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**CANADA**  
**DEPARTMENT OF TRADE AND COMMERCE**  
**DOMINION BUREAU OF STATISTICS**  
**CENSUS OF INDUSTRY**  
**MINING, METALLURGICAL & CHEMICAL BRANCH**

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**THE**  
**NICKEL, COPPER MINING, SMELTING**  
**AND REFINING INDUSTRY**  
**IN**  
**CANADA**  
**1935**

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DEPARTMENT OF TRADE AND COMMERCE  
DOMINION BUREAU OF STATISTICS  
MINING, METALLURGICAL AND CHEMICAL BRANCH  
OTTAWA - CANADA

Dominion Statistician: R. H. Coats, LL.D., F.R.S.C., F.S.S. (Hon.)  
Chief - Mining, Metallurgical and Chemical Branch: W. H. Losee, B.Sc.

THE NICKEL-COPPER MINING, SMELTING AND REFINING INDUSTRY IN CANADA, 1935.

Finally revised statistics for 1935, as issued by the Mining, Metallurgical and Chemical Branch of the Dominion Bureau of Statistics at Ottawa, show a total Canadian production of 138,516,240 pounds of nickel valued at \$35,345,103 as compared with 128,687,340 pounds worth \$32,139,425 in 1934 and 83,264,658 pounds at \$20,130,480 in 1933. The quantity of nickel produced in the Dominion as compiled and published by the Bureau includes the nickel in matte exported, electrolytic metal made at Port Colborne, Ontario, and the nickel in oxides and salts produced in Canadian plants. The 1935 output of nickel was the largest in the history of the Canadian nickel mining industry, surpassing 1934, the previous high record year, by 7.6 per cent and of the total value of all metals produced in the Dominion throughout 1935, the value of nickel comprised 16 per cent, being surpassed only by that of gold.

Employment in the industry totalled 7,009 during 1935 or an increase of 24.8 per cent over 1934. Salaries and wages amounted to \$11,275,650 as compared with \$8,864,772 in 1934 while the cost of fuel and electricity consumed increased from \$4,202,810 in 1934 to \$4,735,768 for the year under review. Exports of nickel and its products during 1935 totalled 1,427,265 cwt. valued at \$36,285,482, representing a pronounced increase over the preceding year's exports of 1,181,521 cwt. appraised at \$28,913,230. The greater part of Canadian exports of nickel and its products is consigned direct to the United States and the United Kingdom; in 1935 the value of these exports to the former country amounted in value to \$16,117,522 while the same products going to the United Kingdom were valued at \$12,572,741.

Practically all of the nickel produced in Canada is derived from the copper-nickel bearing deposits of the Sudbury district, Ontario. Two companies operate mines and metallurgical plants in this area. The International Nickel Company of Canada, Ltd., conducts smelting operations at Copper Cliff and Coniston, Ontario, while the Falconbridge Nickel Mines, Ltd., smelt their ores at the Falconbridge mine located a few miles east of the town of Sudbury. This last named company treat their matte in a refinery at Kristiansand, Norway. The relatively small amount of nickel oxide produced at Deloro, Ontario, is recovered from silver-cobalt-nickel-arsenic ores mined in Northern Ontario. Smelter matte made by the International Nickel Company is treated in plants located at Clydach, Wales; Huntington, West Virginia, and at Port Colborne and Copper Cliff, Ontario.

The International Nickel Company of Canada, Limited, reported that "during 1935 a total of 3,382,409 tons of ore was mined and shipped to smelters at Copper Cliff and Coniston, Ontario. All of this ore was extracted from the Frood and Creighton properties which were operated continuously throughout the year. The Frood mine furnished 2,875,599 tons and the Creighton mine, 506,810 tons.





"Development work in the Frood mine was carried on at a rate to conform to ore requirements. The advance of shafts, drifts and crosscuts, raises, winzes and box holes for the year was 16,012 feet, bringing the total development footage in this mine to 183,211. There are now available for production 103 stopes and 16 pillar stopes having respectively a daily capacity of 125 tons and 55 tons each.

"In the Creighton mine development work was advanced 9,200 feet. Good progress was made in shaft sinking and surface plant construction. It is expected that ore from this development will be available in 1937. The new shaft, 16 feet by 28 feet in cross section, is being sunk to a depth of 4,200 feet and will be served by a hoist capable of handling 4,000 tons of ore per day.

"By replacing mild steel skips with lighter skips made from nickel steel the hoisting capacity at the Frood and Creighton mines has been increased approximately fifteen per cent.

"The concentrator treated 2,584,666 tons of ore, the largest tonnage handled since this plant was built. Milling was increased to 8,000 tons per day and it is planned to expand capacity to 11,000 tons per day during 1936.

"At the Copper Cliff smelter there were produced 118,016 tons of bessemer matte and 121,574 tons of blister copper. All of the reverberatory furnaces, five in number, and all twelve converters, were in use from February until the end of the year. The Orford process department was operated throughout the year with improvement in costs partly due to the increased tonnage of bessemer matte consumed.

"The Coniston smelter with the exception of the month of July ran continuously with four blast furnaces and five converters in operation. Ore to the amount of 790,351 tons was processed and 54,248 tons of bessemer matte produced.

"Increased demand for nickel necessitated operating the electrolytic plant at Port Colborne, Ontario, at capacity for the first time since additional units were installed in 1929. The year began with six circuits in service to which were added during the year the three reserve circuits, thus bringing the refinery to maximum strength. There was produced 80,381,532 pounds of nickel in all forms.

"There was a substantial increase in the tonnage of blister copper treated at the electrolytic copper refinery of the Ontario Refining Co. Ltd. (subsidiary) and plant output and copper shipments from this Copper Cliff plant increased correspondingly. Refined copper production was 109,966 tons comparable with 95,558 tons in 1934. A new selenium plant was completed and put in operation in March, 1935; in order to eliminate silver losses and to further increase recovery of selenium a Cottrell electrical precipitator was installed and showed satisfactory results; a plant to produce "single" and "double" nickel salts for the Canadian market was authorized in 1935 and is now completed and in operation.

"The output of nickel in the form of pellets was 28,579,015 pounds at the Clydach nickel refinery in Wales (Mond Nickel Co. Ltd.), comparable with 25,568,644 pounds in the preceding year. In addition 2,504,902 pounds of metal was absorbed in the production of 12,136,255 pounds of nickel salts for which there is a steadily growing demand for nickel plating and in soap and edible oil manufacture. With the re-conditioning and re-modeling of another unit, shortly to be completed, this refinery will have an annual capacity of 42,000,000 pounds of metallic nickel. The small high-pressure carbonyl plant has passed from the experimental to the production stage and is proving a valuable auxiliary to the refinery.



"The precious metals research and development department at the Acton (Mond Nickel Co., England) plant continued its investigations into the use of platinum metals and their alloys. Sales of "monel metal" by Henry Wiggin & Co. Ltd. (subsidiary of Mond Nickel Co. Ltd., England) continued to expand and now comprise nearly 30 per cent of this company's total sales.

"At the Huntington works of the International Nickel Co. Inc., located in West Virginia, U.S.A., shipments of rolled nickel "monel metal", "Inconel" and other nickel alloys totalled 23,387,507 pounds comparable with 20,699,680 pounds in 1934, an increase of 13 per cent.

"The total number of employees at the end of 1935 was 12,452 distributed as follows: Canada, 8,117; Great Britain, 2,990; United States, 1,293; other countries, 52. Employees on December 31, 1934, numbered 9,154. The increase, amounting to 36 per cent was due to the increased scale of operations and to the construction work in progress in Canada and Great Britain. Proven ore reserves at December 31, 1935, were 205,590,592 tons.

"The International Nickel Co. of Canada Ltd., realized a net profit of \$26,086,527.47 in 1935 after all charges, including provision for taxes, depreciation, mine depletion and other purposes. After payment of preferred dividends of \$1,933,898.75 there remained \$24,152,628.72 or \$1.65 per share of common stock.

"During the summer of 1935, under the terms of the agreement between the Mond Nickel Company Ltd., and the Government of Finland, exploratory work was started on the Petsamo concession. Permanent camps were established and a road was built from the state highway to the most promising prospecting areas. The concession was surveyed in conformity with the Finnish ordnance survey and a geological reconnaissance was made and diamond drilling started; an estimate indicates that \$80,000 will be expended in Finland during 1936."

It was announced in June, 1936, that the electrolytic nickel refinery at Port Colborne, Ontario, was being enlarged to increase its production capacity by 50 per cent, raising the maximum capacity of the plant to approximately 12,000,000 pounds of electrolytic nickel per month.

Falconbridge Nickel Mines Ltd., reported 1935 operations as follows:-  
"Practically all lateral work along the ore zone was confined to the 500 and 1,200 foot levels. On the former, an advance of 986 feet was made easterly in ore averaging 15.1 feet in width, though of slightly below mine average grade. This drive continues in ore at 1,600 feet from No. 5 shaft. On the 1,200 foot level, 153 feet and 807 feet were driven east and west, respectively, from No. 5 shaft in ore of mine average grade, with a mean width of 12.5 feet. Both these faces continue in ore. No. 5 shaft was deepened 856 feet to a point slightly below the 1,400 foot level. Stations were established on the 200, 325, 1,200 and 1,400 foot levels and a loading station commenced at 1,350 feet. Steps were taken during the year to abandon the shrinkage method of mining and adopt the cut and fill system, with the conversion of active shrinkage stopes to the new practice. In preparation for this, as well as to back-fill the old stopes as they are emptied, a fill pass system was established near No. 1 shaft and two further series of passes were commenced. Total ore reserves were computed December 31, 1935, at 4,059,475 tons. From 337,543 tons of ore delivered to the crushing plant in 1935, 35,208 tons or 10.4 per cent of waste was eliminated by sorting. The balance amounting to 302,337 tons was transported over the aerial tramway to the treatment plant bins.





The reduction plant operations during 1935 are tabulated as follows:-

Total ore treated .....	302,510 short tons
Matte produced .....	10,029.50 short tons
Nickel in matte produced .....	5,651.55 short tons
Copper in matte produced .....	2,597.26 short tons
Metals per ton in ore .....	40.97 pounds nickel and 19.71 pounds copper.
Metallurgical losses per ton of ore ...	3.43 pounds nickel and 2.54 pounds copper.

The refinery of the company located in Norway operated very steadily throughout the year, keeping step with the somewhat increased matte production. A certain amount of additions and alterations took place, which raised the total capacity of the plant, including capacity for custom ore, to 7,000 short tons nickel annually, at which rate it occasionally operated; the plant for separation of precious metals started delivery of gold, silver, platinum and palladium. Net sales by the company totalled \$4,640,372.57 and it is stated that forward bookings for 1936 deliveries are again higher than in prior years. The Fahlralloy Canada, Ltd., financed by Ventures Limited and Falconbridge Nickel Mines Ltd., was recently reported to have taken over a plant located at Orillia, Ontario, where equipment was installed for the manufacture of nickel-steels.

In Strathy township, Temagami district, Ontario, Cuniptau Mines Ltd. was active throughout the year and it was reported in June, 1936, that arrangements had been completed by this company for the sale of high grade matte to an English concern.

The British Columbia Department of Mines reports that development work during 1935 at the property of B. C. Nickel Mines, Choate, British Columbia, consisted of 6,300 feet of workings driven in the vicinity of No. 1 tunnel and 760 feet of raising. The latter is part of a programme whereby five 300 foot raises will be put up above No. 1 tunnel and from which a thorough diamond drill campaign will be undertaken. During 1935, 56,000 feet of diamond drilling was done, of which 47,000 feet were driven from No. 1 tunnel, 8,000 feet from No. 2 adit, and 1,000 feet from the surface, to explore areas indicated by magnetometer survey. It is also interesting to note that nickeliferous serpentine occurring near Williams Lake, British Columbia, has been recently investigated as to its economic importance; the nickel content in certain sections is reported to approximate 0.20 per cent.

Table 1 - PRINCIPAL STATISTICS OF THE NICKEL-COPPER MINING, SMELTING AND REFINING INDUSTRY IN CANADA, 1933 - 1935.

	1933	1934	1935
Number of firms .....	4	4	4
Number of mines .....	7	7	7
Number of smelters .....	3	3	3
Number of refineries .....	1	1	1
Capital employed .....	\$ 84,836,327	88,574,427	87,015,617
Number of employees - On Salary .....	191	223	245
On Wages .....	3,407	5,394	6,764
Total .....	3,598	5,617	7,009
Salaries and wages - Salaries .....	\$ 617,599	740,191	800,700
Wages .....	\$ 4,971,011	8,124,581	10,474,950
Total .....	\$ 5,588,610	8,864,772	11,275,650
Fuel and electricity used (c) .....	\$ 2,592,216	4,202,810	4,735,768
Process supplies used (b) .....	(a)	(a)	7,181,698
Estimated gross value of matte exported and Canadian refinery products ...	\$ 25,052,622	52,906,920	58,996,451
Value of production less items (b) and (c) ...	(a)	(a)	47,078,985

(a) Information not available.



Table 2 - WAGE-EARNERS EMPLOYED, BY MONTHS, 1931 - 1935.

Month	1931	1932	1933	1934	1935
January .....	4,726	3,014	1,822	4,811	5,666
February .....	4,656	3,019	1,957	4,876	5,804
March .....	4,641	3,039	2,036	5,048	6,077
April .....	4,620	2,577	1,976	5,189	6,277
May .....	4,597	2,379	2,034	5,409	6,446
June .....	4,422	2,434	3,001	5,622	6,573
July .....	4,324	2,235	3,957	5,658	6,733
August .....	4,262	1,672	4,523	5,566	7,253
September .....	3,657	1,628	4,775	5,500	7,500
October .....	3,068	1,580	5,050	5,722	7,714
November .....	3,195	1,490	4,968	5,707	7,632
December .....	3,094	1,551	4,762	5,609	7,489

Table 3 - FUEL AND ELECTRICITY USED FOR HEAT AND POWER, 1934 and 1935.

Kind	Unit of measure	1934				1935			
		Quantity	Cost at works			Quantity	Cost at works		
			\$				\$		
Bituminous coal - Canadian ..	short ton	96	962			1,373	8,369		
Imported ..	short ton	11,015	63,212			12,250	77,843		
Anthracite coal .....	short ton	61	940			166	2,666		
Coke .....	short ton	793	7,551			637	6,955		
Gasoline (exclusive of motor vehicles) .....	Imp. gal.	14,483	3,415			28,397	6,525		
Kerosene .....	Imp. gal.	5,394	1,153			5,676	1,210		
Fuel oil and diesel oil .....	Imp. gal.	117,024	11,077			127,735	12,311		
Wood .....	cord	2,457	6,629			1,458	4,139		
Gas - Natural .....	M cu.ft.	152	122			131	107		
Other fuel .....	xxx	...	...			...	2,498		
Electricity purchased .....	K. W. H.	253,556	237	788,703	308,706	482	857,441		
TOTAL .....	xxx	...	884,264			...	980,064		

Table 4 - FUEL AND ELECTRICITY USED FOR METALLURGICAL PURPOSES, 1934 and 1935.

Kind	Unit of measure	1934				1935			
		Quantity	Cost at works			Quantity	Cost at works		
			\$				\$		
Bituminous coal - Canadian ..	short ton	152,052	844,580			167,299	963,457		
Imported ..	short ton	21,295	133,030			66,961	358,527		
Anthracite coal .....	short ton	...	...			46	334		
Coke .....	short ton	176,340	1,688,038			170,866	1,713,065		
Kerosene .....	Imp. gal.	214	46			...	...		
Fuel oil and diesel oil .....	Imp. gal.	7,386,845	366,166			8,440,512	380,961		
Wood .....	cord	2,354	16,338			5,368	51,230		
Other fuel .....	xxx	...	30,898			...	3,287		
Electricity purchased .....	K. W. H.	70,961	897	239,450	86,643	652	284,843		
TOTAL .....	xxx	...	3,318,546			...	3,755,704		





Table 5 - OUTPUT FROM CANADIAN NICKEL-COPPER MINES AND SMELTERS, 1932 - 1935.

		1932	1933	1934	1935
Ore and concentrates treated .....	tons	793,552	1,523,814	2,896,359	3,616,223
Refined nickel(x) produced in Ontario. tons		7,063	20,748	35,487	40,191
Blister copper produced in Ontario(a). tons		29,682	60,398	95,826	119,720
Matte exported .....	tons	21,778	43,315	46,755	47,961
Nickel content of matte .....	tons	8,068	20,811	28,771	29,044
Copper content of matte .....	tons	8,825	12,323	6,692	7,414

(x) Includes nickel in salts and oxides.

(a) Copper content.

Table 6 - PRODUCTION IN CANADA, IMPORTS AND EXPORTS OF NICKEL, 1934 and 1935.

	1934		1935	
	Quantity	Value	Quantity	Value
	Lb.	\$	Lb.	\$
<b>PRODUCTION -</b>				
Nickel in matte or residues exported(a) refined and electrolytic nickel, produced; and nickel in oxides and salts sold .....	128,687,340	32,139,425	138,516,240	35,345,103
<b>EXPORTS -</b>				
Nickel, fine; nickel contained in ore, matte or speiss and nickel contained in oxide .....	118,152,100	28,913,230	142,726,500	36,285,482
<b>IMPORTS (specified)</b>				
Nickel in bars or rods (not for anodes) and nickel in strips, sheets and plates .....	591,466	197,230	445,112	191,330
Nickel chromium in bars or rods (60% per cent Ni) - 75 inch diam. for electric resistance strip .....	48,413	45,114	43,434	41,381
Nickel, nickel silver and German silver in ingots or blocks, n.o.p. ....	2,646	771	3,643	959
Nickel-plated ware, n.o.p. ....	...	753,421	...	814,456

(a) Nickel in matte exported valued at 18 cents per pound.

Table 7 - PRODUCTION OF NICKEL FROM CANADIAN ORES, 1926 - 1935.

Year	Pounds	Value	Year	Pounds	Value
		\$			\$
1926 .....	65,714,294	14,374,163	1931 .....	65,666,320	15,267,453
1927 .....	66,798,717	15,262,171	1932 .....	30,327,968	7,179,862
1928 .....	96,755,578	22,318,907	1933 .....	83,264,658	20,130,480
1929 .....	110,275,912	27,115,461	1934 .....	128,687,340	32,139,425
1930 .....	103,768,957	24,455,135	1935 .....	138,516,240	35,345,103



Table 8 - WORLD PRODUCTION OF NICKEL ORE, 1932 - 1935.(a)  
(in terms of metal)

	1932	1933	1934	1935
	(short tons)			
Canada (b) .....	15,164	41,632	64,344	69,258
New Caledonia (c) .....	3,200	4,900	5,500	6,200
Greece .....	1,053	1,344	1,200	1,300(x)
India (d) .....	1,042	1,090	1,354	1,662
Norway .....	1,042	1,096	1,532	1,600(x)
Russia .....	...	...	951	1,500(x)

(a) Production outside of these countries is very small.

(b) Production in all forms from Canadian ores, as reported by Ontario Bureau of Mines.

(c) Exports of matte; content, estimated at 75%.

(d) Nickel content of speiss obtained as a by-product.

(x) Conjectural.

This statement supplied by the American Bureau of Metal Statistics.

Table 9 - NICKEL CONTAINED IN PRINCIPAL NICKEL ALLOYS (Supplied by the International Nickel Company of Canada, Limited.

As guide to the part which nickel has in the industrial world through the alloys now being used in industry, the nickel content of the best known alloys is shown in the following table:-

	Per Cent Nickel
<b>NON-FERROUS ALLOYS</b>	
Malleable Nickel .....	99 /
Monel Metal .....	67
Inconel .....	80
Heat Resistant Alloys (including Ferrous) .....	35 - 85
Cupro-Nickel Alloys .....	15 - 50
Nickel Silvers .....	10 - 30
Nickel Brasses and Bronzes .....	1/2 - 5
<b>FERROUS ALLOYS</b>	
Nickel Steels .....	1/2 - 7
Stainless Steels (Nickel-Chromium) .....	7 - 35
Non-Magnetic Steels .....	10 - 25
Invar Type Steels .....	32 - 45
Nickel Wrought Iron .....	3
Nickel Cast Irons .....	1/2 - 5
Ni-Resist Types .....	14 - 20
Ni-Hard .....	4 - 6
Ni-Tensyliron .....	1 - 2 1/2

The heat resisting alloys are practically all of a nickel-chromium-iron combination with small additions of other elements which impart special characteristics depending upon the type of application. There are a large number of these alloys, in which the nickel ranges from 10 to 80%, which may be divided into the following types:

Type	Nickel	Chromium
1	60-80	15-20
2	25-40	15-20
3	20-25	20-30
4	10-20	20-30





Mr. Robert C. Stanley, President of the International Nickel Company of Canada, Limited, in a review of the nickel industry in 1935 stated that:

"Applications of nickel in various forms continued to spread into the diversified fields which today constitute world industry. Whereas, for example, depression or prosperity among the makers of agricultural machinery used to have no effect on nickel, this particular industry is now a market for nickel alloy steels and cast irons. The broadening base of participation in industry at large has definitely become just as important a factor in nickel consumption as the increased rate of activity in such fields as automotive and food handling, where nickel and nickel alloys have long been established. This wider interest is reflected in the extent to which warehouses are now stocking nickel steels."

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D I R E C T O R Y

FIRMS IN THE NICKEL-COPPER MINING AND SMELTING INDUSTRY IN CANADA,  
1935.

<u>Name of Firm</u>	<u>Head Office Address</u>	<u>Location of Canadian Plant</u>
<u>ONTARIO -</u>		
Cuniptau Mines Development Co. Ltd. (x)	465 Bay St., Toronto	Strathy Tp.
Falconbridge Nickel Mines Ltd.	25 King St. W., Toronto	Falconbridge Tp.
International Nickel Company of Canada, Limited	Copper Cliff	Copper Cliff, Coniston and Port Colborne, Ont.
<u>BRITISH COLUMBIA -</u>		
B. C. Nickel Mines, Ltd.(x)	510 West Hastings St., Vancouver	Choate

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(x) Operating but not producing.

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