SUDBURY AREA RISK ASSESSMENT

CHAPTER 2.0
HISTORY OF THE SUDBURY SMELTERS

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2.0 HISTORY OF THE SUDBURY SMELTERS

2.1 Introduction

Sudbury is a resource-based city that has defied the odds. From rail town to mining mecca, declining centre to thriving metropolis, the city is transforming itself into a model of self-sustainability. The Sudbury of today is a city of lakes and tight-knit communities, full of hard-working, hard-playing people as down to earth as the rock on which they have built. Jutting up beside roads, in playgrounds and backyards, blackened by a century of industrial pollution, the rocks are a constant reminder of why Sudbury came to be. Built on the back of industry, Sudbury can never forget its heritage. The mining legacy of heady successes and devastating downturns has made Sudbury what it is today: tenacious, innovative, and incredibly resilient.

The legacy of mining and smelting activities is also the story of environmental degradation. As the hills of the Sudbury region turn green once more it is important to consider the whole story, from roast yards to emission controls, so that Sudbury and its people can move decisively into the future.

This chapter provides an overview of Sudbury's mining history with a focus on the industrial and socio-political backdrop to the story, without which, there would be no need for the Sudbury Soils Study. At its core, the current study is about the people who live in the Sudbury region now, and about the future of their community and their environment. Sudburians have played a central role in defining and redefining their destiny as a community. The Sudbury Soils Study is the logical next step in the evolution of the region.

2.1.1 Railway Town in the Wilderness: 1824–1885

In 1824 the Hudson's Bay Company established a fur-trading post in the rugged land of pines, lakes, swamps and rock north of Georgian Bay, near what is now the City of Greater Sudbury. The region was sparsely populated by the Anishnabe people, who, with the opening of the post, came into contact with the French and English fur traders, missionaries, and government agents passing through what was near-trackless wilderness. Chicago's Great Fire of 1871 sparked the opening of the region for logging. Massive red and white pines were cut and floated down to Georgian Bay and Lake Huron, then rafted to the northern U.S. sawmills for the rebuilding of the city (Wallace and Thomson, 1993).

While logging did become a key industry over the next decades, it was the arrival of the railway surveyors that precipitated the birth of Sudbury. In 1883, the Canadian Pacific Railroad (CPR) established a camp at the junction between the line heading east from Sault Ste. Marie and the new line heading

westward. The location of the camp, and consequently the city of Sudbury, was due to a surveying miscalculation. The surveyor William Ramsey accidentally plotted the rail line north of the lake that now bears his name rather than south. It is said that he got lost because his compass pointed to the ore body instead of north.

In February 1883, James Worthington, a senior CPR official, named Sudbury after his wife's birthplace in Suffolk, England. A cluster of shoddy, temporary buildings sprung up to house the 3,350 men who worked for the CPR over the next two years (Wallace and Thomson, 1993). When the last construction crew left in 1885, Sudbury could have melted back into the wilderness, as did most railway camps. But a CPR depot remained, and with it, the beginnings of the town.

2.1.2 Mineral Discovery

William Ramsey's surveying error turned out to be a lucky stroke for Sudbury. In 1883, CPR work crews blasting a route through the rock discovered the mineral riches hidden beneath. Legend has it that CPR blacksmith Tom Flanagan noticed a rusty stain on rocks near what was to become Murray Mine, and Sudbury's future changed course forever.

Flanagan’s find was actually a re-discovery of the Sudbury basin copper and nickel deposits mentioned in an 1856 Geological Survey of Canada Report. Even earlier missionary reports that Indians were mining copper north of Georgian Bay in the 1630s had also gone unnoticed (Wallace and Thomson, 1993). Only in 1883, when the railway made the possibility of exporting minerals a reality, did the vast potential of the deposit demand the attention of the mining community (Swift, 1977).

2.1.3 The Amazing Deposit

The mineral deposits discovered at Sudbury are truly remarkable. Although nickel is one of the most common elements in the universe and is thought to make up a significant part of the earth's core, it is scarce in the crust in levels that are economic to extract.

The Sudbury district contains one of the largest known nickel ore bodies on the planet. Proven reserves in the district are in excess of 300 million tons, with nickel content of approximately 1 to 6% (Boldt, 1967). In addition to copper, Sudbury ores contain platinum, palladium, rhodium, ruthenium, iridium, osmium, gold, silver, cobalt, selenium, and tellurium. The deposits are also a plentiful source of iron, and of sulphides, which can be made into liquid sulphur dioxide, sulphuric acid and elemental sulphur. Because the ore at Sudbury is comprised of a combination of 40% iron sulphides, 4 to 5% copper and nickel, and 35% sulphur, separating the nickel and copper is a complicated and expensive process.

Sudbury's nickel ores are located in what is known as the nickel intrusive. Otherwise known as the Sudbury basin, the deposit is an oval, spoon-shaped, multi-layered body of igneous (volcanic) rock (Figure 2-1). At the surface it measures 60 by 27 kilometres, length and breadth. Dike-like offsets extend radially from the outer edges for distances up to 40 kilometres. The floor of the basin is estimated to lie 10 to 15 kilometres below the surface, and contains deposits of lead, zinc and copper. The major nickel and copper mineral deposits lie on the outer rim of the basin (Gunn, 1995; Boldt, 1967).

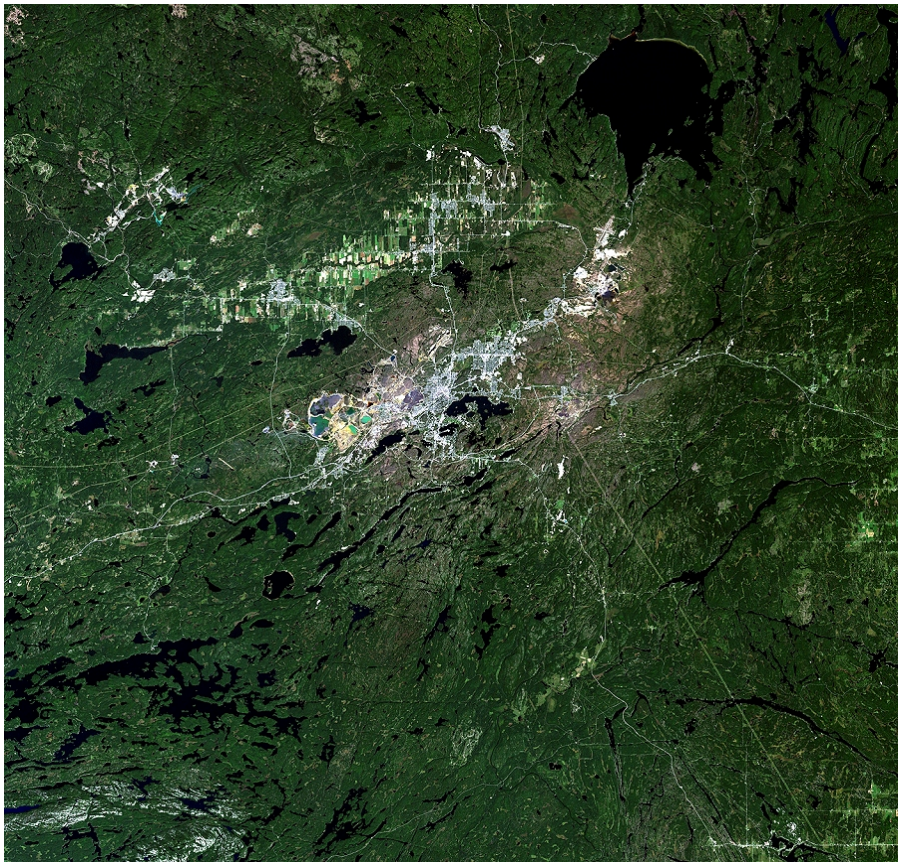


Figure 2-1 Satellite image of the City of Greater Sudbury

2.1.4 Origin Theories

Even after decades of research, the origins of the deposit are still under debate. The most popular theory among geologists is that of a meteorite impact, as presented by Dr. Robert S. Dietz in 1964. The impact of a 10 kilometre-diameter meteorite is thought to have left a variety of shock phenomena, including shatter cones (half-cone-shaped fractures in the rock) and breccia (the welded broken rock characteristic of the area). After impact, large amounts of breccia fell into the crater. This theory is supported by recent research from the University of Toronto, which concluded that the “Sudbury Igneous Complex is predominantly derived from a shock-melted lower crust rather than the average of the whole crust, as has

been previously supposed. The researchers discovered a subtle but significant enrichment of iridium, an extremely rare metal found mainly in the Earth's mantle and in meteorites. Due to the low magnesium and nickel content found in the samples they concluded that the iridium came from the meteorite itself rather than the Earth's mantle" (Kelly, 2004).

When Apollo 16 astronauts visited Sudbury in 1971, it was not to experience a barren "moonscape", but because of the evidence of crater formation in the area. The astronauts practiced describing the rocks and geological features in preparation for reporting on the geology of the moon. Commander John Young of Apollo 16 described a lunar rock sample this way: "It has a black fracture pattern running through the middle of it…It looks like a Sudbury breccia" (Stephenson, 1979).

While some meteorites do contain amounts of iron and nickel, the quantity and sulphur content of the ore in the Sudbury area is too great to have come only from the meteorite. Proponents of the meteorite theory believe that the impact ruptured the earth's crust, triggering the flow of magma that formed the Sudbury Irruptive. The ore separated as hot sulphide droplets from the molten igneous rock erupted from the crater floor. Age dating of the igneous rock shows that it crystallized about 1.85 billion years ago (Gunn, 1995). The elliptical shape of the basin is credited to the 30-degree angle at which the meteorite struck the earth.

Geologists sceptical of the meteorite theory point out that the shatter cones could also have been produced by volcanic activity. This earlier theory posits that a massive volcano fell in on itself, producing the violent explosions that can explain the presence of breccia. The Sudbury area contains the Murray fault system and the Onaping system, both of which present the possibility of volcanic activity. Science North in downtown Sudbury is built on and incorporates the Creighton fault in its architecture.

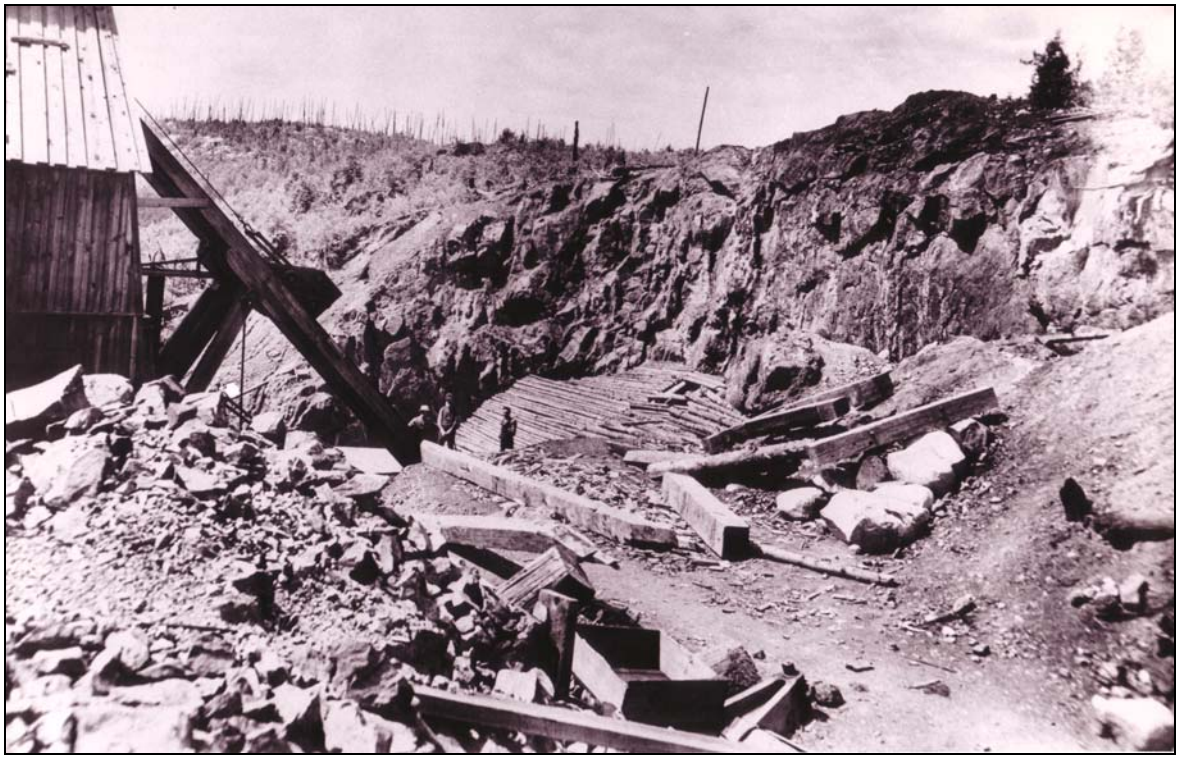


Figure 2-2 Shaft Construction at Creighton Mine

2.2 Enter the Visionaries: 1889–1900

2.2.1 Prospectors

Word about the mineral find in 1883 spread like wildfire, and soon thereafter, Sudbury's first mining boom was on. During the next 100 years, over 100 mines would be in operation in the area at one time or another. Prospectors descended on the region, prepared to endure the clouds of mosquitoes, unforgiving terrain and climate to chase dreams of fortune. Most left empty-handed, but some struck it rich. Their names—Rinaldo McConnell, Francis Crean, Thomas Frood, James Stobie, and others—adorn the mines at the core of Sudbury's history.

Some, like McConnell, who filed some of the most valuable claims, were timber cruisers; others were railway men, teachers, or colourful adventurers out to improve their lots. Stories of their capers and characters fill the frontier pages of Sudbury's history. Aeneas McCharles, who discovered the North Star mine, was known for his habit of drinking birch sap. He considered the water surrounding the nickel deposits so saturated with minerals that it was unfit to drink, so he used birch sap "for cooking everything, from porridge to making tea, and he found the food to be more palatable and nourishing than if he had been using the best water in the world" (McCharles, 1908).

The first patent was issued in October 1884 to Thomas and William Murray, Harry Abbott, a CPR construction boss, and John Loughrin, a businessman and politician. The mining rights to the 310 acres that were to become the Murray mine sold for one dollar an acre (Wallace and Thomson, 1993).

By the turn of the century, independent prospectors had all but disappeared from the Sudbury landscape. The nickel and copper proved to be very difficult to extract and refine, with very little high-grade ore accessible below the surface deposits. Tremendous amounts of capital became an essential ingredient in any bid to reap a profit from the rock. In his memoir, Aeneas McCharles spoke the hard truth:

The Sudbury district is not a poor man's camp. A few big companies are going to make all the money there is in mining there. It takes large capital to work nickel mines, and if a prospector happens to find a good body of ore, the only thing he can do with it, is to try and sell it (McCharles, 1908).

2.2.2 Entrepreneurs

In the 1880s and 1890s the huge investment capital required to develop the Sudbury deposits was not available in Canada. The era of cheaper and more efficient transportation ushered in by the railway, coupled with technological developments in the refining process, attracted investment from beyond the nation's borders. The cycle of foreign ownership and, more pervasively, foreign control over Sudbury's mining industry began before the first shaft was sunk.

In 1885, Samuel Ritchie, an entrepreneur from Ohio, secured 97,000 acres of claims all over the district and formed a syndicate of Cleveland businessmen to begin mining development. On May 25th, 1886, 25 or so workers began blasting at the Buttes (later Copper Cliff) mine and the mining of the Sudbury basin began in earnest (Stephenson, 1979). The seeds of a mining dynasty were planted in January 1886 with the formation of the Canadian Copper Company of Cleveland, Ohio, with Ritchie as president. As the name suggests, copper was still the main draw of the region, and the nickel content of the ore was seen almost as a nuisance.

Figure 2-3 Samuel Ritchie

Ritchie made good use of his political connections to further mining interests, as demonstrated by the visit of Sir John A. MacDonald to the mine site. A 30% duty on mining and smelting machinery and a 75 cent per ton duty on smelting coke—imposed to encourage Canadian industry—were lifted by the federal government in 1889, an indirect result of Ritchie's efforts. The ambitious entrepreneur recognized he needed to create a market for nickel.

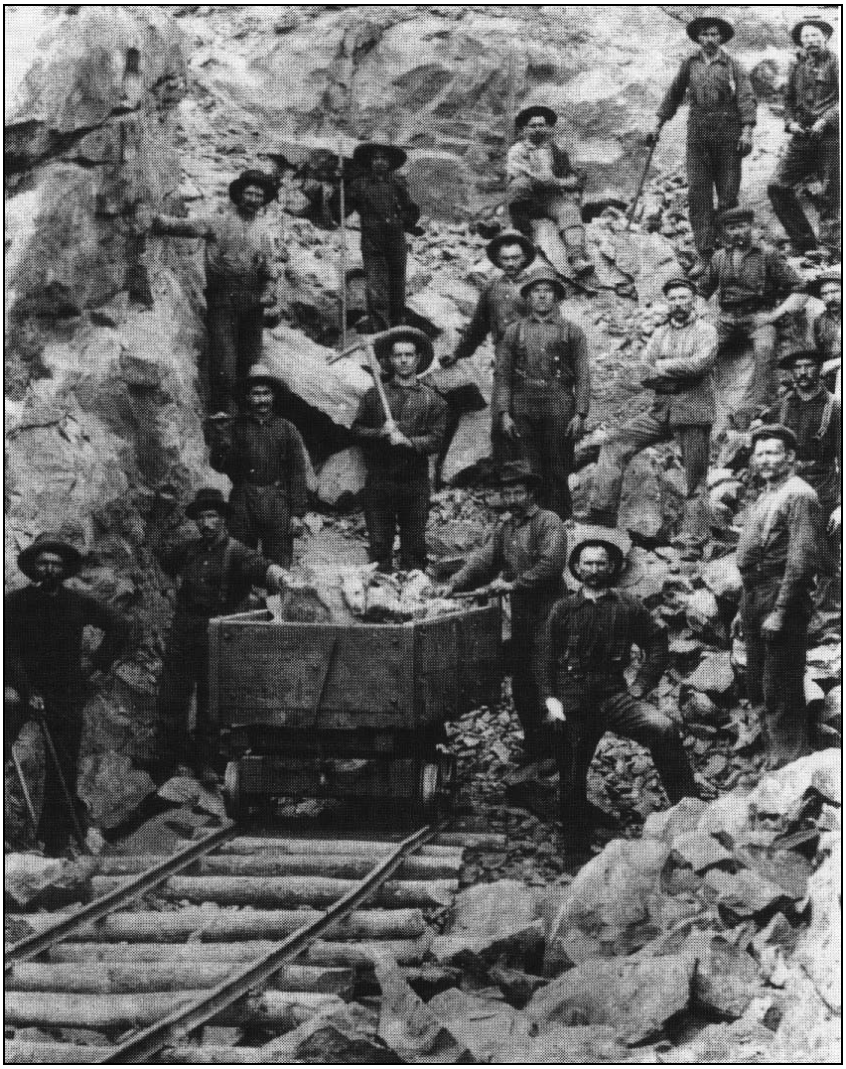


Figure 2-4 Canadian Copper shaft at Copper Cliff, circa 1900

2.2.3 Manufacturing a Market: War

I little thought at that time that the navy clothing herself with this material would make herself mistress of the world. —Samuel J. Ritchie, interviewed in The Globe and Mail, June 1, 1897

As the immense size of the mineral deposits became apparent, the search was on to find a market for nickel. Nickel had been used for decorative purposes in China for centuries, and was being used in Europe for token coinage, silver plating, and as a general underplate, but these uses were not enough to warrant its large scale production. At first, the companies were only interested in copper. The irrepressible Ritchie fervently believed in the “devil's metal”—so named because it got in the way of copper extraction and made the process uneconomical (Gunn, 1995)—and earned the annoyance of his government contacts in his quest for a market.

Finally, in 1889, the breakthrough came in a scientific paper, "Alloys of Nickel and Steel" written in England, which indicated the indispensability of nickel-steel for military applications (Swift, 1977). Ritchie brought the military potential of nickel to the attention of U.S. Secretary of the Navy, B.F. Tracy. Tracy in turn contacted Col. R.M. Thompson, a friend who owned a copper refinery in New Jersey. The powerful combination of the U.S. government defence establishment, Canadian Copper and the Orford Copper Company of New Jersey—which had the rights to a leading refining process—consolidated its control over the American nickel market even as it developed. Tariff policies were introduced to favour the consortium: nickel ore and matte were admitted to the U.S. duty free, while refined nickel carried a 10¢ per pound charge (Swift, 1977).

The involvement of Orford Copper provided the refining capabilities that had been lacking for Canadian Copper, but also began the decades-long struggle to keep nickel-refining work in Canada. The American duty on the import of refined nickel seriously impeded the viability of Canadian refining and fabrication. From the beginning, the pattern of American market control of Canadian resource-based industries was in place.

As Americans, naturally we wish to see the refining done in the U.S. and the work provided for American citizens. —Stevenson Burke, President of Canadian Copper, 1897 (Main, 1955)

The introduction of nickel-steel into armaments was the most important single factor in the development of the nickel industry —J.F. Thompson, former president of International Nickel (Thompson and Beasley, 1960)

As the world recognized the potential of the so-called "war metal", many smaller companies tried to make a go of it in the 1880s. Most came and went without much fanfare. Notable amongst the larger and more powerful were the H.H. Vivian Company of Wales and the Dominion Mineral Company of Montreal, who acquired mining properties on the south rim of the Sudbury basin in 1889. Vivian, a world leader in smelting and metals, acquired Murray mine, adding international prestige to the district. Dominion Minerals opened Blezard mine in 1889, and constructed a smelter (Swift, 1977). Because the ore had to be shipped great distances to refineries in the U.S., the smelting process—and accessibility to refining capabilities—became key to the success of mining companies operating in the region.

2.2.4 Mining: Mond Rises

By 1894 the optimism of the previous years had again waned. A depressed world market forced the closing of both Vivian and Dominion Mineral. Only Canadian Copper remained. When the Spanish-American war contracts arrived, Canadian Copper added a fourth furnace to its smelter.

At various times later in the decade, both the federal and provincial governments tried to impose an export duty on nickel matte to provide an incentive for companies like Canadian Copper to refine their matte in Canada. Each time, political will collapsed under the threat that the companies would shut down and the world market would turn elsewhere for its nickel. Fearing for their livelihoods, the people of Sudbury sided with Canadian Copper's interests (Swift, 1977).

Canadian Copper's local monopoly was broken just as the new century arrived: in 1899 prospector Rinaldo McConnell sold his stake to Ludwig Mond, a Swiss national living in England who had a different method of refining nickel ores. Mond Nickel began operations in 1900, when the European and American navies begin to prepare for the brewing conflict. The fledgling company was not a direct threat to Canadian Copper, because it pursued mainly European markets. With time it would become a key player in the Sudbury mining industry.

2.3 Early Smelting Processes

2.3.1 The Roast Yards: 1885–1929

The primary goal of the smelting process has remained the same from the earliest attempts to the present day: to separate the minerals from the rock. In the case of the Sudbury ores, the biggest challenge lies in separating the pay metals (copper and nickel) from the sulphur, iron and barren host rock to which they are melded. To reduce the amount of material being transported to the U.S. for refining, the need for effective on-site smelting arose. The infamous roast yards were the first stage in the smelting process. After a trial roast in December of 1886 proved its practicality, the first roast yard became operational in 1888. Between 1890 and 1930, approximately 28 million tonnes of ore were smelted, primarily at roast yards, and after 1920, mechanically roasted at the smelters (Gunn, 1995).

In the early years, hand-sorted, crushed ore from the pits was piled on beds of cordwood in the open, covered with finer material to prevent open flames, and ignited. For the first week or more, the burning wood provided the heat until the ore itself began to burn, fuelled by its sulphur content, which burned off as sulphur dioxide. After burning for several months, depending on the size of the yard, the ore was loaded into rail cars and transported to furnaces for smelting and conversion.

Figure 2-5 Roast Yards, Copper Cliff, circa 1890

Figure 2-6 O'Donnell Roast yards, circa 1915

Figure 2-7 O’Donnell Roast yards, circa 1974

Until the process was abandoned in 1929, 11 roast yards had operated, discharging clouds of acrid smoke across the land and nearby communities. Approximately 900,000 cords of wood were burned during this period, or about 27 football fields, all piled 100 feet deep (Gunn, 1995). In 1916, the smaller yard in Copper Cliff was shut down due to numerous complaints and rebuilt as the largest of the roast yards, west of Creighton Mine, near the Vermillion River. The O’Donnell yard was 2,286 metres long by 52 metres wide, and was highly mechanized for its time. While the smaller yards—including the one that is now Copper Cliff Park—were, for the most part, rehabilitated, the remains of the O'Donnell roast yard are still visible today.

Over the 40-year history of the roast yards they released about 10 million tons of sulphur dioxide at ground level, killing plants and acidifying soils (Gunn, 1995). Open-bed roasting was a cheap but ultimately inefficient method, as it allowed some of the nickel and copper to be washed into the soil by rains. The process also required vast amounts of lumber, which led to a depletion of the supply by 1929.

Figure 2-8 Copper Cliff Smelter as viewed through Copper Cliff Park – 1903

Figure 2-9 Copper Cliff Park today

The most significant damage caused by the roast yards was destruction of surrounding vegetation, and subsequent soil erosion. The O'Donnell roast yard area today has been naturally re-colonized by native plants, right up to the perimeter of the yard, because levels of metals in these areas were low. Only the roast yard itself remains toxic and barren because of the metals leached by rainwater into the soil. A more detailed summary of the roast yard "revegetation" is provided in chapter 4.

When the O'Donnell yard began operation in 1916, workers moved from Copper Cliff and formed a small settlement adjacent to the roast yard. Old tales abound about horses getting nosebleeds from the

fumigations at O'Donnell and of citizens in the new community requiring ropes along the wooden sidewalks to guide them through the smoky haze. One former resident was quoted as saying "There were days when I couldn't see my hand in front of my face and I'm not kidding when I say I got lost one day walking the 50 yards to school. Needless to say, we had no gardens – there wasn't so much as a blade of grass growing in the village" (Wallace and Thomson, 1993). From the beginning, the wider community worried that the fumes were dangerous to human health. As the vegetation died and the rains washed away topsoil, the rocks and even the buildings blackened. But what was to be done when the existence of the O'Donnell community was inextricably linked to industry? One was not possible without the other.

2.3.2 Early Smelting and Refining Processes: The Copper Cliff Smelter

In 1888, Canadian Copper built the first smelter at Copper Cliff, consisting of a building that housed a furnace, boilers and blowing engine. After the ore had been roasted for months at the roast yard, it was loaded into railway cars and shipped to the smelter. At the smelter, the ore passed to the blast furnace, which removed more of the barren host rock and iron from the ore and discarded it as a molten waste called "slag". This step increased the proportion of copper and nickel in the molten "matte" to about 35% in relation to the iron and sulphur.

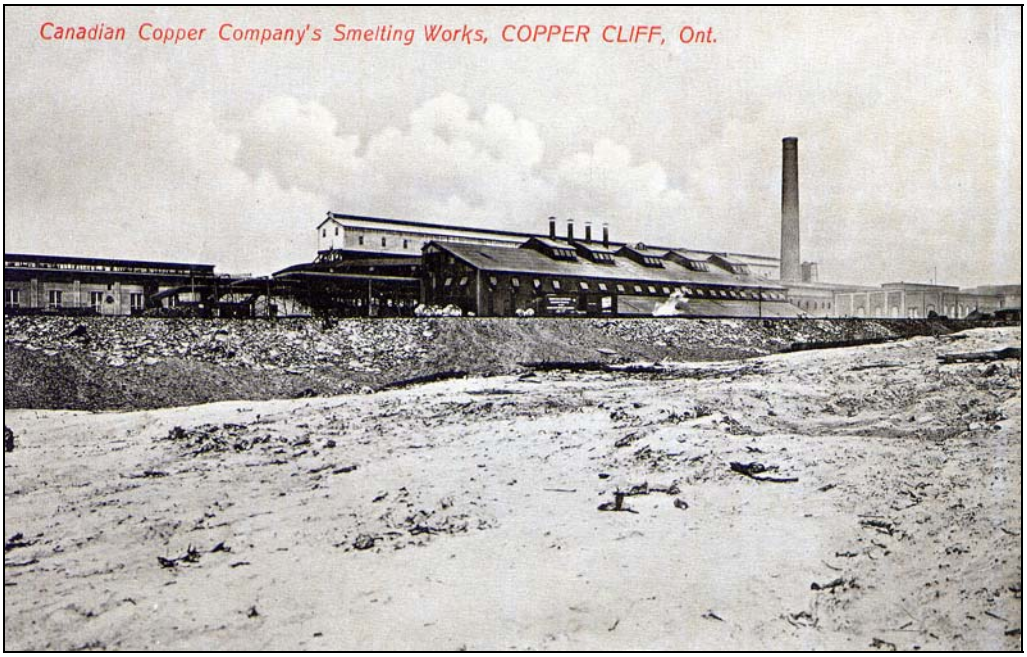


Figure 2-10 Canadian Copper Smelter, Copper Cliff

To further reduce the iron content of the matte, a Bessemer plant was added to the smelter in 1890. The matte was "bessemerized" by adding quartz in a special furnace and forcing an air blast through the molten material. This caused the iron to oxidize and combine with the silica in the quartz to form slag, which could be poured off the surface, leaving matte of an even higher percentage nickel and copper. The early slagheap between Sudbury and Copper Cliff has grown into a massive mountain of over 119 million tons of slag covering an area of 240 hectares. Xstrata Nickel stores approximately 10 million tons of slag on its property (Gunn, 1995).

A century of mining and ore processing has also produced a staggering amount of tailings, the tons of crushed host rock rejected in the milling process. The Copper Cliff tailings area has a total extent of 700 million tons over an area of 2,225 hectares. Xstrata Nickel stores 45 million tons of tailings on site (Gunn, 1995).

Early smelting operations were crude and labour-intensive. The notion of lighting the smelter by electricity was deemed a bad idea, and the idea of smelting 100 tons of ore a day seemed enormous and "rather bewildering" to the metallurgist in charge at Copper Cliff. The first attempts at operating the furnace were frightening:

> *On December 22nd, 1888, the furnace with a crew of French Canadians, who had never seen such a thing before, was fired up. The floor of the furnace room was flooded, and every time the furnace was tapped the explosions sounded like a Gatling gun. McArthur...had a platform slung above the settler, and on this were stationed two men with pails, to put out the fire on the roof that followed each tap. On December 25th, they had to stop work. McArthur's eyes were so badly burned that a boy was told … to lead him round. ...With matte and slag running continuously over the split ring the only wonder is that any of the furnace-men lived to tell the tale (LeBourdais, 1953).*

Once the operators got the hang of the furnace, it could smelt from 80 to 100 tons of ore a day, producing a matte containing about 50% copper-nickel. The production of 8,450 tons of matte in 1888 was twice as much as was produced by the rest of the world in the same year (LeBourdais, 1953).

As mining activity increased, more furnaces were added to the smelting operations. In 1889 the West Smelter, near Mine No. 2, was established as a new smelting centre. In 1900, the Orford Copper Company built the Ontario Smelting Works, half a mile southwest of Copper Cliff, to produce a higher-grade matte. A new, "modern" smelter replaced both the West Smelter and the Ontario Smelting Works in 1904. Dubbed simply "The Smelter", the new facility was designed to operate electrically, with power generated by the Spanish River and High Falls power plant.

Because there were no refining operations in Canada, all of the matte had to be shipped abroad. The Orford Copper Company in New Jersey had the rights to the "tops and bottoms" process, which set the refining industry standard in the 1890s. When Mond Nickel began operations in 1900, it utilized a different refining process, dubbed the "Mond process" at its refinery in Great Britain (Wallace and Thomson, 1993).

Around the same time, Noak Victor Hybinette, a Swedish metallurgist, developed an electrolytic process of refining that he tried unsuccessfully to sell to Orford Copper and later International Nickel during the time he worked for them in the United States. Returning to Norway in 1910, he built a refinery at Kristiansand, Norway. At the time, no one could have foreseen that, from the 1930s on, large quantities of Canadian nickel would indeed be refined using the Hybinette process at Kristiansand, under the refinery's new owner: Falconbridge Ltd.

A detailed summary of the technical aspects of historical and current smelting processes is provided in Chapter 3.

2.3.3 Logging and Industrial Deforestation

From the arrival of the Europeans, every wave of human activity in the Sudbury region contributed to its mass deforestation. Originally named "Ste-Anne of the Pines", Sudbury's vast red and white pine forests did not stand a chance in the face of the early lumber-hungry economies of North America. As mentioned above, the motivation for opening the region in 1872 was logging. By 1902, as many as 19,000 people were employed in lumbering which, although seasonal, continued to be the dominant industry as late as 1927 (Wallace and Thomson, 1993). Early selective logging practices gave way to more clear-cutting tendencies with the arrival of the railway, and the increasing need for railway ties, locomotive fuel and pulpwood. As a greater proportion of timber was removed, the slash left behind created ideal conditions for wild fires, many of which swept through the area. When the prospectors arrived, they would sometimes set fire to an area to expose what lay beneath and to facilitate the staking of claims.

Figure 2-11 Deforestation at Clarabelle Lake, 1975

Figure 2-12 Deforestation near Coniston

None of these assaults on the landscape compare to the effects of the roast yards. In the vicinity of the yards, even the smallest timber was removed as fuel, and between 1913 and 1916, Mond Nickel removed nearly all the woody vegetation, including tree stumps, from the Coniston area to provide fuel for the roasting process. The loss of topsoil along with a century of sulphur dioxide fumes emitted by first the roast yards and later the smelters prevented the natural regeneration of the forests which once covered the Sudbury rocks.

2.4 Meanwhile, back in town...1890–1900[1]

Though Sudbury can boast a court house, gaol, hospital (on a rather diminutive scale), a public alarm in the form of an immense steel triangle, and a host of unlicensed whiskey holes, we have some hesitancy in terming it anything other than a "clearing". The population is transient and uncertain. Picture to yourself an immense camp meeting ground of primitive style, in the centre place three respectable frame buildings, while around the outskirts of the woods, in the shadow of the hills, extend a fringe of log houses and tents, leaving an immense open space unoccupied and you will have some idea of Sudbury.
—The Globe and Mail, September 13, 1884

Sudbury's frontier period, filled as it was with the requisite prospectors, hustlers, bears in backyards, betrayal and bravery, was short. Plans for a more permanent settlement were in the works by the mid-1880s, when the Province of Ontario sent surveyors to divide the region into townships and impose its authority. Although the McKim Municipal Township council was established, the CPR remained in charge, with the consent of the provincial government.

Most of the residents of the townships were from humble backgrounds, and had arrived at the frontier to make their fortunes. The Finns comprised the only ethnic group of any size, with English and French Canadians evenly dividing the majority. The 1891 Canadian census reported 2,354 people living in the district, mostly in Sudbury and in the mining camps of Copper Cliff, Stobie, Blezard and Murray. Although the population was still mostly male, the opening of the roast yard and smelter at Copper Cliff in 1888 provided the sense of stability that attracted families to the area. Eventually, smaller communities such as Levack, Garson and, much later in the 1950s, Onaping sprang up around the more important mines.

The town of Sudbury was incorporated in 1892. The new town council began ambitious public works projects, including improvements to waste management, water, and lighting, the extension of wooden sidewalks and the introduction of town constables to enforce by-laws. These improvements were costly; the large municipal debt the first councils created carried on into the future. Even with the upgrades,

[1] The reference for all social history in this report is Wallace and Thomson, 1993, unless otherwise indicated.

Sudbury remained an under-serviced, rough-looking place, with domestic animals still freely roaming the muddy streets. Open sewers would flow through town for years to come. In this respect, Sudbury was typical of frontier towns of its era. But unlike many similar towns that reached their peaks in those early boom years, Sudbury's star continued to rise.

2.4.1 The "Other" Industries: Lumber and Agriculture

In the early decades, agriculture and forestry kept the local economy afloat during the cycle of mining slumps. The forestry industry was booming, even though the trees were receding. Canadian Copper acquired harvesting rights to the remaining lumber in McKim Township.

By 1891, the Blezard Valley had 81 farms, operated mostly by French Canadians. The provincial government encouraged settlement in the valley, and observers noted "as fine crops of oats, peas, barley and potatoes as we have seen in any other portion of Ontario" (Wallace and Thomson, 1993). Even as the farmers were clearing the land their efforts were being undermined by the roast yard sulphur dioxide emissions. The stage was set for a decades-long battle between mining and agricultural interests in the area.

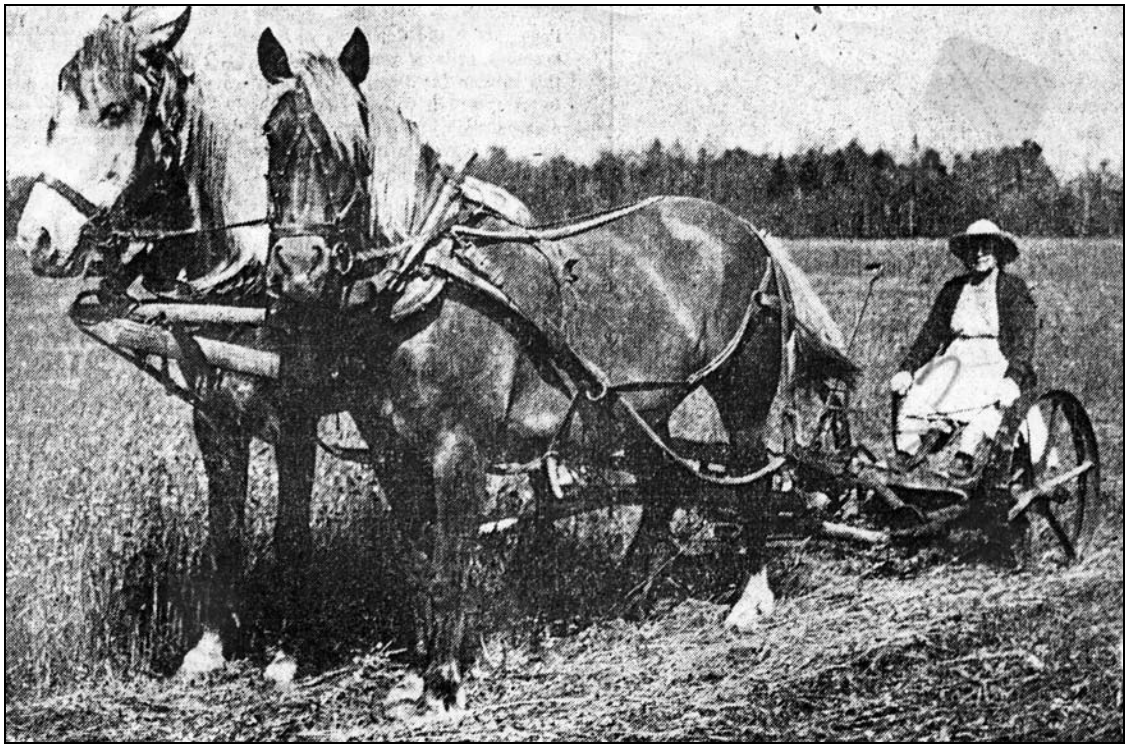


Figure 2-13 Early farming in the Sudbury Area

Figure 2-14 Original Ramsay Lake Tote Road CPR Line

Figure 2-15 Photo near Sudbury (1883) showing lumber operations before mine initiation

2.5 The Smelter Towns: Copper Cliff, Victoria Mines, Coniston

2.5.1 Copper Cliff

With the opening of Copper Cliff Mine in 1886, a new company town rose in the shadow of the head frame. In 1890, Canadian Copper moved its offices to Copper Cliff. The company provided housing only for Canadian English-speaking workers, and those of American and British descent, leaving the balance of the ethnically diverse workforce to fend for itself. A shantytown quickly sprang up at the edges of the Copper Cliff town site, with no electricity or services in its makeshift shack dwellings. This ethnic and class segregation continued into the new century (Goltz, 1990).

Figure 2-16 Copper Cliff around 1900

Through the threat of eviction, the company sought to control all aspects of its workers' lives. Land leased from the company cost 25¢ a month to rent until after 1920. The cancellable leases gave the company the right to approve the new purchasers of privately owned buildings. The leases also prohibited the sale of alcohol (Goltz, 1990).

Copper Cliff became a world apart, divided from Sudbury by the roast heaps and smelter, and by the quickly established company-town mentality of its residents.

Figure 2-17 Power Street, Copper Cliff, around 1910

Figure 2-18 Power Street, Copper Cliff, around 1975

Although Copper Cliff town was incorporated in 1901, in 1902 it was still a primitive place. D.H. Browne, later a Canadian Copper official, describes Canadian Copper's offices:

A photograph of the company's office show half a dozen pigs asleep under the office windows, others disputed with "Barney", Mr. Turner's dog, for the shelter of the kennel. The smelter buildings were all of wood and fires were so frequent that the insurance companies considered the probability that we might have incendiary propensities. There was no system of fire protection and when one house took fire a bucket brigade kept water on the adjoining buildings and left the doomed building to its fate. ... The old Club House, built in 1889, was full of bugs...These were nocturnal, wingless and aggressive. (LeBourdais, 1953).

2.5.2 Victoria Mines

Twenty-two miles west of Sudbury and two miles south of the mine that bore its name, the smelter town of Victoria Mines was constructed in the late 1890s. The mine, originally called Denison or McConnell after the prospector who discovered it, was purchased by Mond Nickel in 1899.

The modern smelter at Victoria Mines supplied the bulk of Mond ore for 10 to 15 years, handling ore from Garson, Worthington, Victoria Mines and probably some Canadian Copper Company ore as well. When, in 1909, the smelter was remodelled for electric power, it could handle 140,000 tons of ore per year. Between the mine and the smelter was a large roast yard measuring 60 x 100 x 8 feet. Horses hauled the huge piles of cordwood required in the process, and a small group of men were paid 22¢ a ton for the backbreaking task of loading and unloading the ore. The gases from the roast yard and smelter made for suffocating working conditions, with men reporting that they had to “lay down on the ground to catch one’s breath” (Sudbury and District Historical Society, 1986).

Both Victoria Mines and the village of Mond—two miles away at the mine—had ethnically diverse populations, few services and amenities, and were relatively isolated from larger communities. In 1913 the trip to Sudbury and back on the original corduroy road took all day, and was not possible in winter. The CPR line carried mail orders from Eatons and Simpsons, groceries and mail from Sudbury. Villagers hopped on the “bucket line” from Victoria Mines to Mond to save the walk. By all accounts, life was simple and peaceful, with the only serious crime being a conviction of attempted murder in a dispute over a woman.

When Mond relocated its smelter and roast yard to Coniston in 1913, Victoria Mines emptied out and slipped into history. The company houses were sawed into sections and transported to Worthington or Coniston. Private homes were torn down and moved to other locations.

Mining continued at Victoria Mine until 1923. The last family moved away from Mond in 1936. Between 1975 and 1978 the ore body was redeveloped but was again shut down because it was not economically viable. No buildings remain at the site today (Sudbury and District Historical Society, 1986).

2.5.3 Coniston

In 1902, the first settlers of what was to become Coniston cleared land off what is now Highway 17, eight miles east of Sudbury, for a family farm. In 1905, the agricultural roots of the community expanded into lumber and construction as first the CNR built its line from the main CPR line, followed by the CPR Toronto-Romford line in 1908. When the growing population petitioned Ottawa for a post office, the name Coniston was chosen after a place in a novel that a railway construction superintendent was reading.

When Mond moved its smelting operation and roast yard from Victoria Mines to Coniston in 1913, the town saw a surge of activity and growth. Five family farms were sold to Mond for the smelting site, effectively ending the agricultural orientation of the community. By 1933, 343 men worked at the smelter. During early boom times, accommodation was insufficient, leading to the practice of "hot bedding": men slept in shifts at the boarding houses, so their beds were never cold.

The 1929 merger of Mond and the International Nickel Company (Inco) slowed growth in the community because the centre of operations was now Copper Cliff. However, the smelter continued operations, and Coniston, incorporated in 1934, had a family feel about it characteristic of company towns. Until 1942, workers reached the smelter by foot or rail; no one had found reason to build a road.

Figure 2-19 Coniston Smelter, 1927

In 1946, an old acid plant north of the smelter became a test plant for the processing of New Caledonian and Venezuelan nickel ores, and then for pyrrhotite experimentation. The result of six years of trials was the construction of the Iron Ore Recovery Plant at Copper Cliff, where the metallurgical process developed in Coniston was used. The air in Coniston was much improved by the construction of a new smelter stack in 1954, followed by a taller, improved stack for the sintering plant in 1959.

The closure of the inefficient, outdated smelter in 1972 was a heavy blow to Coniston. The majority of employees were transferred to Copper Cliff plants or accepted early retirement. Vale Inco sold its company-owned houses to employees or to outsiders who moved into the community. After the smelter was demolished in 1976, an industrial park was constructed on its site. Unlike Victoria Mines, Coniston survived life after mining, remaining a community to this day, and is one focus of the current Sudbury Soils Study.

2.6 Meanwhile, back in town…1900–1910

The early years of the 20th century saw signs of urban progress. With the development of schools, hotels, and churches, Sudbury was becoming a more permanent settlement. Bell Telephone arrived in 1902, as did power lines. The first "automobilly" arrived in 1906; by 1910 there were three. The increasing importance of the town was marked by the establishment of bank branches, including the Bank of Toronto in 1902, the Bank of Montreal in 1906, and what was to become the Bank of Commerce in 1909.

Figure 2-20 Elm Street, Sudbury, 1919

As the labour force expanded, Sudbury got its first real union in 1906 when 16 bartenders formed Local 237 to protect their jobs, which seemed endangered by recent changes in provincial law requiring that they be licensed.

In 1909, the Sudbury Star newspaper began to challenge the highly influential Sudbury Journal for advertisers and readership. In the years that followed, the Star would grow to boast a circulation of 6,500 by 1924, making it the largest newspaper in the north. As did the Journal before it, the Star staunchly supported the mining industry, and under publisher W.E. Mason, the paper relentlessly attacked any attempts at union formation.

Although the trees were becoming more scarce, logging remained the stabilizing element in the economy. Agriculture was second, still ahead of mining. By 1911, there were over 500 farms in the Blezard Valley, with over 90% larger than 50 acres.

During this period there were few challenges to the mining companies for their industrial emissions, or attempts to discipline the CPR for its blasting practices. However grave the dangers posed by industrial operating practices, the town councils were loath to criticize the companies that sustained Sudbury's existence for fear of losing them.

It should be pointed out, too, that the mining industry is one of the most effectual agencies in the settlement of our northern and northwestern districts. It affords employment to labour, frequently on a large scale, and provides the best kind of market for farm produce and manufactured goods. Not only the tillers of the soil, but the artisans and merchants...derive a benefit from the increase in business arising out of the mining industry. —Royal Ontario Nickel Commission, 1917

2.7 The Merger of 1902

The year 1901 saw the rise of monopolies in industries almost as new as the century. J. Pierpont Morgan unified various components of the U.S. steel industry, including coal, iron mining, smelting, refining operations, wire, plate, and rail manufacture into the United States Steel Corporation. To keep control of the nickel supply from competitors, he formed the International Nickel Company (Inco) in New Jersey in 1902. For $10 million, Morgan and the financial interests behind U.S. Steel acquired Canadian Copper, Orford Nickel Corporation Ltd., the Société Minière Caledonienne and a number of non-operating companies with mining rights in Sudbury and New Caledonia, the world's other main source of nickel at the time.

This merger reinforced the growing monopoly position of Canadian Copper, a subsidiary of International Nickel, in Sudbury's mining industry. Between 1887 and 1902, Canadian Copper mined 71% of all ore produced in Sudbury. Its alliance with Orford assured refining facilities and a strong position in the American market. Inco's combined mining and refining operations turned out 60% of the world's nickel supply in 1902. Agreements with Le Nickel of France gave this consortium control of 90% of the world's nickel (Stephenson, 1979). The consolidation of 1902 put International Nickel (Inco) in an almost unassailable position.

In 1907 the Canadian government passed the Metal Refining Bounty Act with an incentive of 6¢ per pound to encourage refinement in Canada. The bounty did not prove big enough in light of continued American trade sanctions that favoured the passage of unrefined ore into the U.S. (Swift, 1977). Once again, the Canadian government bowed to demands of industry customers abroad, and to the economic control of the American government.

2.8 World War One: Patriots and Pariahs

The present situation is that Britishers and other enemies of the Teutonic armies are being shot down by machine guns hardened with Ontario nickel and not an Ontario boy goes into action except at the risk of having to face bullets barbed with the nickel of which his own province has a monopoly.
—Toronto Telegram, Dec. 27, 1914

The years leading up to the First World War were prosperous for the mining industry. Nickel production levels rose from 34 million pounds in 1911 to 49.9 million pounds in 1913, while copper production rose from 18 to 25.8 million pounds (Wallace and Thomson, 1993). Nickel increased its reputation as the “war metal” because of its properties of hardening steel used in armaments and ammunition; the fortunes of the nickel industry became closely tied to periods of war (Swift, 1977).

As pre-war patriotic sentiments grew, the Canadian public became increasingly concerned that nickel refining should be done in Canada to prevent the war metal from arming the enemy. In 1913, Germany was Inco's second-largest customer, accounting for 57% of sales outside of the U.S. (Swift, 1977). When Inco shut down for three months after the outbreak of war, the company's public image took a beating. Rumours spread that trade with Germany was continuing, as American neutrality laws governing Inco’s parent company allowed for export to enemy countries. The rumours were false. In the fall of 1914, Inco officials signed an agreement that gave the British a veto over the company's export sales.

Even after assurances by the federal government that nickel exports were being monitored, public pressure forced the government to take action; in 1915, the Ontario government announced that a Royal Commission would determine the viability of refining in Canada. Before the Royal Ontario Nickel Commission could offer its final report in 1917, world events had forced Inco to draw conclusions of its own. In 1916, an American newspaper revealed that the submarine *Deutschland* had made two trips from America to Germany, the second in November of 1916, transporting 600 tons of nickel to German ports (Swift, 1977). Faced with many factors, including an increasingly hostile public outcry and the threat that its Canadian assets would be expropriated, Inco determined that it could refine profitably in Ontario. The Royal Ontario Nickel Commission weighed in with the same conclusion.

Inco announced plans to construct a refinery at Port Colborne, Ontario. In 1918, International Nickel underwent a structural transformation to turn its Canadian subsidiary, Canadian Copper, into the International Nickel Company of Canada, a "Canadian" corporation with new headquarters in Toronto. These moves were a clear indication that Inco's threats to abandon Canada for their "vast" holdings in New Caledonia were empty; the commitment to developing the Canadian deposits was deep. However, even with the apparent "Canadianization" of the industry, nickel production remained firmly tied to American interests and control.

There is no certainty that large profits can be made every year from the nickel industry. The present activity is in part due to well understood causes, which it is to be hoped will never recur.
—Royal Ontario Nickel Commission, 1917

2.8.1 Meanwhile, back in town…1910–1920: Post-war Labour Woes

Through the war years, Sudbury began to emerge as a leading metropolitan centre in northeastern Ontario. Improvements in rail and highway networks enhanced Sudbury's position as a transportation hub, with connections to Toronto in the south and Montreal in the east, and to all points westward. The prosperity of the town was evident by the number of “horseless carriage”, which increased from three in 1910 to nearly 1,000 in 1921. As early as 1913, town council passed a bylaw directing all vehicles to drive on the right hand side of the road. The province introduced a mandatory driver's license in 1914, but not until 1917 could you drive all the way to Toronto by car.

The town in the wilderness was also becoming a destination city for business. By 1921, Sudbury had 342 businesses, seven major bank branches and 33 grocery stores. Municipal services were slowly being extended to new pockets of residential settlement. Houses now had uniform numbering, and by 1915, regular garbage pick-up began. However, the fire department remained only a voluntary force as late as 1919.

Although sewer and water issues were addressed, the sewage system continued to drain into Junction Creek, and the pollution levels in Ramsey Lake prompted a winter-long boil-water advisory in 1916–17. By 1917 a new chlorination plant and new steel water tower rendered the water safe and potable. In 1915, the Sudbury-Copper Cliff Suburban Electric Railway began operating, linking Copper Cliff more closely to the larger community.

The massive wartime wage increases quickly switched to layoffs and shutdowns when the fighting ended and the bottom fell out of the nickel market. In 1922, nickel production was at its lowest level since 1904. Within six months, Inco's workforce had dropped from approximately 3,200 to 1,000; Mond reduced from 1,800 to 750. On top of the unemployed mine workers, the area flooded with returning soldiers looking for work. Hundreds waited in breadlines and public works projects gave the unemployed work building roads for 35¢ a day (miners during the subsequent boom made an astounding $37 a week). The boom and bust cycle of nickel demand now mirrored the fortune of the town, which was growing ever closer to total dependence on its fickle benefactor.

In the face of wage cuts, layoffs and instability, there were rumblings of the need to organize collectively. Although nothing came of it directly, the Sudbury Trades and Labour Council formed to give Labour a voice in community affairs.

2.9 Sulphur Pollution: Disputes with the Farmers

Some apologists say (cutting down sulphur emissions) can't be done. Nor it won't be done, as long as we fellows grin and bear it—as long as we keep on spitting and coughing. These companies should be indicted tomorrow for maintaining a public nuisance. —A Sudbury area farmer, quoted in the Sudbury Star, March 4, 1916

The wartime surge in nickel production increased the volume of noxious gases that wafted from the roast-beds into the gardens and fields of the Sudbury basin. Agriculture in the Blezard Valley was being smothered by the 600,000 tons of sulphur dioxide being emitted annually by the nickel companies (Swift, 1977). In 1916, after successive years of ruined crops, the farmers had had enough, forcing Canadian Copper to pay $137,398 for smoke damages in the year ending March 31, 1916 (Swift, 1977). So many suits were launched against the companies that the Supreme Court of Ontario selected four suits against Canadian Copper and two against Mond to become a single test case on the issue of sulphur pollution. The trial lasted over fifteen months, with a judgment not being made until 1917.

In the meantime, the farmers went to the Board of Trade for assistance, but the board was afraid to speak directly against the companies. It suggested that the province appoint a provincial commission to assess sulphur damage to crops, that the province give farmers the seed grain they needed for 1916, and that the mining companies consider roasting during the winter instead of the summer. The Ontario government complied, Mond switched its roasting to the winter for 1916–17, and Inco moved its main roast-bed from the centre of Copper Cliff west to the Whitefish area of today (Wallace and Thomson, 1993). The O'Donnell yard became the latest, most technologically advanced and largest of all the yards in the area.

In 1917 the Supreme Court ruled against the farmers. Justice J.J. Middleton awarded compensation less than what the companies were offering out of court. His decision clearly indicated that the pollution inflicted by the mining industries was a necessary evil; mining was considered of far greater importance to the Sudbury basin than was farming. Justice Middleton was not alone in his view. The effects and smell of sulphur dioxide was tolerated by many, since it was considered to be "the smell of money"; as long as the smelters were operating it meant jobs, security and prosperity would continue.

Despite Justice Middleton's attempt to discourage further complaints, the issue did not go away. In reaction to another volley of lawsuits, the Ontario legislature passed the Damages by Fumes Arbitration Act in 1921. A government arbitrator was authorized to make awards for damage to crops, trees and other vegetation. However, judgment of the arbitrator became the only legal option available to complainants. Inco did make payments to farmers before and during this time, but there were issues with the perceived "fairness" of the payments. An amendment to the Act in 1924 gave the provincial Minister of Mines the power to overrule the arbitrator. The arbitration process did force Inco to make some payments for visible emissions or technical violations in emissions reporting, and Inco and the provincial government did have teams in the Sudbury area to inspect crop damage. But not until 1974, half a century after the initial law-suits were filed, was Inco convicted on a charge brought forward by the Sudbury Law Association (Swift, 1977). By this time, new environmental legislation was in place and public opinion had shifted towards environmental protection.

The other financial aid remedy the government instituted was that of "smoke easements", payments the mining companies could make to land owners or lessees for property damages. The agreements bound all future owners to the original easement, and prevented any future lawsuits.

2.10 Mining

2.10.1 Consolidation of Empire

By the mid-1920s, nickel fortunes were again on the upswing as peacetime uses for the war metal developed. While nickel was needed for machinery, mining equipment, stainless steel and aircraft, the greatest demand came from the automobile industry. By 1926, cars were consuming over one third of the nickel used in America.

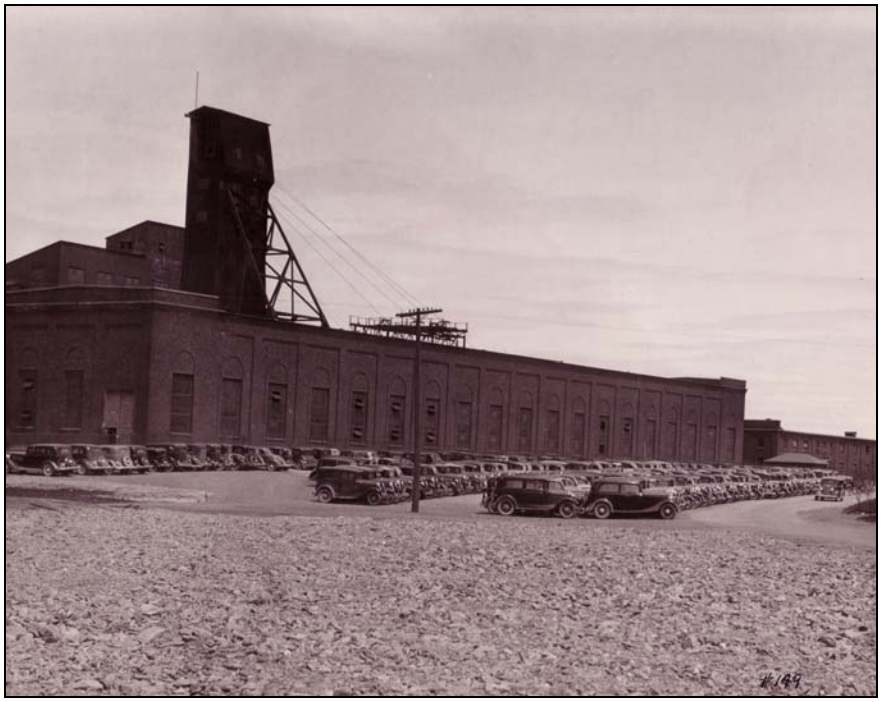


Figure 2-21 Copper Cliff mine headframe, circa 1930

Both Inco and Mond expanded operations. Inco's command of the American market, combined with Mond's influence in Europe, strengthened the dominance these mining giants had on the world market. The only significant challenger to the growing dynasty was the British American Nickel Corporation. By not beginning operations until 1920, it missed the war boom and fell victim to a depressed world market and fiscal mismanagement. In 1925 it was purchased by a dummy corporation set up, as it turned out, by Inco and Mond; the fates of the two companies were moving ever closer together.

When Inco and Mond went to develop their adjacent Frood properties, duplication of operations would have been illogical. After months of rumours and denial, the companies announced their merger in October of 1928.

Just prior to the merger, International Nickel became a "Canadian" corporation by the exchange of shares between the former New Jersey parent and the Canadian subsidiary. Prior to this, Inco was an American company with a Canadian subsidiary—Canadian Copper. From this point on, Inco was a Canadian company with foreign subsidiaries. The motive for the reorganization was the potential anti-trust actions the U.S. might have taken following what was, in essence, the absorption of Mond. By the end of the 1920s, Inco held an astonishing 90% of the world nickel market (Wallace and Thomson, 1993).

This consolidation (of Inco and Mond) was like the dynastic marriages which in the past so influenced the course of European history. —J.F. Thompson, former Inco president (Thompson and Beasley, 1960)

2.10.2 The Rise of Falconbridge

Inco did not enjoy its monopoly position for long. A little over a week after the merger of Inco and Mond, a powerful new player entered the story: Falconbridge Nickel Mines Ltd.

The development of the Falconbridge properties had an auspicious start. In his search for a lead nickel source for battery manufacture, Thomas A. Edison used a magnetic dip needle to discover the ore body that would become Falconbridge's first mine. However, in 1902 Edison abandoned the Falconbridge Township property after several failed attempts to sink a shaft in material resembling quicksand. Further drilling by the E.J. Longyear Company of Minneapolis in 1916–17 revealed extensive nickel-copper deposits. The original Edison claim had long reverted to the Crown, so the Minneapolis interests staked the property. In 1928, the deposit came to the attention of Thayer Lindsley, a Harvard-educated roving geologist and the president of Ventures Limited, a company formed to support his mining development plans. Lindsley, who was to become known as an outstanding mine-maker, recognized the potential of the deposit, and arranged to purchase the Falconbridge properties in the name of a new company incorporated for the purpose, Falconbridge Nickel Mines Ltd. The selling price of $2.5 million was the highest ever paid for a mine in the Sudbury district. However, the purchase was made on more than a hunch; geological engineers estimated that 5,700,000 tons of ore existed above the 500 foot level (Stephenson, 1979).

Work began in the fall of 1928, with only a wood road connecting the nearest settlement of Garson to the mine site. By 1930, the first shaft was down, a smelter ready to treat upward of 300 tons of ore a day was complete, and railway connections were in place. A new company town, complete with water supply, sewage disposal and a school sprang up in the shadow of the smelter.

Simultaneously, the search for refining capabilities led to the purchase of the Kristiansand refinery in Norway. Kristiansand owned the European rights to the Hybinette refining process, which had become

the industry standard. Falconbridge had learned from the failure of other fledgling mining companies that the only way to survive on Inco's turf was to have its own refining capabilities. Anton Gronningsater, a former Inco employee, was sent to Norway to modernize and streamline the refinery. In the years to come, the Falconbridge cargo of nickel copper matte en route to Norway, was said to be the most expensive on the ocean.

Unlike the many companies that sank their fortunes into the Sudbury basin only to come away empty-handed, Falconbridge was to develop into a company more successful than even its visionary founder anticipated; by the 1970s Falconbridge had become the third largest nickel producer in the "free" world.

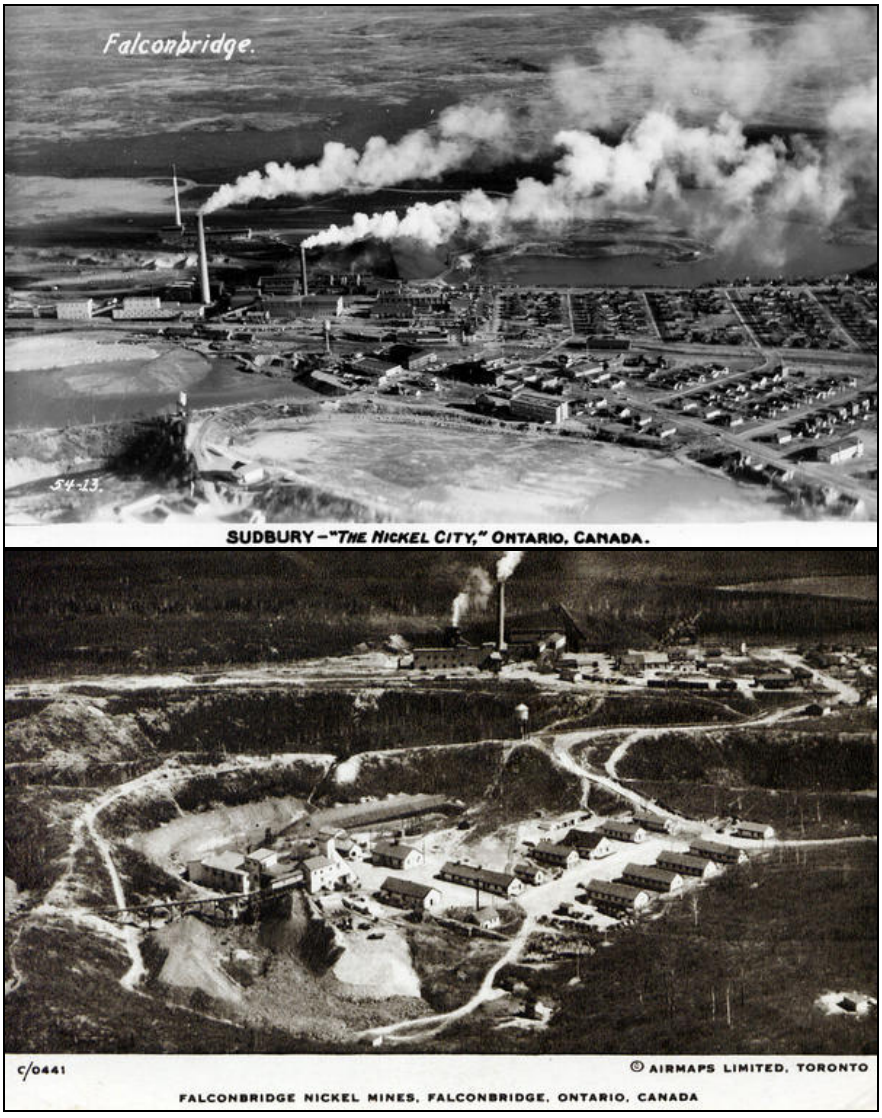


Figure 2-22 Birth of a Company Town: Falconbridge

2.10.3 Evolution and Expansion of Smelting Processes

Quick on the heels of the merger of Inco and Mond came the construction of an 8,000-tons-per-day flotation mill at Copper Cliff. To complement this process, the blast furnaces at Inco were replaced by reverberatory furnaces (see Chapter 3 for technical details).

The construction of six roasters and eight basic-lined converters reduced the proportion of sulphur in the ore. The introduction of newer processes in the smelter marked the end of the roast yard era, with the final roast yard, O'Donnell, ceasing operations in 1929. With the closing of the roast yards and the introduction of tall stacks, the ground level sulphur dioxide concentrations were greatly reduced and the localized vegetation damage was dramatically minimized (Gunn, 1995). These new processes initiated in 1930 were to remain in use, with some modifications and increases in capacity, for 20 years. The construction of an electrolytic copper refinery at Copper Cliff marked another advance, as did a new plant designed for the manufacture of nitre cake and sulphuric acid.

The new Falconbridge mine site was a flurry of activity from 1928 to 1930. The first shaft was sunk in the fall of 1928, with work on the smelter beginning early in 1929. The smelter consisted of a water-cooled blast furnace and two converters. In its first year, the smelter produced more matte (consisting of 83% nickel and copper) than the refinery could handle. In 1932, Falconbridge added a 250-ton concentrator and sintering plant, and further extended the smelter and crushing equipment.

2.11 Meanwhile, back in town...1920–1930

In 1928, Sudbury was riding a rolling wave of optimism. The promise of even more mineral development in the district led to a rash of claim staking. Caught up in the excitement, the Sudbury town council offered a vacant lot on Pine Street as a site for a new smelter. Thankfully, no one took the offer. “Watch your step”, the Sudbury Star wrote on March 14th, 1928, “Guard against being carried away in a wave of excitement, and keep one foot on the ground”. The newspaper warning was a wise one, as the fate of the town was already soundly locked into the rollercoaster ride of mining booms and busts.

The poorly planned town saw the first of many housing shortages as Sudbury filled once again with fortune seekers. The lack of planning was the mark of a resource-driven town; the frontier mentality of impermanence and transience did not change quickly enough to accommodate the increasingly permanent settlement. Unlike most towns built on the back of resource exploitation, Sudbury was gradually acquiring the features of a city. Public works expanded the sewage and water services through the 1920s, and electricity became more the norm than a luxury. In 1925, airplanes were first used to report forest

fires. After a rash of major downtown fires, town council decided to invest in a motorized fire truck. The horse teams were kept on for the winter when the snow was too much for the new truck. Given the growing passion Sudburians were developing for sports, the 100-odd radio owners in town likely listened to the first hockey game broadcast—Sudbury vs. Sault—in 1922. The Grand Opera House became the Grand Theatre in 1922, offering silent movies along with live performances. In 1929 the first "natural colour, talking, singing and dancing picture" was screened. Eaton's opened a mail-order store. Central Park was created, as well as a skating and curling rink. By 1930, the livery stables had been replaced by car lots, with more than 3,000 cars in the area.

Unlike Southern Ontario, Sudbury voted resoundingly "wet" in both the 1921 and 1924 temperance referendums. In 1924, fines for breaches of the Temperance Act reached $30,000 in the Sudbury district. Along with the rink, the tavern was to become central to the social life of many. On August 1st, 1930, Sudbury became a city.

2.12 The Depression: Saved by Nickel

With nickel and copper production at record levels in 1929 and 1930, analysts predicted Sudbury would escape the effects of the Depression. Both Inco and Falconbridge were expanding operations, with a new concentrator and smelter providing 1,200 new jobs at Copper Cliff, and Falconbridge building not only a new plant, but a new town.

The optimism that opened the decade proved overblown in the face of plummeting nickel prices in 1931. From the winter of 1931 to the spring of 1933, continuing shutdowns and layoffs put thousands of workers on welfare, and the future of Sudbury looked bleak. Line-ups at the soup kitchens lengthened as Inco's workforce plummeted from 8,839 in February 1932 to 2,000 by the summer of 1932. Bankruptcies and mortgage defaults abounded as the long shadow of the Depression passed over Sudbury.

The shadow lifted with remarkable swiftness. By 1933 the world nickel reserve was exhausted, and the metal was back in demand. Thanks to nickel, Sudbury became the first city in Canada to emerge from the Depression. Production began again in earnest with Inco reopening Creighton mine, expanding Frood and refiring the Coniston smelter. Suddenly Sudbury became a destination town once more, with jobseekers arriving from all parts of the country. Within the decade, the population swelled by almost 74%. The already inadequate housing and infrastructure conditions were overburdened by the mass influx, but with full employment and soaring wages, no one was complaining. Sudbury was an island of prosperity in a continent mired in economic misery.

By 1934, production levels surpassed the 1929 high, a trend that continued until 1938. In 1934, Inco opened a new converter, and a $6-million expansion of the smelter was announced the following year. Levack and Garson mines were reopened in 1937, and in 1938 a $10-million crusher was added at Frood. Both Inco and Falconbridge created thousands of jobs through both construction and mining at their ever-expanding operations.

2.13 Gearing up for War

There is no nickel at all in rifle or machine gun barrels or even in bayonet steel. … Heavens, (war) would be disastrous. Industry depends on peace.
—R.C. Stanley, president of Inco, in the Sudbury Star, May 22, 1935.

Although peacetime uses for nickel had expanded, rumblings of another war increased demand for what remained the "war metal". As early as 1933, whispers of war in Europe were turning attention once again to Inco's foreign trading activities. In 1934, Inco struck a deal with the German company IG Farben that guaranteed it 10% of the subsidiary Mond's sales in return for not developing its own nickel mines (Swift, 1977). Although the purchase was allegedly for peacetime applications, the deal essentially allowed Germany, with no internal source of its own, to stockpile nickel for potential military use.

Another of Inco's customers was Japan. Highly suspicious of these dealings, the public pressured the government to nationalize the nickel industry, and to place embargos on nickel sales to European armament makers. A long series of debates in the House of Commons concluded with the decision that it would be impossible to control the final destination of nickel shipments (Swift, 1977). The news was greeted with relief in Sudbury, where only the strength of the nickel industry was keeping the economy alive.

2.13.1 Meanwhile, back in town…1930s

There were the same forlorn buildings (as in British smelter towns) against a background of dun hills, the same baked earth and slag heaps; all vegetation killed by sulphur fumes from the smelter. It was as if these houses knew they would be abandoned should the mines run out. Yet the inhabitants, I know, would account it blasphemy to speak one word against the place.
—Julian Duguid, London Daily Telegraph reporter, quoted in the Sudbury Star, Nov. 8, 1933

As the city surged out of the Depression, town coffers did not reflect the riches of the mining industry. The enormous relief efforts of the early thirties had bankrupted the city, forcing it to curtail spending on needed services. The influx of workers strained an already inadequate infrastructure. Despite the high wages, living in Sudbury was far from luxury. Housing was substandard and the most crowded in Canada.

Prices for rent and food were inflated 10 to 25% above the national average. Many people lived in shacks beyond the city limits with no services, but with the space to keep animals and grow the essentials.

By 1940, there were only 32 kilometres of paved roads. Horses were still used for coal, wood, bread and milk delivery. With the legalization of liquor sales in 1934, the tavern became the centre of social activities. Interest in sports, too, was ever increasing. The hockey championships of the 1930s live on as a pinnacle of Sudbury sports achievement, with Sudbury teams capturing one national and several provincial titles, as well as the Memorial Cup in 1932 and a World Championship at Prague in 1938, when Canada was represented by the Sudbury Wolves.

2.14 World War Two

World's Richest Mining Enterprise Grinds Day and Night Without Ceasing to Provide All Nickel for United States: There is no more vital spot in the world wide front forming against Hitler and Hitlerism than right here in Sudbury. —Globe and Mail, May 30, 1942

At the outbreak of war, thousands of men and women stepped forward to enlist. Inco's 11,000 employees registered with the authorities so their valuable labour could be best used to support the war effort. With the men overseas, women took over traditionally male jobs, driving delivery trucks, working as mechanics for the CPR and as announcers for the local radio station. When women took over men's jobs at Inco—soldering cables on batteries, operating ore distributors, repairing flotation cell equipment and the like—it caused quite a stir.

Figure 2-23 Full-page ad in The Inco Triangle, thanking women workers, December 1945

While Sudbury suffered less than most Canadian cities during the war, the impact on the various ethnic groups was intense. Their European homelands were either under attack or on the offensive; citizens of Italian, German, Austrian, Czech and Slovakian descent had to register as enemy aliens or face internment.

INCO TRIANGLE

VOLUME 4 COPPER CLIFF, ONTARIO, DECEMBER, 1944 NUMBER 9

THE TRIANGLE "ON ACTIVE SERVICE" OVERSEAS

Johnny Burke, former sampler at Copper Cliff, and Pete Danyluck, ex-mucker from Creighton Mine, get a load of news from home in the September issue of the Triangle. Both boys are aero-engine mechanics overseas with the famed Snowy Owl Squadron and work on the "kite" Sweet Sue, seen in the background. Each heart represents an operational flight. This picture of our magazine "on active service" overseas gave us the biggest thrill we've had in a long time. That's not a bad looking bimbo, either.

Figure 2-24 Inco Triangle, December 1944

As was the case through the Great War and the Depression, nickel carried Sudbury through the Second World War. The demand for nickel remained high throughout the 1940s, and Inco and Falconbridge prospered accordingly. Between 1939 and 1944, 5,000 new jobs were created, with underground development in the region totalling more than 16 kilometres. Approximately 90% of the world's nickel was originating in Sudbury mines. Inco stated that the amount of ore mined during the war was equal to what it had produced in the preceding 54 years. After the Falconbridge refinery at Kristiansand fell to the Germans, Inco took on the refining of Falconbridge ore for the duration of the war.

Figure 2-25 Sudbury Downtown, Elm Street, 1948

2.15 Environmental Concerns: Early Emissions Studies

As the landscape around the smelters deteriorated, the effects of emissions could no longer be ignored. In 1944, representatives of government and industry met to discuss the pollution problem. They initiated studies on meteorology, atmospheric sulphur dioxide levels, the sulphur content of conifer foliage, lichen distribution and forest damage. These studies were conducted during the summers of 1942–1944 when the smelters were in high production because of the war effort, and emissions were at a peak (Gunn, 1995).

Staff in fire towers and aircraft recorded the dispersal pattern of emissions from the smelters. They could see smoke from Sudbury smelters at least 120 kilometers away, and smell sulphur 60 kilometers from the source. The first vegetation damage report noted severe burns of tree foliage 35 kilometres to the northeast, 20 kilometers to the north, and 20 kilometers to the south of the smelters. As far as 40 kilometers to the northeast of the smelters, white pines were stunted and dying.

These early studies dealt primarily with sulphur dioxide emissions. Not until the late 1960s did the focus expand to include metal contamination and acidification of the soils. At that time, studies by local foresters and ecologists showed that soil acidity and concentrations of copper and nickel were elevated in the same areas where sulphur dioxide damage had been measured.

Early photographs of the Copper Cliff, Coniston and Falconbridge smelters show large areas of damaged vegetation. By 1970, nearly 20,000 hectares of land around the smelters was barren, and more than 80,000 hectares surrounding were semi-barren (Gunn, 1995).

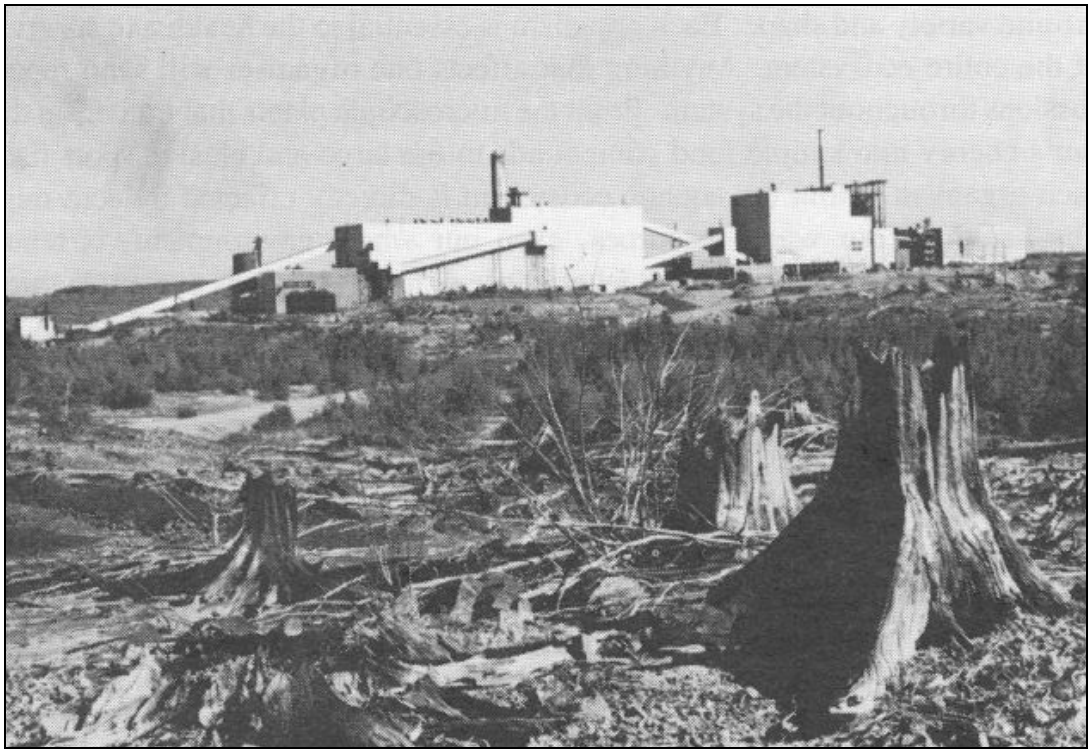


Figure 2-26 Deforestation near the smelter facilities

2.16 Enter the Unions

The average workman employed in the mining industry is too well satisfied with his lot to be led astray by paid radicals fermenting disturbances. —Sudbury Star, April 27, 1935

Inco is just another four-letter word. This is demonstrated by the obscenities Canadian workers have to endure while governments in Ottawa and the provinces sit on their hands and allow Inco and others to continue their rape of our natural and human resources. —Dave Patterson, President, Local 6500, United Steelworkers of America, 1977 (Swift and The Development Education Centre, 1977).

In the 1930s, Sudbury was the least unionized city in Canada. Mine workers were amongst the highest paid in the country with an average yearly income of $1,391. (In contrast, women, whose yearly earnings stood at $484, were the lowest paid in the country.) Despite the attractive wages, the mine jobs were dangerous, with high injury and death rates. These conditions provided both the incentive to organize collectively and the reason why it did not happen quickly; 12-hour days, hazardous working conditions and frequent layoffs drained the motivation needed to build a union.

Like most companies in Canada, the mining companies did everything they could to prevent the unionization of the workforce. They enlisted the assistance of the government, the legal system and the media to deter their workers from organizing.

The companies also applied more direct intimidation tactics. Union publications were banned, and any worker belonging to a union or even heard discussing union issues was fired on the spot. “Goons” were hired as well as spies from the famous Pinkerton Agency to keep organizers from infiltrating the ranks. When the International Union of Mine, Mill and Smelter Workers brought their meetings into the open in 1942, their new office was sacked in broad daylight by “a dozen goons”, who also seriously beat two union workers (Wallace and Thomson, 1993). This vigorous suppression of unions created an atmosphere of suspicion and mistrust, severely dividing the community between bosses and workers. The bitterness hardened over the following years, gaining Sudbury unionists the reputation of being among the most militant in Canada.

The prosperous war years created a national climate more open to unions. Despite enormous hostility, the International Union of Mine, Mill and Smelter Workers moved towards certification at both Inco and Falconbridge, and Local 598 was chartered on April 21, 1942. To counter, Inco immediately created its own union, the United Copper Nickel Workers Union. It was quickly dubbed the "Nickel Rash" by Mine Mill supporters, who outnumbered the Nickel Rash 6913 to 1187 in the December 1943 certification vote. At Falconbridge, close to 80% of workers voted in favour of Mine Mill. With Mine Mill as the recognized bargaining unit, the first contracts were signed in 1944. In the years that followed, Mine Mill

won a number of victories for its members, including higher wages, improved working hours, medical benefits, and paid vacations.

2.16.1 Raids by the Steelworkers

Although Mine Mill had considerable success for its members, the organization was plagued by ongoing internal leadership struggles. The other major factor weakening Mine Mill was the Cold War. Although union leaders swear communism played no part in Mine Mill, Sudbury was seen as a hot bed for communist sentiment. The American anti-communist witch-hunt extended its long arm to Sudbury, and in 1950 the American Congress of International Organizations (CIO) expelled Mine Mill because of alleged communist ties. The Canadian Labour Congress (CLC) had already done the same in 1948, citing bad unionism and raiding.

Without the support of the CLC, Mine Mill lost the strength of its bargaining power. A 1958 strike led by Local 598 over contract disputes and layoffs was unsuccessful. Bowed by Inco's use of accumulated reserves and mass layoffs, the union was forced to accept a humiliating contract. With this strike, the pattern was set for labour unrest at the end of each three-year contract. To this day, strikes are a common part of life for mining employees.

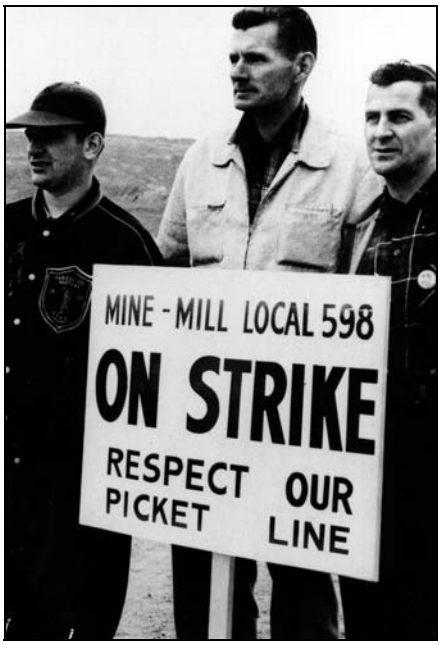


Figure 2-27 Striking Mine Mill workers

With its expulsion from the CLC, the much weakened, internally divided Mine Mill was vulnerable to raids by CLC affiliates. The CLC granted rights for Mine Mill territory to the United Steelworkers of America (USWA), which attempted its first raid, unsuccessfully, in 1950. After another failed raid in 1955, the USWA regrouped for a full-on attack. In September 1961, a mass rally turned ugly, forcing police to use tear gas to break up the crowd. Inco took advantage of the strife by refusing to bargain with Local 598. In 1962, an extremely close vote saw the USWA inch ahead of Mine Mill by 36 ballots. After much contestation of the results, the USWA was certified as the new bargaining agent at Inco, and remains so to this day. Mine Mill Local 598 continued to represent Falconbridge workers, and in 1993, merged with the Canadian Auto Workers to become Mine Mill Local 598/CAW.

2.17 Mining in the 50s and 60s

2.17.1 Growth, Prosperity and Unbridled Optimism

The 50s and 60s were brimming with prosperity and optimism. Both Falconbridge and Inco were continually expanding their operations and increasing production as America stockpiled for the Korean and Cold Wars.

Under Inco's new president, Henry Wingate, mines went deeper than ever, with underground development taking over from open pits. In 1956 the new Copper Cliff stack extended 194 metres skyward, becoming the world's tallest smelter chimney. The introduction of oxygen flash-smelting of copper concentrates in 1952 led to the large-scale production of liquid sulphur dioxide by Canadian Industries Ltd. (an Inco subsidiary) (Wallace and Thomson, 1993).

The new flash furnace technology reduced both the amount of sulphur dioxide released into the atmosphere and the fossil fuel consumption of the smelting process. Existing technology captured the high sulphur dioxide strength off-gas as marketable products like liquid sulphur dioxide and sulphuric acid. The sulphur dioxide captured in this way would otherwise have been released to the atmosphere.

Another major development was Inco’s iron ore recovery plant, constructed in 1956. This new plant diverted 1 million tons of high-grade iron ore into industry instead of discarding it as slag. In 1957, a 400-tons-per-day sulphuric acid plant was completed at Copper Cliff. The cleaner gas it used allowed production of high quality clear sulphuric acid, which was easily sold to lead acid battery makers, detergent manufacturers, and pulp and paper processes. Into the 1960s, the expansions continued at both Inco and Falconbridge. New mines were opened, and construction began on a new $85 million nickel refinery in 1969 at Copper Cliff (Wallace and Thomson, 1993).

2.17.2 Global Expansion and Waning Dominance

In 1950, Inco held a monopoly of the "free world's" nickel, with 95% of the world supply originating in Sudbury mines. To encourage competition and break up monopolies seen as feeding communism, the U.S. decided to reduce its nearly total dependence on Inco. In 1953, Falconbridge agreed to supply 100 million pounds of nickel to the Americans. By 1958, Falconbridge was producing 55 million pounds of nickel a year. Analysts view this contract as the securing of Falconbridge's future (Stephenson, 1979).

The demand for nickel rose dramatically once again with the manufacture of stainless steel home appliances, kitchen sinks, and with the entry of the U.S. into Vietnam in 1965. The increased global demand sparked the emergence of competing producers. International competition coupled with local production shortfalls eroded Sudbury's share of the nickel market to 66% by 1968 (Wallace and Thomson, 1993).

By the mid 1960s, both Inco and Falconbridge were expanding their interests abroad, with Falconbridge leading the way. The multinational had emerged as a new way of organizing the nickel industry, and both companies became components of huge conglomerates of banking, steel and oil interests. Major banks provided the support behind exploration and development of Third World laterite ores in Indonesia, New Caledonia and Australia (Stephenson, 1979). These new developments were touted as the way of the future for the nickel industry.

2.18 Meanwhile, back in town…1950s and 60s: Sudbury's Rising Star

Improvements in communication and transportation systems solidified Sudbury's importance as a regional hub. In 1952, Highway 69 between Parry Sound and Sudbury opened; TransCanada Airlines began regular flights to Sudbury in 1954. In 1953, CKSO-TV became Canada's first privately owned commercial TV station. There were now three radio stations, including a French station.

With the building of significant new hospital facilities, Sudbury became the region's medical centre. Laurentian University, established in 1960, made the city the centre for post-secondary education in northeast Ontario.

Bit by bit, poorly built structures were replaced by new ones in a city that was acquiring the trappings of a major urban centre. Chain stores—Canadian Tire and Zellers—arrived in 1953 and 1958 respectively. The New Sudbury Shopping Centre was constructed in 1957, drawing shoppers to the suburbs.

The suburbs were expanding in a spate of indiscriminate urban sprawl exacerbated by the overcrowded conditions. Agricultural land in the Blezard Valley was turned increasingly to residential use as

unprofitable milk and potato production led many farmers to sell out to developers. The city could not keep up with the demands of its swelling population. By the 1970s the province had stepped in to impose a regional planning strategy for the city.

Planning and development proceeded with considerable order in Inco and Falconbridge company towns. The Levack town site was expanded; construction began at Lively in 1950, which was incorporated in 1953 with a population of 3,000, a number typical for company towns across the region.

2.18.1 Growing Pains

To cope with the massive financial pressures of urban expansion, the city tried to annex all of McKim Township. This move was designed to gain the benefits of government grants to the mining industries, on which Sudbury had been missing out because no mines fell within its tiny 4.5 square mile official limit. It was also hoped to increase population size and thus the tax base necessary to expand services. In 1960, the Ontario Municipal Board (OMB) agreed to the annexation, with one major caveat: the mining towns of Copper Cliff, Coniston, Creighton, Snider, Falconbridge, Waters, Broder and Dill were excluded from the deal. The mining companies had kicked up a fuss over the tax consequences of annexation, and, true to government history, the OMB sided with the companies over the wishes of the city. Not until 1973 did Copper Cliff become a ward of the city.

After the annexation, Sudbury found itself with a much-expanded area needing to be serviced, with almost no additional funds coming in. Hospitals, schools, churches, colleges and the university all faced revenue shortages as the city struggled with an exponentially expanding debt load.

By the end of the 1960s, the Ontario government decided that, although mining was still the lifeblood of the region, Sudbury should follow a new course. Although mining was still the largest employer with 41% of men working in the industry in 1966, new avenues of opportunity were opening. Sudbury's growing role as a regional centre created jobs in public administration, teaching, health care, trades and services. In 1959, the city had authorized an ambitious urban renewal plan, which was approved in 1966. The overhaul of the downtown became the largest public undertaking in the city's history.

2.19 Environmental Consciousness Awakens

With the birth of the environmental movement in the 1960s, major sources of industrial pollution came under increasing public scrutiny. Although the dangers present in smelter emissions had been a concern to the community since the days of the early roast yards, only in the 1960s did local, national and global concern reach the critical mass necessary to bring about change.

In 1967, the Ontario legislature passed the Air Pollution Act, and announced a schedule for reducing Inco's emissions. That same year, Inco's annual report included a section called "Pollution Control" for the first time (Swift, 1977). In 1968, the province created the Environmental Health Studies and Services Branch of the Department of Health. The first site selected to study the effects of long-term exposure of plants to SO_2 levels was Sudbury, with results being shared with the international scientific community. However, the problem of poor local air quality was about to change dramatically.

In 1972, three major factors led to a dramatic improvement in air quality: first, the construction of Inco's famous 381 metre "superstack"; second, the closure of the Coniston smelter; and third, the closure of Falconbridge's pyrrhotite (iron ore sintering) plant. Ground-level concentrations of sulphur dioxide dropped by 50% immediately, and Sudbury began to register lower pollution rates than Hamilton or Toronto (Wallace and Thomson, 1993). Closing the pyrrhotite plant allowed Falconbridge to reduce its sulphur dioxide emissions by about 50% (Gunn, 1995). When Falconbridge constructed its new $85 million smelter in 1978, pollution levels continued to decline. The reduction was largely due to a new acid plant that diverted significant quantities of sulphur dioxide to marketable sulphuric acid (Gunn, 1995). The antiquated Falconbridge smelter had to be replaced to meet the requirements of new environmental legislation and the Control Order mandating reduction targets over specified time frames.

GREEN THUMB

What Inco does by

DON YOUNG

This series has been concentrating on personal achievements in gardening, and on providing a source of basic knowledge so that the average home gardener can reap the maximum possible rewards from his efforts. Landscaping on a grand scale throughout the Nickel District is the job of Inco's agricultural department.

They are responsible for over 1,200 acres of grounds in various stages of landscape development. Inco's efforts are directed at using vegetation to improve the human environment in this district as much as possible, through a continuing program of land maintenance and development.

Work is divided into two broad categories: one being the landscaping of areas around Inco plants and townsites, and the other being the reclamation of barren areas under company jurisdiction in the Sudbury District. All areas designated as either landscaped or reclaimed must receive regular maintenance in the form of fertilizer and lime applications, cutting, cultivating, flower planting, etc, depending on the particular requirements of each location.

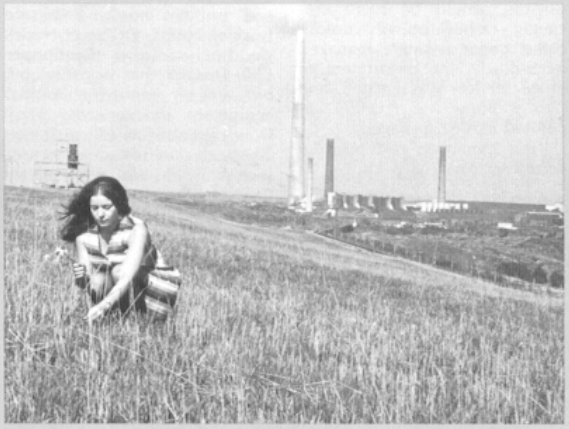
The program of land reclamation began very modestly back in 1917 when the old roast yards were filled in Copper Cliff. Over the years this area was graded, planted and maintained and now exists as the Copper Cliff Nickel Park. Work on this area continues even today in the form of a strong maintenance schedule to keep grass, flowers and trees growing. One of the biggest problems is keeping ahead of deliberate vandalism which lays waste many of the park's young trees each year and necessitates replanting where possible. Projects are underway now in the park to improve soil conditions and surface drainage of grassed areas so that they will be better able to support a top quality vegetative cover.

After 1917, work was continued, mainly in areas within Inco townsites, as efforts were made to revegetate open areas with plantings of grass and trees.

1956 was a major turning point, as continuing advancement in techniques and increasing concern for the environment focussed more attention on the vegetation, or lack of it, in certain areas.

Experiments to develop new procedures and to adapt existing methods to our peculiar needs began to show definite signs of success. With increased knowledge and funding, the agricultural department has begun a new era of land reclamation and environmental enhancement.

A young Red Pine, its roots firmly embedded in tailings, reaches above the grass.



The South Dam is no longer a source of blowing sand as it now greets the eye with acres of green grass.

The department's projects are many and varied. As well as regular maintenance of all reclaimed areas, it is involved in a continuing program of improvement to reclaimed and landscaped sites to bring them up to a high standard. Increased use of fertilizer and lime is showing a marked effect on the color and quality of grassed areas.

New projects are scheduled to fit in with existing maintenance and improvement programs, bearing in mind our short working season and the optimum climate conditions necessary to successfully establish growth.

Tailings farm born

Attempts to stabilize the tailings areas near Copper Cliff began in 1947 when test plots were initiated in the abandoned CD area. Perseverance and experimentation led to the formulation of a

8

INCO TRIANGL

Figure 2-28 Inco Triangle, 1972

successful planting program which has converted over 700 acres of tailings dustlands into fields of grass and legumes.

The yearly cycle of plant growth has created a buildup of organic matter in the older established areas forming a layering effect in the earth.

Seedling birch trees have been evident in the older areas for several years, and now many of these have reached a height of 10 feet and more, while thousands of others can be found in all sizes from seedlings to young trees.

The volunteer growth of trees led to experimentation in 1971 with the planting of forestry seedlings. The results were surprising even to Inco's agriculturists, as the seedlings took hold and growth equalled or surpassed growth of similar seedlings on native soil. The success of this program has resulted in an annual seedling planting program. Red Pine, Jack Pine and White Spruce will soon be found in groves on our formerly barren tailings dumps.

Our agricultural department is confident that within a few years we will have a soil environment better than the original layer which covered the area years ago.

Landscaping of Inco installations has become a major job, particularly because of recent expansion programs. Winter months are spent drawing up and revising practical and sound landscape plans for new buildings. The project is phased within the limitations of completion of heavy construction and the working season. Materials are ordered so that they will be available when required.

The agricultural department is always striving to achieve plans which are more people-orientated by examining such things as pedestrian circulation at any early stage in the planning sequence.

Projects currently under way include the landscaping of the nickel refinery, Creighton No. 9 Shaft, Copper Cliff South Mine, Levack West Mine and Shebandowan.

Maintenance of these areas is a critical consideration in the planning and development phases. All of our landscaped sites require constant maintenance.

Over 100 acres have been grassed in Coniston. This is beside Highway 17.

This machine is simultaneously seeding and rolling.

Coniston

The program of rehabilitating barren areas around Coniston is showing definite signs of progress, with over 100 acres now established in grass. Hundreds of trees are planted annually with the eventual goal of reforesting these areas to provide a maintenance-fre ground cover.

The technique for establishing grass in Coniston is similar to that used on most soil areas which Inco revegetates.

An average acre of ground requires the following preparation. Two months prior to seeding, the area is limed with five tons of agricultural limestone and disced. In early August, the area is again disced and fertilized with 600 pounds of 10-20-20 fertilizer. Sixty pounds of rye is broadcast on the ground which is then harrowed. A special seeder applies 60 pounds of grass seed and rolls it into the surface. The seed is a custom blend which has been developed by Inco for our conditions. In certain light soil or sandy areas, it has been necessary to apply a binding chemical to the soil surface after seeding to prevent erosion until the rye can germinate and protect the seedling grasses.

Landscaping of the new Garson Mine office was completed in 1971. Wire mesh was laid under the sod on the steep slopes to prevent slippage until the roots took hold.

Shrubs, flowers and grass enhance the Copper Cliff general engineering building's entrance.

AUGUST/SEPTEMBER 1972

Both Inco and Falconbridge had conducted experiments to restore vegetation to tailings and barren areas. Inco began its tailing reclamation research in the 1950s and Falconbridge began its own in the 1970s. The companies placed increased emphasis on the environment and began to hire specialists such as biologists and environmental engineers to address environmental issues. Inco formed its Environmental Department in the early 1970s, replacing the former Agriculture Department. Falconbridge also opened an environmental department in the early 1970s. For the first time, internal environmental-watchdog responsibilities shifted from the production personnel to a dedicated department whose sole purpose was to provide technical support and to guide the company in environmental matters.

2.19.1 The Government Response

Although the companies were complying with existing emission controls, the bottom line remained of paramount importance; the Coniston smelter was closed because it was obsolete, and the Falconbridge pyrrhotite plant was an uneconomic operation. When the companies complained that the emission reduction targets threatened profits and jobs, the government capitulated, allowing the companies more time to meet reduction targets.

The trend of government placing the interests of the mining industry ahead of environmental problems was highlighted by the widely publicized Happy Valley episode. Happy Valley was a tiny hamlet of 23 houses located less than a mile from Falconbridge's smelter. In 1972, air pollution readings recorded conditions unfit for human habitation (Swift, 1977). The provincial Energy and Resources minister decided it would be better to move the families than to interrupt production.

Happy Valley has become the first community to be wiped from the map of Canada to make way for continued air pollution. –Neil Stevens, Canadian Dimension, Nov. 1974

The extent of the pollution problem was brought into sharp focus by a secret 1974 federal government document titled "The Sudbury Pollution Problem: Socio-Economic Background", inadvertently made public in 1977. Using a U.S.-based formula, the report concluded that environmental damage would cost Sudbury "approximately $465,850,000 caused by emissions to human health, vegetation and property value in the Sudbury area on an annual basis" (emphasis in original). Although it is difficult to place a dollar value on health effects, and both the Ontario Ministry of the Environment (MOE) and the companies had invested considerable time, money and expertise into producing hundreds of reports investigating the environmental health of the area, this report brought the enormity of the problem to the public eye (Swift, 1977).

Government has been extremely lenient with Inco and Falconbridge. Historically there have been no prosecutions under applicable environmental legislation, and from 1924–1970, there was a curtailment of a citizen's right to sue for pollution damages, and there has been a lack of government-sponsored research on the damage caused by the copper-nickel smelters. —The Sudbury Pollution Problem, Environment Canada, 1974

Although the bottom line was naturally of primary importance to the mining companies, it was not the only factor slowing the wheels of change. Metallurgical processes generally take time and effort to change; time is needed to research and develop new technologies. Changing any facet of the process may have severe consequences to the functioning of a plant. These changes are always piloted first to ensure that the entire plant will not fail, and that metal recovery will not be reduced. To complete these process alterations effectively to comply with the control orders at the time, both Inco and Falconbridge asked the provincial government to grant leniency in legislation regarding emissions. Control Orders were issued to both Inco and Falconbridge to allow the companies to temporarily exceed the existing legislated sulphur dioxide ground level concentrations, provided that the companies demonstrated that they were working towards sulphur dioxide reduction targets within reasonable, specified timeframes.

Decreasing sulphur dioxide also resulted in decreased amounts of dust and metals being released from the stacks. Many efforts on the part of both companies, such as electrostatic precipitators, have also contributed to reduced metal emissions. Limits for sulphur dioxide and other air emissions from Inco and Falconbridge have been legislated since 1970 by the Ontario Environmental Protection Act, Regulation 346, Control Orders and Regulations (Gunn, 1995).

2.19.2 Acid Rain and Sulphur Dioxide

In the 1970s, another "new" environmental issue hit the headlines: acid rain. Although Inco's superstack had reduced the effects of emissions in the immediate area of the smelter, studies were showing that dispersion did not necessarily equal elimination; what goes up must come down. As lakes across North America showed damages from emissions produced in other provinces and even other countries, increasingly stringent controls came into effect. Inco performed their own studies after the superstack became operational. These studies indicated that long-range transport of soil, dust and suspended particulate did not increase.

Even after the improvements, Sudbury area smelters were still belching 1 million tons of emissions in 1980, making Inco the largest single point source of acid rain-producing emissions in North America (Gunn, 1995). In 1985, the Ontario government introduced the Countdown Acid Rain Program, a control strategy to meet the sulphur dioxide reduction objectives. The annual upper limit for the Sudbury region

was set at 365 kilotonnes of sulphur dioxide per year (Inco was allowed 265 kilotonnes and Falconbridge 100 kilotonnes), to be met by 1994. This level would be 14% of the 1960 emission record of 2,327 kilotonnes.

As a testament to the proactive approach taken by Falconbridge and Inco, both companies did better than meeting the 1994 target (Gunn, 1995). By researching and implementing several process changes Falconbridge was able to reduce their sulphur dioxide emissions to approximately two thirds of the allowed 1994 limit several years prior to the deadline. An additional $15–20 million was spent by Falconbridge to achieve these reductions.

Inco was also spending hundreds of millions of dollars to replace furnaces and improve processes, demonstrating that the companies were not simply reacting to meet a legislated target, but were going beyond what was required by the provincial government. The substantive decreases in SO_2 emissions from the two companies are illustrated in the accompanying graphs (Figure 2-29, 2-30) below:

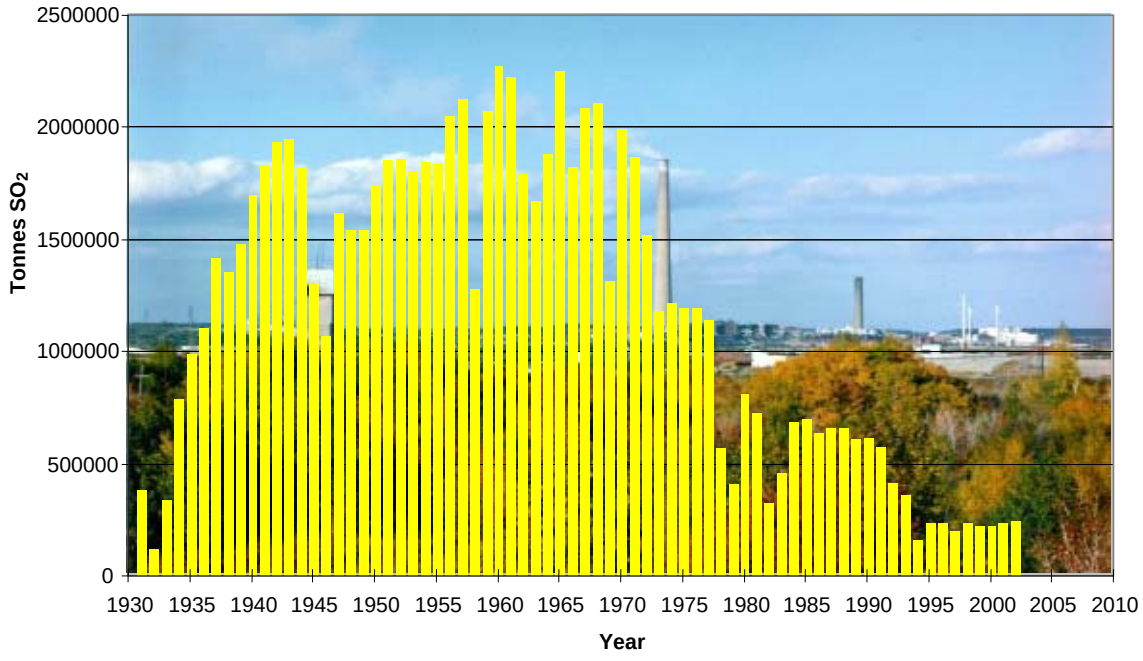


Figure 2-29 Inco Limited Sudbury Operations Sulphur Dioxide Emissions

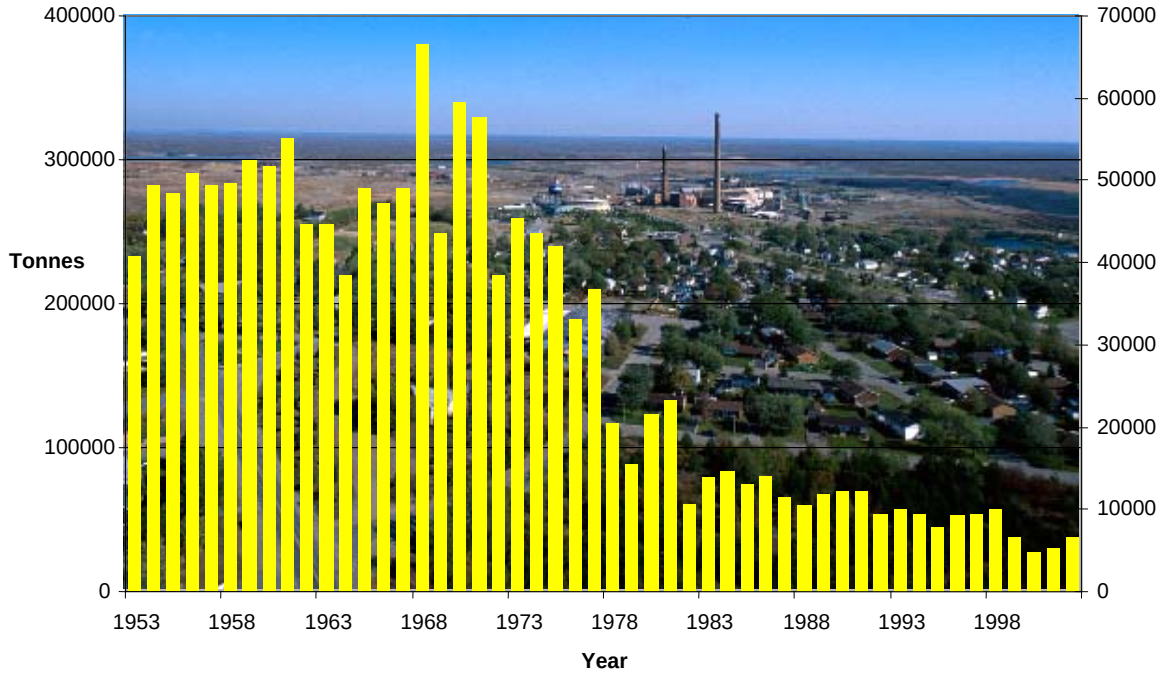


Figure 2-30 Falconbridge Limited Sudbury Operations Sulphur Dioxide Emissions

2.20 In the mining world...Bust

In 1971, Inco hit an all-time high of over 20,000 employees, and Falconbridge was employing approximately 4,000. However, the years of unbridled growth were coming to an end. By 1974, Inco had laid off 1,500 workers and closed the smelter for a month of repairs.

Two main factors precipitated the decline of the Canadian nickel industry in the 1970s: international competition in Third World laterite deposits and unstable markets. Competition from newcomers in a temporarily glutted market caused the Sudbury producers to lose control of the nickel market. New players in Third World laterite deposits were able to undersell Inco with a cheaper workforce and less costly extraction methods. The fact that many Third World countries had little or no environmental legislation also reduced the costs associated with mining. Sudbury ore bodies were also getting deeper with time after the easier surface ore bodies were depleted, and it was therefore becoming more costly to operate (for example, Falconbridge's Craig mine shaft cost ~$280 million to complete).

Both Falconbridge and Inco invested heavily in laterite sources as a survival strategy to remain in the nickel business. What the companies did not predict was that unrest and war in the Middle East would drive oil prices up, making the fuel-intensive laterite operations less competitive than anticipated. The competitiveness of the Sudbury ore body was also reduced because it was being developed by two companies, with considerable costly duplication of resources and infrastructure. By the mid-70s, Inco had lost its world monopoly.

The gravity of the situation led to round after round of massive layoffs, with 3,000 laid off in 1977 and a six-week halt in operations. The community was enraged. Sudbury area residents were deeply invested in the region and in the companies for whom they worked, and felt abandoned. The strike of 1978 was a turning point in labour and mining history. Although the strikers succeeded in saving 1,000 jobs and preventing further layoffs, a massive change in the mining industry was at hand. If Inco and Falconbridge were to remain competitive in world markets, they would have to radically streamline operations through mechanization and automation; the era of the blue-collar dominated workforce was ending.

The layoffs and cutbacks by Inco and Falconbridge have made a mockery of these companies' protestations of commitment to the region. Even if their concern for Sudbury were authentic, they no longer have the power to re-establish their dominance in the world scene. The conclusion we must reach is that the future of the nickel industry lies in the Third World.
—A Guide to the Golden Age, 1979

2.20.1 Meanwhile, back in town…1970s–80s Gloom

Strike-ridden Sudbury—the bitter lesson: In 1980 Sudbury's gears are in reverse...The city is staggering and being rendered sterile...this is a falling and failing city.
—Edmonton Journal, September 19, 1980

The wild optimism and prosperity of the post-war decades turned to gloom in the 70s and 80s, as nickel prices fell and Inco lost its dominance in the world market. In 1971, 50% of the workforce was tied, directly or indirectly, to mining. By 1981, after a decade of layoffs, strikes and cutbacks, Inco and Falconbridge had reduced their combined workforce by 10,000. The vacancy rates in the once over-crowded city rose with unemployment. “Like all mining towns”, the Sudbury Star commented in August of 1973, “Sudbury's housing market rises and falls according to the length of the lines at the mines' employment offices”. By the end of 1973 the vacancy rate stood at 10%.

The Inco strike of 1978–79 marked the beginning of the end of labour-intensive heavy industry. New market realities were forcing companies worldwide to streamline, automate, mechanize and computerize operations to survive.

Sudbury, too, would have to adapt to survive. As the nickel industry workforce diminished, the city could well have shrunk to a fraction of its size, as has been the fate of many other resource-based communities, such as Cobalt. But even as the mining industry was in decline, the city was beginning, slowly, to live by other means. From 1971 to 1981, the number of federal government employees nearly quadrupled. There was an increase in small business, and an expansion in the communications industry. Growth in education and medicine were significant in refocusing the workforce.

However, although the workforce diversified, Sudbury remained dependent on outside trends for its survival. The dependence was now dual: mining and government programs supported the city. Decentralization at the upper levels of government led to the strategic relocation of ministries such as the Ministry of Northern Development and Mines and centres like the Taxation Data Centre to the economically struggling city. The opinion grew that government—provincial and federal—should provide the funds, strategy and enforcement required to stimulate the economy. By the late 1970s, even the Liberals and Conservatives were squabbling over who could win more of the patronage pie for the district.

The population decline continued into the 1980s, as did the general gloom of a city that had lost its historical life support. A 1982 strike at Inco precipitated a shutdown that lasted over nine long months. Falconbridge also suspended operations. Twenty-six percent of the Sudbury workforce was unemployed, and the soup kitchens had returned. From a peak of 169,580 in 1971, the population of the Sudbury District had declined to 152,470 by 1986. At this darkest of times, no one would have predicted that, by 1990, Sudbury was to be considered one of the best places in Canada to live.

2.21 The Miraculous Regreening

The regreening of Sudbury has been the most remarkable achievement in the history of the region. This program is described in greater detail in Chapter 4 but is mentioned here as it represents an integral part of Sudbury's history. The task was mammoth in scope: in 1970, nearly 20,000 hectares of land were barren and another over 80,000 hectares were semi-barren, with some hardy grass clumps, stunted birch and red maple clinging to severely eroded slopes and hilltops (Gunn, 1995). Much of the remaining soil was acidic and metal-contaminated, preventing anything from growing. Erosion was also a problem, as

the trees died or were cut, resulting in a huge loss of organic material, and exposing the underlying metals in the soil to rain, resulting in runoff to local water bodies. With the infusion of tremendous amounts of work, time, and money—over $23 million to date by the City's Land Reclamation Program alone—this infamously labelled "moonscape" was transformed.

Figure 2-31 Regreening is apparent in Copper Cliff, 2003

In 1974, the Regional Municipality (now the City of Greater Sudbury) created the Vegetation Enhancement Technical Advisory Committee (VETAC) composed of representatives of government, industry, academia and the public to provide technical expertise and give direction to the regreening effort. After test sites showed promising results, the full-scale reclamation program began in 1978. A summer student employment program funded by the government and mining companies provided the hands needed to cover the vast areas under treatment. This was unfortunately viewed as a make-work project, in response to the numerous lay-offs at the time.

The plan was to lime (neutralize) and fertilize the acidic soils and barren rocky outcroppings, seed with a grass legume cover, and then introduce shrub and tree species.

Between 1978 and 2005, nearly 3,400 hectares, or 20% of the barren land, were limed, fertilized and seeded under the City's Land Reclamation Program. During the same period, nearly 8.5 million trees were planted on sites previously seeded with grass. Between 1978 and 2005, more than 4,400 temporary

employment positions were created by the municipality's land reclamation program (City of Greater Sudbury, 2005). For many years prior, the mining companies have pursued their own regreening initiatives, working to cover tailings areas with vegetation and to rehabilitate the lands surrounding their operations. In 1994, Inco celebrated the planting of the one-millionth seedling grown in its underground nursery at Creighton Mine. The regreening programs are discussed in further detail in Chapter 4.

Sudbury's regreening efforts have been recognized by many awards, including a 1992 United Nations Local Government Honours Award at the Earth Summit in Rio de Janeiro. These awards are listed below.

Environmental Awards Related to Sudbury Regreening Initiatives

Date	Award
1984	Noranda Land Reclamation Award (to Tom Peters, Inco Ltd., by Canadian Land Reclamation Association)
1986	Community Improvement Award (Ontario Horticultural Society)
1989	Appreciation for Hosting the 25th OSTC Annual Meeting (Ontario Shade Tree Council)
1990	Arboricultural Award of Merit (International Society of Arboriculture Ontario Inc.)
1990	Lieutenant Governor's Conservation Award (Conservation Council of Ontario)
1991	Noranda Land Reclamation Award (to Keith Winterhalder, Laurentian U., by Canadian Land Reclamation Association)
1992	The United States 1992 Chevron Conservation Award
1992	Noranda Land Reclamation Award (to Robert Michelutti, Falconbridge Ltd., by Canadian Land Reclamation Association)
1992	United Nations Local Government Honours Award
1994	Dr. Edward M. Watkin Award (to Biology Dept., Laurentian U., by Canadian Land Reclamation Association)
1995	Noranda Land Reclamation Award (to Peter Beckett, Laurentian U., by Canadian Land Reclamation Association)
1995	Model Project Award (The Society for Ecological Restoration)
1997	Community Achievement, Elaine Burke Memorial Award (Active Living)
2001	Finalist Award Certificate for Bremen Partnership Award in the area of Global Responsibilities Through Local Action (Mayor of Bremen, Germany)
2002	Pioneer in Reclamation Award (to Tom Peters, Inco Ltd., by the American Society of Mining and Reclamation)
2002	Peggy Thompson Publication Award (to Nicola Ross by the Alberta Society of Professional Biologists – for "Healing the Landscape"
2003	Dr. Edward M. Watkin Award (to William Lautenbach, City of Greater Sudbury, by the Canadian Land Reclamation Association)
2003	Certificate of Recognition for 25 years of enhancing and sustaining a healthy environment for residents of the City of Greater Sudbury through the restoration and protection of our land and water (Sudbury 2003 Mining and the Environment Committee)
2004	Community Builders Award, Environment Category (to Peter Beckett, Laurentian U., by the Northern Life newspaper, Sudbury)

2.22 "Sudbury's Sunny Renaissance"

—Peter Newman, Maclean's, April 1, 1991

Even at the darkest moments of the early 1980s, seeds of a brighter future were being planted. Creative political and planning leadership, combined with financial assistance from senior levels of government, developed a new vision for Sudbury.

An important impetus behind this new vision was Sudbury 2001, formed in 1978. Supported by provincial funding and local groups, this innovative organization introduced a venture-capital program to support small business and diversify the economy. Over its 11-year existence, Sudbury 2001 helped bring the community together in tackling the issue of self-sustainability.

Through the 1980s and 1990s, the city fought hard to improve its public image. Government, industry, academics and students all pitched in to transform both the urban and natural landscape. The urban renewal project initiated in the 1970s came to fruition as the downtown core was given a face lift. Many new public buildings were constructed, and the massive regreening effort began to reverse a century of environmental degradation. The mining companies began to make unprecedented contributions to the community, funding high-visibility projects like Science North. Opened in 1984, the $35 million educational marvel was created through the combined funds of Inco, Falconbridge, and all levels of government.

Figure 2-32 Science North (photo credit Chris Meyer)

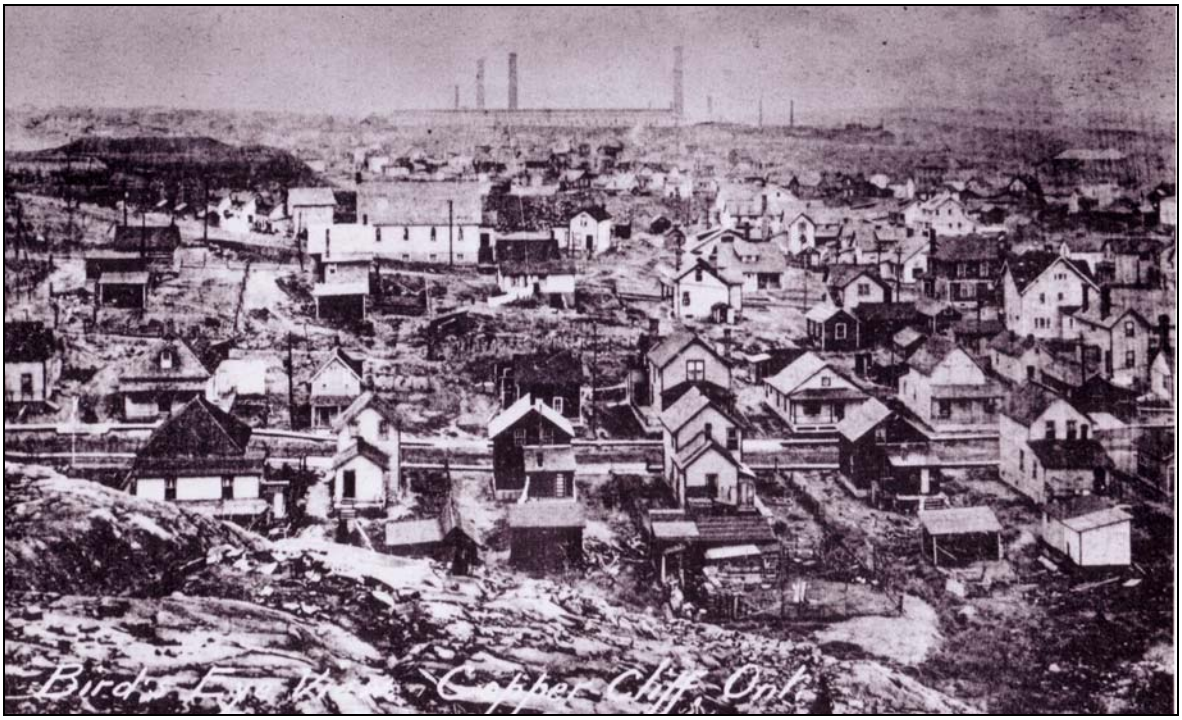


Figure 2-33 Copper Cliff, early 1900s

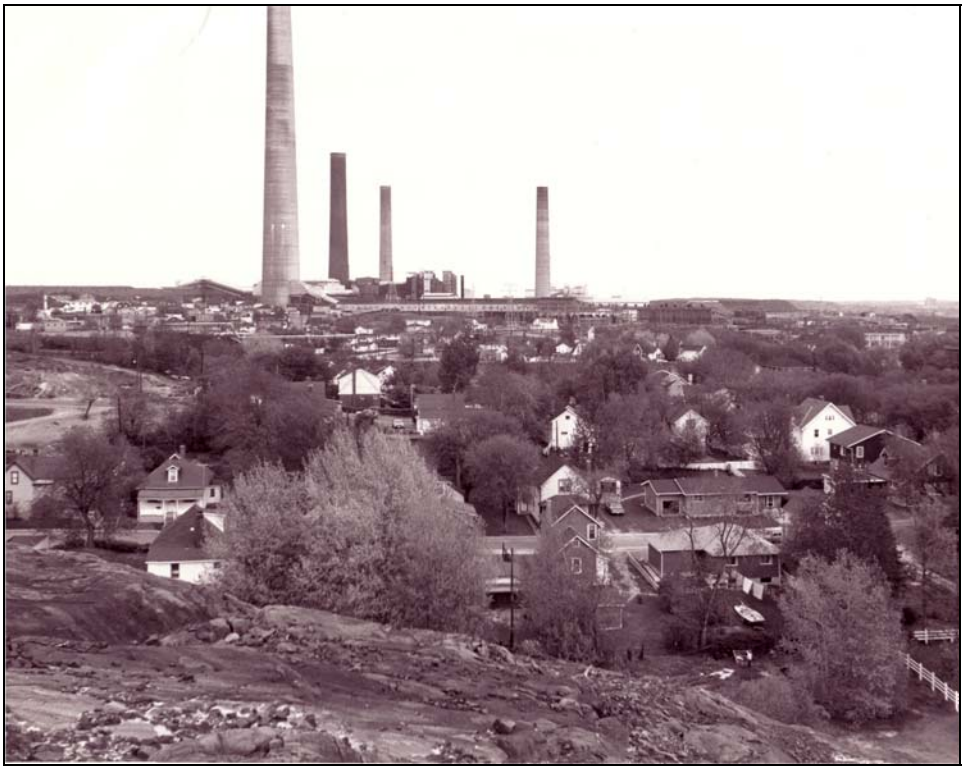


Figure 2-34 Copper Cliff, early 1980s

When Inco reopened after its lengthy shutdown in 1983, it emerged equipped with a strategy to regain its position amongst the top nickel producers of the world. By 1989, it shed a profit of $753.4 million (U.S.), surpassing all previous years. Falconbridge posted profits of $357 million. In 1990, Inco contributed $925 million to the local economy in wages, services, and mine and plant development. Although the mining industry was still the largest employer, the combined workforce of Inco and Falconbridge made up only 16.3% of employment in the district.

The struggles of the previous two decades made it abundantly clear that weaning Sudbury off its mineral dependence remained essential. However, in recent years, the city has taken a new slant to the mining-related sector by developing itself as a world-class technological centre for mining. Mike Castron, President of the Sudbury Mining Supply and Services Association (SAMSSA) has said "For the first time in Sudbury's 120 year history as a mining community, it is now clear that more people are employed in the Northeastern Ontario mining supply and service sector than in primary mining, smelting and refining." "Our analysis indicates that 17,300 people are directly employed in the mining supply and service industries in Sudbury and North Bay, compared with fewer than 10,000 now working in the extraction, smelting and refining sectors", Dick DeStefano, Executive Director of SAMSSA stated. "Our conservative estimate of the annual payroll in our sector is upwards of $1 billion."

Capitalizing on its new stature as a city that takes a pro-active approach to improving the environment, Sudbury is also working to bill itself as a centre for "green" industry. Among the options under consideration are a bio-diesel production plant and an innovative tire recycling facility.

2.22.1 Metals in Sudbury Soil

Not until the late 1960s did environmental concerns expand to include metal levels and acidification of the soils. Into the 1970s, studies by local foresters and ecologists showed that soil acidity and concentrations of copper and nickel were elevated in many of the same areas where sulphur dioxide damage had been observed. Researchers reported that it was the acidity of the soil combined with metals that created an environment toxic to plant growth.

Public and regulatory interest in contaminated soils has greatly increased in the past decade. With the publication and subsequent revision of the MOE's *Guideline for Use at Contaminated Sites in Ontario* in 1997, regulators and industry had a clear set of criteria with which to compare monitoring data. In September 2001, the MOE released a summary report of approximately 30 years of soil metals data collected in the City of Greater Sudbury entitled *Metals in Soil and Vegetation in the Sudbury Area – Survey of 2000* and additional historic data. That report concluded that the concentrations of nickel,

copper, cobalt and arsenic are elevated in the three historic smelting centres of Copper Cliff, Coniston and Falconbridge. That report is the basis for identifying the Chemicals of Concern (COCs) and Communities of Interest for the Sudbury Soils Study.

Among other things, the MOE report recommended that additional sampling be conducted to better determine the extent and magnitude of metal and arsenic concentrations in soils in the City of Greater Sudbury. The additional sampling was conducted during the summer and fall of 2001 by Inco Ltd., Falconbridge Ltd., and the MOE. A random stratified grid system was developed to choose the appropriate number and location of soil sampling sites for meaningful statistical interpretation of results. In addition, sensitive sites such as residences, playgrounds, parks and daycare centres were sampled extensively. Approximately 8,000 samples were collected in 2001 (See chapter 7).

Information collected in the 2001 survey forms the basis of information for the Sudbury Soils Study, and is being used in the detailed human health and ecological risk assessments.

2.23 Living Sudbury: 2001, Today and Beyond

On January 1, 2001, the Regional Municipality of Sudbury joined seven local municipalities to form the City of Greater Sudbury. The new city covers 3,627 square kilometres. The population of 164,059 is decidedly multicultural, with the third largest francophone population in Canada, outside of Quebec. With the bell-weather vacancy rate dropping to 3.6% in 2003 from 11.1% in 1999, an increase in residential and commercial building, and a plethora of exciting initiatives underway, once again there is optimism, growth and pride in Ontario's largest city north of Toronto.

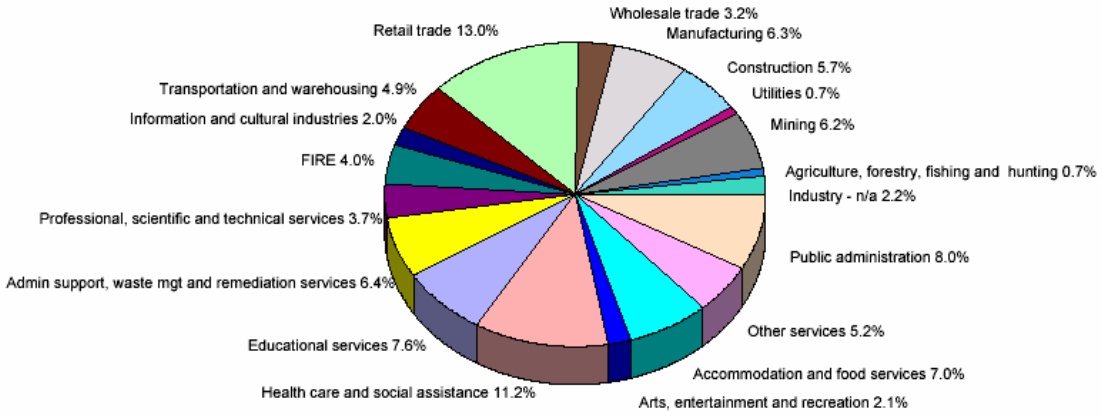


Figure 2-35 Labour Force Division by Industry, 2001.

Source: City of Greater Sudbury, 2004.

Although the percentage of direct mining employment has fallen to a mere 6% of the Sudbury workforce, Inco and Falconbridge still play a key role in the economic life of the area. Inco continues to push the boundaries of mining possibilities at Creighton Deep, the world's deepest nickel mine. By 2019, the mine is scheduled to hit 8,180 feet—deep enough, according to the company, "to bury Toronto's CN Tower 4.5 times to bottom". As of December 31, 2002, Noranda became the owner of 59.5% of Falconbridge, Ltd. In October, 2005, Inco launched a friendly $12.5 billion takeover bid for Falconbridge Limited that will create the world's largest nickel producer. The eyes of the mining community are watching the evolution of this giant.

Amongst the recent Sudbury area initiatives of note are MIRARCO, the Sudbury Neutrino Observatory, the Northern Medical School, Dynamic Earth, the Northern Centre for Advanced Technology (NORCAT), Collège Boréal and Earthcare Sudbury. Sudbury has also become the oncology and medical centre for northern Ontario with the recent construction of the new Laurentian Hospital, an amalgamated medical facility.

The Mining Innovation, Rehabilitation and Applied Research Corporation (MIRARCO) is doing miraculous things in the field of mining technology. An applied research and service company, MIRARCO was formed in 1998 to help small and medium sized enterprises as well as mining companies to integrate cutting edge technologies into their mining operations. Another exciting player in mining technology is the non-profit NORCAT corporation. "NORCAT is a multiple success story in applied

innovation. Not only has it developed a new robotics mining technology which will allow for safer operations underground but it has gone further to pioneer a drilling platform for Mars exploration", praised then Minister of Industry Allan Rock in 2002. "NORCAT is a model for all of Canada on how to find new markets and commercialize quickly the results of research and development."

The Sudbury Neutrino Observatory, located 6800 feet under ground in Inco's Creighton mine, provides rare insight into the properties of neutrinos and the core of the sun, and to confirm theories of the origin of the universe with respect to dark matter.

The Northern Medical School, announced in May of 2001 and scheduled to open in the fall of 2005 with campuses in Sudbury and Thunder Bay, will aid in recruiting and retaining health care professionals in the North. Collège Boréal, a French-language community college with six satellite campuses across northern Ontario, uses state-of-the-art multimedia communications technology to provide numerous courses and post-secondary programs to students across north eastern Ontario. It offers the highest level of distance education activities in Canada.

Dynamic Earth, a $14 million tourist attraction focused on earth sciences, opened in 2003.

On the environmental front, Sudbury is moving forward with its formidable regreening efforts. In 2000, a unique new partnership between the City of Greater Sudbury, 37 community agencies, organizations and businesses formed to place a continued focus on "enhancing (Sudbury's) environment, ensuring economic viability, and reducing greenhouse gas emissions to improve the quality of life in our community". The organization is called Earthcare Sudbury.

The mining companies also continue to spend millions of dollars on emission reduction strategies, as well as on industrial land clean-up efforts. Continued concern about the environmental legacy of smelting has sparked the commissioning of the Sudbury Soils Study. Inco and Falconbridge are voluntarily financing the multi-year, multi-faceted study that began in 2001. The citizens of Sudbury are following the progress of the study, which will determine if there are ecological and human health risks posed by elevated metal levels in the soil.

2.24 Conclusion

Sudbury has come a very long way from the days of open sewers and roast yards. The citizens of Sudbury can take pride in their stabilized economy, greening hills and clean air. However, just below this exciting new reality lies the legacy of mining and smelting, a legacy that cannot be ignored. Without the mining industry, Sudbury would never have developed into the centre it is today. Mining not only developed the

basin but added much to the wealth of the province and of the country. Several years ago, Sudbury was named by *Chatelaine* magazine as one of the top 10 Canadian cities in which to live (*Chatelaine* magazine, September 1995). The ongoing environmental effects of the mining history will continue to be studied and addressed so that Sudbury can move confidently into a bright future.

2.25 Epilogue

The economic face of mining in Sudbury has continued to change even since the beginning of the Sudbury Soils Study. Worldwide demand for nickel and copper, particularly in emerging markets such as India and China, drove the price of these two commodities to unprecedented levels in 2005 – 2007. This, combined with a growing trend toward globalization of major industries around the world, made both Inco and Falconbridge ripe for takeover by larger companies. The companies attempted a merger during 2005 – 06, but this was delayed due to lengthy reviews by various anti-competition tribunals. Eventually, Falconbridge Ltd. was acquired by the publicly traded Xstrata Corporation based in Zug and London. The former Falconbridge operations became Xstrata Nickel. In summer 2006, the majority of shares of Inco Ltd. were acquired by the privately owned CVRD mining company of Brazil to form CVRD Inco. Late in 2007 the company name was formally changed to Vale Inco. Time will tell how foreign ownership of these two cornerstones of Sudbury will influence the community in the future

2.26 References

Boldt, J.R. Jr. 1967. The Winning of Nickel. Toronto: D. Van Nostrand Company, Inc.

Bray, M., and Thomson, A., eds. 1992. At the End of the Shift: Mines and Single-Industry Towns in Northern Ontario. Toronto: Dundurn Press Limited.

Bell, B. 2004. Retired Superintendent of Environment, Inco Ontario Division. Personal Communication.

Chatelaine magazine, 1995. Canada's 10 best cities. September, 1995.

City of Greater Sudbury. 2003a. Key Facts: Labour and Employment. Available: http://www.city.greatersudbury.on.ca/content/keyfacts/documents/Labour%5FIndDivChart%5FFeb03%2Epdf.

City of Greater Sudbury. 2003b. Land Reclamation Program 2003 Annual Report. Sudbury: Economic Development and Planning Services.

City of Greater Sudbury. 2005. Annual Report – 2005. Land Reclamation Program, Environmental Planning Initiatives. Available on-line at:

http://www.city.greatersudbury.on.ca/content/div_landreclamation/documents/Annual%20Report%202005.pdf

Cranstone, D.A. 2002. A History of Mining and Mineral Exploration in Canada and Outlook for the Future. Ottawa: Natural Resources Canada.

Dietz, R. 1964. Sudbury structure: an astrobleme. Journal of Geology, v 72, p. 412–34.

Deverell, J., and the Latin American Working Group. 1975. Falconbridge: Portrait of a Canadian Mining Multinational. Toronto: James Lorimer & Company.

Gunn, J.M., ed. 1995. Restoration and Recovery of an Industrial Region. New York: Springer-Verlag.

Howard-White, F.B. 1963. Nickel: An Historical Review. Toronto: Longmans Canada Limited.

Inco Limited, Ontario Division. 2003. Emission Reduction Program Operations Manual. Revised December, 2003.

Kelly, K. 2004. Meteorite crash turned Earth inside out: New research paints a picture of what happened billions of years ago when a devastating meteorite crashed into the Earth. News@ U of T, June 3, 2004.

Laroche, C., Sirois, G., and McIlveen, W.D. 1979. Early Roasting and Smelting Operations in the Sudbury Area – An Historical Outline. Ontario Ministry of the Environment Experience '79 Program.

LeBourdais, D.M. 1953. Sudbury Basin: The Story of Nickel. Toronto: The Ryerson Press.

Main, O.W. 1955. The Canadian Nickel Industry: A study in Market Control and Public Policy. Toronto: University of Toronto Press.

McCall, J., Gunn, J., and Struik, H. 1995. Photo interpretive study of recovery of damaged lands near the metal smelters of Sudbury, Canada. Water, Air, & Soil Pollution 85(2):847–852.

McCharles, A. 1908. Bemocked of Destiny: The Actual Struggles and Experiences of a Canadian Pioneer, and the Recollections of a Lifetime. Toronto: W. Briggs.

Michelutti, B. 2004. Retired Superintendent of Environment, Falconbridge Limited, Sudbury Operations. Personal Communication.

Royal Ontario Nickel Commission. 1917. Report of the Royal Ontario Nickel Commission. Toronto: A.T. Wilgress.

SAMSSA, 2005. Ontario Mining Reaches Historic Tipping Point: SAMSSA Survey Suggests Major Shift in Mining Employment. Sudbury Mining Supply and Services Association Newsletter Special Edition, February 2005. Available: http://www.samssa.com/index.php?option=com_content&task=view&id=69&Itemid=64&lang=en

Smith, P. 1986. Harvest from the Rock. Toronto: Macmillan of Canada.

Stephenson, R. 1979. A Guide to the Golden Age: Mining in Sudbury, 1886–1977. Sudbury: Laurentian University.

Sudbury and District Historical Society, ed. 1986. Industrial Communities of the Sudbury Basin. Sudbury: Sudbury and District Historical Society.

Swift, J. and the Development Education Centre. 1977. The Big Nickel: Inco at home and abroad. Kitchener: Between the Lines.

Thompson, J.F. and Beasley, N. 1960. For the Years to Come: a Story of International Nickel of Canada. New York: Putnam.

Trott, R.P. 1987. The Story of Onaping Falls. Corporation of the Town of Onaping Falls.

Wallace, C.M, and Thomson, A., eds. 1993. Sudbury: Rail Town to Regional Capital. Toronto: Dundurn Press Limited.