,590	950,236	184,723	912,907	163,772
Manufactured:						
Nickel silver or German silver in sheets, strips, and rods-----			(1) 75	74		
All other manufactures of nickel-----	(1)	15,696	(1)	21,921	(1)	53,325
		10,762,417		13,431,333		17,181,538

¹ Quantity not recorded.

Nickel exported from the United States, 1933-35, by classes

Class	1933		1934		1935	
	Pounds	Value	Pounds	Value	Pounds	Value
Nickel-----						
Monel metal and other alloys-----	1,509,301	\$546,878	4,576,459	\$1,505,286	3,452,590	\$1,207,048
Manufactures-----	(1)	504,760	(1)	738,515	(1)	1,101,476
Nickel-chrome electric resistance wire-----	262,743	285,033	345,482	372,900	264,633	325,009
Nickel silver or German silver in bars, rods, or sheets-----	330,176	57,645	531,339	95,562	668,448	114,218

¹ Quantity not recorded.

CANADA

The record recovery of the Canadian nickel industry has had a beneficial effect throughout Canada. Total production in 1935 exceeded the output for 1934 by 7.6 percent, the Sudbury district of Ontario accounting for nearly all of the output.

Falconbridge Nickel Mines, Ltd.—The company owns a mine and smelter at Falconbridge, Ontario, and a refinery at Kristiansand, Norway, in addition to investments in other mining and smelting properties. The ore produced by this company, according to its annual report for 1935, averaged 1.93 percent nickel and 0.91 percent copper. In 1935, 302,337 short tons of ore were treated. Sales

⁵ Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

during the year aggregated 10,829,865 pounds of nickel and 5,129,483 pounds of copper. During the year the main operating shaft was sunk to 1,400 feet, and through lateral exploration a large body of new ore was added to the known reserves. During the year the company added 633 claims to its holdings. The capacity of the refinery was increased to 7,000 short tons of nickel per year.

*International Nickel Co. of Canada, Ltd.*⁶—In addition to several inactive mines at Sudbury, this company has two operating properties known as the Froid and Creighton mines; two smelters, one at Copper Cliff and the other at Creighton; and two refineries, one at Copper Cliff, full control of which was acquired during 1935, and another at Port Colborne, Ontario. The International Nickel Co. of Canada, Ltd., controls the Mond Nickel Co., which, in turn, owns the Acton Platinum Metals Refinery, London, and a refinery and colliery near Swansea, Wales. The company also owns Henry Wiggin & Co., Ltd., and Birmingham Electric, Ltd., of Birmingham, England, and the Zenith Works of Glasgow, Scotland. In the United States the International Nickel Co. of Canada, Ltd., owns a rolling mill at Huntington, W. Va., and a foundry at Bayonne, N. J. During 1935 plans were made to spend about \$9,400,000 in new works and improvements at the Sudbury properties of the company. The smelting and refining equipment was in operation during the year, and milling operations reached a record high—8,000 tons daily.

Other Canadian mines.—In the Sudbury district Van Nickel Mines, Ltd., has been incorporated to operate properties near Worthington and a refinery at Hamilton, Ontario. It is reported that the refined product will be shipped to the United States. British Columbia Nickel, Ltd., during 1935 blocked out 950,000 tons of ore, averaging 1.3 percent nickel and 0.4 percent copper, near Hope, British Columbia.⁷

OTHER COUNTRIES

New Caledonia.—In 1935 certain Japanese groups showed pronounced interest in New Caledonia nickel properties. The Japanese organization is reported to have a nickel mine on the eastern coast of Kua. The Karoola mine located near St. Louis, began operations during 1935. The ore from this property is reported to contain over 5 percent nickel. The principal nickel deposits of New Caledonia are operated by the Société Calédonickel, a company formed by the amalgamation of the Société le Nickel and La Société Calédonia. The deposits are in the N'goye district, the smelter is at Nouméa, and the nickel matte is shipped to France and Belgium.

Japan.—For several years the Japan Mining Co. has treated ferro-nickel at its Hinodi plant, but the amount of metal recovered from this source has been negligible. A new plant has been erected at Saganoseki, where this type of ore will be treated. Two thousand tons of New Caledonian ore were imported during 1935 for treatment at a refinery at Omachi. The Oceania Mining Co., controlled by the Nippon Mining Co. and the Masuyada Trading Co., has acquired and will develop a mine in New Caledonia. During 1935 the Japanese Electroindustry Co. produced a small tonnage of 99.8-percent nickel at its aluminum plant in Yokohama, using ores from the Hyogo prefecture.⁸

⁶ *Annalist*, International Nickel Co. of Canada, Ltd.: vol. 46, New York, Nov. 22, 1935, p. 721.

⁷ North, C. B., The nickeliferous Deposits near Hope: *The Miner*, vol. 8, no. 3, Vancouver, March 1935, pp. 23-25.

⁸ *Chemical Age*, Far Eastern Chemical Notes: Vol. 34, no. 868, London, Feb. 15, 1936, p. 157.

India.—The Burma Corporation, Ltd., continued shipping to Hamburg, Germany, speiss composed of about 25 to 30 percent nickel and some copper, sulphur, and cobalt, which is mined in the Northern Shan States.⁹

Brazil.—Progress was made during 1935 in the development of Brazilian nickel deposits.¹⁰ The most important deposits located thus far are in the State of Goyaz. The Empreza Commercial de Goyaz S/A operates these properties, and over 2 million tons of ore averaging 5 percent nickel have been outlined. Transportation difficulties have influenced exploitation of these deposits adversely.

Many nickel deposits occur in the State of Minas Geraes, the most important of which is the Livramento deposit, which carries ore running from 2 to 5 percent nickel.¹¹ The Siemens Co. of Germany is reported to have erected a blast furnace at this locality for the Companhia Nickel de Brasil.

Other deposits of nickel have been reported in the States of Bahia and Rio de Janeiro.

Thus far Brazil has exported no metallic nickel.

U. S. S. R. (Russia).—For years exploratory work has been under way in Soviet Russia in an effort to be independent of foreign sources for its nickel.¹² Nickel deposits occur in the vicinity of Orsk and Aktubinsk in the Ural Mountains. In 1934 a refinery was completed at Ufalei with a planned capacity of 3,000 tons of ferronickel. Although the output of this plant is increasing, the established quota has not been reached. In 1935 a plant with a productive capacity of 500 tons of metallic nickel was under construction at Orsk. This plant is expected to begin operations by 1937. It is reported that plans are under consideration for the construction of comparatively small nickel plants in the Kola Peninsula and in the Norilsk district, Siberia.

Germany.—Although nickel ore was produced at Frankenstein, Prussian Silesia, during the World War, the annual output running as high as 100,000 tons per year, none of the metal has been produced from domestic ores in recent years. The Gewerkschaft Frankenstein Nickelwerke, a property of the Krupp Co. of Essen, operates a nickel smelter but obtains its ore from Greece.

Italy.—Although in the past nickel has been recovered from ores produced in Sardinia and the Province of Novara, northwestern Italy, cessation in the exploitation of Italian nickel deposits accompanied the development of the richer oxidic ores of New Caledonia.

Norway and Greece.—Little change occurred in either country during 1935. Mining activity generally expanded in Norway during the year, and the Falconbridge Mines, Ltd., made known its plan to expand its Norwegian smelter some time in 1936. The nickel deposits of Locris and Boetia, Greece, remained the principal sources of Greek nickel ore, the greater part of which was shipped to Germany in 1935.

Finland.—In Finland, the Mond Nickel Co. began exploratory work of the Petsamo concession.

⁹ Roy, S. K., and Krishnaswamy, S., Notes on the Microscopic Character of Bawdwin Ores: Geol., Min., and Met. Soc., India, Q. J., vol. 7, no. 2, Calcutta, June 1935, pp. 59-69, 6 pl.

¹⁰ Moraes, L. J. de, Nickel no Brasil: Serviço de Fomento da Produção Mineral, Bol. 9, 168 pp. (Portuguese), Rio de Janeiro, 1935. Reviewed by M. C. Malamphy in Mining and Metallurgy, vol. 17, no. 351, New York, March 1936, p. 161. Also Malamphy, M. C., More Respect Claimed for Brazil's Nickel Deposits: Vol. 16, no. 342, New York, June 1935, p. 270.

¹¹ Guerreiro, A., [Nickel at Livramento]: Rev. chim. ind., vol. 4, Rio de Janeiro, 1935, pp. 104-107, 140-142, 183-186.

¹² Mining World, Russian Nickel Industry: Vol. 130, no. 3385, London, Feb. 15, 1936, pp. 153-154. Russian Economic Notes, Bureau of Foreign and Domestic Commerce, no. 296, May 15, 1935, p. 8, no. 316, Mar. 30, 1936, pp. 7-8.