

FALCONBRIDGE NIKKELVERK

1910-1929-2004

AN INTERNATIONAL COMPANY IN NORWAY

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FOREWORD

I was both flattered and full of enthusiasm when asked to write a book on the history of Falconbridge in Kristiansand, especially as I had spent my early childhood in the small mining town of Falconbridge in Canada, where my father worked as an engineer. The history of the nickel refinery in Kristiansand contains elements of drama, international politics and perhaps even more importantly: demonstrates how advanced industrial culture and competence was patiently built up.

Kristiansands Nikkelraffineringsverk was established in 1910. Today, the original plant no longer exists and the refining process has been reorganised so that the workers now have quite a different working day from their predecessors. In addition, major environmental problems have been solved and there has been a change in ownership. At first glance, it would seem that the past and the present are two completely different worlds. But if we take a closer look, the links are still quite visible. Decisions made in the initial years of the company plotted the course for the next 40 – 50 years and much of the building mass remains from the expansion period in the 1950s.

As author, I have had unrestricted access to the company's archives in Norway and Canada up till the 1970s. There is an excellent supply of information for the period between 1929-47, whereas this is in short supply for the period before 1920 and after 1960 in particular, as most of the material has been discarded. However, as regards the first period, information provided by a few key personnel that have written retrospective notes and the controversy in the newspapers and investigations in the wake of the scandals at the nickel works have compensated for this. For the latter period, I have received information from retired Falconbridge employees in Norway and Canada. In addition, I have also sourced material from the National Archives in Kristiansand, KEV's archive, the Labour Movement's archives, the National Archives of Norway and the National Library.

After two and a half years of work, the book has now been completed. During this time the book committee, comprising Arne Johan Finne, Ed Henriksen, Realf Høy-Petersen, Jørn Jacobsen, Terje Næss, Erling Stensholt and Hagbarth Aanensen as well as editor Jens Vetland and historians Ketil Gjølme Andersen and Knut Sogner, has been an important source of inspiration and friendly criticism. However, as author I am responsible both for assessments and all errors and discrepancies.

I would like to thank everyone at Falconbridge for the goodwill and generosity they have shown me. I am especially grateful to Jørn Jacobsen and Erling Stensholt. My father Knut Lyng Sandvik has given me good advice and technical insight. For more than two years my friends at the Department of History in Trondheim have patiently had to hear about nickel prices and refining methods and have given useful help in return. I would particularly like to thank Hans Otto Frøland, Ingar Kaldal, Kristian Steinnes and Lars Fredrik Øksendal. I have also learnt a lot from my good colleagues at the Norwegian School of Management about how corporate history can be interpreted and written.

As usual, Svein Henrik Pedersen has provided a wealth of both constructive and less constructive comments, has proofread and has compiled the index. Finally, I would like to thank my dear Margrethe - who would have thought that she would become an authority on nickel?

Trondheim, August 2003

Pål Thonstad Sandvik

My book on the Falconbridge nickel refinery was published in Norwegian in 2004. Falconbridge generously translated my manuscript to English. I proofread and edited the translation in 2005. However, the English text was never published. In early 2020, a former Falconbridge employee, Michael Sudbury, suggested that I should give the manuscript to Laurentian University. Rereading it during my summer holiday in 2020 I spotted a few new errors and inaccuracies. These have been corrected. Some arcane points have also been cut or clarified, but the rest of the manuscript has been left unchanged. In the sixteen years which have passed since the original book was published new historical scholarship has emerged. I will recommend readers who are interested to look at the work of Olav Arne Kleveland, Jonas Scherner, Knut Ola Naastad Strøm as well as my own work. This new research deals with the mines at Eyje, the world wars, the nickel market in the 1930s, the relationship between the Kristiansand subsidiary and the Canadian mother company and environmental development in Kristiansand from the 1970s onwards.

Trondheim, August 2020

Pål Thonstad Sandvik

On 14 June 1929 Canadian Falconbridge Ltd. took over an ailing nickel works in Kristiansand. But in spite of a turbulent past, the company is now proudly celebrating its 75th anniversary. The special occasion is a good opportunity to reflect over the history of the nickel works.

In all these years, the urban community, local hydroelectric power production, the company and the parent company have evolved together, in mutual dependence. This interaction has given Kristiansand the largest nickel refinery in the western world, which produces first class products from one of the most environmentally friendly plants in the industry.

I feel humble when I look back at the company's history and I am full of respect for former colleagues and for the way in which they tackled their challenges. Each era has had its heroes, but the path to success has always been paved with innovation and creativity.

Today, we produce nickel in a high-cost country, face global competition for raw materials and export all our production. Competence and technology are our competitive advantage in a world where changes take place at an even faster rate than before. In order to succeed, we must follow the same path and continue a harmonious interaction between employees, customers and society – locally and globally.

Through words and pictures, this anniversary book primarily describes the company's local development: technologically, financially, environmentally and socially. In addition, it illustrates the relationship with others, local industry and the parent company. I would like to thank the author, Pål Thonstad Sandvik at NTNU, for his excellent work. A special thank also goes to the book committee, who has shown great enthusiasm for the project. The committee has comprised historian Knut Sogner from the Norwegian School of Management BI, his colleague Ketil Gjølme Andersen from the University of Oslo, local historian and former editor of the Kristiansand newspaper Fædrelandsvennen, Jens Vetland, employee representatives Terje Næss and Arne Johan Finne, the company's own representative Erling Stensholt, and also co-ordinator and company representative Jørn Kjetil Jacobsen. A big thanks also goes to Hagbarth Ånensen, Realf Høy-Petersen and everyone else who have contributed.

Falconbridge Nikkelverk has become a global player. I would like to thank all former and present employees for their contributions to this book. They have helped give the company a sound future foundation.

Eric Edwards Henriksen
Managing Director
Falconbridge Nikkelverk AS

PART 1. PIONEERING, PROFIT AND PROTEST

In 1910, Kristiansands Nikkelraffineringsverk set up business in the buildings and orchard of the old estate at Kolsdalen. The company arose from the traditional Norwegian nickel industry and was based on the industry's established knowledge and used its raw material resources. At the same time, the refinery was more than just a continuation of something old. It was also a product of the new industrial capitalism in Norway at the time. A new generation of investors had appeared, of whom Sam Eyde is the most well known. These investors wanted to exploit Norway's raw materials, hydroelectric power and modern technology. A number of electrochemical companies were established, including Elkem, Norsk Hydro and Kristiansands Nikkelraffineringsverk.

The refinery used Victor Hybinette's newly developed nickel refining process. From a purely technological point of view, this process also represented a new industrial phase in Norway. In cutting edge technology, such as nickel refining and other electrochemical processes, it no longer sufficed to establish a business based on practical experience and technical know-how gradually acquired over time. Even if these elements remain important, laboratory trials and scientific insight were also required. We will take a closer look at the background of the Hybinette process, why it achieved its industrial breakthrough in Norway and the struggle to get it to function in practice.

From there we will take a step further. The refinery was a new kind of work place with different tasks, challenges and hazards than people were used to. The work was heavy, dusty and at times uncomfortably hot. Burns were a common everyday occurrence in the smelting plant and in the electrolysis area many workers suffered from serious nickel allergy. The acid damaged clothes and in the worst cases caused lesions.

However, production technology was only one of many elements that influenced the working environment in the refinery. Teamwork between the management, the workforce and the trade union, and of course, the owners' required rate of return, shaped the working day. At Kolsdalen the workers quickly joined the radical union "Arbeidsmandsforbundet". We will look at the complex relationship between people, finance and technology – as far as possible from the available source material.

From a purely technological point of view, Kristiansands Nikkelraffineringsverk (KNR) became a global leader in its field and therefore may be used as a reference point for the rest of Norwegian industrial development. In the historical literature Norway is often described as quite underdeveloped around 1900, a nation that prospered thanks to an

abundance of natural resources (hydroelectric power) and major foreign investments. In KNR, the technology at least was partly developed in Norway and the capital was purely Norwegian.

An international cartel dominated the nickel market and was linked to leading finance and industrial circles: Rothschild in France, Mond in England and Morgan in the US. It is surprising then that KNR managed to develop a leading refining technology. The path to the market was also far from straight. It is true that KNR was such a small market player that the cartel did not take any notice of the newcomer, but the level of tension soon rose and ultimately escalated into a full-scale price war.

KNR spearheaded the greatest foreign investment made in Norwegian industrial history. While foreign capitalists were the dominant owners in Norsk Hydro, Orkla, Sulitjelma and a number of other large companies, KNR aimed to go against the tide. We will follow the major nickel interest in Canada, which took a very dramatic turn for the worse. Profit potential was enormous due to the huge demand for nickel as an armament metal during the World War I. Rich Canadian nickel deposits were married with Norwegian refining know-how and together formed a new industrial giant.

In the end, however, everything went horribly wrong. The losses shook the foundations of Norwegian industry and commerce in general and Kristiansand in particular. Shareholders and creditors were up in arms in protest. The so-called “nickel affair” became a hot potato at the time and was the subject of several parliamentary debates. The question is *why* did things go so wrong – and *what* were the consequences?

Initially, however, we will start at the beginning and the growth of the Norwegian and international nickel industry – and to the peculiarities of and difficulties with nickel.

1. THE ROAD TO KRISTIANSAND

Initially, nickel was a problem, as it contaminated the copper, making it brittle so that it had little or no value. Its name is said to originate from the German "Kupfernickel" and refers to the devil, or the occult powers that diminished the value of the valuable copper.

The Swedish physicist, Axel Emil Cronstedt, isolated nickel as a metal in 1751, but it was not exploited until much later. In 1824, the Germans began using nickel alloys to produce nickel silver, especially in cutlery production. But consumption remained low until the nickel-plating process was developed in the 1840s. Use of nickel alloys in coins started in 1850 and helped to make the coins far more wear resistant.¹

Norwegian nickel, international competition and cartel activity

In Norway, nickel production started in 1849 with the establishment of Espedalens Nikkelverk between Valdres and Gudbrandsdalen and Ringerike Nikkelverk on the shores of Tyrifjorden. Several plants followed; Evje, Bamble, Skjækerdalen in Verdal and Senja being among the most important of these. At the most, there were up to 40 mines and 7 smelting plants in operation, and these reached a peak in production in the mid 1870s. According to Professor Johan H. L. Vogt, around 40 per cent of the world's nickel was produced in Norway.²

It did not take long, however, before the Norwegian ores and smelting plants faced competition. In 1875, mining started on New Caledonia in the South Pacific partly using prisoners serving hard labour. This was the beginning of the French Le Nickel-group, whose owners included the powerful Rothschild financial group. Le Nickel soon started a price war against its competitors and the price of nickel plummeted from 90 cents per pound in 1879 to 18 cents in 1886. Most of the Norwegian mines and smelting plants were closed down, as the ores here were too low grade.³ Only Evje and Ringerike survived, though they also experienced periods of closure. As we will see, however, competition and personal contacts from the pioneering period were important for the future success of the Norwegian nickel industry.

At the end of the 1880s, the Canadian Copper Company began exploiting the rich nickel and copper deposits in Sudbury in Ontario, Canada. This company was one of the forerunners to the future giant International Nickel Company. New price wars broke out, but it eventually became clear that the North American producers had richer deposits than Le Nickel.⁴

The competition damaged both parties and in 1896, the key players entered into an alliance. After this, the markets were divided and prices stabilised at around 40 cents per pound. This sales cartel dominated the nickel industry for the next 60 – 70 years, but the customers eventually reacted against this a few years later.⁵ The major steel and arms producers secured themselves influence over nickel production through shareholdings and long-term sales agreements.

The arms factories became interested in the industry after the English metallurgist James Riley developed nickel-based armour steel at the end of the 1880s. Adding nickel to the steel significantly improved the strength of the steel plates. The arms race between England and Germany led to increased arms production, and at the same time, new use of nickel in batteries and electrical appliances drastically increased the demand for the metal. As a cartel dominated the market, the price of nickel remained stable and high and this opened new opportunities for small Norwegian producers.

Evje Nikkelverk

Following a few years of pilot production, Evje Nikkelverk was eventually established in 1872. After several lean years with low production, the mine was leased to British H. H. Vivian & Co. in 1883, which ran the mine and the smelting plant for eleven years with a workforce of around 60 – 70 people. Due to the price war between Canadian Copper and Le Nickel, Vivian closed down production at Evje in 1894 and instead moved to Canada in search of nickel.⁶

Production resumed at Evje in 1899, as the new Setesdal railway reduced freight costs to Kristiansand to a sixth of what they had been. Nickel prices had also improved, thanks to the cartel. However, production at Evje never really exceeded the levels in Vivian's time and there was also a lack of capital. In his historical account of Evje Nikkelverk, Olav Arne Kleveland wrote that the workers often had to wait for their wages.⁷

In 1908-09, the company was refinanced under the management of Admiral Jacob Børresen, who in addition to his officer training had studied electrical engineering at the technical college in Charlottenburg, Berlin. Børresen had been a technical innovator in the navy. He designed a new type of torpedo and a new underwater mine and also wrote textbooks for the war colleges. Børresen was promoted to Rear Admiral in 1899 and commanded the flagship Eidsvold in 1904-05, which was one of the navy's new armoured vessels and was of course equipped with modern nickel alloy armour. Børresen had first hand knowledge of the military importance of nickel and foresaw that the demand for nickel would increase.⁸

Børresen was a colourful, though quarrelsome man, and in 1905 he resigned from the navy following intense personal conflicts. However, he went on to become one of the most prominent industrial leaders in Norway and became involved in companies like Norsk Hydro, Meraker Brug and Vamma Fossekompagni. Børresen also had an international network of contacts, both through his German education and during his service as an Admiral. In addition, he married into American industrial family, Levick, which eventually brought him in contact with the American steel trust.

Sam Eyde also joined Børresen at Evje. They were close friends and business partners and Eyde was Norway's greatest entrepreneur and a man with indomitable energy. Eyde was a driving force in, among others, Norsk Hydro, Elkem and Arendal Smelteverk and was involved in several major power development projects.

This meant that two of the leading men in Norwegian industry and commerce were behind refinancing and expansion of Evje Nikkelverk. The prospectus for the company was based on a calculated production of 10,100 tonnes of ore with a net percentage of 1.68% nickel after deduction of smelting losses, which would give 170 tonnes of nickel per year.⁹ A recommendation from Professors Waldemar Brøgger and Johan H. L. Vogt was included with the prospectus. They were two of the country's leading geologists who enjoyed international recognition. Brøgger and Vogt were both natural scientists and nation builders and they wanted to marry science and industry in order to create a new and richer Norway.¹⁰

The planned production at Evje equalled around 1% of the global production. Following a merger process, only three key nickel producers remained worldwide and International Nickel (INCO) was by far the largest of these. INCO was an amalgamation of previously mentioned Canadian Copper and Orford Copper. The other two were the Rothschild dominated Le Nickel and British owned newcomer Mond Nickel. These three

companies controlled the markets through a cartel, so that prices remained both high and stable.¹¹

The Norwegian investors appointed engineer Anton Martin Grønningsæter as production manager and he eventually became a key person in the Norwegian nickel industry. Grønningsæter came from Hjørundfjorden in the county of Møre, and was educated as a chemical engineer at “Trondhjems Tekniske Lærestalt” before going on to study at the technical college in Freiberg, Germany. Freiberg excelled in chemical analysis technique and Grønningsæter took this know-how back with him to Trondheim, where he started work at the laboratory at “Trondhjems Tekniske Lærestalt”. He worked there for one year, and then at the copper smelter in Sulitjelma before he, as many of his former student colleagues, emigrated to the US.¹²

By the time he was called to Evje, 29 year old Grønningsæter had already been a laboratory manager and a metallurgist at two large plants in the US and Canadian nickel industry. In spite of having a good salary and making a career for himself. Grønningsæter wanted to return to Norway, as he disliked the tough working conditions and authoritarian management style and to top it all, suffered from nickel allergy. He therefore asked his family and friends to be on the lookout for a potential job in Norway.¹³

At Evje, Grønningsæter soon found out that the forecasts were unrealistic. Firstly, there was not enough money to modernise the company. Even more serious was the fact that the mine failed. In spite of Professor Brøgger and Vogt’s calculations, the net percentage never exceeded 1.2% nickel. In comparison, at competitor INCO and Mond’s deposits in the Sudbury area of Ontario, the percentage was around 2% or higher and as the ore had a higher copper content, these companies had an extra leg to stand on. In addition to this, the orebody at Evje was not very large and it was impossible to scale up mining production in order to produce enough nickel. Grønningsæter wrote later laconically that: “my faith in the professors took a blow, and was never restored”.¹⁴ But without these two optimistic and nation-building professors, production at Evje would probably never have started again.

Grønningsæter resigned after four months, in spite of being offered a higher salary. He later stated that his thoughts were as follows: “How could a higher salary for a few months help when things were doomed to go wrong?”¹⁵ Grønningsæter wrote in his unpublished reminiscences that only one thing could have saved production: That a refinery was built, instead of selling semi-finished nickel matte at a low price. However, this required a complex technical process and this is where a clash of interests in the company proved to be of help.

Victor Hybinette

Swedish-American inventor, Victor Hybinette, had fallen out with INCO, which dominated the global nickel market. According to his version, he had been promised co-ownership in Orford Copper Company due to his technical development work, but was squeezed out in the merger process, which led to formation of INCO.¹⁶

However, Hybinette subsequently became INCO's senior metallurgist. In this job he developed his electrolytic nickel refining process. At that point, work on this process had been in progress for 10 – 15 years. The Hoepfner Refining Company had built an electrolytic nickel refinery in Canada in 1900, but technical difficulties and high costs made commercial production impossible. Subsequent trials were also unsuccessful in achieving an industrial breakthrough.¹⁷

Hybinette was familiar with this development work and as senior metallurgist in INCO, he had enough resources to carry out his own trials. Hybinette simplified the refining process and made this more reliable by combining metallurgical and electrochemical techniques. But once more he felt himself badly treated and decided to resign, taking with him his know-how and on the look out for other business partners.¹⁸

Hybinette already had experience from the Norwegian nickel industry. As a young man he had been manager of a small nickel smelter at Hommelvik outside Trondheim from 1888 and up until its closure in 1891. After leaving INCO, Hybinette travelled to Norway in 1906 to explore the possibility of establishing a nickel industry here. With its nickel traditions and inexpensive hydroelectric power, conditions in the country should have been just right for his electrolytic process.

His visit was in vain, but in 1909 Admiral Børresen at Evje Nikkelverk summoned him back to Norway as a last attempt to save production. After long negotiations, they agreed that Grønningsæter was to travel with Hybinette to Frederickstown, Missouri, where Hybinette ran a small electro-plating pilot plant for The North American Lead Company. Grønningsæter was allowed to study the refining process thoroughly. However, according to other sources, the plant was not functioning particularly well,¹⁹ but Grønningsæter must have seen that the process had potential. In any case, he concluded that it was better than the Vivian process, which was the only alternative at the time.²⁰

Using the refining methods of major nickel companies INCO, Le Nickel or Mond, was out of the question. They were definitely not interested in allowing a newcomer to use their production technology. On the contrary, nickel refining was technically difficult and to prevent newcomers from entering the market, the established companies kept their secrets closely guarded. Vivian could have sold its process, but this was already technologically outdated. The closed know-how structure of the nickel industry meant that Evje Nikkelverk had to put its money on an outsider like Victor Hybinette and his practically untested process.

Hybinette returned to Norway in 1910 and this time he was one of the prominent figures in the new nickel company and soon made a strategic move that was to be decisive for the future of the Norwegian nickel industry. Most people expected the refinery to be built close to the mine at Evje, where the mining company owned $\frac{3}{4}$ of the Fennefossen waterfall, which could supply low-cost hydroelectric power. It was also still the trend to locate industry close to power sources. At the same time and for this reason, Norsk Hydro built the factory town of Rjukan, deep in the mountains of Telemark.

However, Hybinette foresaw that the nickel refinery would not be self-sufficient with regard to raw material, as the deposits at Evje were too small. He believed that the company should build near the sea in order to minimise transport costs. In Kristiansand there was a good supply of reasonably priced power. The electricity board already supplied German industrial conglomerate, BASF's, pilot artificial fertiliser production plant at Fiskå, and still had more than enough spare capacity. In addition, it was easier to find labour in the town and the company did not have to build houses. Hybinette won through, and thus was the originator both of the process and the location of Kristiansands Nikkelraffineringsverk.²¹

In a previous book on the history of Falconbridge, Jørgen Skeie writes that finding a suitable site close to town was not easy.²² In November 1909, the investors were offered the Smedemyren estate, a property of around 25 acres. Merchant Kolsdal ran the estate, which also had a large orchard. The plot was very hilly, which since then has given the company a few challenges and extra costs over the following 90 years, but the location was otherwise ideal. The site extended down to the sea, was close to the railway station and was a short distance from the electricity company's distribution station at Krossen. There was also a supply of water from Dueknipen.

The investors

Things progressed quickly after Grønningsæter returned home from Frederickstown. Admiral Børresen and the rest of the board of directors at Evje Nikkelverk wrote to the shareholders that his reports were "very favourable".

The new refinery was to be established as a separate company "in close connection with Evje Nikkelverk". The facilities were estimated to cost NOK 200,000, while the annual production costs for 200 tonnes of nickel were NOK 550,000 and the stipulated profit was NOK 80,000. With a production of 250 tonnes, the profit would be NOK 140,000.²³ Key representatives of the new wave of entrepreneurial capitalism in Norway after 1900 were behind the initiative. Bank managers Jens Andersen-Aars and Nicolay Kielland-Torkildsen in "Centralbanken for Norge" were also active in the major mining companies A/S Sydvaranger (iron ore) and Store Norske Spitsbergen Kulkompagni (coal). Kielland-Torkildsen's ambition was to build a national, industry-financing bank, which Norway lacked at the time.²⁴ Involvement in the nickel plant was therefore incorporated in his and Centralbanken's plans. Anders Børresen, Bank Director in Drammens Privatbank, Nicolai Martens, Bank Director in Søndenfjeldske Privatbank, Kristiansand, Engineer Christian Wisbech and also Colonel Frithjof Henriksen, former owner of Evje Nikkelverk, were also part of the share issue.

The most striking thing, however, was the close link to the milieu around Norsk Hydro, to which Admiral Jacob Børresen, Sam Eyde and Claus Frimann Dahl were associated to at different levels. They brought with them technical expertise, financial contacts and connections with sub-contractors. The ties with Norsk Hydro were so close that the head office of the nickel company was located in Hydro's offices in Christiania (Oslo). Initially, Sam Eyde also arranged so that Hydro paid the new company's office costs.²⁵

Kristiansands Nikkelraffineringsverk (KNR) acquired the patents right to the Hybinette process in Norway. For this Hybinette received NOK 80,000 in bonus shares plus dividend certificates worth NOK 175,000, while the other investors subscribed for NOK 320,000 in shares. Any profit was first to be put towards 10% depreciation of the invested capital. After that the shares were to give 10% dividend. The surplus profit was to be paid to the owners of the dividend certificates. Each shareholder received free dividend certificates with a face value equal to the amount for which they had purchased shares.²⁶

On 7 March 1910, KNR held its first general meeting in Christiania. In addition to Hybinette's bonus shares, investors had subscribed for shares totalling NOK 320,000. One of Kristiansand's largest industrial companies had now been established, but on a national scale

the company was still fairly insignificant. In comparison, the metallurgical company Elkem was established with 5 MNOK and Norske Hydro with 7.5 MNOK in share capital.

A piece of Norwegian history

In 1909, 85% of the share capital in the Norwegian chemical industry was in foreign hands. In the mining industry, this share was 80%, whereas it was 47% in power production. Foreign-owned companies were sometimes described as enclaves or isolated islands within Norwegian industry. Many of these imported raw materials and exported their products and were not particularly integrated with the rest of Norwegian industry. Not only that, the profit usually ended up in the hands of the foreign owners. In the Kristiansand area, for example, the metallurgical plants Fiskaa Verk was in German hands and Vigeland Brug was British-owned.

Evje Nikkelverk and KNR were therefore two exceptions. The initiative and financing of both stemmed from Norway and they had both more or less emerged from Norwegian industrial traditions. However, this was no local-based industry. Most of the capital was raised in and around Christiania (Oslo), where the headquarters were also located.

As a rule, metallurgical technology was obtained from abroad. Different processes were developed, patented and put into operation abroad and then production plants were built in Norway in order to exploit the country's hydroelectric power supply. Electrical equipment, electrodes and smelting furnaces were all imported. Key personnel came from abroad or had been educated at foreign universities and had worked in industrial conglomerates.

However, there was one remarkable exception from this dependence on foreign technology and that was Norsk Hydro and its synthetic fertiliser production; the so-called Birkeland-Eyde process. But establishment of Norsk Hydro was based on foreign capital and as the historian Ketil Gjølme Andersen has shown, the Birkeland-Eyde process was based on international research activity over a long period of time.²⁷

Kristiansands Nikkelraffineringsverk is another example of what the Norwegian investor and technology milieu could accomplish in the period before World War I. In this case, the capital was Norwegian, and as in Norsk Hydro, the nickel electrolysis was based on foreign experience, but in Kristiansand production was scaled up for the first time and improved. Two of the key experts came from abroad: the process' creator Hybinette and smelting master MacGill. Hybinette had lived in Norway before and became a Norwegian

citizen while he lived in Kristiansand. Grønningsæter on the other hand, had taken parts of his education and had most of his industrial experience from abroad.

However, it would be misleading to draw clear distinctions between Norwegian and foreign technology environments during this period, as it is rather the contact between them that is characteristic. A large number of Norwegian engineers emigrated to the US, Australia or South Africa in the decade around 1900.²⁸ From the engineer registers we see that many of them achieved remarkable careers.

Several of these engineers returned home after their education or practice abroad and brought with them technological expertise, international experience and in a few cases, financial contacts. Sam Eyde, Christian Thams (Orkla), Mathias Sem and Carl Wilhelm Söderberg (both Elkem), Georg Tysland and Ivar Hole (among others, KNR and Spigerverket) and Anton Grønningsæter were examples of this.

Another aspect of the technological development also belongs here. The industrial processes were often a result of long development chains and therefore it may not be right to stick national labels on these. Within the nickel industry, there were different development stages in Germany, France, US, Canada and Norway. In this way, KNR can illustrate a neglected aspect of Norwegian industrial history: the interaction between national industrial traditions, foreign know-how and a risk-willing investor class. Together these gave new life to Norwegian nickel industry in 1910.

2. THE PLANT AND THE PROCESS

The roasting furnace was ready by June 1910, but because connection to the electricity network was slightly delayed, roasting did not get underway until the middle of July. Copper extraction began on 18 September and on 1 November nickel electrolysis got underway.

Construction manager, Engineer Endre Refsnes, positioned the buildings so that they could be extended in all directions. This was just the first phase of an industry that was destined for growth. The buildings were built using as inexpensive materials as possible and were left unpainted. The old main building on the estate was used as an office, temporary laboratory and manager's residence. The transformer and high voltage system were positioned in the cow barn, with the material office in the one corner. The hay barn was given a new lease of life as an engineering and plate workshop and the hayloft became a carpentry shop.²⁹

The equipment was also as simple as possible. There were a total of only 10-12 electric motors in the whole refinery and cranes and blocks were operated manually. However, money was invested in at least one thing. A fair-sized laboratory was built just about where the copper electrolysis area stands today. Special analysis equipment and specialised personnel were required to find faults, improve the process and control the quality of the products.

The improvised facilities did not agree with investor Sam Eyde's taste. He believed that the buildings should have a more solid design, in keeping with the visions of winning a significant slice of the global market. It was he that made sure Norsk Hydro used first class architects at the Rjukan plant. However, Grønningsæter and Refsnes prevailed, until nickel production was up and running, everything had to be done as cheaply as possible.

From mine to anode furnace

Nickel is a difficult metal to isolate and at Evje the ore only had a nickel content of 1%, while it contained significantly more iron, copper and sulphur, in addition to arsenic and precious metals. Therefore the ore had to undergo several processes in order to remove other metals and contaminants. At Evje, the crude ore was sent first to a flotation plant where the gangue was separated out. The ore was then roasted and melted to remove sulphur and iron. The

remaining concentrate, which was called nickel matte, was transported by rail to Kristiansand in 40-kilogram blocks.³⁰

The blocks were then smashed into fist-size pieces using a sledgehammer, which Grønningsæter subsequently referred to as an "extraordinarily strenuous job".³¹ Around one thousand tonnes were dealt with annually in this way. The matte was sometimes so metallic that it was impossible to break, so the blocks were heated up over an open fire until they were red-hot. They were then cooled in water so that they became brittle and easier to break.

The material was then sent through a crushing machine, where the air was thick with dust, as there was no such thing as a suction unit. From the crusher, the fine material was sent once again for roasting. The first roasting furnace looked more like a large baker's oven. It was 16 metres long and 4 metres wide with a double heating furnace at one end. The matte was slowly pushed towards the heating furnace using oar-like, hand driven paddles and it was important that the matte did not melt. The aim was to bring the sulphurous material in contact with the air so that the sulphur was burned off.

The roasted matte was transported in wheelbarrows across the yard and up a steep incline to a working floor above the leaching plant. From here the matte was placed in the leaching tanks containing sulphuric acid. To avoid lumps, the matte had to be spread evenly over the entire surface, just like you would sprinkle sugar on porridge.

Most of the copper in the matte was dissolved in the sulphuric acid. The resulting fluid was then transported to the copper electrolysis where the copper ions were attracted to the cathodes. Initially, all installation and replacement of anodes and cathodes was done manually. The cathodes were hard rolled copper plates, which were blackened with graphite so that they could be used several times. Grønningsæter wrote that this was an unpopular and dirty job. Graphite dust filled the air and covered the workers from top to toe in a layer of black grime.

The matte remaining after leaching was filtered and transported in wheelbarrows to the anode furnace in the loft, which was accessed by crossing a steep sloping bridge. One person had to always stand with a hook and rope to help the person with the matte pull the wheelbarrow up the bridge. According to foreman, Knut Larsen, it was a great relief when a lift was eventually installed so that wagons could be used to transport the matte to the loft.

The anode furnace itself, which had an internal diameter of less than 1 metre and was only 1.5 metres high, had been purchased from a closed down lead melting plant in Missouri. Once the slag began to bubble in the furnace, it was time for tapping. However, the furnace worked very erratically and violent hammering was frequently required to open the discharge

gate. Not only was this very hot and heavy work, it was also fairly hazardous. If the furnace was not tapped in time, the slag rose so high in the furnace that it overflowed.

The anode furnace was water cooled, but initially, there was an inadequate water supply, so that the water in cooling system began to boil. This made the whole furnace vibrate and everyone had to evacuate the building due to the risk of explosion. In his recollections, foreman Knut Larsen wrote that this was a daily occurrence. A pump was finally installed after one such explosion and this provided a supply of water from Kolsdalstjernet.

The 130-150 kg anodes were broken loose from the moulds with a crowbar. This had to be done quickly and in intense heat, and afterwards the anodes were transported in a wheelbarrow to the nickel electrolysis plant. The anode carriers had to take a run up in order to make it up the steep incline to the working floor on the 1st floor. The anodes often contained more than 30% copper and therefore were fragile and difficult to handle. From hard-earned experience, the anode carriers knew to protect their legs with solid pieces of sheet iron. A moveable platform was installed above the tanks in the electrolysis hall and from here the heavy anodes were lifted carefully in place using lifting blocks.

Hybinette's innovation, nickel electrolysis and cementation

Before 1910, the most efficient nickel process was the so-called "tops bottoms" method.³² The matte was melted together with sodium sulphide or carbon and when cooled it separated into two layers; one layer with sodium sulphide in the bottom and one layer of, among other things, copper sulphide on top. The melting process was repeated five times. The process worked well if the nickel ore contained a lot of copper or noble metals, as these could be fairly easily separated out. The disadvantage was that the concentrate had to be melted and cooled down many times to remove contaminants, but in spite of this, it was still difficult to obtain pure nickel as the end product.

With the so-called Mond process it was possible to produce purer nickel. This process was named after British inventor and industrialist Ludwig Mond. Nickel carbonyl $\text{Ni}(\text{CO})_4$ was formed by mixing the roasted nickel matte with carbon monoxide (CO) under very high pressure. The nickel carbonyl could be degraded to nickel and carbon monoxide by heating the nickel carbonyl to above boiling point at 43°C . The problem was that carbon monoxide was very toxic. In addition, pressure-handling costs were also substantial.

Victor Hybinette developed an electrolytic way of isolating nickel. Many people had tried before him, but together with personnel in Kristiansand, he was the first to succeed on an industrial scale. As in the above-mentioned “tops-bottoms” method, the concentrate was sent for smelting after roasting, but instead of slow cooling, the anodes were moulded and used in the electrolysis process. The anode comprised mainly of nickel, copper and some iron.

The electrolysis area at the refinery was equipped with 30 nickel tanks. The nickel anodes were dissolved in a sulphate solution and from here the metalliferous solution was passed to cementation tanks, where most of the copper was precipitated. The iron in the solution was then precipitated with nickel carbonate and filtered out. The nickel electrolyte was transported back to the nickel tank. The great innovation was that each cathode was surrounded by canvas (diaphragm) and pure nickel electrolyte was continuously infused to maintain a higher solution level inside the cathode compartment. At the same time, the canvas prevented impurities from the anode (iron and copper) from migrating into the cathode compartment.

Knut Larsen wrote that removing the nickel from the cathode plates was laborious and hot work and required two men. One man stood on the top of the tank to lift up the plate, place it in a trough and support it in an upright position, while the other stripped off the nickel. This was done using a chisel, hammer and iron rod. With twelve men in action at the same time, the sound of hammer blows could equal that of any shipbuilding yard.

After stripping, the nickel was sent to the next stage in the production process, where it was melted in a small furnace and oxidised by “flapping”, i.e., the liquid metal was stirred for several hours using an iron rake. The slag was drawn off and the metal was poured into a ladle that held around 150 kg. The molten metal was then poured carefully into a large water tank. “The ladle had to be moved back and forward to spread the flow of metal as good as possible. If this was not done, minor explosions occurred, but these were usually quite harmless. However, on one occasion the man operating the ladle lost his head completely and let go of the ladle. This resulted in a tremendous explosion, which ripped off part of the roof, smashed the water tank to smithereens and spread the nickel contents of the tank around the whole building. Strangely enough no one was hurt, apart from the man operating the ladle, who sprained his thumb.”³³

Making the process work

In short, the refining process was based on four components; scientific knowledge, engineering technology, organisational ability and hard and sometimes unskilled labour. The inventor, Victor Hybinette, who grew up in the mining town Falun in Sweden and was educated at Chalmers technical college in Gothenberg, had long experience from the nickel industry. The process he invented combined scientific insight from several different areas, electrolysis, acid-alkaline reactions, electrotechnics and metallurgy. Hybinette also had the ability to apply this knowledge in practice. Parts of the equipment had to be specially designed, and knowledge of the available equipment, corrosion-proof types of material, etc. was also required. However, it must be remembered that the plant at Kristiansand was not the first one he had worked in; it was rather the result of a long personal and professional development.

The Hybinette process was never tested using the same ore qualities as those from Evje nor was it tested on the same scale. According to Hybinette, only the main principles were the same as those at his small refinery in Frederickstown, where the matte had contained far more copper, lead and cobalt.³⁴ Changes were also made so that it was possible to make full use of the inexpensive hydroelectric power in Kristiansand. Therefore the various stages of the process had to be replanned and redesigned. In Fredrickstown, there had only been sequential and periodic production and the plant had not functioned completely satisfactorily.

If Hybinette had the original ideas and patent rights, the remaining sources indicate that Grønningsæter played an important role in making the process work industrially. In August 1910, he was assigned NOK 10,000 in bonus shares and dividend certificates from Hybinette's shareholding, an amount at least equivalent to 3-4 years wages for a young engineer. Grønningsæter was also authorised to enter into contracts with suppliers, though "in consultation with Hybinette".³⁵

Some of the problems that arose during commissioning have been written down as anecdotes. "Initially, we tried to dead roast the matte", Grønningsæter wrote later, i.e., they tried to burn off as much of the sulphur as possible during roasting. This resulted in the melting point of the concentrate being far too high. "We froze up one furnace after the other. ... Eventually, we found out that it wasn't possible to melt using coke with a sulphur content of less than 4%."

"Starting up copper cementation was probably our most difficult problem. ... We made the mistake of arranging ventilation in the tanks, which is absolutely the wrong thing to do in such a process. Therefore, we ended up boiling the solution for many days without managing to remove the copper. One morning when we arrived at work, we suddenly found

that the solution was copper free and the explanation was that the air supply had ceased.” In other words, a technical failure led to a breakthrough in production, but the situation was usually the other way round. Faults were weeded out through systematic work and analyses in the laboratory.

The entire company board was present when nickel electrolysis started up for the first time on 1 November 1910. The board members signed the first cathode plates that were lowered into the tanks. However, when the plates were removed the next day, they were completely black and it was impossible to see any of the fine signatures. The cause was eventually found. The surface of the fluid was covered with brown foam, and it was found that this foam and the black coating on the plates was organic material. After this, the wood used in the electrolysis tanks was leached before it was used, to prevent the acid from releasing organic substances in the timber.

There were also difficulties with short circuits, leaking diaphragms, impure electrolytes and strong temperature increases in the electrolyte. And due to the acid, the pumps, pipes and packings did not last very long. The workers were therefore on the hunt for improvements to avoid constant repairs and replacements.

In retrospect, Grønningsæter also placed emphasis on the importance of establishing fixed maintenance and inspection routines. These were probably just as important with regard to costs as the improvements in the process itself and extended the lifetime of the equipment and reduced losses along the way. In addition to this, the workers had to contend with the problem of leakages. Somehow, some of the solution, i.e. some of the metal and profit disappeared down the valley and into the sea. When this was discovered, several collecting wells were dug in the terrain, but the problem continued as long as the company was in business.

These recollections and anecdotes conjure up a picture of the work being some kind of creative process, where people had their hands full trying to deal with challenges and making improvements in the process. This was probably very much the case for those sitting at the top, and it is also they who have written down their memories from the pioneering years.

A thousand devils and know-how in daily production

”The furnace is a living thing; half friend and half foe. It may be in a good mood and produce by the tonne, without you having to wear yourself out, or it may refuse to work and create hell

for those working with it. There were times when the furnace seemed to be possessed by a thousand devils and forced smelters and tappers to work their socks off in one single shift ... one single shovel of coal too much was enough for the furnace to act up and cause trouble for the rest of the shift."³⁶

This quote is from a metallurgical plant in Sauda, but the description could just as well have been from the refinery in Kristiansand, where we have already seen how erratically the anode furnace worked. In a complex process such as the one at the nickel refinery, it was impossible to accurately predict how the equipment and the raw material would function, as there were too many elements of uncertainty. For example, the metal and sulphur content of the nickel concentrate varied and what worked well one day could go on strike the next.

The nickel refinery worked on the edge of what was technically possible. Several types of competence were needed, both among the workers on the floor and in the management, in order for it to function industrially. Only then could the “devils” be tamed and the problems solved in a cost-effective way. In Kristiansand, five to six engineers were the only ones to have scientific understanding of the process and they also had overall technological responsibility. However, their knowledge far from solved all difficulties. The complex chemical processes involved were not directly available to anyone, not even the engineers.³⁷

The foremen managed the daily production and provided training, management and control. The instructions for the foreman in the nickel electrolysis were instructive in that respect; his job was to check the temperature in the electrolytes and whether they contained copper contaminants. He also had to check the voltage and current density and that the diaphragms (i.e. the canvas ducks that separated the electrolytes) were clean, etc.³⁸

These regular checks gave the foremen a unique knowledge of the processes. The foremen learned the consequences of various faults and how problems could be prevented and the work best organised. The foremen had the responsibility of ensuring that all work was done properly and that no one shirked their duties. The foremen entered into piecework agreements and ensured the correct workforce, etc. In daily production, this type of accumulated experience was of greater direct value than theoretical knowledge from both a human and technical point of view. For this reason, foremen could act like petty kings in the production areas. The engineers, on the other hand, took care of the office functions, made technical calculations and carried out laboratory work.

In addition, there was significant competence on the factory floor. Several of the practical tasks required specialised knowledge and skills. For example, the company required skilled lead burners to reduce the problem of leakages, as well as skilled electricians, carpenters and mechanics. The Hybinette process had no standard equipment or set up. In many cases, therefore, it was up to the skilled workers to find solutions that worked, though according to the foreman's instructions.

It was impossible to find experienced furnace workers locally. Initially, KNR tried to recruit such workers from the copper smelter at Røros and other smelting plants, but those who came were not very reliable and had alcohol problems. Therefore, construction workers were employed as work on the plant gradually neared completion. Strong stone workers were chosen, as roasting furnace work was very heavy, but they could not deal with the intense the heat and resigned one by one, until the company had to employ stokers who were used to the heat.

Competence in this field had to be built up at the refinery. Tending a furnace required a significant amount of endurance, skill and experience. Without measuring equipment, a furnaceman had to have an ear for how the furnaces were working, as they were "living things" that had to be minded with care, as faults were both costly and hazardous.

Solidarity and strife

In 1910, the labour movement was growing fast and there were more than 10 times the number of trade unionists in Norway than at the beginning of the 1900s. However, the southern parts of the country was an exception, as the area was little industrialized. In the south of Norway, the labour movement had a far weaker position than the lay Christian movement or the temperance movement.

In this respect, Kristiansands Nikkelraffineringsverk heralded a new era. It was only one of many large companies established around 1910. On 16 October 1910, 20 of the plant's workers formed the trade union "Samhold" (*Solidarity*), but if the minutes of proceedings are anything to go by, the union was not very active and no meetings were held from December 1910 to October 1911.³⁹

In the autumn of 1911, Karl Strøm was re-elected as union leader and activities were resumed. However, the problems were not over. Several of the trade unionists were fired and therefore the union asked "Arbeidsmandsforbundet" (*the Workers' Association in Norway*) in

Kristiania (Oslo) for help. The treasurer was fired without grounds and the management did not "recognise union rights".⁴⁰ "Arbeidsmandsforbundet" was well aware of the problem of harassment of shop stewards, as this occurred in many places where people joined a trade union.⁴¹ The help from Kristiania obviously solved the acute problems at the plant, because treasurer Knut Johnsen was reinstated after two months.

This small victory seemed to be enough to revitalise the trade union. Even if the minutes of meeting were brief, we can see that interest was extended to working environment matters, wage issues and politics.⁴² One statement reads that: "The work is unhealthy due to too much acid vapour and dust and also due to working with too much acid". The acid vapour led to nickel allergy, which at times was so serious that people were off work for weeks at a time, without receiving any wage compensation. Following a lecture given by the Editor of "Sørlandets Social-Demokrat", Ola Solberg, the trade union jointly (and unanimously) joined Kristiansand's Labour Party. They eventually also designed their own banner for the 1st May parade.

Last, but not least, was the work with wage issues. The union became involved in the "Arbeidsmandsforbundet's" tariff negotiations in 1912. According to Grønningsæter, wages were increased 20% and a day-worker's pay rose to 42 øre per hour, while skilled workers received up to 50 øre per hour. There were a number of different rates for furnace men and electrolysis workers, with copper refiners earning the most at 55 øre per hour.⁴³ In spite of the wage increment, the workers did not take much more home with them in their wage packet. The wage increase primarily compensated for a reduction in working hours.

Stability under collective agreement

In May 1915, the union required that shift workers be paid according to agreement if they were made to do any odd jobs. Day-workers and clean-up workers were not to be allowed to work shifts, unless any of the permanent workers were prevented from turning up for work. As much work as possible had to be done by shift workers that had a fixed employment contract.

The reason for this was that day-workers received lower wages. These were only hired when needed and had to leave when the company no longer had use for them. The shift workers wanted to guard against this situation, as casual and lower paid workers could be a threat to wage level, job security and solidarity.

The union also demanded an increase for overtime pay and for work on Sundays and holidays. In addition, they demanded an 8-hour shift.⁴⁴ Nearly all their demands were met, as KNR did not want a strike and shutdown of production right in the middle of a boom period. The most important thing, however, was that the nickel refinery accepted that shift workers should take precedence over day-workers. Similar arrangements were also agreed in other parts of the metallurgical industry, as companies wanted more stable conditions. In the long run, the employers benefited from having a stable workforce rather than employing rootless day-workers. Only then did the companies make full use of the workers' skills.

In 1914-15, the majority of workers in KNR had been employed for one year or more.⁴⁵ This meant that the plant now had an experienced and competent, as well as self-aware and organised workforce, which became a permanent element of the company's history. Neither the owners nor the management could do completely as they pleased.

The Fjermeros affair

On 3 April 1913, non-unionist Knut Fjermeros sought refuge with production engineer Hans G. Martens. The other workers had been trying to get him to join the trade union for some time. Now one of them, Johan August Jahnsen, had criticised him so harshly that Fjermeros felt threatened. Jahnsen was fired on the spot and in the union minutes the dismissal was characterised as a "breach of union rights" and it was demanded that Fjermeros be dismissed, as he had been a blackleg at Vigeland and had now broken solidarity at the nickel refinery.⁴⁶

However, the management was adamant and Fjermeros remained inside the factory gates, whereas Jahnsen was left out in the cold. The trade union engaged the help of the editor of "Sørlandets Social-Demokrat", Solberg, to compose missives and arguments. The matter eventually snowballed with written reports and hearings with the people in question. On 15 April, Jahnsen was reinstated in return for promising to keep quiet in future.

Early on the morning of 2 May, the workers at the copper furnace refused to work with Fjermeros. Three of these were dismissed immediately. The union's foreman, Gudbrand Paulsen, then declared that everyone would walk out by the breakfast break, except those who were absolutely required in production.

There was an angry mood. Almost all of the 100-110 workers were organised and they could obviously shut down the plant. Grønningsæter bowed down and the three who had been dismissed were reinstated and Fjermeros was given 24-hours notice to leave the refinery.

After that, Grønningsæter continued his inspection of the plant, though not before the other workers had promised not to cause Fjermeros "any injury to life and limbs". Fjermeros remained in place the rest of the morning, but by 1.50 p.m. three men carried him straight out. The records state that: "They had only come a short way when the manager came and prohibited such violent action and promised that he would expel Fjermeros himself as quickly as possible".

The trade union had won a small, but important victory. It was one thing that a blackleg and "morally objectionable" person had been thrown out, but actually this also meant that the management accepted that all employees should be organised – and that non-trade unionists could be squeezed out. However, this did not mean the end of non-trade unionists, as some workers refused to join the trade union for religious reasons. During the World War I, there was a higher turnover of employees and it was difficult to get all the newcomers to join the union. However, the main principle was forced through.

A moderate union?

The nickel worker's union joined Kristiansand Labour Party in February 1912. Karl Strøm became the union's representative in the local party executive committee for many years to come. He also continued on the shop steward committee even after he left the nickel plant in 1912/13.

Strøm seems to have been more radical than most of his work colleagues. He was, among other things, one of the initiators in establishing a co-operative trade association in Kristiansand and he persuaded the union to give this financial support. Strøm was also in favour of introducing compulsory subscription to the radical newspaper "Sørlandets Social-Demokrat". He believed that the workers had to break the information monopoly of the bourgeoisie-press and support their own newspapers, but he faced a lot of opposition regarding this. At a union meeting in 1915, it was asked: "whether subscribing to the newspaper should be compulsory? If so, I can't agree with this, because if we weren't slaves before, we certainly will be if such rules are forced upon us". Union chairman, Augustinus Davidsen, admitted that this was "force, but that it doesn't help to stand united, if we don't work politically. "Social-Demokraten" is a newspaper that supports our cause and does everything in its power to promote our interests". And he added bitterly: "it looks rather like there probably shouldn't have been anything other than conservatives and liberals in our

union”. The proposed compulsory subscription was voted down, as it was several times later.⁴⁷ Political moderation has also been a hallmark of the rest of the labour movement in the region. Southern Norway has never been a radical part of the country. Several of the early union activists at the refinery were in fact people who had moved to the area from eastern and mid Norway as well as from Sweden.⁴⁸ The locally born members were less active and sometimes wanted to tone down political involvement.

Following initial minor disputes in 1911-12, the relationship between the company and the union became more organised and they found compromises with regard to wage and employment matters. As the nickel refinery was not a member of the National Employer Association, the company also avoided being involved in sympathy strikes and lockouts, which were disputes that often caused great bitterness.

An up-and-coming enterprise

In the annual report 1910, Director Jacob Børresen concluded that: ”the refining process kept what had been promised in the prospectus. ... Of course, a few changes were necessary and some experience had to be acquired before everything functioned completely satisfactorily. Training workers was one of the things that gave significant difficulties, but these were eventually overcome”.⁴⁹

In 1911, production at KNRs reached 284 tonnes of nickel and 167 tonnes of copper, i.e. more than originally estimated. Though the company was still in a commissioning phase, the book profit reached NOK 114,000, and was actually even better than this. With the help of the current operating income, the company had accumulated significant assets in the form of material stocks and metals in process.⁵⁰

Sales were going well and a German conglomerate, “Metallgesellschaft”, purchased most of KNR’s nickel and sold it onwards to customers in Europe. Without access to “Metallgesellschaft’s” sales organisation it would have been difficult for a small and unknown company such as KNR to capture customers from the international nickel cartel. “Metallgesellschaft” also wanted to establish a nickel producer that was outside French or British control.⁵¹ That way Germany could secure nickel supplies if war broke out.

In 1912, KNR’s annual capacity was extended to 900 tonnes of nickel and to 1,200 tonnes two years later. The challenge was to find enough ore and nickel matte. From May 1910, KNR leased the smelter at Evje from Evje Nikkelverk. The aim was to have the best

possible control of this part of production too. Hybinette was sent to Evje, where he improved the efficiency of the smelting process. In 1913, a new basic converter was put into use and Grønningsæter wrote latterly that the converter made it possible to continue production at Evje.⁵²

However, the mine at Evje was still too small and ore had to be acquired from Greece and New Caledonia, but KNR was unable to secure long-term purchase agreements. In December 1911, KNR leased Ringerike Nikkelverk's plant in Eastern Norway. Initially, KNR invested NOK 180,000 in the mine and in a new smelting plant.⁵³

In 1913 and 1914, the book profit was almost 20% of the turnover and the shareholders could enjoy fat dividends. Behind the progress lay a masterly piece of industrial work and a commercial success. In spite of a few complaints from customers, KNR's nickel achieved a better price than nickel from giant INCO⁵⁴, even though INCO had experience and market power. With these results, KNR was a financially sound and offensive company at the start of the World War I.

Financial key figures for KNR between 1910-14, in 1000 NOK⁵⁵

	Share capital	Debt 31/12	Book value 31/12	Metals in progress	Credit balance	Depreciation	Profit	Dividend
1910	400	335	735	215	60	0	-17	0
1911	650	700	1,450	670	100	40	115	65
1912	1,150	1,000	2,390	865	75	35	160	115
1913	1,500	1,085	3,050	980	464	170	360	160
1914	1,500	1,024	2,897	1,020	225	115	370	225

Shares issues took place at 115% of par of exchange. Metals in progress (tied-up in the process) and credit balance is included in the book value. The credit balance was sometimes high because the nickel was not sold for cash payment.

Production in KNR between 1910-14, in tonnes⁵⁶

	Imported ore	Ore Evje	Matte prod. Evje	Ore Ringerike	Matte prod. Ringerike	Nickel prod. Kr.sand	Copper prod. Kr.sand
1910		11,300	331			21.5	21.5
1911	2,100	26,500	790			284	79
1912	2,540	28,900	920			390	170
1913	3,250	30,500	960	13,000	400	602	388
1914	3,600		1,285		415	794	408

Imported ore was sent to Evje or Ringerike for roasting and smelting. In 1910, 126 tonnes of the matte production at Evje was sold to Germany in accordance with Evje's old contracts. KNR refined the rest. At Evje, Evje Nikkelverk managed the mining operations and KNR managed the melting, whereas at Ringerike, KNR was responsible for mining operations and melting.

3. TURBULENT TIMES 1914-1926

Kristiansands Nikkelraffineringsverk had experienced three good years when the World War broke out in 1914. The start of the war marked the beginning of a new era, which for KNR worked very much like a financial suction pump. While the war lifted the management and shareholders onto cloud nine, it was a time of hardship for the workers, as their wages did not keep pace with the general price level. In the end, however, both the company and the employees were caught in the maelstrom and dragged into the abyss.

It is difficult to reconstruct KNR's development during World War I. The company's archives contain little else apart from annual reports, and even these are remarkably non-informative from 1914 onwards. There was no longer any information about how much nickel had been produced and eventually no proper accounts were reported. The written notes, which were extensive at the beginning in 1910, mentioned little or nothing about the war years. The reason may be that this era was a prelude to disaster, financial loss, shame and unemployment. Newspaper articles, the trade union's records, a collection of letters and the report from the investigation commission set up following a period of speculation were all that were available.

Wartime conditions

KNR shut down production when war broke out in August 1914. Shipping traffic across the North Sea also ground to a halt due to the war, as the British and Germany navy were expected to clash. This meant that the nickel refinery was without a supply of coke and coal and it was not until the beginning of September that production eventually got underway at Evje, Ringerike and in Kristiansand.⁵⁷

The German advance towards Paris was thwarted almost about the same time, but it became clear that the battles would drag on. However, the war provided unforeseen opportunities for KNR, as nickel was used in armour steel, torpedoes and other war equipment. However, torpedoes became a source of criticism against the company, as hundreds of Norwegian ships were sunk and torpedoes containing KNR nickel probably killed thousands of seamen.

KNR was the only company that exported nickel to the Germans, who paid almost whatever they had to ensure a supplies. Nearly all of the world's remaining nickel production was carried out in allied territory, under French and British control. Therefore, in 1916, the Department of Commerce in the German Ministry of Foreign Affairs determined that nickel from KNR was "essential for our arms production".⁵⁸

Just before the outbreak of war, KNR had entered into long-term agreements with German sales company Beer-Sondheimer & Co. But this did not stop the nickel refinery from playing the warring parties off against each other. The British were usually willing to pay a higher price to prevent the Germans from getting hold of essential goods and this also seems to have been the case with nickel. Admiral Jacob Børresen, who was Chairman of the Board and Managing Director in KNR, wrote in his memoirs about repeated visits to England during this period. The British Government also tried to take over KNR, but their offer was obviously too low. Instead, in the summer of 1915, KNR entered into an agreement with the British that exports to Germany would not exceed the volumes agreed in the applicable contracts and that excess production would be sold to the UK or to a neutral country. The price was high and the following year, according to Sam Eyde, the British Government owed KNR 800,000 dollars, which corresponded to a whole year's turnover in 1913.⁵⁹

In 1915, profit was 1.2 MNOK and 2.2 MNOK the following year, and the entire profit was shared out to the shareholders in the form of dividend or bonus shares. In comparison, called up and fully paid capital in the company was only 1.5 MNOK.

Period of expansion

In 1915, KNR acquired the majority of shares in Evje and Ringerike Nikkelverk with their mines and smelting plants, which KNR had previously leased. Ringerike was bought in cash for 700,000 NOK, while settlement for Evje comprised shares in KNR worth 750,000 NOK.⁶⁰

The bottleneck was and remained the supply of nickel ore, and therefore extension of the Ertelien mine at Ringerike started in the following year. In addition, the company took over ore deposits at Hosanger in Hordaland and Høiaasen in Holt, Aust-Agder, where production got fully underway in 1917. Preparations were also made to work the mine at Beiarn in Nordland. KNR was on the threshold of becoming one of the most important mining and industry groups in Norway, with six to seven national production sites and also significant foreign interests. However, during the war supplies and equipment were at a

premium. At Hosanger, neither the mine nor the concentration plant was ready for use until the spring of 1920 and production never did get underway at Høiaasen and Beiarn.⁶¹

There was also a plan to expand the refinery in Kristiansand, where capacity was to be almost doubled to 2,250 tonnes of nickel. The cost was estimated to be more than 4 MNOK, but the money was never spent.⁶² It was not even possible to use the old capacity of 1,200 tonnes nor was it possible to purchase Greek or French ore and there was no way the allies were going to sell ore to a nickel company that also traded with the enemy.

KNR continued its investments in technical competence. As mentioned before, refining was a vulnerable process, and comprised many different processes where a lot could go wrong. One goal was to improve product quality, among other things, through reducing contaminants such as lead and other undesirable substances in the finished nickel. Another goal was to extend the product range to include forgeable nickel. KNR succeeded with both of these objectives. At the same time, attempts were made to improve production technology. Ivar Hole developed an electric furnace for melting cement copper, a project that was the kick off to his career in electric melting furnace technology. He also designed a gas generator to make so-called reduced matte, an important innovation which was put into use in 1929. KNR also tried to extract the valuable contents of cobalt and precious metals in the matte.⁶³

KNR had a conscious recruitment policy in order to achieve its technological objectives. At least fourteen of the engineers recruited to the company between 1910 and 1920 were either educated abroad or had worked abroad. At the most, the company employed around 20 engineers and chemists and there were few other Norwegian companies who spent more resources on technological development. It was not until the late 1940s that the refinery was again able to recruit a technical staff of the same size. The future careers of these engineers also demonstrated that KNR managed to create a competence-stimulating environment, as several of them took up executive positions in Norway or abroad.⁶⁴

In addition to improvement in the processes, there was also a cautious improvement in the efficiency of work methods. Among other things, several tracks were laid to facilitate more use of wagons rather than wheelbarrows for transport. In addition, several small electric cranes were installed, which eliminated heavy lifts.

The road to Canada

From the start, Victor Hybinette wanted to use his nickel process outside Norway. In August 1910, Admiral Børresen acquired 10% of Hybinette's international nickel patents (HUN) and after that Sam Eyde, Consul-General Hans Olsen and KNR each acquired a 10% share of HUN.

Sam Eyde used his international network of contacts and linked HUN with the American investor Fred Stark Pearson.⁶⁵ Just like Eyde, Pearson was an entrepreneur and engineer with an insatiable energy and drive. Pearson initiated various development projects in Canada, South America and eventually in Spain. Pearson and his associates are also described as being tough businessmen or project makers, who made promising prospectuses to attract co-investors. However, they were not too concerned about preparing proper annual and audit reports and exploited legal loopholes to the full.⁶⁶

In 1912, Pearson sent his engineers to Kristiansand, where they carefully inspected the plant and concluded that the Hybinette process was superior to other refining methods.⁶⁷ The outcome of further discussions was that Pearson's company, British America Nickel Corporation (BANC), was to use the Hybinette process in North America in return for KNR purchasing 10% of the matte (concentrate) they produced at a favourable price. In addition, the HUN-owners were to receive shares in BANC.

However, BANC was only a fictitious company that owned a few large ore deposits in Sudbury, Ontario and had neither mining facilities nor financing. Up to 1914, Pearson had been struggling to get hold of fresh capital.⁶⁸ Canadian nickel industry historian, O. W. Main, claimed that the American business tycoon, J. P. Morgan, had thwarted this. Morgan had ownership interests in International Nickel and did not want any competition. Main describes how Morgan, with his tentacles in high finance and steel cartels, thwarted a number of attempts to establish independent nickel production.⁶⁹ There is also another obvious explanation for why it was difficult to finance BANC than Morgan's resistance: BANC's owners possibly wanted far too much money for the deposit.

Regardless of the reason: The lack of capital opened the door for Norwegian interests. In the spring of 1914, Eyde knew the potential of the Hybinette process and he grabbed the chance with both hands and managed to unite KNR, Elkem, German sales company Beer-Sondheimer and BANC. The outbreak of war in 1914 brought negotiations to an abrupt halt, as an alliance between German and Canadian interests was now out of the question.⁷⁰

By that time KNR and Elkem had sent engineers Gustav Haglund and Fredrik Nannestad to Canada to investigate the deposit and they submitted a very optimistic report in October 1914. The main mine was estimated to contain 7.6 million tonnes of melting ore, but

the deposit was assumed to be much larger. The nickel content was 1.93% (one and half times as much as the ore at Evje and Ringerike) and the copper content was 0.86%. In addition, the melting ore percentage was 66%, which meant that only 34% was rock.⁷¹ The ore body was also located such that mining would be more efficient than at Evje.

It is easy to imagine the Norwegian investors' reaction. They already had a superior refining process and now large ore deposits were within their reach. And all this was at a time when the world's nickel requirements exceeded all previous expectations.⁷²

Investment in the British America Nickel Corporation

In June 1915, Børresen, Eyde and Hybinette were in London in conjunction with discussions regarding nickel. BANC's director Pearson had just been killed during a torpedo attack on the passenger liner Lusitania and his second in command, Sir James Dunn, had taken his place. The British Government had also become a party in the matter due to the war demand for nickel and to restrain the nickel cartel. However, a nominee company, Anderson, Anderson & Co., was acting on behalf of the Government.

The parties agreed that KNR should invest one million Canadian dollars in BANC and the aim was to achieve an annual production of 3,000 tonnes nickel, on which KNR would receive a royalty of 750 NOK per tonne. An agreement was entered into with Anderson regarding annual sales of 3,000 tonnes of nickel over 20 years at market price, with a minimum price of 145 pounds per tonne. This amount was much higher than the planned production costs and the previous world market price. Hybinette also had to promise only to work for KNR and BANC as long as the war lasted. In addition, KNR would receive matte supplies from BANC with a metal content of 3,000 tonnes nickel per year.⁷³

KNR decided not to invest in BANC this time around and the work in BANC stopped after Pearson's death. Pearson had been the driving force and was a difficult man to replace.⁷⁴ New discussions eventually got underway in London in 1916, with Hybinette taking the leading role on behalf of the Norwegians, while Dunn represented the Canadians / British. BANC was now in a difficult financial position, as the company still had no income and had significant debts. Through its nominee company, Anderson, Anderson & Co., the British Government was willing to invest two million Canadian dollars, if other investors, i.e. the Norwegians, put up another million.

During the discussions, the British Government added an extra million to its contribution, but demanded full control of BANC in return. KNR agreed that the British could manage the Norwegian shareholders' rights. According to Hybinette's travel report to KNR's board of directors, the discussions were closed with a threat. The head of BANC claimed that the company had received an offer of financing from nickel trust INCO. This would mean that Hybinette and KNR's process would not be used and that KNR would lose future access to the nickel concentrate from Canada. Hybinette signed the agreement.⁷⁵

In his travel report, Hybinette also wrote that the one million dollar investment would give a dividend of at least 16%, and 21% after a further two years, "and without being too optimistic, it was also feasible to expect much more." A union between KNR and BANC would create "a major power in the world nickel market. But most important is our matte supply contract. At a conservative estimate, this would earn KNR one MNOK per year."⁷⁶

KNR purchased shares and debentures⁷⁷ in BANC worth almost 1.75 million Canadian dollars.⁷⁸ Most of these securities were sold to other Norwegian investors. According to the prospectus, the plan was to produce 5,000 tonnes of nickel and 3,000 tonnes of copper a year, which was significantly higher than in 1915. The anticipated nickel price was raised to 175 pounds per tonne, of which 105 pounds was gross profit before financial costs. The building programme was stringently outlined and Jacob Børresen and KNR also issued two circulars in conjunction with the share issue. One of these said that BANC would start production in the autumn of 1917 and the other said that this would be in the winter of 1917-18.⁷⁹

Investment in BANC marked the start of a new type of relationship between Norway and Canada. Previously, Norway had only "exported" people to Canada, immigrants who wanted to settle on the prairie. The aim now was to make strategic investments and export technology. With its foreign investment, KNR also trail blazed a new path in Norwegian industry and commerce. As we saw in the first chapter, foreign interests controlled much of Norway's natural resources and industry. Few Norwegians made investments abroad. There was one important exception to this rule. Norwegian entrepreneurs in the wood processing industry had invested abroad, first in Sweden and then in Finland and Russia.⁸⁰

Preparation for large-scale production

Construction work at BANC took a conspicuously long time. According to Grønningsæter, development of a waterfall was the only significant work initiated in 1916, but this was

stopped and drawing and planning work was all that appeared to have been done. There was preparation for large-scale production at the mine, but the senior mining engineer left for the war in the summer of 1916.

The Norwegians did not carry out any inspections. Between September 1916 and April 1917, none of KNR's management visited Canada nor did any of the Norwegian board members in BANC, i.e. Børresen, Eyde and Hybinette, attend any of the meetings in the company. There was also no auditing of the accounts.

Though little was done, the plans began to grow. The plant was to be dimensioned for 10,000 tonnes of nickel a year,⁸¹ which was more than double the previous size. Neither Hybinette nor Grønningsæter were particularly pleased about this. They believed it was better to start on a small scale. It would also take longer to make a large plant operational and the time factor was crucial during the boom period of the war. Any delay would cost money, but the Norwegian shareholders had no say in the matter. BANC's management focused on scale economies and the huge profit that a 10,000-tonne project could give at high wartime prices.

Expansion required extra financing and in the spring of 1917, KNR provided a guarantee for a share issue of two million Canadian dollars. Clear conditions were set regarding matte supplies to KNR, British support to BANC's construction work (especially power supply) and regarding control of accounts. KNR was entitled to have its own supervisor in Canada. In addition, the British Government's annual purchase obligation was increased from 3,000 to 6,000 tonnes of nickel. The price guarantee of 145 pounds per tonne was dropped and instead it was agreed to use the market price. An arbitration scheme was also established to determine the price of nickel matte to be delivered to Kristiansand.

However, the British Government did not manage to secure a supply of electricity for the production plants, as this was under the control of the regional authorities in Ontario, and they had little to offer. There was not enough power in the province to supply to the huge war needs. BANC's top management also made a real bungle of their work. In his thesis, Canadian historian, James Colussi, describes how BANC's management spent more than two years negotiating with two local power companies. But these negotiations fell through due to disagreement about price and about who would pay for the power lines. BANC ended up having to build its own steam power station outside Sudbury to supply the mine and smelting plant with electricity and the refinery had to be moved to Deschenes in the province of Quebec in order to have an adequate power supply.⁸²

In spite of all the problems arising in Canada, in August 1917, KNR issued an optimistic invitation to Norwegian investors to subscribe for new shares in BANC. The

circular stated that BANC had established an excellent organisation and that the war had delayed start of production, but the power issue and the withdrawal of the British price guarantee were never mentioned. The share issue was also increased from two to three million dollars. Admiral Børresen later explained that he felt that he was under pressure. BANC's director Dunn again threatened with the INCO nickel trust. If the Norwegians did not manage to raise the capital, they would play the ball into INCO's court. This would have been damaging to Norwegian interests and especially to KNR.

In 1917, boom conditions had reached a peak in Norway and the BANC shares were easy to sell. Share prices seemed only to continue to rise in an economy driven by speculation.⁸³ Obligations and shares for almost four million dollars were subscribed for in BANC, which was a significant over-subscription. And finally, in the autumn, the construction work got underway.

Economic warfare hits KNR

World War I provided great opportunities for KNR in Norway and abroad. As mentioned previously, registered share capital in KNR was 1.5 MNOK and this was gradually increased to almost 5 MNOK in 1918, mainly through distribution of free shares to the owners.

In January 1916, the company was listed on Kristiania stock exchange and the share price climbed quickly above 3,000 NOK, which was three times the nominal value. By the spring of 1917, the shareholder value had reached 19 MNOK.⁸⁴ The shareholders also received dividends that equalled the original called-up capital. In this respect, KNR very much resembled the shipping companies of the boom period, which also had fat earnings from the war and whose share prices rocketed sky-high.

However, on 3 May 1917 the new roasting plant and part of the smelting plant burnt down. They were quickly rebuilt with much greater capacity than before. By Christmas the plant was ready to resume production, but alas for KNR, the good times were over.

This was a result of the tug-of-war for Norway's resources during the war. Allied diplomats were trying as hard as they could to limit export of essential war materials to Germany. This concerned, among other things, copper ore, pyrite, molybdenum, nickel and eventually fish. The allied nations' demands meant that Norwegian industry risked losing significant income. The Germans gave veiled threats of military countermeasures if there was too much restriction on exports. They also promised relief in the submarine war if the

Norwegians stood up to the pressure from the allied powers. However, Norway was completely dependent upon supplies of food, coal and oil from the west and exports to Germany were gradually reduced.⁸⁵

In November 1917, the Norwegian Government helped stop nickel exports to Germany. This came at an inconvenient time for KNR, though it came hardly as a surprise. Not only was the plant in Kristiansand almost ready to resume production after the fire, the company had also spent large sums of money searching for ore, developing and expanding mines, preparation work and smelting plants elsewhere in Norway.

Instead, KNR was ordered to refine copper. This was also a result of a conflict between Norway and the allied powers. Due to Norwegian export of pyrite to Germany during the war, the allied powers had blocked sale of copper to Norway. This led, among other things, to delays in development of the electricity network, because copper was required for cables and other electrical equipment. Pure copper was not produced in Norway, other than in small quantities, which were a by-product at KNR. From February 1918, nickel production was stopped in favour of copper production. Though KNR achieved very good prices for this copper, this did not compensate completely for the loss of income from Germany. In 1918 profit was 800,000 NOK and almost 1.1 MNOK in 1919.

The strange thing was that the shareholder value of KNR remained high, in spite of the fire and the export ban. Indeed, in the summer and autumn of 1917, there was a Kristiansand-based raid on shares in the company at a premium of 4-500%. Hybinette and Grønningsæter could no longer work with Børresen and therefore Hybinette requested David Vogt and his brother-in-law Oscar Jebsen to buy shares from, among others, the Admiral.⁸⁶ Børresen was a willing seller, he may well have known about the coming ban of nickel exports to Germany. In 1918, Vogt took over commercial responsibility and moved the head office from Oslo to Kristiansand. People with links to southern Norway took over the helm: In addition to Vogt and Jebsen the shipowners Salve Bech and Emil Stray, brewery owner Carl Christiansen, Solicitor Christian Vogt (David's brother) became leading share owners.

Vogt had previously been the company's office manager, while Jebsen owned a textile factory at Høie outside Kristiansand. He had international industrial experience and had earned his fortune in shipping. Jebsen's family was a key player in Norway industry. His father Peter had been a leading entrepreneur in the textile industry, a steamship pioneer, etc. His brother Gustav was a chemist and director of Elkem and his other brother Kristian was director of the second largest bank in Norway, Bergens Privatbank. Oscar Jebsen himself was active in another international industrial investment. The cross veneer factory Lumber &

Veneer Co. at Fiskå had made substantial investments in Brazil, though the project led to huge losses.⁸⁷

Production at KNR's plants at Evje, Ringerike and Kristiansand 1914-20, tonnes⁸⁸

	Nickel in matte from Evje	Nikkel in matte from R.rike	Nickel prod. Kr.sand	Copper in matte from Evje	Copper in matte from R.rike	Copper prod. Kr.sand
1914	458	207	794	274	118	408
1915	537	411	892	310	310	494
1916	365	352	808	273	240	554
1917	219	290	379	166	198	344
1918	128	44	33	103	31	1.254
1919	85	17	222	61	14	170*
1920	138	29	422	101	94	350

* Mine statistics do not give copper prod. in Kr.sand in 1919. The figures in the table have been calculated by Halvor Rykkelid based on the Cu:Ni ratio in the matte in 1918-19. Rykkelid emphasises that the estimate is uncertain.

In the shadow of speculation

Share trading was all about large figures, while workers' wages were all about small figures. The 1912 wage agreement applied for four years and in 1914 gave workers a 5% pay rise. However, war brought inflation and by the summer of 1915 the price level was already 15% higher than the previous year. By the time the armistice came in the autumn of 1918, the consumer price index was two and a half times higher than in 1914.

In April 1915, the Workers' Association requested payment of a cost-of-living allowance. Unfortunately, the minutes do not say how much this allowance was, only that the union thanked the management for it. In the spring of 1916, the trade union demanded 60 øre per hour for shift workers and a minimum wage of 44 øre for people under the age of 18. This demand was rejected and the union lowered its demands.⁸⁹

Again, the minutes of meeting mention nothing about the result, but according to Grønningsæter, the wage increase was 20-30%. In addition, the company paid a cost-of-living allowance of around 3 øre per hour for a spouse and for each child under the age of 18 years. Grønningsæter later wrote that: "at the time the company was trying to follow a family

friendly policy and gave allowances according to the employee in question's family responsibilities. Strangely enough, this type of classification was not very popular among the workers, possibly because bachelors were in the majority at the trade union meetings."⁹⁰ Therefore, means testing of cost-of-living allowance was dropped at the next revision of tariff.

In addition to this, the vacation period was extended and in 1912 workers were granted 3-9 days holiday, depending on their length of service. During the revision in 1916, the workers were granted 6 days holiday after one year of service, 10 days after two years and 12 days after three years. In spite of an increase in wages, the workers' purchasing power decreased. This was also the case in most industrial jobs at the time. After two-three generations with almost stable prices, people were not used to sudden inflation and it took time for them to adjust their way of thinking and to adjust to the demands of this unfamiliar situation. At the same time, the company had a higher profit than every before in its history. The total pay rises given in 1916 were actually no more than the profit the company achieved from six days of production.

The decline in real income came at the same time as the Norwegian Labour Movement entered its most radical phase. The activists wanted to pursue a line of confrontation. The union in Kristiansand joined the moderate wing.⁹¹ However, it is fairly obvious that the nickel workers could have benefited from following a more activist line, at least for a short while. The word strike does not actually appear in any minutes of meeting during the period up to the spring of 1917.⁹² KNR was making so much profit that the company had more to lose from a dispute than the workers, but no attempt was made to exploit the opportunity. The profit went instead to the shareholders and their Canadian venture.

BANC gears up the speed

The new management in KNR had acquired shares in the company at high rates and were optimistic about the future. Investments in the Norwegian nickel mines continued and in 1919 KNR also took over Hybinette's shares in the Finnish mining company Outokumpu for 2 MNOK. Outokumpu used Hybinette's copper electrolysis patents in Finland. For Hybinette, sale of his shares to KNR was a condition for devoting himself completely to the work in Canada.⁹³

Investor David Vogt knew that the relationship with BANC would be decisive for the company's future. KNR had been trying since 1917 to make requirements regarding access,

control and sales agreements, but the previous management had surrendered to the British Government its right to vote for all Norwegian shares in BANC. KNR was therefore left with no instrument of power, except from stopping further supply of capital from Norway. But this could not be done without a risk, as it could lead to bankruptcy or open the door for the nickel trust.

Grønningsæter returned to Canada in February 1918. BANC's construction work had picked up speed, but by May had only come as far as the foundations for many of the buildings. Up to July, the workforce increased to 1500, but the numbers fell again, as it was difficult to get hold of enough people. Many of the workers were called up for war service, while others were victims of an epidemic of Spanish influenza. However, the management of BANC hoped to have the mining facilities ready during the year and the smelting plant and refinery ready by the autumn of 1919, two years later than originally planned.⁹⁴

World War I ended in November 1918 and the armistice led to a fall in the artificially high demand for nickel as an armament metal. The management of KNR left for Canada in January 1919 only to be greeted with bad news. BANC needed more money. The cost estimate for 1917 had been too low and the delays had cost money. In addition, wages and material prices had also risen. According to BANC's management, it was still impossible to raise the capital in the US or England. KNR's management found itself in a fix. They either had to write off the 5.75 million Canadian dollars that had been raised in Norway or they had to raise more capital.

They chose the latter solution and in March 1919, KNR purchased debentures and shares with a nominal value of 3.5 million dollars at around 70% of the par value. Previously, most of the securities had been sold to other Norwegians, but this time KNR held onto these themselves. KNR's management and owners must still have hoped for profitability after a few years of production. KNR raised the capital through a share issue of 8 MNOK, which also helped finance acquisition of shares in Outokumpu and of Hybinette's various patents.⁹⁵

In return for the supply of capital to BANC, KNR demanded have a say in the business. One third of BANC's board members were to be appointed from among KNR's personnel, including the vice president. However, future supplies of nickel matte to Kristiansand were cancelled. Originally, this had been the reason for KNR's involvement in Canada. David Vogt claimed afterwards that BANC's production price had risen so much that the contract would have been a millstone around KNR's neck. KNR was to receive a royalty of 1 cent per pound (weight unit) of nickel production in Canada as compensation for the matte contract. However, this was not enough to compensate for the loss in income.⁹⁶

The hour of reckoning

In conjunction with the infusion of capital in 1919, KNR also demanded an audit of BANC's accounts and these turned out to hide a few unpleasant surprises. BANC had only held one annual general meeting since 1913 (in 1917) and had also only submitted one set of accounts and these apparently had very "little to do with reality". BANC's new vice president, David Vogt, found that parts of the share capital (300,000 Canadian dollars), which were supposed to have been paid in from the Canadian side, had never been paid. Following a long battle, David Vogt managed to call up more than half of this amount.

Vogt also discovered that the previous Norwegian management in KNR had had their fingers in the honey pot. In conjunction with the share issue in 1916, they had received 5 million dollars in bonus shares.⁹⁷ It was difficult to obtain accurate information, but Vogt eventually found out that Hybinette had received more than 2 million dollars and Børresen and Eyde 820,000 dollars each. The remaining 6 members of the management and board of directors, including Anton Grønningsæter, had received 90.000 dollars in shares each. In addition, they had also shared a bonus of 750,000 dollars in shares, which was a small fortune at the time.⁹⁸ All the nickel workers in Kristiansand would have to have worked for around 100 years at the refinery before they had received the same amount in wages.

Vogt was furious and demanded that KNR should be allowed to take over 5 million dollars in BANC shares free of charge and this was a condition for participating in the new financing in 1919. Børresen was immediately willing to surrender the shares he had not sold, which amounted to a nominal value of 650,000 dollars. The others were not so obliging and Sam Eyde refused point blank. Finally, the company's President Sir James Dunn handed over 1.4 million dollars in free shares, while the British Government handed over 1 million dollars and Hybinette 1.35 million dollars in free shares. Sam Eyde was eventually forced to hand over 650,000 dollars in free shares, but only in return for a written declaration from KNR that he was not obliged to do so and that no demands would be made upon him. The others each returned 40,000 dollars in shares, with the exception of bank manager Andersen-Aars, who had sold his shares. In total, Vogt and KNR managed to reach their demand in shares worth 5 million dollars.⁹⁹

New delays 1919-20

The plan was to start production in BANC in the autumn of 1919. However, problems arose with the blowers in the smelting plant and though these were solved in January 1920, new difficulties loomed on the horizon. In February 1920, the management of KNR met with Hybinette and Dunn in London. There was a new shock in store. BANC had to find more money immediately, or the company would have to stop payments. The result of the discussions was that KNR agreed to give BANC a loan of 2 million Canadian dollars. With this money there would be no “shadow of a doubt” that BANC could start full production.¹⁰⁰

KNR then sent technical personnel to Canada to solve the problems.¹⁰¹ Grønningsæter became Chief Metallurgical Consultant and subsequently Technical Director. The reason for this was not just that the refining process had been organised much along the same lines as it was in Norway. It was impossible to get help from the other two nickel companies that were active in Sudbury, as they probably hoped that BANC would fail. In addition, there was no independent nickel competence and instead, experts were headhunted from other mining and smelting industry.¹⁰² Therefore specific nickel expertise in BANC had to be brought in from Kristiansand.

Construction was finally completed with the help of KNR, but according to the investigation commission’s report on KNR and BANC: “Start of production did not bring an end to the disappointments.” David Vogt was given yet another cold shower when he arrived in Canada in May 1920. Production capacity was not 10,000 tonnes, as expected but closer to 6,500 tonnes. The teething problems were far from over and production was only 930 tonnes of nickel for the whole of 1920.

During the summer and autumn of 1920, it became clear for the fourth time that money was in short supply. KNR granted a further 300,000 dollars and a Canadian bank 2 million dollars in loans to BANC. Confidence was beginning to wear thin, however, and BANC’s creditors hired American experts to inspect the company’s facilities. The conclusions were relatively positive. Technically speaking, the facilities were good, even though a few problems still remained. But the experts assumed that when these problems were solved BANC would have nickel production costs that were 15% lower than INCO. This was primarily due to Hybinette’s superior refining method, which also helped make BANC’s nickel purer and therefore of a higher quality.¹⁰³

The next disaster was that the British Government terminated its entire purchase agreement. Now that the war was over, the country no longer needed such large volumes of

nickel. Other customers were difficult to find and in 1920 there was also a decline in the demand from the private sector. In addition, customers were tied to INCO through long-term agreements. However, BANC did manage to secure contracts with a few steel companies and KNR also purchased large quantities of nickel from BANC to keep the company afloat. In spite of this, income was far too small to cover costs.¹⁰⁴

The problems eventually threatened to cause serious consequences in Norway. More than 90% of the bonds, with a nominal value of 9.25 million Canadian dollars, were in Norwegian hands. The same was the case for shares with a nominal value of 14 million dollars, though these were free shares that the bond owners had received into the bargain. In addition to this, there was KNR's loan of 2.3 million dollars, where KNR had not been given the security it had been promised.

In September 1920, Sam Eyde travelled to London to take part in discussions with BANC's management, shareholders and creditors and also with the British Government regarding refinancing.¹⁰⁵ After long negotiations, he managed to secure a complex agreement in May 1921. In practice, this agreement meant that the previous shareholders and bondholders lost the possibility to recoup their money, which for KNR's part was around 4 million Canadian dollars. KNR also agreed to relinquish receiving royalty income from the refining process. But the agreement at least ensured a new infusion of capital to BANC. The Canadian Bank of Commerce was to renew its loan of 2 million dollars and Norwegian banks were to provide a similar loan (fresh capital), but with 1st mortgage security.¹⁰⁶

KNR totters on the brink

In 1920, KNR had an operating loss of 3.3 MNOK and the company also had outstanding debt of more than 15 MNOK, which was an increase of 8 MNOK at the end of 1919. Electricity supply was reduced due to drought, which affected production at the refinery. In addition to this, costs had risen. At the end of 1919, the wage level was four times as high as in 1914, which meant that the workers had recovered lost ground. To top it all, a strike broke out in June 1919 and production did not resume until the middle of August.¹⁰⁷

The most serious problem, however, was the loss of income. Profitable exports to Germany had dried up and the German importer refused to fulfil his purchasing contract now that the country was no longer at war. Nickel production was shut down once again and 225 of the 250 employees at Evje were given their notice.¹⁰⁸ In Kristiansand more than half the

workforce kept their jobs due to resumption of copper production in the autumn of 1920, but it didn't last long before the bottom fell out of the copper market.

KNR could probably have survived this had it not been for the losses in their international ventures. The two million dollars invested in Outokumpu was written off. Firstly, the Finnish mining company had lost its copper mines in Siberia following the communists' victory in the Russian civil war. It had also been difficult to get the Hybinette process to function well in Finland. In addition, the situation at Outokumpu had become hopeless due to huge loans, low metal prices and chaotic conditions following the civil war in Finland. As if this wasn't enough, the Finnish management wanted to throw out the Norwegians with the help of the authorities.¹⁰⁹

KNR failed in three areas as regards Outokumpu. It did not have enough capital to solve the problems that arose; it lost control of the local management and it could not provide enough technical support to ensure that the plant achieved full production. However, BANC was the enfant terrible and as in Outokumpu, the lack of capital and control was fatal. And though the technology eventually functioned, the lack of nickel competence led to delays and increased costs. BANC shares plummeted in value and became almost worthless. In addition, KNR had borrowed money, which it then lent to BANC. As BANC did not manage to pay the interest, KNR was the one that had to take the heat.¹¹⁰

The road to bankruptcy court

"In the last year, the nickel market has hit absolute rock bottom. ... Our plant has not been able to produce nickel". These were the opening sentences of the KNR's annual report 1921. Copper production did continue, even if this was at a loss. However, there were a few bright spots. The company was sitting on "quite good stocks" of nickel concentrate and broken ore. The mines were ready for several years of production without requiring special investments, so if the markets could only improve, there were still possibilities.

In 1919, Sigurd Giertsen was appointed Managing Director after Grønningsæter, who was in Canada. Giertsen was a chemical engineer who was educated in Darmstadt in Germany. He had been a production engineer and manager in electro-chemical companies in Odda. The main reason why he was chosen was probably his family connection with investors David Vogt and Oscar Jebsen,¹¹¹ but he was also a skilled engineer. Giertsen threw himself into the company's development work and took out several patents himself.¹¹²

The banks' representatives joined the board of directors of KNR, as they wanted to protect their interests in the struggling nickel company. KNR was suspended from the Stock Exchange and the shareholders were on the verge of uproar. "There has been a web of deceit and slander," David Vogt complained to Grønningsæter. At the next annual general meeting, most of the businessmen from Kristiansand were thrown out from the board and the KNR-management, including Vogt. In retrospect, it is difficult to have a complete overview of the battles between the shareholders. However, it would appear that Børresen-Eyde-Hybinette and the furious investors, who had lost money, were behind this manoeuvre.¹¹³

1922 was as bad as the year before, but 1923 brought a glimmer of light to an otherwise bleak horizon. Firstly, KNR entered into an agreement with its creditors so that 95% of the debt was written off. At the same time, the share capital was correspondingly reduced.¹¹⁴ Secondly, drastic cuts were made in wages and workforce.¹¹⁵ Thirdly, global demand for nickel began to grow again. INCO, British Mond Nickel and BANC resumed production.¹¹⁶ Optimism spread to Kristiansand and KNR resolved to start new production, but there was a lack of capital and no one was willing to give the company operating loans.¹¹⁷

BANC won a number of contracts with American steel companies, which made it a threat to INCO, who replied with a price war.¹¹⁸ Income was again too small to cover costs, something that INCO could live with, but the ailing BANC could not. One source mentions that BANC also experienced new technical problems. At this stage even minor difficulties could have disastrous consequences.¹¹⁹

In addition, BANC faced a lawsuit. During the reorganisation in 1921, the original owners in the company had been "squeezed" out. One of these was demanding 625,000 dollars plus interest as compensation. The claim made it impossible to raise new loans and BANC went bankrupt in July 1924.¹²⁰ Even though the price of nickel rose soon after, attempts to salvage KNR failed and in April 1926, the facilities, patents and ore deposits were sold in a forced sale. Thus the curtain closed on the first act in the history of the refinery.

4. THE SCANDAL – AND THE CONSEQUENCES

Following the bankruptcy in BANC, Norwegian losses totalled 33 million kroner.¹ In addition to this, there were bad debts and lost share capital in KNR totalling more than 20 million. In total this equalled an eighth of the national budget or more than 1% of the GNP. The nickel affair was one of the biggest industrial and financial scandals in Norwegian history. For Kristiansand it was a minor catastrophe.

In October 1921, Norges Bank (Bank of Norway) commissioned an investigation of the nickel business. Norges Bank had guaranteed some of KNR's loans to BANC and considered further support to the company. The report was damning and showed that BANC had actually been on the verge of bankruptcy already in 1916 and that the shareholders had been misinformed. It also exposed that KNR's management had mixed their own private finances with those of the company in an unethical way.²

In February 1922, the Blehr (Liberal party) Government set up an investigation committee, the so-called Nickel Commission whose report is our main source of KNR and BANC's history during these turbulent years. The Commission disclosed the following. In 1914, the owners of the Canadian ore deposit made a fictitious sale of the nickel deposit from a company called PSC to BANC, but the owners remained the same. The only change was that BANC owed PSC 20 million Canadian dollars. At the time, BANC had no liquid reserves and no development of the deposit had been initiated.

The situation remained the same when the negotiations between Sam Eyde and Jacob Børresen and BANC were concluded in 1916. As mentioned previously, the outcome of these discussions was that Eyde and the board of directors in KNR received free shares in BANC worth a total of 5 million dollars. At the same time, they issued an invitation to subscribe for bonds and shares in BANC, but Eyde & Co. bought almost none of these securities

¹ 39 million kroner was spent on share acquisitions, loans and guarantee liabilities in BANC, which equals 12.7 million Canadian dollars. However, there are different figures with regard to the Norwegian losses. These vary according to the dollar exchange rate. If we use the exchange rate from July 1924, 12.7 million dollars equalled 91 million kroner. Following BANC's bankruptcy, 1st priority creditors received 70% of their receivables covered and Norwegian creditors received 6.3 million kroner. The creditors' losses were in addition to the loss of KNR's share capital. In 1923, the company had 42 million kroner in unsecured debt, of which much of this was guarantee liability for BANC and therefore not calculated in the Norwegian losses in BANC. In an agreement with the creditors in 1923, the unsecured debt was written down to 300,000 kroner. Sale of KNR in 1926 covered this and the priority debt of 270,000 kroner.

² The National Archive, Norges Bank's archive, report to the board of directors of Norges Bank in Christiania, "Ad Kristiansands Nikkelraffineringsverk" 12/10/1921.

themselves, nor did they inform about BANC's 20 million dollar debt. It was later revealed that the Norwegian capital had not been spent on starting development.³

The Nickel Commission also strongly criticised subsequent development and especially the business ethics. There were constant conflict of interests, all the way from the initial negotiations between Pearson and KNR, when Sam Eyde acted as the representative of both parties. It was partly due to HUN (Hybinette's foreign nickel patents) that KNR was lured into the Canadian project. If BANC had started production with the Hybinette process, the HUN owners (Hybinette, Børresen, Eyde and Hans Olsen) would have received significant patent income. In Allied Metal Selling Company, Sir James Dunn, Hybinette and Børresen started to run a "business within a business" to an even greater extent. They formed their own sales organisation, which was to take two per cent of the sales, without informing the other shareholders.⁴ In addition to all this, there was KNR's recklessness with money. The management allowed itself staggering fees, but Sam Eyde probably went furthest of them all by receiving 225,000 kroner for a three month trip to Canada.

The Commission concluded that the Norwegian investors in BANC had been misinformed at almost every turn. The Norwegian management was also partly unaware of what was going on in Canada, but still issued promising reports, and therefore new millions continued to be invested.⁵

Why did they not give better information? To a certain extent this may have reflected the business ethics of this boom period, when manipulation of share prices was not uncommon.⁶ In the case of KNR, it is also easy to see that the management had a personal interest in giving misinformation. The original founders wanted to use the Hybinette patents abroad, but were later most likely tempted by the profit from free shares. Perhaps David Vogt and his men acted more through desperation when they discovered the real state of the affairs. They had purchased shares in KNR at a premium in 1917 and felt cheated. If they did not manage to raise more capital for the Canadian plants, everything would have been lost. Therefore, it was also important for them to conceal the bad news as long as possible.

³ The Nickel Commission, p. 12ff.

⁴ The Nickel Commission, p. 66ff. Sam Eyde was involved in the preliminary discussions about the Allied Metal Selling Company, but withdrew. He perhaps foresaw that problems would arise. At about the same time, he also sold himself partly out of KNR.

⁵ Annual Reports BANC 1919-21. The Nickel Commission, p. 151ff.

⁶ Hans Christian Erlandsen, "Jobbetiden" in Oslo Børs, *Kapitalkilde for næringslivet, Oslo Børs gjennom 175 år*, Oslo 1994, p. 87.

”Such a large carcass cannot left to lie and rot”

The nickel affair was debated in the Norwegian Parliament in July and August 1924. The Nickel Commission had asked the public prosecutor to investigate the matter in order to assess criminal liability, but he found nothing illegal. The question now was whether the Norwegian Storting would send the matter to the prosecuting authority.

Svend Svensen from the Norwegian Conservative Party in Kristiansand opened the debate with searing criticism of KNR and BANC. He was followed by Olav Sæter MP from the Labour Party: ”I’ve read many fraud stories from England and the US; but when I read the Nickel Commission’s findings ... I found that fantasy paled in comparison with reality. ... An affair of such dimensions cannot be hidden behind protocol. Such a large carcass cannot be left to lie and rot. The Nickel Affair must be taken to court.”⁷

Alfred Madsen (Labour) said that when a worker does something wrong ”he is immediately arrested, ... but when it comes to those sitting in the top echelon of society and who have swindled away millions of dollars ... then it is covered up and buried in one committee and commission after another”.⁸

Christian Fredrik Monsen of the Norwegian Communist Party continued with an argumentation about class justice. He believed that there “had been strong forces at work to prevent full publicity of the affair and that a lot of money had been spent.” Monsen did not believe that the prosecuting authority would act independently and more than indicated that the matter probably would be dropped once again.⁹

Criticism was strongest from the Socialists. The Conservatives were significantly more subdued. This was possibly done in an effort to protect their own government, which had dealt with the matter, because some of those involved belonged to the party. Eyde had been a member of parliament for the Conservative Party. Several speakers also mentioned the ”debt of gratitude our nation had to the industrialist Sam Eyde”. It was also pointed out that BANC was not a unique phenomenon during the war’s speculative economy. The affair was unique due to its magnitude.

However, during the discussion both the conservatives and liberals said that the Norwegian Storting should not go too far in instructing the prosecuting authority, as this would break with constitutional principles. The Storting was split in half on this matter, but

⁷ Parliamentary debates 1924, vol. 8, p. 653. The statement about a carcass was a quote from assistant secretary Lassen in the Ministry of Justice.

⁸ Parliamentary debates 1924, vol. 8, p. 661.

⁹ Parliamentary debates 1924, vol. 7b, p. 3139-3141.

with the casting vote of President of the Storting, Lykke (Conservative) it was decided not to request an investigation. And the matter was dealt with just as Monsen from the Communist Party had feared. Following a round of judicial examinations of the people involved, the matter was dropped once again.¹⁰ The carcass was left to lie and rot.

Implications for the Norwegian business system and for local society

Joh. N. Tønnessen wrote in the history of Kristiansand that the collapse of BANC came as a shock.¹¹ The shareholders and creditors had been blinded for a long time with optimistic reports, promising prospects and high share prices. It is not surprising that mistrust and anger grew when it was no longer possible to conceal the difficulties.

This, and similar affairs, cast a shadow on the equity market for a long time to come and also helped to change Norwegian society and Norwegian capitalism. Before 1920, financial investors and industry builders, such as Eyde and Børresen, had had quite free reins, but these were subsequently tightened significantly. The scandals weakened the legitimacy of the industrial bourgeoisie and probably intensified the general radicalisation at the time. Just as important in our context, it became near impossible to raise capital for new Norwegian ventures in the nickel business.

Locally, the nickel affair threw Kristiansand into a deep crisis. Many of BANC and KNR's owners, creditors and guarantors lived there and big investors, such as David Vogt, Oscar Jebsen and Emil Stray, had lost millions of kroner. The nickel affair also led to the downfall of Kristiansand's largest bank, Søndenfjeldske Privatbank. This bank collapse shockwaves through the local community as it hurt a large number of businesses and small savers. Even the foundations of the powerful Central Bank in Norway were shaken as a result of its total nickel engagements of 20 millions. Seven of these millions were reputedly lost when Hybinette went bankrupt.¹²

KNR's problems also hit the municipality of Kristiansand. Firstly, the company has been the largest taxpayer in the city and from 1911 to 1920 had paid a total of 3.3 million kroner in tax. This was now reversed and in 1920-21 the company was remitted more than 1.5

¹⁰ For more details on the political repercussions, see Sandvik 2005, p. 71-75.

¹¹ This and the next paragraph are based on Joh. N. Tønnessen, *Kristiansands historie 1914-39*, Kr.sand 1974, p. 149-54.

¹² Nicolai Rygg, *Norges Bank i mellomkrigstiden*, Oslo 1950, p. 72. Tønnessen 1974, p. 14-15 and 150. Bank of Norway's losses included loans to KNR and BANC, loss of own shares and loans to the many investors.

million kroner in tax in order to stay on its feet. The state remitted most of this, while the municipality remitted 180,000 kroner.

Secondly, the basis for the municipality of Kristiansand's modernisation strategy also disappeared. The municipality had invested heavily in hydro-power development. The fall of KNR meant that the municipal electricity company lost its largest customer. The electricity company therefore ended up with unused capacity and a huge deficit. In fact, the deficit was greater than the municipality's total allocations to education and poverty relief.¹³

Due to the nickel affair and the crises in world shipping Kristiansand was one of the most depressed cities in Norway in the 1920s. The consequences spread like rings in water and the city's other commercial bank, Sørlandets Kreditbank, was forced to close its doors. Tønnessen concludes in his history of Kristiansand that there were few households that did not pay directly or indirectly for the consequences of the collapse: "There was not even a maid in Kristiansand that had not been affected."¹⁴

This catastrophe had important bearings also for our story – as it provides a key to understanding Falconbridge's subsequent role in local society.

Was BANC viable?

It is easy to get the feeling that everything that could go wrong, did go wrong in BANC. The Norwegian shareholders sat with no authority or influence, the schedule was overrun, there were technical problems and a decline in prices and to cap it all there was the financial dodging.

However, at the outset Jacob Børresen and Sam Eyde probably had sincere faith in BANC's business concept. During the period 1911-14, INCO had an annual profit of 5 – 7 million USD and production increased during the same period from 15,000 to 25,000 tonnes per year. During the war, the company doubled production and tripled its profits, so it was therefore not inconceivable that BANC could do well with its efficient process and large ore deposits. It could also have paid interest on the debt of 20 million Canadian dollars to the previous mine owners. At that time it was difficult to foresee all the difficulties and the subsequent collapse of the nickel market.

¹³ Pål Thonstad Sandvik and Espen Andresen, *Kristiansand Energiverk i elektrisitetens århundre 1900-2000*, Kr.sand 2000, p. 61ff. Pål Thonstad Sandvik, "Kommunale e-verk og store industrikunder", in Harald Rinde and Lars Thue, *Samarbeidets kraft. Elforsyning og bransjeorganisering 1901-2001*, Oslo 2001.

¹⁴ Tønnessen 1974, p. 53-55 and 150-54.

How far were Eyde, Hybinette, Børresen and Vogt from being successful? In spite of all the difficulties, BANC eventually started production in 1920. However, it was difficult for the newcomer to establish itself in a market with falling demand and full stocks of nickel. Even nickel giant INCO stopped production for a whole year.¹⁵ Therefore, it was understandable that BANC was forced to do the same.

Unlike INCO, BANC did not have a sales organisation and a financial muscle to resume permanent production. INCO also lowered its prices to squeeze out its new competitor.¹⁶ However, it was not until BANC was ordered to pay huge compensation to one of its former shareholders that the company finally went bankrupt. INCO purchased the facilities and patent rights for five million dollars.¹⁷

At that point there were substantial assets in BANC and the company lacked mostly trust and operating capital. Five years later, one million dollars in operating capital was enough for the newly established Falconbridge. BANC was three times as large and probably required correspondingly more capital. It was no longer possible to raise so much money in Norway, as there were hard times and too much distrust for that.

Grønningsæter later stated that BANC had a strong technological potential. He made a point of the fact that most of the technical management was competent. The BANC management subsequently took up leading posts in INCO, Noranda and Falconbridge and CEO Sir James Dunn eventually became head of Algoma Steel.¹⁸ Grønningsæter believed that the fault lay in the early choices of strategy in BANC. These caused delays during the war and contributed towards the subsequent lack of capital.

BANC's failure also strengthened the monopoly trend in the nickel industry. INCO took over both the company's production capacity and the North American rights to the efficient Hybinette process. From 1925 onwards, INCO operated at a significant profit and four years later, it consolidated their monopoly status through purchase of British Mond Nickel Co.¹⁹ Following this takeover, the group controlled more than 90% of the global production, but at that time another newcomer was already on the way.

¹⁵ Matt Bray and Angus Gilbert, "The Mond-Inco Merger of 1929: A Case Study in Entrepreneurial Failure", *Can. Historical Review* 1995, p. 25.

¹⁶ O. Main, *The Canadian Nickel Industry*, Toronto 1955, p. 96-97.

¹⁷ Letter from N. Rygg in Norges Bank to Christianssands Sparebank 18/08/1924 with attachments "Agreement between Norges Bank & The Canadian Bank of Commerce and INCO 25.07.1924" in an envelope marked "BANC Sparebanken".

¹⁸ James Colussi, *The Rise and Fall of BANC 1913-24*, Sudbury 1988, pages 81-82, 187-88. Duncan McDowall, *Steel at the Sault*, Toronto 1984.

Conclusion

The Canadian failure marked the end of a formative phase in the Norwegian nickel industry. Due to systemic weaknesses in corporate governance and very questionable business ethics the losses in Canada became so massive that it drove the otherwise viable and profitable KNR to bankruptcy. In spite of having a world class refining process and substantial human resources it proved impossible to finance another Norwegian based nickel company. There was simply no investor confidence left. As we will show in the next chapter, production only continued at small scale at the mines and smelter at Hosanger and Evje and at the Kristiansand refinery. The Ringerike mine was closed and development of Høiaasen and Beiarn was never resumed.

This lack of capital and confidence opened the door for foreign investors. They were more than welcome. As we have seen, the enormous financial losses in BANC and KNR had been an economic catastrophe for the local society in Kristiansand. The municipality worked therefore hard to attract new industries and investors to the city. Cheap hydro-power and favourable tax agreements were offered. If the collapse of BANC marked the end of one formative phase in the Norwegian nickel industry it also opened for another, namely the arrival and embrace of outside investors.

¹⁹ Matt Bray and Angus Gilbert, "The Mond-Inco Merger of 1929: A Case Study in Entrepreneurial Failure", *Can. Historical Review* 1995, p. 19ff.

PART 2. SUBSIDIARY IN A CANADIAN COMPANY

In 1932, the new Kolsdal stack in Kristiansand continued to extend skywards. In the middle of the depression, the Canadian company, Falconbridge Nickel Mines Ltd., had started major expansions to its newly acquired nickel refinery and the bricklayers arranged a topping-out ceremony, 116 metres above the ground. The stack and the smoke signalled business, work and prosperity in a hard-pressed city.

In 1926, the nickel refinery and the small mines at Setesdal, Hosanger and Ringerike had been sold through a compulsory sale. The buyer was a Norwegian-German consortium that had neither the capital nor enough nickel matte to exploit the refinery to the full. In the next chapter we will look at how and why newly established Falconbridge came onto the scene. Anton Martin Grønningsæter played a key role once again and Canadian ore resources were again linked with Norwegian refining competence. The pattern was more or less the same as with BANC, the only difference was that this time the Norwegian ownership was insignificant.

What consequences did the change of ownership have? The history of Falconbridge can give us an insight into something important. Most of the Norwegian process industry was in the hands of foreign owners and little effort has been made, at least at company level, to investigate the consequences of this.

Falconbridge was no average company, and as we will see, it had its peculiarities with regard to ownership, management control and the distribution of know-how. To the main owner, Thayer Lindsley, Falconbridge was only one of several companies in which he was involved. Preferably, he wanted to use money from Falconbridge to finance his other projects. At times, almost the entire profit was paid out as dividend to the shareholders. This meant that the management had to fight to keep the resources within the company – and to spend the funds on things that were important to Falconbridge and the Kristiansand plant.

From our view-point, the tug-of-war between the Norwegian and Canadian interests is perhaps the most exciting. The question of moving some of the refining to Canada soon arose, but Grønningsæter fought the whole time for further expansions in Norway. It was important for the business in Kristiansand to keep up with technology, to protect own interests and to keep costs down.

However, the biggest challenge of all was to survive. In previous chapters we have seen how a nickel cartel controlled the world nickel market. Market power was consolidated

further when the two largest producers, INCO and Mond Nickel Co., merged into one company, which in 1929 represented 90% of the world's nickel production. The merged company also maintained its old alliance with French Le Nickel.

In spite of INCO and Le Nickel's almost total monopoly and the onset of the depression: Falconbridge became a success. In Kristiansand the workforce increased from 150 men in 1930 to almost 600 in 1939. By the end of the decade, every fourth industrial worker in Kristiansand earned his wages at the nickel refinery. Falconbridge became the largest industrial workplace in the South of Norway and production capacity had more than tripled since the start in 1929-30.

The Labour Movement gradually became a more important power factor than before, at a local as well as national level. This changed Norwegian capitalism, as no company manager could avoid the trade unions. However, at Falconbridge's production plant in Canada, trade union activities were banned. A kind of "fire and hire" principle was followed there, where people were fired as soon as they became superfluous. This was something that was no longer possible at its refinery in Norway. On the one hand, this led to increased costs, but on the other hand we will see that it may have developed a greater sense of responsibility – on both sides of the table – than at the parent company's plant in Sudbury.

From the 1930s onwards we have an abundance of sources regarding wage and workforce issues, with material from the trade unions and the company management. What influence did the head office in New York have on wage settlements and on the lives of the Norwegian nickel workers? How much was decided locally? In such questions, different considerations had to be balanced against each other: the group's financial freedom of action, the owner's required return on investment, the local management's ambitions and not least the political situation in Norway. We will soon see that these various factors could give quite paradoxical or unexpected results.

The outbreak of World War II turned everything upside down. Nickel was still an essential war material and from day one Falconbridge was part of the British-Canadian blockade of Germany. This phase did not last very long though, as Norway was occupied in 1940. The Germans took control of one of the most strategically important companies in the country. But before we start on the company history during the war, we will return to the adverse times in the 1920s.

5. FALCONBRIDGE TAKES OVER

Falconbridge is located northeast of the mining town of Sudbury in Ontario, Canada. Thomas Alva Edison was the first to try to exploit the nickel deposit in 1901, as he was interested in using nickel in batteries. When the shaft reached a depth of 80 feet, the workers were surprised by large quantities of quicksand and Edison gave up the project. Mining investor, E. J. Longyear, eventually took over the mine. Longyear also had interests on Svalbard, where he even had a mining town named after him. During World War I, Longyear's staff established that there was a relatively high nickel content in the Falconbridge deposit, but he sold this onwards without preparing for any production. The end of the war and the subsequent collapse of the nickel market meant that opening a new nickel mine would be very risky.

However, the Falconbridge deposit was not forgotten and a couple of managers in BANC were in favour of establishing a low-cost nickel producer, based on the ore deposits in Falconbridge and the refinery in Kristiansand. At the same time, a few of the old shareholders in KNR tried to start new production at Evje, Hosanger and in Kristiansand, based on the concept from 1910-11. Personal animosity blocked co-operation between the two groups. Both had problems finding sufficient capital, and in the end neither side got what they wanted.

Cadillac, cartel and control

The military demand for nickel dried up after the end of World War I, but civilian demand for nickel grew through the 1920s, though from a fairly low level and most of the nickel was used in various alloys. In iron and steel alloys, nickel (sometimes together with chrome and molybdenum) gave more impact resistance, hardness, tensile strength, wear resistance and resistance to fatigue. Up to 6% nickel was used in structural parts that had to tolerate special loads in cars, plane engines, railway material, bridges, etc. Stainless steel containing nickel was introduced in 1913 and was increasingly used throughout the post-war years.

In 1919, Cadillac began using 1.75% nickel in its cylinder blocks and pistons, which was the first commercial use of nickel in cast iron. After the crisis in the car industry subsided in 1922-23, Cadillac's example spread in Detroit and eventually to similar industry elsewhere in the world.¹²¹ By 1924, the old production records for the nickel industry were broken and

up to 1929 global production increased by an additional 70% and reached a total of 70,000 tonnes per year.¹²²

BANC's bankruptcy in 1924 brought an end to direct competition and the old nickel cartel and fixed prices were revived. As mentioned previously, the two dominant companies, INCO and Mond, merged to a new conglomerate in 1929, which produced a total of around 90% of the world's nickel.¹²³

Both INCO and Mond had put a lot of research into extending the areas of application for nickel alloys. In addition, they conducted a energetic information and marketing campaign to capture potential customers. As they had control of the market, they were fairly certain of reaping the benefits themselves. In 1924, INCO implemented a seven-year expansion program with a cost framework of 50 million USD.¹²⁴ This figure alone says something about the power situation in the nickel industry, as it was almost 10 times more than what was required to get Falconbridge underway in 1929, including mines and a newly constructed smelting plant. The figure was also more than 100 times more than what was required to resume production in KNR's old plant at Evje and in Kristiansand.

Intermezzo with Raffineringsverket A/S

In 1926, KNR sold all its property, mining and patent rights for 600,000 NOK, which was less than 5% of the insurance value. The management of the new consortium comprised KNR's last General Manager, Sigurd Giertsen, and his brother-in-law, timber merchant and captain, Roal Breien. Breien's fellow officer, Major Eivind Eckbo, was also part of the team.¹²⁵

However, they only managed to raise 200,000 NOK in share capital. Firstly, nickel had become so steeped in scandal that no one dared to invest money in it. And secondly, there was antagonism between the potential investors. Grønningsæter and his colleagues deeply mistrusted Giertsen. Even in the spring of 1926, Grønningsæter had hoped to be able to take over with the help of, among others, Otto Børresen (the admiral's son), general manager Georg Simonsen, brewery owner Carl Christiansen and possibly Sam Eyde.¹²⁶ If he had managed to do so, development of the Norwegian nickel industry could have followed a different path. Grønningsæter's aim was to create a company with both Norwegian and American share capital.

His plans failed when Giertsen got two German industrial companies to join the owners. However, neither Giertsen nor the Germans had Grønningsæter's network of contacts

in the North American mining industry nor did they have any knowledge of the mining rights in Sudbury. However, with the help of the Germans' investments of 400,000 NOK, it was possible to resume production. Freiherr von Hagen was appointed General Manager with special responsibility for taking care of the German ownership interests. Mining was resumed at Evje and in Hosanger outside Bergen. The mine at Ringerike was kept in reserve, but KNR's mines elsewhere in Norway were abandoned. The smelting plant at Ringerike was also closed down for good. Instead, all the ore was melted at Evje before being sent to Kristiansand for refining.

Raffineringsverket A/S also purchased inexpensive scrap metal containing nickel. By doing so, Giertsen hoped to avoid or at least reduce the problem of low nickel content in the mines at Evje. The refinery started production in the autumn of 1927 and nickel production reached 591 tonnes the following year. According to Halvor Rykkelid's information, the mining activity at Evje was more extensive than in the boom period around World War I.¹²⁷

The hourly wage at the refinery was around 80 øre. In comparison, a litre of milk cost around 30 øre. It did not take long, however, before problems arose between the management and the trade union. Shop steward August Davidsen was dismissed in November 1927. In spite of pressure from Norsk Kjemisk Industriarbeiderforbud (the Norwegian Association of Chemical Industry Workers), Giertsen and production engineer Hans G. Martens refused to reinstate Davidsen and due to the situation at the time, the union did not dare to push the matter further.¹²⁸

Giertsen made Raffineringsverket a member of the National Employers' Association in February 1928, though membership meant that he had to accept the agreed rules of the game of business. Following an arbitration award, the rates from the electro-chemical industry were also made applicable at the refinery, i.e., an hourly wage of around 1 kroner and 15 øre.¹²⁹

However, the company lacked money to pay the wages and the arrears increased through the autumn of 1928. According to the oral tradition at the refinery Hans G. Martens gave the workers an advance from his own pocket so that they could manage. His wife also helped as much as she could.¹³⁰ It was not until almost Christmas that the company paid the workers what it owed them. There were an increasing number of complaints about the working environment and the dust problem was particularly severe around the crusher and the furnaces and many workers in the electrolysis area had problems with nickel allergy. Therefore, the union contacted the Factory Inspectorate with a request to inspect the plant in order to implement improvements, if possible.¹³¹

The fundamental problem for the refinery was that it did not have enough capital. The company was forced to live from hand to mouth and at times did not have enough money for production and wages, not to mention the necessary modernisation and maintenance. There was also a lack of nickel concentrate so that the company never managed to establish stable production. This in turn led to high costs per tonne nickel.

In addition to this, the company developed technical problems. Use of scrap metals created problems and introduced undesirable substances into the process, which both delayed production and damaged the finished products. In this situation, the Germans broke their promise of an extra infusion of capital. The outlook looked bleak for the company when the flotation plant at Evje burnt down in January 1929¹³² and interest in newly established Falconbridge came just in the nick of time.

From BANC to Falconbridge

The collapse of KNR and BANC shattered many dreams, ended careers and sent savings up in smoke. Anton Martin Grønningsæter suffered all of these. Since he also had guaranteed BANC's loan he had to sell his house in Kristiansand. And due to the infamous free shares and all the financial wheeling and dealing, all those who had been involved in the BANC affair were disgraced.

Grønningsæter still believed in the nickel industry and together with BANC's former mining engineer, Horace L. Roscoe, he began planning a small nickel company in 1924-25. Roscoe was familiar with the Falconbridge deposit and knew that it contained a rich section. Grønningsæter prepared plans for an inexpensive smelter, with the same layout as the Ringerike smelter. The idea was to refine the nickel matte in Kristiansand.¹³³

However, the new owners of the deposit, the Bennett group in Minneapolis, were not interested. If the most valuable part of the deposit were mined first, it could be difficult to maintain stable production later. Most of this deposit had a poorer nickel content than INCO's deposits and it was even poorer than BANC's disastrous mines. Grønningsæter did not dare start large-scale production, as this would have required more capital. In addition, he had to be careful not to challenge INCO in order to avoid a new price war.¹³⁴

In 1924-25, Grønningsæter worked at the old inventor and nickel entrepreneur, Victor Hybinette's small pilot plant in Wilmington, but this did not generate a steady income. Hybinette developed new nickel alloys, but without making a major commercial

breakthrough.¹³⁵ In 1925, Grønningsæter got a job with Detroit Smelting and Refining Works, which was a scrap iron works. This work probably gave him a good knowledge of both the steel and the car industry, which were two of the main nickel consumers.

A new boom in Canadian mining industry began in 1926. This was for a large part financed by American investors.¹³⁶ Russell Bennett and his partners were among the most prominent investors in the North American mining industry. In 1927, Grønningsæter moved to Minneapolis to make plans for Falconbridge and in the spring of 1928, he travelled together with Russell Bennett to Kristiansand in order to acquire “Raffineringsverket”. However, the German-Norwegian owners were not interested in selling. Sigurd Giertsen, who was the new general manager of “Raffineringsverket”, also had a very strained relationship with Grønningsæter after the turbulent period in KNR. The refusal to sell was a disappointment for Grønningsæter and Russell, as building their own refinery would require large additional investments.

In the early summer of 1928, mining speculator and entrepreneur Thayer Lindsley arrived in Minneapolis together with his mining engineer, J. Gordon Hardy. Lindsley was educated as a geologist and is described as a skilled specialist. In addition, he had obvious strategic abilities as an investor. Based on Grønningsæter’s letters, it would seem that Lindsley could also be a difficult man to deal with. Among other things, Lindsley carried out systematic geophysical ore exploration in the wilds of Canada, i.e. exploration for ore using magnetic methods. According to Grønningsæter, he also had a unique nose for things. Based on one set of samples, he could usually decide whether a deposit was interesting or not. Over the next ten years, Lindsley used his knowledge to buy up ore deposits. And through 50% ownership in the investment company, Ventures Ltd., he controlled substantial mining interests. At the top of his career Lindsley controlled 15 mining companies, 20 companies that were in the process of being built up and 145 ore deposits. But in the summer of 1928, Lindsley was a newcomer to the North American mining industry.¹³⁷

Lindsley and his company, Ventures, offered 2.5 million dollars for the Falconbridge deposit. According to Grønningsæter, Russell Bennett did not want to sell, but his co-investors forced the sale through. Lindsley’s second in command, Gordon Hardy, visited Grønningsæter and was informed of his nickel production plans. In the meantime, the refinery in Kristiansand was also put up for sale.

Grønningsæter became Lindsley’s metallurgical advisor. Without Grønningsæter’s involvement, Lindsley would probably not have purchased, extended and modernised the plant in Kristiansand. Grønningsæter also prepared drawings of the new smelter that had to be built

in Sudbury. Like BANC, Falconbridge was based on a marriage of Norwegian nickel competence and Canadian ore resources, but this time without Norwegian capital.

Falconbridge takes over

It was an advantage for Falconbridge that the refinery was located in Norway, at least during the company's start phase. The main reason for this was that INCO (following BANC's bankruptcy) owned the patent rights to the Hybinette process for North America. Until the rights expired, this would have created difficulties for a possible new refinery in Canada. It was also possible to get production underway more quickly in Kristiansand, where there was a finished plant and personnel with technical know-how.

In addition to this, there were cost considerations. Both the wage level and electricity prices were significantly lower in Kristiansand than in Canada. Falconbridge planned to sell nickel on the European markets and it actually did not cost much more to transport the matte in large volumes to Kristiansand and the finished nickel in single consignments from the refinery to the customers than to send similar single consignments directly from a Canadian refinery to Europe.¹³⁸

However, Director Giertsen in "Raffineringsverket" was a tough negotiator and he knew that Falconbridge needed the refining capacity and that any other alternative would be more expensive for the new Canadian company. He insisted on a high price, even though "Raffineringsverket" was doomed.

Giertsen received 1.5 million NOK for the refinery, in addition to a favourable refining contract. Falconbridge was to refine the matte from Evje at a low price for several years ahead. Giertsen's company held onto the smelting plant and the mines at Evje. Falconbridge had little interest in taking over the mines there, as the nickel content was so much lower than in Canada.

However, it was also in Falconbridge's interests that "Raffineringsverket" continued production at Evje. Firstly, Falconbridge was ensured extra supplies of nickel matte and secondly, the slag from the anode furnace at the refinery in Kristiansand could be sent to the smelter at Evje, which secured reasonable extraction of the remaining nickel content. Even though there were frequent differences of opinion between the two companies, they had mutual benefit of each other. "Raffineringsverket" was closed down in 1946, thus bringing to an end 75 years of nickel production at Evje.

In Kristiansand production capacity was doubled to 2,500 tonnes of nickel a year and everything was organised to facilitate subsequent expansion to 4,000 tonnes. This was no longer a question of partial exploitation of the Falconbridge deposit, but of full production. This meant that the refinery had to be expanded correspondingly. In addition to the new buildings, the work also involved a lot of extraordinary maintenance. This had been given less priority since 1919, due to financial difficulties.

Falconbridge allocated 500,000 USD, i.e. 1,865,000 NOK towards upgrading and expansion of the plant in Kristiansand. In the middle of September 1929, Grønningsæter reported to his superior, Gordon Hardy that the financial calculations would hold.¹³⁹ Grønningsæter apologised that there had not been time to send invitations to tender for much of the work. The main contractor, Høyer-Ellefsen, also received an extra 50,000 NOK to get the work done in record time.

The changes in the refining process were relatively modest. The matte from Canada contained more iron than the matte from Evje and therefore required iron precipitation. A more demanding change was use of water gas to reduce some of the nickel oxide in the filter cake to pure nickel. This was less costly than sending everything through the anode furnace. Engineer Ivar Hole, who had previously worked with this at KNR, was granted leave of absence from Christiania Spigerverk to help Falconbridge.

There was a relatively low degree of mechanisation at the plant and the wage level was half of the level in Canada. It was therefore often more profitable for the company to employ more people than to use expensive equipment. Though a couple of trucks were hired and a few electric cranes were installed, much of the internal transport was done using trolleys that were pushed manually or using wheelbarrows. Most of the work operations elsewhere in the plant were also done more or less in the same way as in 1919-20. Just like before, the refinery combined advanced chemical technology with simple, inexpensive solutions, which were based on hard physical labour.

The new management in Kristiansand

Sigurd Giertsen resigned when Falconbridge took over. He had been head of the nickel refinery since Grønningsæter left for Canada in 1919 and had subsequently been involved in establishing new production, through with varying success. Giertsen continued as general manager of Raffineringsverket A/S from 1929, i.e., for the company that owned the mines in

Setesdalen and Hosanger and the smelting plant at Evje, a company in which he also had ownership interests.

Grønningsæter took over management at the refinery during the first few months, as it was he who had contact with Lindsley and Hardy. He also mastered the refining technology better than anyone else. He must also have had good organisational skills. He persuaded key people from KNR and BANC to leave their jobs or take leave of absence to work at Kristiansand. Grønningsæter also had the necessary contacts in local industry and commerce, in the municipality and in the electricity company to secure sub-contracts, power supply, tax agreements, etc.

In the Falconbridge group, Grønningsæter was given the title "Consulting Metallurgist", but in reality he had a fairly wide and flexible area of responsibility. Once the busy start-up phase in Kristiansand was over, Grønningsæter was constantly travelling between Falconbridge's various plants and offices, sub-contractors and customers. In addition, he was technical advisor to the group's main owner, Lindsley, and was constantly being sent to inhospitable mine sites in Northern Canada. Grønningsæter eventually settled down in New York where Falconbridge established its first head office. He visited Kristiansand twice a year, usually for a month or more. Two of his brothers still lived in the city and at the end of the 1930s he bought a house in Baneheiveien in Kristiansand.

Thirty-nine year old Sverre B. Steen became general manager at the refinery. He had emigrated to America in his youth, where he had bought and ran a ranch in Wyoming. After a few years, he returned home to study and graduated as a chemical engineer from "Trondhjems Tekniske Lærestalt" in 1915. Steen got his first engineering practice at the smelter at Evje, where he got to know both Grønningsæter and nickel metallurgy.

Steen became production engineer at Vigeland Brug aluminium plant in 1916. He excelled in his job there, especially in research. It was at Vigeland that the so-called Söderberg electrode was tested in what was one of the most successful development projects in Norwegian industrial history. Vigeland Brug was also a subsidiary of British Aluminium, so Steen became used to dealing with foreign owners.¹⁴⁰

Falconbridge recruited much of the staff from the Norwegian-German operating company, including Giertsen's former second in command, Hans G. Martens. He was an engineer from Horten's Technical College and had worked at the nickel refinery since 1910. Besides Grønningsæter, Martens had the longest nickel experience at management level. In addition, Axel Petersen continued as senior chemist, a post he had also had in KNR. It was also important for daily production that the three foremen Kristoffer Krispinussen, Knut

Larsen and Gunnar Øvland also continued. They managed the daily operations and therefore had experience and expertise that was difficult to replace.

Former KNR and BANC engineers, Rikard Løken and Torgny Torell returned from well paid jobs in the US to work at the refinery in Kristiansand, though the Swede Torell resigned after six months when he was offered the post as director of Boliden's new copper refinery in Skellefteå in Sweden. As mentioned previously, Ivar Hole took leave of absence from Spigerverket in order to help. Hole was known as one of the best metallurgists in Norway and was one of the originators of the so-called Tysland-Hole furnace. These three veterans significantly strengthened nickel expertise in the decisive start-up phase. After a few months, three young chemical engineers, Carl Dahl, Fridtjof Grøntoft and Bertin Hommeren were recruited and all three remained at the nickel refinery for almost 40 years.

In June 1929, Grønningsæter was optimistic. He knew that he had managed to get hold of skilled and experienced people and there was no doubt that Falconbridge would achieve a profit, if the prevailing nickel price was maintained. As a metal, nickel had great potential. But things had gone wrong before, and he was painfully aware that money was tight. Once again, he did not have luck on his side and Falconbridge never managed to start production under the boom conditions of the 1920s. Instead of experiencing huge demand, the business involved a struggle for survival from day one.

6. ON THE BRINK OF COLLAPSE

Falconbridge was established at the worst possible time. The famous Wall Street crash came only three months after the company had acquired the refinery at Kristiansand and the bottom fell out of the market during the subsequent depression. In the US, nickel consumption fell from 53,000 tonnes in 1929 to less than 10,000 tonnes in 1932. In addition, INCO and its French partner Le Nickel had a strong grip on the remaining market through long-term contracts with consumers. Several steel companies were also shareholders in INCO. INCO also had substantial financial reserves and could easily weather a crisis period. To survive, Falconbridge had to break INCO's monopoly. At the same time, it was important to avoid that INCO started a price war, as it had done to break BANC.

The staff in Kristiansand had to get production started, produce high quality nickel and to bring costs down. All this had to happen as quickly as possible. The roasting of nickel matte from Evje started in the middle of October 1929 and copper leaching began on 4th November the same year. The first reports to Canada were optimistic, but then a series of problems delayed production. The sulphur content was too high and therefore the whole process of finding chemical solutions for the electrolysis was delayed.

On 1st February 1930, an excited Grønningsæter reported to Canada that the nickel electrolysis would start that same day. A week later the result was clear. The purity of the nickel was sufficient, but the mechanical properties had to be improved. The aim was a daily production of 2-3 tonnes in order to ensure that everything functioned properly. After that, production would be reduced to 2 tonnes per week until the commissioning phase was over.

At the same time in Canada, work was in full swing at the mine and smelter. Initially, the people working at Falconbridge lived in tents, but workman's huts replaced these before the end of 1929. The work on the shaft began in September and following a few busy months, production eventually got underway. The smelter, on the other hand, posed greater technical challenges. The company used Grønningsæter's plans and drawings. The smelter functioned well and had greater capacity than calculated.¹⁴¹

It took longer than expected to reach full production at the refinery. One of the main problems was that the old roasting furnace did not have enough capacity. In the electrolysis area, the tanks and pipe system had corroded and some of the solution leaked into the sea. In addition to this, there were problems with the cementation. The matte from Canada had other chemical qualities than the matte from Evje.

We can follow the start-up phase through Grønningsæter's reports to Canada. The challenges were solved one-by-one. By the beginning of June 1930, the leaks had been reduced and the operation of the electrolysis tanks had been improved. However, the filter presses were still too small and required a lot of manual work. In the anode furnace it was difficult to get the iron into the slag phase.¹⁴²

A week later Grønningsæter reported that the roasting furnace was working better. 10 tonnes of matte were treated every day. The workers had gradually learned to use the anode furnace and of a total production of 162 tonnes of nickel, only 0.9 tonnes was rejected and sent back to the anode furnace. 2.7 tonnes had been second grade quality, but 98% of production had been first grade quality.¹⁴³

Production increased gradually and reached a weekly production of 20 tonnes in July and 30 tonnes by September. By the end of October, the new roasting furnace was functioning perfectly mechanically, but in a letter to Gordon Hardy Grønningsæter added that "we have not yet learned how to reduce the sulphur". After a month in operation the furnace broke down, but following repair and a few minor adjustments it worked well. By December, capacity was almost fully utilised. Weekly production was close to 60 tonnes of nickel.¹⁴⁴

The equipment in Kristiansand was a mixture of old and new. In order to limit costly investments, one had to make do with solutions that were far from optimum. The results were however only partly determined by the equipment, the furnace design or the design of the electrolysis tanks. The various processes had to be continuously monitored and controlled. This was important both for production volume, costs and for the quality of the end product. The exact chemical reactions taking place were unknown as the theoretical background for the process was not yet fully developed. A combination of experience and chemical knowledge was required to achieve good results.¹⁴⁵

The effort to establish stable production conditions consisted mainly of three elements: The first was to improve and adapt the equipment. The second was to gain experience, establish fixed routines and to recruit a competent and motivated workforce. Even if the company had a large group of seasoned nickel workers, many were new and inexperienced. Before introduction of automatic control equipment, very much depended upon the key persons' skills and ability to "read" the process correctly and it took time for new employees to master this.

The third element was to gain the best possible control over the input factors. The problems regarding this were greatest in the start phase, before experience was gained with

the matte from Canada. It took more than one year from when the roasting furnace was fired up in the autumn of 1929 until stable production was achieved.

Impaired working conditions?

Falconbridge also introduced the start of a new era on the shop floor. In chapter 2 we looked at working conditions in 1910-11, when the operations were small. Under Falconbridge's management, there was a higher level of and more stable production than ever before and work became more routine. In the electrolysis area, one day became much like the next and the tasks were standardised. Even though a few tasks had been mechanised, the work was still heavy and strenuous. Work in the smelter also became more routine. Several furnaces were in operation at the same time and charging and tapping was done according to fixed procedures, though workers had to put up with the furnaces not always melting evenly. The furnace usually melted best in the middle and when the "crater" in the middle was deep enough, the sides collapsed causing excess pressure in the furnace. The door was blown open and smoke and sulphur filled the atmosphere and made the air pitch black. Fridtjof Gundersen later told that if things were really bad, even older workers made a dash for the exit "as if they had grown wings".¹⁴⁶ Accidents and burns were a relatively common occurrence.

Increased production resulted in deterioration in the working environment, especially in the smelter. Following a complaint from the workers' union, Engineer Martens claimed that it was impossible to solve the smoke and sulphur gas problem, but Grønningsæter promised to do all that he could to improve conditions.¹⁴⁷ Acid vapour in the electrolysis area gave many workers serious eczema or nickel allergy. Many people became unable to work for weeks at a time, which almost brought ruin to the union's welfare funds, which provided a health insurance. Exchange of jobs internally meant that workers with better resistance could be used in the electrolysis area.¹⁴⁸

When the money has almost run out

"3-4 of the oldest workers have still not returned after the production shutdown". <...>
"There are protests regarding the latest dismissal of 4 senior workers and against recruitment of young people".¹⁴⁹ In 1929, the new refinery management did not want to take over the

senior workers from “Raffineringsverket”, they wanted young and strong people. On the other hand, job security was a priority for the trade union. It was important to follow the seniority principle so that work could be reasonably secure and predictable. If the oldest workers were thrown out just like that, it could be someone else’s turn next time. The matter seems to have been solved with a tacit compromise. The older workers were reinstated when lighter tasks were found for them.

After the change in ownership, wages were always paid regularly, but wage increases took a long time coming. The company was not interested in negotiating when the union demand a 45% wage increase in December 1929. After a few months, Grønningsæter and Steen threatened with a wage reduction instead. The union received help from the Norsk Kjemisk Industrierarbeiderforbund (the Norwegian Chemical Industry Workers’ Association), but this only resulted in 20 øre extra per shift for the dustiest tasks at the roasting furnace. The company had little financial leeway, although finances were never as tight as in Raffineringsverket’s time.¹⁵⁰

Wage negotiations were not the only thing to cause sparks between the union and the management. In the autumn of 1930, the union’s leader Gottlieb Thomassen felt harassed and this ended up with him being locked out from the electrolysis area. However, the company was forced to retreat and Thomassen was reinstated and was immediately re-elected as union leader.¹⁵¹

The minutes from the trade union meetings usually mention the problems. This is in the nature of things, but it would seem that the parties learned to live with each other and that they learned to find compromises that both could accept. Occasionally, it was possible to see a different side to the relationship. For example, the union sent a telegram of congratulations on the occasion of Grønningsæter’s 50th birthday and he was always spoken of respectfully. The union also laid a wreath on Mrs Marten’s grave. As it was a fairly small environment, everyone was fairly close to each other, both for good and bad.

Falconbridge and nickel sales

If it was difficult to achieve stable production, the threshold for selling was just as high. As mentioned before, INCO and its French partner Le Nickel controlled the market and had long-term agreements with the customers, which usually contained a clause stating that they must be an exclusive supplier of nickel.

It is important to add that cartels were quite normal in the business world during the inter-war years. It has been estimated that a total of 87% of mineral and metal sales in the US were under the control of cartels.¹⁵² This usually made it difficult for newcomers to establish themselves – and it secured the existing producers higher prices and profit. The special thing about nickel was that one single company like INCO had such strong market power.

Technical matters also complicated Falconbridge's sales work. Unlike copper and lead, nickel was not a completely standardized product. Many of the applications were new and the refining process was somewhat more complex than for many other metals. Some consumers were therefore sceptical of new suppliers.

In addition, demand for nickel fell drastically in the years following the stock market crash in 1929, which hit the US hardest. In 1932, US consumption was less than 20% of what it had been in the top year in 1929. Falconbridge found a blessing in disguise. With its refinery in Kristiansand, the company had intended to sell nickel to the European market. Nickel had fewer civilian areas of application in Europe than in the US, but arms production was significantly higher. The depression did not curb the arms race.

However, the head office in Toronto was too far away to attend to the daily sales work in Europe. After all, it still took a week to send a letter across the Atlantic. There was also no one at the head office with the necessary competence. Therefore the work was assigned to Brandeis & Goldschmidt in London, who received a 3% sales commission. Brandeis & Goldschmidt was one of the leading metal trading companies in Europe¹⁵³ and had a network of agents in industrial centres on the continent.

However, the relationship with Brandeis & Goldschmidt was not always plain sailing. There was disagreement about commission and Anton Grønningsæter criticised their business methods. He wanted more aggressive sales work and claimed that the company only "corresponded from London." It should have sent men with technical authority to potential customers, instead "ignorant sub-agents" were left to do the work".¹⁵⁴ However, Falconbridge could not afford to break this connection and the company had no means of building up its own marketing organisation.

Grønningsæter probably exaggerated. Brandeis & Goldschmidt must have been good at introducing Falconbridge to the European market. It was far from being a matter of course that the company would achieve a market share of around 15% within two years. And as most of the nickel sales were tied up in old long-term contracts, Falconbridge's share of new contracts must have been high.

Brandeis & Goldschmidt also had good contacts in financial and political circles, from which Falconbridge benefited. In 1932, the UK considered introducing 20% customs duty on refined nickel, a proposal that the agents lobbied energetically against. Such a customs duty would only have strengthened INCO's monopoly and might have raised the nickel price for British consumers. The proposal was therefore dropped.¹⁵⁵

Even though London became Falconbridge's commercial centre, the Kristiansand division was also involved in the sales work. There were people here who were familiar with the nickel's qualities and who could visit the customers if technical difficulties arose or when a customer complained. These technical contacts were sometimes the gateway to new sales contracts, though all contracts went formally through Brandeis & Goldschmidt, even when Falconbridge sold nickel to the Norwegian Royal Mint in Kongsberg. The British agents had played no role in this contract, but they still demanded and received their percentages of the sales.

The road to the market

By reading the sales reports we can follow Falconbridge's path to the market. The first major contract was landed in the middle of November 1930. Midgley & Son's steel works purchased 150 tonnes of nickel at a price of 158.17 pounds per tonne delivered in Sheffield.¹⁵⁶ In comparison, INCO's price was 170 pounds, but included freight.

Falconbridge's nickel was gradually introduced into the market and by the end of 1930 the company's nickel had passed the British War Office's quality test,¹⁵⁷ which was an excellent reference in the future sales work. After this, Falconbridge managed to achieve a better price for its nickel.

Grønningsæter was particularly concerned about gaining access to the Swedish steel industry, which was known for its quality. He made several attempts with varying success. The steel producer Avesta was one of the first key customers, but others were reserved about trying an unknown nickel producer when there was little price difference. The arms manufacturer Bofors declined to change supplier at first, because there was more lead in the nickel from Falconbridge than in the nickel from Mond. However, Falconbridge achieved a market share of 58% in Sweden as early as in 1934.¹⁵⁸

What appeared to be a disadvantage, i.e. INCO's dominance of the market, turned out to be a blessing in disguise. INCO was able to maintain a high and stable price both in good

and bad times. The price level of the 1920s was even maintained when sales collapsed in the US between 1931-32. This saved Falconbridge and the company was able to gain a foothold in the market by positioning its prices slightly below those of INCO, but it was careful not to go too low in price. Falconbridge did not have the financial backbone to weather a price war. It was also not profitable for INCO to reduce the price for its entire production in order to get rid of the newcomer. The INCO management may also have believed that Falconbridge would fail anyway.

This did not happen, but the “cease-fire” between David and Goliath was fragile. There was competition for several contracts and both parties reduced their prices somewhat. It was difficult to balance between short and long-term interests, especially for Falconbridge, which at times had major liquidity problems. There was growing irritation in INCO too and the management in Falconbridge feared that INCO would start a price war. BANC’s fate from 1922-23 was still fresh in mind.

On the brink of collapse

In spite of their efforts, Falconbridge did not manage to achieve high enough sales and at the beginning of 1931 only 70% of the capacity was used. In view of the dramatic economic downturn, this was not a bad result for a newcomer. In INCO production had fallen 75% since 1929, but unlike INCO, Falconbridge did not have adequate liquid reserves.

Luckily, nickel prices remained stable, though Falconbridge had to go below its budgeted nickel price of 165 pounds per tonne, but not much. Things were worse as regards copper. As there was no cartel here as in the nickel market, the price of copper was fell from 13 cents per pound in 1929 to 8 cents in 1930 and then to 5 ½ cents the following year.¹⁵⁹

Falconbridge’s total loss in 1930 and 1931 amounted to 500,000 Canadian dollars. Jobs were cut at the head office and Grønningsæter wrote to Steen and asked him to save money wherever possible. He suggested that installation of toilets in the electrolysis area should be postponed. “If the carpenters are still not finished, perhaps a few of these could be given their notice. ... it must be possible to use these hard times to put pressure on them give the best possible work performance and cheaper piecework.”¹⁶⁰

In spite of the pressure: the situation was acute by the end of 1931. If short-term debt was deducted, the company only had 18,000 dollars in cash and securities left.¹⁶¹ Loan possibilities had dried up due to the depression and the financial markets had no confidence in

the ailing company. The solution was to increase production and if necessary sell the nickel at an even lower price than before. Falconbridge dumped the nickel on the US market, where INCO had previously had a monopoly. INCO did not counterattack, probably due to the fear of the antitrust legislation.¹⁶² Falconbridge also started a sales campaign in Japan,¹⁶³ as the country was busy with rearmament in connection with its aggressive expansion plans in the area of the Pacific Ocean.

What caused the biggest dispute internally in Falconbridge, however, were sales to the Soviet Union. Grønningsæter had been in favour of this from the start, but without finding support. In February 1932, he wrote to his friend Sverre Steen in Kristiansand: "In Toronto, hatred of the Russians has almost become a religion and those concerned cannot see these issues from a business point of view".¹⁶⁴

The Soviet Union needed nickel in its arms production, but it seemed that INCO would not sell this to them. Therefore, the Russians offered a very high price and in the end Falconbridge's strained economy tipped the scales. The sale was made in co-operation with "Raffineringsverket" at Evje. However, the Russians did not pay more than 60-65% of the agreed purchase price,¹⁶⁵ but production costs were still more than covered.

Another external circumstance also helped to improve the situation. The British had devaluated the pound in September 1931 and this resulted in INCO raising its nickel price 20% (calculated in GBP). The company did this in order to maintain the old price measured in dollars.¹⁶⁶ This price had a very favourable effect for Falconbridge, as costs had almost stagnated at the same level, at the same time as the company was paid 20% more for its nickel. Falconbridge earned its first profit, even though global nickel consumption fell to an all time low in 1932.¹⁶⁷ Finally, it was time to bring out the expansion plans from 1929.

7. EXPANSION IN THE 1930s

In 1932, the crisis was over for Falconbridge and future began to look bright. As a result of rearmament up to World War II, the demand for nickel rose year-by-year. At the same time, new producers appeared on the market. The Germans, Japanese and Russians aimed at being self-sufficient in producing nickel for the armament industry.

Falconbridge still managed to set new production records. However, in 1937, the plant was shutdown for five weeks due to a strike. The trade unions' records show the other side of the coin, which involved disputes, pressure of work and a bad working environment. These records also give an insight into the Norwegian industrial system. They show the workers' collective attempts to improve their own working day – and how their struggle was linked to Norwegian politics. The inter-war years were a time of class struggle in Norwegian history and this also made its mark on the nickel refinery.

Finally, we will look at how the top management in New York understood this side of Norwegian matters, as the trade unions were banned at the plants in Canada. But before we get this far, we will turn our attention to the competitors and nickel sales.

Military metal

Falconbridge was enjoying success in the 1930s. From 1932 to 1939, world nickel consumption grew from 28,500 tonnes to 162,000 tonnes and most of the growth came in Falconbridge's main markets in Europe and Japan. As we have seen, INCO had control of the market in the US, but nickel consumption here stayed below 1929 level all the way up to 1939.¹⁶⁸

However, some of the sales growth had to be shared with new competitors. As mentioned previously, nickel was too important as a military metal for the various great powers to allow the metal to remain under British-American and partly French control. The Germans aimed at being as self-sufficient as possible with strategic products. Therefore, they were exploring for nickel ore and built a refinery. The Japanese followed a similar policy. In both countries, however, the nickel deposits were insufficient to cover domestic consumption.

The Russians also started nickel production, and even though they had larger and richer ore bodies, they did not have any nickel for export.¹⁶⁹

In the first few years, Falconbridge sold most of its nickel to Japan, France, Italy and Sweden. The UK eventually became the largest market, but the Germans also purchased significant volumes of nickel from the refinery in Kristiansand.¹⁷⁰ Exports to Germany were primarily used in weapon production and to build up strategic stocks. It may seem strange that Falconbridge sold nickel to Germany's rearmament. Canada was still very closely linked to the UK and people were becoming increasingly aware that a new war with Germany could be imminent.

As far as this issue was concerned, Falconbridge conducted its business the same as the rest of industry and commerce within the British Empire. Nor did the authorities advise against such nickel sales. In the UK it was argued that continued trade links with Germany could strengthen the moderate powers in the Nazi regime. The British authorities also depended upon importing strategic products from Germany. A boycott would therefore be a double-edged sword.¹⁷¹

Due to declining US sales, INCO was also focusing more on Europe. As a result of the merger with Mond, INCO had already taken over Mond's refinery in Wales. This was now extended with a view to the European market. In 1934, the company acquired the rich nickel deposits in Petsamo on the Kola Peninsula in what was then Northern Finland. The plan was to produce enough matte here to produce 10,000 tonnes nickel metal a year. The matte was to be refined in Wales. It was a challenging task to build production facilities at Petsamo, as there were no technical infrastructure or local sub-contractors. The harsh and almost Arctic climate was also a drawback and the smelter did not start production until the war broke out.¹⁷²

Even in 1938, 83% of the world's nickel was extracted from the mines around Sudbury in Canada. Besides Petsamo, Sudbury had the richest deposits of nickel. 11% of the nickel was produced on French New Caledonia in the Pacific Ocean. INCO's business partner Le Nickel was the dominant producer on this group of islands. On a global basis, the other players only had control of 6% of the raw material supply and therefore were no real threat, especially when there was strong growth in the market.¹⁷³ In the long term, however, the Japanese and the Russian both became significant nickel producers. In this way, the 1930s self-sufficiency policy had consequences far into the future.

Falconbridge expands

In 1929, the plant in Kristiansand was dimensioned for an annual production of 2,500 tonnes of nickel. After solving a few teething problems, it became clear that the plant could produce more and in 1931 production reached 3,000 tonnes. In the summer of 1932, Grønningsæter and Steen managed to gain acceptance that the production be expanded to 4,000 tonnes. Both the mine and the smelter in Sudbury had spare capacity. The expansion in Kristiansand only required an investment of NOK 400,000.¹⁷⁴

It was the middle of the depression and nickel consumption had fallen to half of the level in 1929. The company had also been on its knees a few months before and could not afford to make any mistakes. Grønningsæter and Steen were told in no uncertain words that: "if sales stop, and the expansion proves to have been hasty, you'll both be fired".¹⁷⁵ However, the timing could not have been better. Hitler's rise to power in January 1933 initiated a growth in rearmament and thus in nickel consumption. The nickel price at the time earned the company NOK 7-800 per tonne. The investment was paid back within less than a year.

When Hitler came to power, Falconbridge had already started to plan its next expansion. According to the cost estimates made by construction engineers Endre Refsnes and Torleiv Skajaa, the expansion would cost NOK 700,000 and increase capacity to 5,000 tonnes of nickel a year. In the next few months, they reviewed the proposal point-by-point together with Grønningsæter, Steen and Grøntoft in order to reduce the costs. In the electrolysis area, engineers Carl Dahl and Axel Petersen and foreman Knut Larsen managed to increase production per tank, thereby saving significant outlay. In May 1933, the board of directors of Falconbridge approved the expansions with a cost limit of NOK 500,000.¹⁷⁶

In the autumn of 1933, Grønningsæter took the initiative to move the nickel shears out of the electrolysis hall. And this meant that there was room for more electrolysis tanks and it also improved the working environment. Cutting the nickel was an extremely noisy process.¹⁷⁷ In addition to this, a number of minor projects were carried out, such as improvement of the water supply, construction of the quay, building storage sheds, etc.

By 1935/36, however, the capacity was fully utilised. If production were to be increased, this would require further investment of around 2 MNOK. A new roasting plant and copper plant were required and the cementation and electrolysis area had to be expanded.¹⁷⁸ In Canada, the staff fought to have the money invested in building a refinery close to Sudbury. As we will see later, political and inter-company factors pointed in favour

of such a solution. But this was not to be and the board of directors eventually decided to increase capacity in Kristiansand to 6,500 tonnes.

Grønningsæter stressed how important it was that the expansions were not too expensive. The fate of BANC and KNR had taught him a lesson for life as regards cost control. From 1929 to 1936, the group allocated around 5,5 MNOK to the expansion of the nickel refinery. In addition to this, some investments were entered as operating costs. In nickel industry terms, however, the total investments were relatively low. And this was also the reason why the company chose to expand in Kristiansand rather than build a new plant in Canada. A new plant would have been much more expensive.

Costs and calculated risk

In order to keep costs down, Grønningsæter accepted a certain technical risk. As refining consisted of many process stages, it was usually only parts of the plant that had to be expanded. Other processes usually had enough capacity. The challenge was to predict where bottlenecks and serious technical problems might arise.¹⁷⁹

Weighing the options was sometimes difficult. Refining was a vulnerable process that was never totally predictable and it was not always possible to calculate the efficiency of the technical equipment. Balancing on the edge of what was possible meant that accidents were almost bound to happen. By looking at one of these we can get a glimpse of the way of thinking in the company. In conjunction with the investment programme in 1936, Grønningsæter and Steen decided not to do anything with the reduction furnaces. In consultation with engineer Bertin Hommeren and foreman Gunnar Øvland, they decided that the capacity was high enough and that the money should be used in the electrolysis area instead.

However, at the end of July 1937 one of the furnaces broke down. The problems were so serious that a new furnace had to be built. This would take a couple of months, which hit production and cost money. In their letter to the top management, Grønningsæter and Steen wrote that: "such situations will arise when you do your best to keep investment budgets down. Having small margins sometimes goes well and sometimes not" ".¹⁸⁰

Wrong decisions could have serious consequences, In this case there was another reduction furnace so that refining could continue, though at reduced capacity. The problems with the reduction furnace were an exception. However, the episode illustrated the importance

of identifying problem areas. This required both theoretical knowledge and sound production experience.¹⁸¹

Grønningsæter had more than 20 years of acquaintance and a long-term working relationship with the foremen and the senior engineers. They knew each other and the different parts of the Hybinette process almost outside in. There was therefore a personal closeness between the shop floor and the top management, which must have been rare in this type of transatlantic enterprise and which helped make the most of the resources. Serious technical problems were rare and Grønningsæter could claim, with a certain amount of truth, that the plant was the "world's most modern nickel refinery with the lowest production costs".¹⁸²

Number of employees and production in tonnes at Falconbridge, Kristiansand 1930-39¹⁸³

	1930	1931	1932	1933	1934	1935	1936	1937	1938	1939
Nickel	1.086	2.939	3.131	4.168	5.304	5.892	6.108	6.740	8.467	9.107
Copper	.559	1.514	1.584	2.156	2.831	3.023	3.016	3.329	4.218	4.321
Salaried employees	19	20	30	35	29	43	47	52	60	59
Workers	200	207	224	319	328	322	476	507	461	527

More personnel and lower production costs

In 1929-30, Grønningsæter had established what could be called a minimum organisation in Kristiansand. The workforce was just big enough to achieve stable production and high product quality.

More engineers were recruited from 1933 onward, partly as a result of the expansions, partly to reduce dependence on individuals and partly because Grønningsæter and Steen saw the need to strengthen technical competence at the works. The number of engineers rose from 7-8 in 1932 to around 20 in 1938. Most of the new engineers were young and had come straight from the Norwegian Institute of Technology in Trondheim. A few did have work experience from other chemical and metallurgical industry.

In 1938, there were nearly as many engineers as in the heyday of KNR, but development work was less extensive. Production of finished nickel had increased tenfold since then. In the 1930s the engineers were primarily occupied with operational tasks and troubleshooting and the focus was on keeping costs down.

In 1936 Officer Manager Holme made a list of the costs at the works.¹⁸⁴ He calculated that operating costs per tonne of nickel were around 20% lower than five years before. According to a subsequent survey by Carl Dahl, the savings were primarily a result of higher production reducing the personnel effort per tonne.¹⁸⁵

A number of tasks had been mechanised and cheap electric motors had replaced muscle power. In addition, there were major improvements, such as a new and improved roasting furnace, a new nickel furnace, nickel shears, etc. A conveyor belt was installed in the second half of the 1930s. In 1931 each employee produced 13 tonnes of nickel and 6.6 tonnes of copper, while in 1939 the corresponding figures were 15.5 and 7.8 tonnes.¹⁸⁶

The hunt for gold, dust and sulphur

Rikard Løken and his assistant, Peer Arnesen developed the extraction of precious metals. Løken had been a chemist in KNR and BANC and then in US industry. Grønningsæter lured him back to Norway and to Falconbridge. Arnesen arrived in 1935 as a newly educated chemical engineer from Stuttgart in Germany. Together they had the theoretical and practical background to exploit the noble metals. Within two years they had developed industrial methods for extracting gold, platinum and palladium. Previously, these metals had been sold as impure concentrate to an American specialist company. Consequently, Falconbridge lost out on most of the profit.

Løken and his team subsequently found ways of extracting bimetals such as iridium, rhodium and ruthenium. As far as bimetals were concerned, the management both in Canada and in Norway were rather reluctant to give funds, as the technical risk was too high. Even on a global basis, there were very few companies that managed such tasks and they kept their secrets close to their chest. But Løken eventually succeeded with his powers of persuasion. "Astoundingly good results", Steen reported to head office.¹⁸⁷ The precious metal area was a new example of the refinery's ability to develop expertise.

If the ruthenium seemed far-off, the dust and dust loss was a lot closer to home and a lot of money went literally up in smoke. A 3% metal loss was estimated at the start in 1929,

mostly as dust or leakages from tanks and pipes. In addition, the dust was a pain in the neck for the working environment both from an efficiency and welfare point of view. Under the management of the engineers Fredrik Collin, Carl Dahl and Fridtjov Grøntoft and foreman Gunnar Øvland a number of small improvements were made to the crusher, the anode furnace and roasting furnace. In 1938, a new dust collection system was installed. The collected dust was sent back to the roasting furnace, in order to recover the metal content. In addition, efforts were made to limit leaks and runoff. Using many small and simple measures, the total loss was reduced to 1.75% for nickel and 2% for copper.¹⁸⁸

The extraction of the sulphur, however, was linked to the efforts to limit pollution. Grønningsæter was the first to raise the problem in 1931. He was familiar with the problem from Canada, where the vegetation was so singed around Sudbury. In Kristiansand, the sulphurous smoke hit the steep Duekniben behind the plant and was sometimes blown toward the build-up area in the centre of town. The trees in the vicinity of the plant were black and dropped their leaves. Engineer Martens wrote that the company filled the cracks in the rock at Duekniben with soil and sowed “the toughest type of grass they could find”. Even though no complaints had been received, Grønningsæter was concerned about the company’s reputation. But due to the company’s strained finances there was little that could be done.¹⁸⁹

A few years later it became clear that the sulphur smoke had also damaged the top of the new stack. A total of 7,000 tonnes of SO₂ had been emitted in 1937. The repairs would be expensive. The solution to the problem was either to remove the sulphur from the emissions or to build a separate stack for the roasting furnace. Grønningsæter opted for the first solution. With “our cheap hydroelectric power, we can produce liquid SO₂ directly by compression”, he wrote. This could be sold to the paper mill at Hunsfos a few kilometres north of Kristiansand. After several postponements, a turnkey absorption plant was purchased from US copper group Guggenheim & Co. This was allegedly the second one of its kind in the world. The plant was put into operation in 1938 under the management of engineers Fredrik Chr. Collin and Bertin Hommeren.¹⁹⁰

The company had chosen different methods in its hunt for precious metals and sulphur. In the first case it developed the technology itself, and in the second this was purchased. Both cases indicate technological awareness and a willingness to invest in cutting-edge technology. As far as the dust and runoff problem was concerned, it was the sum of many small and simple measures that had an effect.

The price of work

In the spring of 1934, the foreman of the Norsk Kjemisk, (the Norwegian Chemical Industry Workers' Association), Halfdan Jønsson, visited the electro-chemical plants in the Kristiansand area. "Fiskaa Verk is the ugliest plant I have ever seen <... > Falconbridge is also not as it should be, and requires many improvements".¹⁹¹

Some time before, worker Tønnes Tønnessen had had his leg torn off at the hip by a crane and died in hospital. Accidents were a part of life in industry at that time, but this had a consequence. Before the accident, Tønnessen had complained about having to paint the crane during ordinary working hours, i.e., when it could be started. However, foreman Knut Larsen had refused to allow it to be painted at other times, because this would have cost more money. He claimed that he had ordered Tønnessen not to paint when the crane was in operation. The local union wanted to take legal action against the company and the foreman, but the Norwegian Chemical Industry Workers' Union and the Norwegian Federation of Trade Unions' lawyer Trygve Lie advised against this, as negligence could not be proved. A lock was subsequently fitted on the crane, to avoid such an accident from happening again.¹⁹²

The working environment, wages and job security were the trade union's three main concerns in the 1930s. As far as environmental issues were concerned, the union was particularly concerned about the dust problem and finally consulted the Factory Inspectorate, but it could not help. Financial and technical factors put a stop to significant improvements for some time, but the environment was not given special priority even when profitability improved. The money was invested in expansions or given as dividend to the shareholders.

The expansions lead to more strain and discord. The trade union tried repeatedly to get manager Steen to hire more people. According to the union, production was increased without the workforce being strengthened correspondingly. On two occasions the union sought support from the Norwegian Chemical Industry Workers' Association without this being of very much help. Steen only accommodated the demands regarding more personnel in a few exceptions. However, the union gradually gained strength and organisational experience and then the company was forced to take more consideration.

In this area, there were significant differences between Falconbridge's plant in Norway and Canada. In Sudbury, as in the other mining areas in Ontario, there was a far higher turnover of jobs. If people were dissatisfied with salary and other matters they left to go to other plants. The labour market functioned almost like an ordinary market, with less

protection of the workers' rights. In the mining industry, trade union activists were harassed or simply fired.¹⁹³ But even without the trade unions, the wage level among the Canadian nickel workers was significantly higher than among their organised colleagues in Norway. The reason for this was quite simply that Canada was a richer country and that there was a lack of workers in the mining and heavy industry.

The Norwegian system was based on negotiations. Public authorities supported this through the State Mediator. As a last resort, disagreements could end in strikes or lock-outs, but the parties usually came to compromises. At the refinery the trade union was affiliated with the Norwegian Chemical Industry Workers' Association and through them with the joint agreement with the employers. Membership of the Norwegian Chemical Industry Workers' Association gave increased leverage, but also represented a hindrance. As far as Falconbridge was concerned, we will see that the wage issues were primarily resolved centrally.

The nationwide labour dispute in 1931 ended with a cut in wages. The electro-chemical industry also cut wages, even though it was not directly affected by the dispute. The general price level was falling at this time, so that the standard of living could be maintained, even with lower wages.

The central wage increases were very small in the next few years. The Norwegian Chemical Industry Workers' Association had to take into consideration that the aluminium industry in particular was facing hard times. The demands were therefore moderate, which caused much irritation in Kristiansand where living costs were quite high.

In 1935 the local union demanded a 25% wage increase, but was unsuccessful with its demand with the Norwegian Chemical Industry Workers' Association. At the beginning of July, therefore, the union resigned from the joint agreement, but this was turned down because the union was bound to central agreements. But the rejection was swept aside and three weeks later, it was decided to call a local strike.¹⁹⁴

The following day General Secretary Nic. Næss arrived in Kristiansand to pour oil on troubled waters. This meant that the matter no longer had only local dimensions. After the Labour Party came to power in March 1935, the Norwegian Confederation of Trade Unions tried to create industrial peace and the aim was to support the government. After the major dispute in 1931, the trade union and the employers realised that they had a mutual interest in avoiding disputes.¹⁹⁵ Together with the local union's foreman, Randulf Fjermeros, Næss succeeded in calming the mood at the plant in Kristiansand. Even though there were those who warned against the central union gaining "dictatorial power", the majority gave in and reluctantly approved the results of the central negotiations.¹⁹⁶

However, the will to fight lived on, especially in the dustiest areas of the plant. In March 1936, union members working at the reduction and roasting furnace handed in their notice, even though this action was unlawful according to the agreement. Steen gave in and allowed the matter to go to arbitration. The workers were given a dust allowance of 5 øre an hour, which was a fifth of what had been demanded. In addition, he also agreed to hire more people so the workload could be reduced.¹⁹⁷

Hourly wages in the electrolysis area (NOK)

	1927	1928	1931	1935	1937
Day work	0.80	1,15	1.10	1.10	1.33
Shift work	0.90	1.27	1.25	1.25	1.47
Price index	100	93.5	82.1	80.7	89.7

In comparison, a litre of milk cost 30 øre in 1927-28 and 32 øre in 1937. If piecework is taken into consideration, however, the wages increased more than these figures show.¹⁹⁸

Strike!

In 1937, the moderate approach was dropped at top level in the Norwegian Chemical Industry Workers' Association. In consideration of the Labour Party Government, the Norwegian Confederation of Trade Unions was still trying to curb wage growth. The negotiations with the employers in the electrochemical industry were not successful and the State Mediator's proposed compromise was rejected. At the nickel refinery in Kristiansand, 321 members voted in favour of a strike and 55 were against.

The dispute started on 4 September. Steen applied immediately for dispensation to unload ships with nickel matte, but was refused. Strangely enough, the trade union records mention nothing about the strike itself. This possibly indicates that everything went according to plan, at least as far as they were concerned.¹⁹⁹

Steen had seen what was coming and had informed Hardy in New York that the strike could last for 4-6 weeks. Hardy soon became concerned about the consequences, especially with regard to the customers. The plant had already been running at reduced capacity for two months due to problems with one of the reduction furnaces. The stock of finished nickel was at a minimum and the strike could hardly have come at a worse time.

With Falconbridge's high profit margin, it became clear to Hardy that the company had far more to lose from a long dispute than from giving a wage increase, especially when closure of the smelter in Sudbury was mentioned. After 14 days, Hardy indicated that Falconbridge should resign from the Norwegian Employers' Association in order to bring an end to the strike. He also instructed Steen to get the employers to be more compliant. Grønningsæter believed that the company had to close ranks and he told Hardy this in no uncertain terms. Grønningsæter had the depression and the KNR and BANC affairs still fresh in his mind and he wanted to avoid high fixed costs at any price. Wages actually represented more than half of the costs at the refinery.²⁰⁰

Work was resumed on 7 October and with a few minor improvements, the State Mediator's old proposal was accepted. Falconbridge also agreed to give a local wage increase of 4-5 øre. However, a quarter of the nickel workers were still dissatisfied and they voted against the result.

The fixed hourly wage remained unchanged over the next few years, as Falconbridge was bound by agreements that the Electrochemical Employers' Association had entered into. This meant that dissatisfaction and willingness to strike continued to grow. However, Grønningsæter warned against taking the nickel refinery out of the employers' association. He claimed that the connection to the Norwegian Chemical Industry Workers' Association and the Norwegian Confederation of Trade Unions helped to discipline the workers locally. If the company ended relations with its central union, this would result in even more strikes and higher wage costs. Grønningsæter referred to Union Carbide's plant in Sauda in Western Norway, which was independent from the Employers Association. The wage level there had been pushed considerably higher than elsewhere in the electrochemical industry. Hardy listened to the advice, but found a way of evading the employers' associations wage framework and at the same time avoiding high fixed costs. All employees received a generous Christmas bonus.

Wages, politics and work

As far as the wages were concerned, it must be said that the company was lucky in the 1930s. Organisational issues and political considerations at top level in the labour movement helped keep demands moderate.

However, the trade union had a strong influence in other areas and it managed to a certain extent to "humanise" the company. Older workers were no longer "discriminated" against. In case of job cuts, the union usually managed to ensure that seniority should have priority. Even if the company had steady growth after 1932, it was a roller coaster existence. Economic trends and the contract situation changed, and at regular intervals the company cut jobs and then recruited people again. Historian Knut Kjeldstadli has claimed that security was a leitmotif for the workers, who were insecure, because they did not have control over their own situation. Therefore, the trade unions tried to compensate for this, among other things, by fighting for the seniority principle and by limiting use of overtime.²⁰¹

In Kristiansand the union was also vigilant to ensure that the work didn't become too strenuous. Most of the jobs were physically demanding and it was important to avoid a worker being worn out. Relatively inexpensive, but essential things such changing rooms, showers, work clothes and eating areas, were also improved. Workers did not have to go home dirty or in soiled work clothes. This was important to families who lived in cramped accommodation with limited washing facilities.

Falconbridge got its own industrial medical officer in 1936. Initially, several people in the trade union were against the arrangement, possibly because they feared that the medical officer would pick out sickly workers so that these could be fired. This says a lot about the lack of trust between the management and the workers at that time. However, the mood changed when the arrangement was put into operation. The first major task of doctor Guttorm Haaversen was to investigate the risk of silicosis. Neither it nor other occupational diseases were at that time identified.²⁰²

Health issues were one aspect of the working environment, human relations were another. This concerned in particular restraining the foremen's use of power. At different times several foremen were accused of misusing their power. The union discussed the problem with Steen, which did seem to help. But one foreman in particular refused to tow the line and that was Knut Larsen in the electrolysis unit or "Knut the "omnipotent", as he was called. There was no denying Larsen's technical competence. He had worked in KNR and BANC in Canada. Grønningsæter called him the greatest technical talent he had met. However, there were repeated complaints about Larsen regarding unfair dismissal and harassment. He also ran a grocery shop "on the side", and it was claimed that he forced the workers to buy from him. Relations and people who were his customers were also preferred when it came to employing new people. It is difficult to prove whether the accusations were

true, but illustrate that industrial working life was also a question of power and of counter-power in the form of the trade union.²⁰³

In addition to this the union also engaged in politics and solidarity work. The shop stewards were mainly moderate Labour Party supporters. The union subscribed to the party newspaper "Dagbladet Sørlandet", and supported the cooperative trade association and other left wing causes. It donated money to refugees from Nazi Germany, to the republicans in the Spanish civil war and subsequently to Finland's battle during the winter war against the Soviet Union.

This political involvement was also important to the company. It made its mark on the trade union work and through this on local understanding of disputes, co-operation patterns and wage demands. Through politics, the union achieved greater purpose and self-awareness and as part of a larger political and class fellowship it achieved more clout. At the same time, the union had to adapt its demands to the movement's objectives – something which Falconbridge paradoxically benefited from in the 1930s.

Ten years at the top

In June 1939, Sverre Steen celebrated his tenth anniversary as manager of the nickel refinery. After the battle to survive, focus was moved to expansion. Production had been more than tripled to 9,000 tonnes of nickel a year and almost 600 men walked through the plant gates to work each day. Due to his ability to organise production, solve technical problems and deal with customers and the trade union, it seems that the staff at the head office had complete trust in Steen, but the strain took its toll. Today, this would probably be called stress or fatigue. At times, the pressure was so great that Hardy sent Steen on vacation to Denmark to recharge his batteries.

Under Steen's management Falconbridge had become Kristiansand's industrial locomotive. At the end of the 1930s, every fourth industrial worker in the town worked at the nickel refinery. With the exception of Elkems ferrosilicium smelter at Fiskaa Verk and cross-veneer producer Lumber, most of Kristiansands other industrial businesses stagnated in the 1930s.

There were several reasons for Falconbridge's success. Most important were favourable external circumstances, such as INCO's price policy and Brandeis &

Goldschmidt's efforts in sales and rearmament prior to the World War II. But Falconbridge also proved competitive. In Kristiansand the staff managed to produce high quality nickel cheaper than anyone else and the company also managed to keep costs of expansion down.

But not everything was quite so rosy. The refinery was riding on past investments in competence and process ideas and it used KNR's old methods without particular process development of its own. Therefore, Falconbridge was at risk of falling behind INCO, which invested a lot of money in this type of work.

A multinational company, such as Falconbridge had to deal with different industrial cultures. In Norway, for example, the trade unions had a far bigger role than in Canada. The top management of Falconbridge were aware of these differences and allowed Steen and Grønningsæter to have the last word in questions concerning labour relations.

8. A NEW CANADIAN REFINERY?

A cloud soon appeared on the horizon for the employees at the refinery in Kristiansand. Strong forces in the top management wanted to build a refinery in Canada, which could mean that all expansion plans in Kristiansand would be shelved, and be a threat to the future of the refinery.

Several factors affected the choice of path the company faced. One of these was a question of costs: What would it cost to refine in Canada compared with Norway? Access to technology, patent rights and process competence was another factor and a third factor was related to the market: A Canadian refinery would produce for North America. It would challenge INCO in its primary market, which could trigger a price war.

A fourth factor was the political conditions. Both Canada and Norway had an abundance of natural resources, which in Norway's case primarily comprised cheap hydroelectric power. For both countries, a key to economic growth and modernisation was exploitation of natural resources. In both places investors often came from abroad. The authorities tried to protect important political and social interests through regulation.

We will come back later to politics and economy. In order to understand Falconbridge's development and choice of path, we must first turn our attention to the top level in the company.

Grønningsæter, Steen and the Falconbridge organization

The letters between Grønningsæter and Steen give a unique insight into how the management in a multinational company such as Falconbridge functioned, though viewed from only two people's point of view. Where Steen was careful about what he wrote down on paper, Grønningsæter was more direct. A few of the letters ended with "Burn this letter". Annual reports, status reports and the official inter-company correspondence complete the picture, but they lack some of the nerve and commitment that filled the personal letters.²⁰⁴

Thayer Lindsley was the main shareholder and president of Falconbridge. To him, Falconbridge was only one of many projects and his other commitments took most of his time. From the start, daily management of Falconbridge was left in the hands of the Vice President Gordon Hardy. With his energy and thoroughness, he soon established an

independent position of power, also with the main shareholder. However, Thayer Lindsley kept a hand on the helm as chairman of the board. In addition, his brother Halstead was given a post in the top management as Vice President. In theory, he was on the same level as Hardy, but he was Hardy's subordinate as regards daily tasks. The structure did not change until 1936, when Hardy and Thayer Lindsley swapped places as President and Vice President.²⁰⁵

Falconbridge established its first head office in Toronto, it ran the mine and smelter in Sudbury and carried out refining in Kristiansand. Even though the units were geographically quite separate from each other, the tasks linked them together. At least some of the key persons were also old friends or acquaintances from BANC. The staff in Toronto was rather small and one gets the impression that the plants in Sudbury were granted almost as much autonomy as the one in Kristiansand.

Compared with nickel giant INCO's formal and well-organised managerial structure, Falconbridge almost gave the feeling of improvisation. This was further strengthened when Thayer Lindsley, Vice President Hardy and a key person such as Grønningsæter moved to New York. The aim was to move nearer to the financial markets and the technological environments in the world metropolis. For political reasons it was impossible to move the rest of the head office out of the province of Ontario, and therefore this remained in Toronto. The outcome of this was that the top management and the rest of head office were separated. As mentioned earlier, independent agents managed sales from a third city, London.

The organisational structure affected two things, which are important in our context: The loose structure allowed Grønningsæter room to have a strong influence, more or less across the formal units in the company. He was recognised on all levels for his technical insight and his skills as a troubleshooter. Secondly, the open and almost minimalist organisation system helped the company to survive the depression – and to expand after 1932. The administrative costs were kept low and even more important, was the close relationship between top management, the technical management and the shop floor. In spite of large geographical distances, the top management soon became aware of problems. Grønningsæter had personal friends and old colleagues among the management, engineers and foremen at the production units in Sudbury and Kristiansand. In this respect, the company differentiated itself from many other similar companies. Distance has usually been used as an excuse to explain a failure in the flow of information, control and finally profitability.²⁰⁶

Falconbridge stood in a favourable position when the demand for nickel began to grow again, but it was no matter of course that the company received money for further investments.

“Tackling the man at the top”

Thayer Lindsley controlled more than 50% of the shares in Falconbridge. The company was the golden goose of his system and was the only company that gave stable and significant profit. Lindsley wanted therefore to tap money from Falconbridge in order to finance other, more speculative type investments or to pay debt.

The daily management in Falconbridge became concerned about this at an early stage and tried to shield the company. One tactic was to charge as much of the investment costs as possible against the operating accounts. This would reduce the profit and make investment decisions easier.

In future, I will charge all minor costs to production in order avoid bother and explanations. (...) It may even be necessary to distribute major new acquisitions over several months of production. Hardy proposed that even the cost of a new stack could be distributed over several months of production. The business could tolerate quite a lot, particularly when costs are less than 8 cents per lb.

Grønningsæter to Steen 05/01/1930.²⁰⁷

Over the next few years, attention was focused on survival. There was no money for dividend and the investment budgets were also modest. However, the battle for resources resumed from the mid-1930s and again the managers had different interests than the main shareholder.

There is no one else (other than Hardy) who can tackle the man at the top, and who knows that if he goes to far, Hardy will back out just like he has done in all his companies other than Falconbridge. You could say that we have enough contending with problems in production, without having to contend with management at the top; my experience is that we have had most trouble with people such as Hybinette, Børresen, Eyde, Eckbo, Lindsley, etc. We are extremely lucky to have such a good manager as Hardy, who is so accommodating and who is willing to weather the battles with Lindsley. I don't think I could manage him, as this would require financial independence. (...)

If profits decline, it will be difficult to reduce dividend, as Falconbridge is still the only business that is keeping Lindsley afloat. Therefore, it is important to keep the profit down while the prices are high, otherwise the dividend would be increased and the money would

run down a drain in Northern Canada. It would be better then that the extra profit is used to strengthen our own company.

Grønningsæter to Steen 28/12/1934.²⁰⁸

In 1932, Falconbridge had a profit of 800,000 dollars from a turnover of 3 million dollars. This was surprisingly good, as few other companies managed the same feat in the middle of the depression.

The profit was sorely needed to increase operating capital and for investments. The expansion at Koldsdalen in 1932-33 was a result of the new freedom of action, but the pattern changed after this. Almost 80% of the following year's profit was spent of paying dividend to the shareholders. And some of the remaining liquid reserves were used to buy shares in Lindsley's other mining businesses.²⁰⁹

Paradoxically, it was important for the management to avoid profit being far too high. In Kristiansand, most of the investments were charged against the operating budget. In 1936, 700,000 NOK was entered in this way. This amount equalled around 20% of the operating costs and around one third of the total investments in Kristiansand. The managers thus avoided a battle with Lindsley. An indirect benefit was that the book investments looked less expensive on paper than they actually were. This also made it more profitable and tempting for the owners to approve new expansions. As regards the latter, the source material does not say whether Lindsley and his people saw through the tactics.

It is not unusual that the management wants to use the current cash flow to finance expansions.²¹⁰ By using money, which they control, the management can reduce their dependence upon the owners or the capital markets. The interesting thing about Falconbridge is that the investments were concealed in the accounts as ordinary operating costs.

It must be emphasised that tax rules did not motivate this accounting. As we will see, income tax was based on the production volume, not on the company's ongoing results. Property tax was calculated on the basis of a discretionary assessment of the value of the plant. Both were done in a dialogue with the authorities in Kristiansand and in this respect, it was fairly irrelevant how the refinery kept its accounts. The reason why the management entered the investments in the operating budget was not to avoid tax, but to protect the company from its dominating owner.

The dividend was increased to 1 million dollars in 1935, but after that remained stable until the outbreak of war. The book profit increased to 2 million dollars in 1939 from a turnover of around 7 million dollars. In the latter half of the 1930s, Lindsley allowed 40% of

the profit to remain in the company. And together with the “concealed” investments, this was enough to finance significant expansions.²¹¹

The top management followed this kind of policy for the following reason: Whereas Falconbridge was only one of many projects for Lindsley, the situation was quite different for the top management, whose long-term interests were more one-sidedly linked to the future fate of Falconbridge. As well as their careers, the top management also had much of their wealth tied-up in the company. Both Grønningsæter and Steen had a significant numbers of shares in the company, though the financial or career aspects were perhaps not the most important things for them.

Hardy’s motives are not known, but the correspondence between the two Norwegian leaders clearly indicates that the building of Falconbridge was a kind of lifetime project. Managing to get the company, and the especially the plant in Kristiansand to survive became a goal in itself.

Canada or Norway?

In the 1929 annual report, Hardy stated that expansions over and above 4,000 tonnes per year would be made in Canada.²¹² However, this did not happen, and as we have seen, the first expansions in Kristiansand were gradual and inexpensive. This was a logical way for a young company with limited capital to expand, especially as it was so rich in process competence on the Norwegian side of the Atlantic. It must also be remembered that the management did not know whether the stable nickel prices would last. But these gradual expansions also suited Grønningsæter and Steen from a purely tactical point of view. Each investment brought the plant more up-to-date.

A major investment program was adopted in 1936. The capacity in the mine, smelter and refinery was to be expanded to 8,000 tonnes finished nickel a year. And once again, the plans for a Canadian refinery fell through at an early stage of the planning process. It was not until the next round in 1938 that plans for a new Canadian refinery finally became a reality. Canadian senior engineer, Jack Hunt, was sent to Kristiansand to make accurate calculations of what it would cost to build a similar refinery in Canada. All technical drawings were copied and sent to Toronto to be used in the planning work.

The process gives a picture of Kristiansand's advantages and disadvantages. This concerned market issues, politics and in particular technology.

The cost of refining

In the Canadian's eyes, Kristiansand was off the beaten track as regards technology. However, the plant had proved its strength and it had managed to recruit competent workers. Norway also had a wide industrial environment within the chemical and metallurgical industry, from which Falconbridge could benefit.

After the experiences with BANC, the management knew that the technological risk must not be underestimated. What functions well in Norway does not necessarily function equally as well in Canada, at least not initially. For example, it would take time to acquire personnel with the same amount of training. In addition, the patent issue made it difficult to build a new plant in Canada. As mentioned before, INCO acquired the North American rights to the Hybinette process following BANC's bankruptcy. However, INCO did not secure the Norwegian rights and this was one of the reasons why the refinery was located in Norway in 1929. Even though the original patents had expired, INCO had patented improvements and adjustments. Any use of the Hybinette process in Canada could therefore lead to a dispute with INCO.²¹³

The costs were low in Kristiansand. As we saw in the previous chapter, it was far cheaper to expand an existing refinery than to build a new one. Building refining capacity in Canada would also mean loss of scale economies, as the refining would then be divided between two locations.

With an annual production of 8,000 tonnes of nickel, wage costs constituted around half of the costs. The wage level was twice as high in Ontario as in Kristiansand and the price of electricity was also almost twice as high. Electricity constituted around 15% of the costs in Norway. Together, these would give significantly higher costs at a Canadian nickel refinery. The Canadians maintained that a newly built plant in a flat area could be run more rationally than the plant in Kristiansand. Grønningsæter agreed with this to a point, but he still believed that the costs would be far higher than in Norway.²¹⁴

After a few months in Kristiansand, senior engineer, Jack Hunt, decided his work was almost a waste of time. The cost differences were so great that he doubted that the planned

refinery at Parry Sound on the shore of Lake Huron would be realised.²¹⁵ But money was not everything and there were also other things that helped to push through refining in Canada.

Refining and Canadian politics

The potential of Canada and the province of Ontario lay in its vast natural resources, but the size of population and also the risk capital and industrial base were too small to make full use of these themselves. The question was how to facilitate modernisation and growth on Canadian terms.

Canada was a federal state where the various provinces formulated their own policies and regulations. The large nickel deposits in the Sudbury area lay in Ontario, and this province was one of the most restrictive as regards exports of raw materials. It all started with timber. Large quantities of timber were floated down the rivers and towed across the lakes for processing in the US. The province banned timber export in 1897 in order to promote the domestic sawmill industry.²¹⁶ Subsequently, export of pop timber was also banned in order to support the cellulose and paper industry.

Around 1900, a few of the province politicians also tried to force through a similar modernisation policy for hydroelectric power and mineral exports.²¹⁷ As regards the latter, the nickel industry in particular was a focal point. INCO based its business on ore from Sudbury, but for a long time sent the nickel matte to the US for refining. As this was the most value creating and competence developing part of nickel production, it soon became a requirement that refining had to be moved to Ontario. INCO threatened to close down all its business in Sudbury and use ore from New Caledonia. As the ore from here was much poorer in nickel, this was actually an empty threat, but it stopped the politicians in Ontario.²¹⁸

There was a strong rise in Canadian nationalism during the World War I, which resulted in a more restrictive resource policy. In 1917, it was resolved to forbid export of minerals for further processing abroad and this was to apply to deposits found and registered after 1917. By that time, INCO had already bowed to the political pressure and decided to build a nickel refinery in Canada.

Nickel was a political issue, though the matter had calmed down by 1929-30 when Falconbridge started production. The management of Falconbridge knew that the pressure, which had previously been used on INCO, could soon be aimed at them. The Falconbridge mine was registered before 1917, so that it avoided the ban on export of nickel matte.

However, the deposit could not last forever and within a few years had to be supplemented with ore from other mines, which would very likely be subject to the export ban. Therefore, at each crossroad, the management had to consider whether all or parts of the refining should be moved to Canada and only the cost differences held the company back.

Threat of war

The threat of war and rearmament had been a blessing for Falconbridge, but at the end of the 1930s this became a double-edged sword. A war could threaten the link across the Atlantic and the connection between Canadian ore resources and the Norwegian refinery. If shipments had to be stopped, the company could no longer refine its nickel, at least not at its own refinery. Military contingency considerations also indicated a concentration of production within the British Empire.

There were growing concerns at the head office in Toronto,²¹⁹ which led to a thorough report on the matter. Initially, this was only about future expansions possibly taking place in Canada, but in August 1938, Hardy wrote to Steen that:

... You can imagine that the threat of war – which thankfully has begun to subside – has led us to consider building a refinery outside war-threatened Europe. The US is not an option due to the high wages, unrest in the labour market and the public sector's greedy tax demands. Canada remains as the natural alternative ...

However, we will continue production in Kristiansand for "Raffineringsverket" [at Evje] and for the volumes of nickel matte we manage to sneak across the Atlantic. I have therefore asked Grønningsæter to plan a plant [in Canada] with an annual capacity of 10,000 tonnes.²²⁰

Hardy to Steen 30/08/38

When the reports were finished, however, Hardy was alarmed at the huge cost differences. Instead, he put his trust in the hope that Norway would remain neutral in case of war. He counted on being able to maintain production in Kristiansand and that the shipments could continue more or less as normal. To be on the safe side, production was accelerated in order to build up stocks of nickel in England. The customers would therefore not suffer in the event of a brief pause in the sailings.²²¹ Hardy would come to regret this decision, but it illustrates how

profitable refining in Norway was. In addition to industrial competence, this profitability was linked to natural advantages and political conditions.

Georg Lous, a door opener to Norwegian business

Falconbridge had three important points of contact with Norwegian authorities. These were hydroelectric power supply, tax regime, and legal protection for foreign companies. One of the first things the company did was to engage the services of barrister Georg Lous in Oslo. Lous represented a type of business lawyer that had a multifunction as regards his clients. He was a lawyer, and, when required, also a business and tax advisor and a kind of lobbyist for the company. Lous was Falconbridge's advisor for almost 30 years on concession issues, tax matters, various contract issues and other disputes that eventually arose. In addition, he was a member of the company's Norwegian board.

Hardy was basically sceptical to the Norwegian legal system due to his other experiences from international mining business. Hardy doubted that a foreign company, such as Falconbridge, would receive equal treatment in lawsuits against nationally owned companies.²²² To his pleasure he found that his doubt was unfounded. Hardy's enthusiasm for Lous was particularly noticeable after the latter won an important lawsuit against Raffineringsverket A/S (Evje), a lawsuit that was brought before various judicial authorities all the way up to the Supreme Court during the period 1932-35.

Now and then the company's New York management used Georg Lous as a kind of consultant for Norwegian affairs and in order to get assessments that were independent of Grønningsæter and Steen. These two also used Lous in a similar way and asked Lous to send his view on important Norwegian business to New York in order to support their own views.²²³ As Lous enjoyed trust on both sides, he seems to have acted as a kind of "honest broker". Potentially delicate matters such as wage increases and special Norwegian matters could thus be solved with limited discord between head office and the subsidiaries.

Lous eventually assumed a more extensive advisor role. Hardy also used him as a legal advisor in connection with international sales work and as regards Falconbridge's agent Brandeis & Goldschmidt.²²⁴

Falconbridge and municipal taxes

Falconbridge's tax burden in Norway was decided locally. The tax issues were arranged directly with the chief administrative officer in the Kristiansand municipality; Andreas Kjær. In 1929-30, Kjær actively tried to entice new businesses to invest in Kristiansand. The tax rates were therefore very low.

Falconbridge was to pay 19,500 NOK annually in wealth tax and 33,000 NOK in income tax, making a total of 52,500 NOK. This was the total amount of tax to the state and the municipality, but in the first few years, there were almost no tax payments, because of depreciation of the start-up costs, Falconbridge did not pay full tax until 5-6 years later. "We do not feel that this is an unreasonable arrangement", Hardy wrote as a satisfied understatement. However, Grønningsæter, Steen and office manager Trygve Holme were told to continue to work towards keeping taxation low, but had clear instructions to "comply fully with the law".²²⁵

Taxation increased during the 1930s. Due to ongoing investments, the value of the plant continued to grow, which resulted in increased wealth tax. In addition, income tax was also raised. Grønningsæter pushed to have the valuation estimates adjusted upward, as there was not much point in avoiding taxation when the demands were so modest.

Hydroelectric power to Falconbridge

The electricity supply was the most important thing the municipality of Kristiansand had to offer. Falconbridge checked electricity prices in the spring of 1928, but it was not until the following year that real negotiations got underway. Following several meetings, the parties agreed in the summer of 1929 to a power volume of 2,193 kW for 80 NOK per kW-year.²²⁶

This agreement meant that the municipality of Kristiansand finally succeeded with its hydropower-based industrialisation strategy. This policy had taken shape during World War I and the city council resolved at that time to develop the large power plant at Nomeland in order to "give the city a head start in the battle for industry." Grønningsæter also played a key role in this process. He was a member of the city council at the time and also a board member in both KNR and of the municipal power company, but the industry-oriented power policy continued long after he had left the town hall and the power company.²²⁷

The Norwegian concession acts from 1907-17 had given the municipalities a key role in development of hydroelectric power. One aim was to curb the power of large-scale industry and private capitalists. Norwegian authorities wanted to have control over how the natural resources were used. The interesting factor in Kristiansand's case was that the public ownership of hydropower was used to attract a foreign owned industrial enterprise.

In 1914, the municipality of Kristiansand took over the city's private electric power plant and its waterfall rights. However, hope of securing enough energy-intensive industry was completely dashed around 1920. The main customer, KNR, was closed down and Elkem's Fiskaa Verk had serious financial problems and there were no new key industrial customers on the horizon. As a result, the municipal hydropower company suffered large financial losses throughout the 1920s.

Falconbridge thus helped the municipality out of its financial quagmire. In step with the expansions in the 1930s, the company's power needs increased to 10,000 kW in 1939. The price of electricity to Falconbridge was reduced to 75.43 NOK per kW-year. It was more important for the municipality that the refinery expanded and created jobs than achieving high electricity prices.²²⁸

However, the growth took Falconbridge into a political minefield. The municipal power company (KEV) and the regional power company (VAE) were political rivals. They were fighting bitterly about who should be allowed to develop new power resources. Ten years previously, the British owned aluminium smelter at Vigeland just north of Kristiansand was left holding the baby in a similar case. Both KEV and VAE wanted to sell electricity to Vigeland. The question of matter developed into a political dogfight, lasting several years. In the meantime Vigeland had to put its industrial development were put on hold.²²⁹

Sverre Steen had been employed at Vigeland during this period and he manoeuvred very carefully when a new storm blew between the two power companies. New energy sources had to be developed in order to satisfy Falconbridge and other's power needs. The question was by *whom*? In connection with the planned development of the Iveland waterfalls at the end of the 1930s, Falconbridge behaved loyally as KEV's customer, but took care not to participate in the political tug-of-war between the two publicly-owned power companies. Unlike Vigeland ten years earlier, Falconbridge therefore signalled that it could purchase electricity from VAE instead.

In 1939, the Norwegian Government refused KEV a concession for development of Iveland. KEV solved Falconbridge's power supply problem by purchasing electricity from

VAE and selling this onward to the refinery. The price was kept low, as it was also in VAE's and the regional interest that Falconbridge expanded.²³⁰

Through the taxation arrangement and the energy sales, the local authorities went to great lengths to attract modern industry to Kristiansand. This meant that the city was able to compete as a production location, which eased Falconbridge's expansion. This was a rather unusual choice for a municipal power company. Other Norwegian municipalities used their power plants as financial cash cows or prioritised procuring cheap electricity for general consumers, not for multinational companies as Falconbridge.²³¹

Falconbridge, a distinctive multinational company?

In this chapter, we have looked at four areas that were important for Falconbridge's development in Norway: political conditions, the relationship with the local community, the relationship between the parent company and the subsidiary and the management system.

There has been little research done on multinational companies that carried out production in Norway. Most of these companies were active in energy-intensive industry. There were perhaps several managers who played a similar role as Grønningsæter. As a rule, however, multinational companies were more formally organised and the tasks were clearly divided into functions and the local management had limited influence upward in the system.

American historian Alfred D. Chandler has analysed the growth of large management-dominated companies. It was usually professional management – not the owners – that organised large, efficient and powerful businesses. In Chandler's view, it was the companies that built large-scale production plants, extensive distribution systems and management hierarchies divided according to function that succeeded best.²³²

Falconbridge challenged INCO, one of the successful companies in the 1920s. INCO produced on a large-scale, it focused strongly on research and had massive market power. The company was professionally organised with functional management structures. In short, INCO was a textbook example of Alfred D. Chandler's management capitalism.²³³

Falconbridge was different. As we have mentioned before, the interests of the owner, Lindsley, and those of the management did not always coincide and around half of the profit was paid out in dividend instead of being reinvested. The company also had lower grade ore than its larger rival INCO. With its modest and geographically divided head office,

Falconbridge barely had any management hierarchy in Chandler's sense of the word nor had it established its own distribution system.

Falconbridge did have an advantage in that nickel giant INCO cut its own production in order to maintain its high monopoly price during the depression between 1930-32. In addition, Falconbridge was a kind of non-paying passenger as regards INCO's research. INCO spent large sums of money on finding new areas of application for nickel alloys, from which Falconbridge also benefited. However, this does not fully explain Falconbridge's success both as regards product quality, profitability and expansion ability.

Falconbridge and INCO were like "David against Goliath". As in the Bible, Goliath was the largest and strongest and had the best weapons, which in this case were scale economies, distribution and research. David used superior weapon skills to compensate for what he did not have in size. We have previously discussed that Falconbridge succeeded due to its flexibility, open organisational structure and its ability to keep costs down. It was able to use its distinctive features to its advantage, but in this case Goliath was not slain. The giant only forfeited some of its huge market power.

9. OCCUPIED AND ISOLATED 1940-45

With the German attack on Norway April 9th 1940 the ties between the parent company in Canada and the subsidiary in Kristiansand were torn apart. The mine and the smelter were safely located on the other side of the Atlantic, while the refinery was located in German-occupied territory. Nickel was a metal of military importance. The question was how did the refinery in Kristiansand fit in with German plans?

As a manager for a Canadian-owned armament plant, the situation must have been utmost difficult for Steen. The occupation was even more dramatic for the trade union. Ordinary union work was soon forbidden and several of the leading union members were arrested.

Falconbridge entered a very extraordinary era on 9 April. The industrial logic behind the company collapsed in ruins and a new regime – based on German bayonets – took its place.

War!

On the eve of April 9th, the thunder of canon fire shattered the peace. Kristiansand was under attack from German warships. "It didn't take us long to realise that we had to evacuate the plant and run up into the hills behind the laboratory", recalled Fridtjof Gundersen. "We eventually sought shelter in Rosindalen, where 10-11 men lay and listened to the sound of grenades exploding behind us."²³⁴

Hagbarth Aanensen arrived at work at 9 a.m. and was greeted by manager Steen and the treasurer, Håkon Hansen, outside the main entrance. "We'll have to see how things go", Steen said, "but at the moment things look difficult". He had no sooner said this when a Germany dive-bomber flew low over the plant – equipped with sirens to increase the shock effect. The refinery did not receive any direct hits from the artillery fire and none of the employees seem to have been hurt. When the situation had quietened down and the workers returned to the plant, the furnaces were tapped and production was stopped and the plant was secured as best as possible.

However, this was not Falconbridge's first encounter with the war. World War II had broken out six months before the invasion of Norway. From the outset, the British and the Canadian Government had made an all out effort to prevent the enemy from gaining access to

raw materials and products. As a Canadian company of military significance, Falconbridge was naturally part of the economic warfare against Hitler's Germany.

In 1938, Falconbridge had sold more than half of its nickel to Germany, Italy and Japan. At that time, it had been an open secret that most of the nickel was used in war material. Nickel alloys were used in rifle and canon barrels, armour plates, plane engines, etc. Nickel prevented the steel from corroding in saltwater and consequently was used in submarines, torpedo tubes and periscopes. In spite of the threat of imminent war, Falconbridge continued its sales in the winter and spring of 1939.²³⁵ It is possible that the Italians accelerated their nickel purchases from Falconbridge that spring in order to build up strategic stocks, but the German sales continued business almost as normal.

It must be added that Hardy was no more cynical or profit-oriented than any other business managers of the time. Most the other industry of military importance in the British Commonwealth sold products to the Axis powers. This took place with the understanding of the British authorities. Correspondingly, the British themselves purchased war material from the Germans in the spring of 1939.²³⁶

In April 1939, manager Sigurd Giertsen at "Raffineringsverket" at Evje demanded that sales company Brandeis & Goldschmidt had to find agents in the "new German areas" in the east, i.e., Prague and Brno in the occupied Böhmen-Mähren area (Czech Republic). Hardy obviously felt that this was politically awkward, but left the decision to Brandeis & Goldschmidt. Due to its Jewish connections, this company was already on its toes as regards Nazi Germany. No decision seems to have been made regarding agents before events continued to roll.²³⁷

The risk of war was acute at the end of August 1939 and even the usually optimistic Hardy began to fear that war was imminent. When the Ribbentrop-Molotov Treaty between Germany and the Soviet Union was announced on 24 August, Hardy wrote with concern to Steen. All the nickel in stock had to be sent to England as quickly as possible, but sales to Germany were still to continue. A counter-message was soon sent from Brandeis & Goldschmidt regarding sales to Germany and Steen followed their instructions.²³⁸

The shipments of nickel matte across the Atlantic were stopped temporarily until a convoy system was organised. Sailings started in the middle of September 1939, but it only took two weeks before a German submarine sank the first vessel laden with matte. The connection between Canada and Norway had now become the company's weakest link.²³⁹

With the loss of the Italian and German market, there was no need for the whole of Falconbridge's production capacity, at least not in the short term. At the end of September

Falconbridge reduced its activities in the mine and smelter by 20% and Steen was instructed to make a corresponding reduction in Kristiansand.²⁴⁰ However, Steen protested against the cut in shipments to Kristiansand. The stocks of matte were exhausted and 40% of the nickel in the "system" had been taken out. In order to maintain stable production during wartime, there had to be at least two months of stock at Kolsdalen. Hardy brusquely rejected the protest. Sending extra vessels laden with matte to Kristiansand would mean that these sailed straight into the path of the German submarines. Steen was also criticized for having maintained such a high production rate, so that the stocks were depleted. But Steen maintained his wish, and in the middle of October, Hardy agreed to accelerate the shipments.²⁴¹ As winter approached, the situation stabilised and the supply of matte improved. With British approval, there were even limited sales to Mussolini's Italy, which was still neutral.²⁴²

At the same time, other bones of contention arose between Falconbridge and "Raffineringsverket" at Evje. Relations between Giertsen and Steen eventually became strained. "Raffineringsverket" sold nickel to the Germans and according to prewar agreements; Falconbridge was obliged to refine the nickel. If Falconbridge refused, it could force Giertsen to sell all his nickel matte to Germany. Therefore, Falconbridge offered to purchase these consignments of nickel. Giertsen refused, as the offer was probably nowhere near what the Germans paid. In this respect, the situation from World War I was about to repeat itself. Norwegian nickel production profited from the warring parties being played off against each other.²⁴³

Occupied and isolated

The German invasion on April 9th 1940, brought an abrupt end to contact with the head office. A month later the Germans had conquered Southern Norway and on June 6th the King and the government fled Northern Norway and sought refuge in Great Britain. In Kristiansand, Steen was left with responsibility for the nickel refinery without any instructions from the company head office. In the last days of May communication between Norway and the still neutral US was resumed. Hardy sent a telegram via the American consulate general in Oslo to Falconbridge's Norwegian lawyer Georg Lous.

I'm taking advantage of an opportunity to let you know how glad we were to receive news of the safety of our staff and employees, and also that our plant was unharmed. Under the

*circumstances we have to rely on the good hands of yourself and Mr. Steen to protect our interests - and principles – insofar as is possible, until such time as regular communications can be reopened.*²⁴⁴

At the end of the summer, Grønningsæter and Steen resumed their correspondence. The letters were private, but some important information about the company was sneaked in. Grønningsæter kept Steen updated about how things were going with Falconbridge's plans for a Canadian refinery. And he also gave snippets of information about technical development in the US, probably to make Steen aware of future challenges. Steen, who had to take German censorship into consideration, had to be more careful. The exchange of letters continued up to the Japanese attack on Pearl Harbour on December 7th 1941, which brought the US into the war.

Subsequently, radio contact was apparently established between people in the company and the British intelligence service. Via this communication channel it was possible to notify of production-related matters and about shipments of matte and finished metal. Some of the information appears to have been passed on to the management in Toronto, but direct contact was well and truly broken.²⁴⁵

The industrial logic behind Falconbridge quite simply collapsed following the occupation of Norway, as it was impossible to join Canadian nickel ore with Norwegian refining capacity. The first thing Falconbridge head office thought of was to build a new Canadian refinery, as had been considered in the 1930s, but this plan was shelved following the defeat of the allies in France. It was no longer possible to squander resources on such a building project. INCO had spare capacity and took over refining of the Falconbridge matte.²⁴⁶

Production at Kolsdalen stopped on 9 April 1940. German Admiral Schenk, who was in command in Kristiansand, summoned Steen on 15 April to obtain information about ownership, production and raw materials. A week later, Steen travelled to Oslo to seek advice from the Federation of Norwegian Industries and other electro-chemical companies about how he should act. The Germans demanded that production be resumed and that the old prices be maintained. In the further negotiations lawyer Georg Lous took care of Falconbridge's interests.²⁴⁷

Steen was in a difficult position. He was head of a company that was in allied ownership, but he was forced to work for German interests. A special German "Reichskommissariat" for "enemy property" now managed ownership. Dr. K. Breisch, a

manager from the large German steel and armament company Krupp was appointed custodian of the Falconbridge refinery. Breisch was said to be one of Germany's leading experts on nickel, but he had his hands full with Germany's own war production. He did not get involved in the daily operations at Kolsdalen nor did he attend any of the board meetings.²⁴⁸

The same phenomenon can be found at two other Norwegian companies, which were put under German administration.²⁴⁹ However, it has not been investigated whether this was a typical situation. Krupp engineer Graustein was sent to Kolsdalen in 1944, though he was also not given a leading role. But the German bayonets were never far away. A German-Norwegian guard was stationed at an early stage in the plant area. Falconbridge's Norwegian board of directors and management were allowed to continue, though under German supervision and control.²⁵⁰

Steen's task was to protect the plant and personnel as well as possible during the war. According to Steen himself, he tried to keep production down and to keep as large volumes of nickel and copper as possible tied up in the process. He was successful with this, in the sense that the company still had 670 tonnes of nickel and 430 tonnes of copper in solution at the end of the war.²⁵¹ Some finished nickel was also concealed in the cellar at the plant. There is other evidence to show that Steen was responsible for a cautious, but clear line of resistance. He had been a member of the Norwegian Federation of Industries' executive board since the 1930s. During the war, this federation followed a German-friendly policy, and Steen was one of the few who protested.²⁵²

German plans

The Germans had ambitious plans for Norway. Norway's advantage, with its ore-rich mountains, hydroelectric power and fisheries, was to be exploited within the new German Grossraumwirtschaft.²⁵³ The German objectives were basically very long term. English historian Alan Milward has pointed out that surprisingly, the objectives had little direct link to the war effort. For example, the Germans used significant resources on railway building, which did not have a clear military purpose. In addition, they focused on development of Norwegian hydroelectric power, the aluminium industry and on magnesium production. These were extensive projects, which at best would take several years to finish.

Surprisingly enough, nickel, which was an important armament metal, ended up far down the list of priorities.²⁵⁴ The Germans did not exert themselves particularly to resume and

expand production at the old Norwegian nickel mines. The reasons for this were, among others, the following. Firstly, they had built up a relatively large stock of nickel before the war broke out. In addition, the Germans had seized large volumes of nickel during their campaign through France, Belgium and the Netherlands in May-June 1940 and this alone amounted to almost a whole years' supply.²⁵⁵

The most important thing, however, was that the Germans had cast their eyes on a far richer nickel deposit outside Norway, and that was INCO's almost completed mining facilities and smelter at Petsamo in Northern Finland.²⁵⁶ According to the plan, the plant had an annual capacity of 10,000 tonnes (pure) nickel, but due to war and the sub-Arctic climate, production was seriously delayed.

In 1941, Finnish mining company Outokumpu opened a nickel mine in Nivala and began refining nickel the following year. However, production was small compared to the German's needs.²⁵⁷ Petsamo did not achieve full production until the spring of 1943.²⁵⁸ Conglomerate IG Farben sent the matte to Germany where it was refined at Oppau close to Ludwigshafen. This conglomerate had already refined INCO's nickel matte before the war using a so-called carbonyl process. During the war, annual production at Oppau fluctuated around 4,000 tonnes, which was not enough to meet the German's ongoing needs.²⁵⁹ In addition, IG Farben developed an electrolytic refining process. A pilot plant at Ascherleben delivered 240 tonnes of nickel in 1944, and the aim was to expand this plant to an annual capacity of 2,000 tonnes.²⁶⁰

Initially, only small quantities were sent from Petsamo to Kristiansand.²⁶¹ It is difficult to say why this was so, as the plant had spare capacity and good access to electricity, both of which were in short supply in Germany. The explanation possibly lay in IG Farben's company strategy. The conglomerate played a key role in the German war economy and it wanted perhaps to refine the nickel itself in order to acquire more nickel competence. Regardless of the reason: In the first phase of the war Falconbridge was relatively peripheral to German interests.

Increasing production for the enemy

Falconbridge resumed production in the first half of May 1940. Initially, the monthly nickel production was 150 tonnes, which was only a fifth of the pre-war level, but it did not take long before the Germans demanded an increase. Access to nickel matte was the limiting factor

and monthly production fluctuated between 50 and 300 tonnes up to 1943, which gave an average of around 200 tonnes. Initially, Falconbridge refined matte from its own stocks, but eventually everything was done on a sub-contracted basis. The company neither purchased matte nor sold nickel, but was forced to make its plant and competence available to the occupying forces.

Falconbridge continued toll refining for Raffineringsverket at Evje at the pre-war prices, and the Evje company benefited significantly from this. However, the ore beds at Evje were about to be exhausted and in 1943 the nickel percentage had fallen to 0.6%. In comparison, the nickel content of the Falconbridge deposit in Canada fluctuated between 1.6% and 1.9%, while the nickel content at Petsamo was up at 3.5%. To replace the declining ore resources at Evje, production was increased at the Hosanger mine near Bergen. The ore from Hosanger was transported to the smelter at Evje. In total, however, production of nickel matte at Evje fell from 2,500 tonnes in 1939 to 1,000 tonnes in 1944.²⁶²

In the autumn of 1943, Falconbridge began to receive more matte from Petsamo,²⁶³ and the supplies to Kristiansand increased even more in the summer of 1944. It is not known whether the Germans were afraid that the refinery at Oppau could be damaged through bombing or whether IG Farben had capacity problems due to the pressure on the war economy. In August – September, around 2,400 tonnes of matte were unloaded in Kristiansand, but this was to be the final delivery, as a short time afterwards, German forces destroyed the facilities at Petsamo as they retreated.

The Petsamo matte gave increased activity at Kolsdalen in the autumn of 1944. In his report on the war years, Steen wrote that he tried to refuse to refine this matte on the grounds that the company lacked chemicals and special equipment.²⁶⁴ The Germans replied by flying in cotton cloth, boric acid and other raw materials. There was an acute shortage of nickel and the Germans had no alternative raw material sources of any magnitude and it was now too late to develop the Norwegian mining business.

With the help of the Petsamo matte, Kolsdalen became one of the Germans' most important nickel producers. The refinery at Oppau was bombed in September 1944 and was knocked completely out of operation following a new attack in December.²⁶⁵ Kolsdalen was probably saved from the same fate because the plant was located in Norway. The British and the Americans were careful about attacking targets in allied countries. However, a few other plants of military importance were bombed, including Norsk Hydro' plant at Herøya and Rjukan.

Sales and economy

During the first year of occupation, Falconbridge received the same payment for nickel refining as before April 9th 1940. This resulted in a financial loss, as the costs per kilogram were far higher now that production was on such a small scale. In the autumn of 1941, the German authorities raised payment for refining from NOK 3.80 to NOK 5.36 per kg of nickel. When the Petsamo matte was to be refined in the autumn of 1944, payment was increased to NOK 7.43, which was almost twice as high as in the initial phase of the war.

We do not know much about what Falconbridge or the company's lawyer Lous did to raise the payment.²⁶⁶ But it is clear that it would have been difficult for production to continue if the pre-war price had been maintained. There is very little information about financial results during the war, but by the time peace arrived, the company had accumulated a net debt of MNOK 1.8.²⁶⁷ This strengthens the impression that the Germans did not try to cooperate very closely with Canadian-owned Falconbridge. Other enterprises of military importance were usually generously paid for their services, but the Germans were perhaps more restrictive about payment to companies in allied hands. At least one other such company was subject to similar financial starvation, and that was Belgian-owned Norsk Zinkkompani in Odda.²⁶⁸

Most of the nickel was sent to Germany, but some was sold to Italy and to Norwegian customers. The Swedish delivered scrap nickel and received pure nickel in return. Falconbridge was also given the task of refining blister copper from Sulitjelma, just like during World War I. However, this was not to any great extent, as the Germans took over most of the blister copper from there themselves. However, a fair amount of scrap copper was re-melted at Kolsdalen and most of this was used in Norway, among other things in electrical equipment. The Germans, on the other hand, took over a share of the noble metals, but most of this was sold to the domestic market. Falconbridge supplied, among others, Norwegian goldsmiths and dentists with gold during the occupation. Platinum was supplied to Norsk Hydro, who required this in one of their processes. Falconbridge also managed to hide away a fair share of noble metals, as it was not easy for the Germans to have insight into this part of production, because it was kept secret even before the war.

Jobs and trade union work

When Falconbridge resumed a limited production in May 1940, there was no longer work for everyone. The employees were therefore encouraged to find new jobs. This was far from easy, as many companies had to cut back their production. At Falconbridge, temporary employees, apprentices and people who had farms were given their notice and of an original workforce of 600 people, only 390 arrived for work in May. In consultation with the trade union, Steen introduced a three-day week and was thereby able to give work to 280 people.²⁶⁹ As people eventually found other employment, those remaining began to work full time again. In this situation, the company tried to hold onto its key personnel. A few foremen and special workers, who were no longer needed in their old posts, were allowed to keep the same wages even though they were given other work to do.

However, most had to make do with lower wages than before. The 12% cost-of-living allowance was removed in May 1940 already. Many industrial enterprises did this in 1940 which was reluctantly accepted by the Norwegian Confederation of Trade Unions.²⁷⁰ Prices rose around 50% during the war years, but “Reichskommissar” Josef Terboven ensured that industrial wages could not be increased. The company gave one week’s wage as a Christmas bonus and provided free firewood. The nickel workers also received extra rations of work clothes, shoes, soap and bread. Due to the difficult supply situation, the company began to serve soup for dinner in January 1941.²⁷¹ In spite of this, the remaining Falconbridge workers experienced a drastic fall in standard of living.

At the nickel refinery, the trade union managed to maintain its independence during the war years. The minutes from the meetings indicate, however, that people were careful about what they wrote down on paper and thus we know relatively little about what went on. In the autumn of 1940, however, the local union leadership appealed to the members to protect the organisation. Nazi infiltration of the leadership in the Norwegian Confederation of Trade Unions began in the autumn of 1941.²⁷²

The lawfully elected union leadership sent a message to all the trade unions to break contact with the nazi-controlled Norwegian Confederation of Trade Unions, but this was not followed up. A shortage of goods meant that the local union had to keep asking the new national union leadership for help to procure everything from fish to cooking pots and work clothes.²⁷³ The usual trade union work continued too, though more in secret. Shop stewards Anker Hansen and Randulf Fjermeros were arrested in February 1944 and the whole leadership in the illegal branch of the Norwegian Confederation of Trade Unions in

Kristiansand were pulled in.²⁷⁴ Klaus Eskeland, Alvin Kittelsen and Aage Stangenes from the nickel refinery were also arrested. Randulf Fjermeros was killed when the vessel "Westfalen", which was transporting prisoners, hit a mine on route to Germany. Fjermeros' demise meant that the union had lost one of its key representatives. He had been foreman for several periods, among others between 1943-44, and he had also been a member of the executive committee in the Norwegian Chemical Industry Workers' Association before the war.

The trade union and the company put aside their differences during the war, as the management and the workers faced common challenges both as regards the difficult supply situation and especially as regards the German occupants. A feeling of community developed between the two sides and subsequently formed the basis for the post-war collaboration between the union and the management.

However, the differences of opinion did not disappear completely. One of the shop stewards emphasised later that Falconbridge gave less to its workers during the war than many other companies.²⁷⁵ The explanation for this is probably that the company had strained finances during these years. In addition to this, there were other disputes. In May 1943, former union leader Gottlieb Thomassen was given his notice. Steen accused the workers at the anode furnace and Thomassen in particular, of sabotage and breach of tariff. Many of the workers wrote a letter of protest to Steen and Thomassen was eventually offered his job back, but turned this down.²⁷⁶ Accusing someone of sabotage was a very serious and potentially dangerous matter and the whole affair became a festering sore, which is still remembered 60 years on. After the war, the local trade union sent the matter to the Norwegian Confederation of Trade Unions' legal office, but to Thomassen's disappointment the accusations were never investigated.²⁷⁷

Research for the future

Steen used the spare time and capacity to implement an extensive research and development programme. In this way, he could hold onto to key personnel and also strengthen the knowledge base. Steen must have been an optimist at heart with regard to the future, otherwise there would not have been much point in increasing research. At the same time, he was able to delve into matters that probably were close to his heart. During his previous employment at the aluminium smelter at Vigeland, he had played a key role in testing the so-

called Soderberg electrode, one of the most important development projects in Norwegian industrial history.²⁷⁸

At the nickel refinery a total of 87 different series of tests were carried out during the war years. Most of these concerned minor adjustments in various stages of the process, but in several places experiments were carried out to find a means of reducing corrosion damage. The research effort to remove lead and arsenic from the process was also continued. Due to the low pressure on the production side, it was possible to use more laboratory resources on exploiting several of the basic elements in the nickel matte. A series of tests were implemented to produce cobalt, if possible in an alloy with nickel. This was not successful on an industrial scale, but useful experience was gained. The same applied to extraction of selenium.²⁷⁹

The special circumstances during the war helped strengthen generation of know-how at the nickel refinery. In the 1930s, the laboratory had primarily been a support function for the rest of production. Acute problems had been solved, or at least reported on, using analyses. The most long-term development project had been Rikard Løken's systematic work to extract precious metals. In addition, from 1938 the company started research on cobalt extraction. In the heyday of KNR during World War I, the company had focused strongly on development work, but this has been cut back on during the crisis years and in 1929 Falconbridge had still not picked up where it had left off. Focus then had been on surviving and keeping costs down. Following the liberation in 1945, investments in research were reduced somewhat, but were increased again in 1947.

The wartime research effort was partly a means of holding onto expertise, which was given priority, even though the company was running at a loss. Without key personnel in place, it would have been difficult to get the vulnerable nickel refining in full swing again once peace came. At the same time, Steen used a unique opportunity to use a full-scale industrial plant, or at least parts of it, in research. Falconbridge was not the only company that focused on research and development during the war years. Norsk Hydro did the same only on a much larger scale, though in direct co-operation with the Germans.²⁸⁰

An intact nickel refinery

In June 1940, Steen received a message from Hardy to stay in Norway in order to take care of the company's interests and principles. We do not know what Steen thought about the

possibility of an allied victory in 1940, but he did have firsthand knowledge about the US and the country's industrial potential. His own career and friendships tied him also to Canadian and allied interests. The source material available indicates that he tried to keep production down, even though he avoided provoking the Germans or directly violating Germans injunctions.

Eleven of the company's people were arrested for illegal work. This was almost 5% of the wartime workforce, which a high figure in a Norwegian context. Among these eleven were engineers Mikael Buås, Carl Dahl and Bertin Hommeren and office manager Trygve Holme. Two prominent foremen, Kristoffer Krispinnussen and Knut Larsen were also arrested along with the five aforementioned shop stewards.²⁸¹

Not all industrial leaders in Norway followed the same cautious line of resistance as Steen. Sigurd Kloumann, Managing Director of NACO (aluminium) and Norsk Hydro's management went as far as to compete for German favour.²⁸² Sigurd Giertsen in "Raffineringsverket" at Evje delivered as much nickel as he could, at least in the early stages of the war. Falconbridge's neighbour, cross veneer factory Lumber, was also a key supplier to the Germans. The owner, Henry Johansen, became the largest "barracks baron", i.e. war profiteer in Norway.

Steen chose to follow a different path and showed once more his strategic abilities as a company manager. Not only did he help keep the plant intact and hold onto some of the key personnel, he also helped expand the company's knowledge base. Key production and scientific problems were cleared up.

When the German forces in Norway finally capitulated in May 1945 Steen sent a telegramme to Hardy in Toronto to inform that the plant had survived occupation. The Canadians seem to have been genuinely impressed by the management and workers' efforts. However, five years of separation had made its mark. Falconbridge's nickel matte had been refined in Canada during the entire period. The question then was whether the Kristiansand refinery could regain its place in the company organisation.

PART 3. THE KRISTIANSAND REFINERY 1945-73, STRATEGIC STOCKS, GROWTH AND SOCIAL DEMOCRACY

On May 7, 1945, the Norwegian flag flew proudly once again at the top of the Kolsdal stack. To Falconbridge, peace meant that Canadian ore resources, Norwegian refining capacity could be reunited.

However, nickel was primarily a military metal and so when the armistice came in 1945, the demand for nickel fell drastically. No one could predict either how things would go with the civilian nickel markets in Europe. Many of the old customers had been bombed and those that were in production had usually nothing to pay with.

Continuity was clearer on the technical side. Steen had initiated extensive research work during the war, and this resulted in important process improvements. In the next few years, the number of engineers was increased and the company focused more consciously on continuing to develop its competence.

The Cold War was a positive period for Falconbridge. Due to technological weapon development, there was an increasing demand for both nickel and Falconbridge's new by-product, cobalt. It was now the military procurement offices in Washington that more or less decided the future of the various nickel producers. For reasons that we will soon see, the nickel producers were all treated quite differently, though Falconbridge turned out to be one of the luckiest. Large military contracts helped the company expand.

But whether the increase in production would benefit Kolsdalen was another matter. At Falconbridge's headquarters in Toronto there was doubt as to whether making new investments in Norway was the right thing to do. No one knew Norway's fate if a new war should break out. Those who wanted to take a cautious approach were in favour of locating new refining capacity closer to the mines in Sudbury. And pressure from the Canadian and certain US politicians was focused in the same direction.

In Norway, politics had changed. The Labour Party dominated Norwegian politics up till the mid-1960s. Labour believed strongly in state planning and a regulated economy. Modern, large-scale industry was to be built to secure future prosperity. State-owned industrial plants such as a new steel mill in Mo i Rana and the aluminium smelters at Årdal and Sunndal were prioritised.

The question is how was foreign-owned Falconbridge treated? The nickel refinery was completely dependent upon allocation of hydroelectric power and currency licences and therefore upon political goodwill. Moreover, the company was vulnerable to tax changes. Wage development was also politically regulated to a certain extent. In addition, elements in the trade unions wanted to have a say in management of the companies.

Little archive material has been kept at the headquarters in Toronto. The sources available are primarily from the nickel refinery in Kristiansand. As a rule, multinational companies are studied through the eyes of the parent company or head office and the subsidiaries are overshadowed. From this point of view, Kolsdalen's history tells something important about modern industrial capitalism, about how such plants were managed, about what degree of freedom the local management have had and about how the company has adjusted to Norwegian conditions.

We will take a look at how management of Falconbridge and the nickel refinery evolved. A more professional structure gradually replaced personal ownership power and a few ad hoc-like solutions. The Norwegian influence in Falconbridge was reduced after Grønningsæter retired. New refining competence was established at the new research laboratory in Toronto, which gave the top management a better opportunity to scrutinize Kolsdalen.

At the same time, Sverre Steen and his successor Ragnar Jahnsen knew to exploit Norway's competitive advantage. We will follow expansion in Kolsdalen in the 1950s and look at the innovations made and at the investments in new know-how. During the decade, nickel production was tripled and productivity per worker doubled.

Even though the long-term military contracts expired in 1962, financial results remained good through the 1960s. The new shareholders also allowed more of the profit to remain in Falconbridge's hands than the previous owners had done. This meant that the level of investments could be kept high.

With a positive economic trend and good liquidity, the pressure from Canadian politicians to refine the nickel matte in Canada increased. Falconbridge had developed the so-called ML process, which was more suitable for Canadian conditions than the old Hybinette process.

This had two important consequences for Kolsdalen, one of which was good, whereas the other was more ominous. A large research and development unit was established at the refinery and the whole approach to production became more scientific and also competence was significantly strengthened. The company became a technological pioneer once again,

only this time within computerisation of production. But the aim was to develop a process that was more suitable in Canada, and which in the long-term could knock the legs out from under the business in Kristiansand.

10. CURTAILED EXPANSION

”We can achieve full speed in a short time. Supplies are the only things stopping us. We can produce 150 tonnes of nickel a month, as soon as we have received the nickel matte and within three months we’ll manage to produce 800 tonnes,” Steen wrote to the top management in Canada in June 1945.²⁸³

However, things were not that simple. Nickel was important to the weapon industry and the allies were still at war with Japan. At Sudbury mining had still not reached production targets. And sending nickel matte from Sudbury to Kristiansand would lead to further delays and a greater shortage of nickel. Therefore, the allied authorities believed that Falconbridge’s nickel should still be refined at INCO’s plants. Due to the war, business considerations had to take second place. Falconbridge sought support from the Norwegian embassy in Washington, which was keen to get Norwegian industry on its feet again. Following new negotiations with the US authorities, the company was allowed from July to send 3-400 tonnes of nickel matte per month to Kristiansand.²⁸⁴

The first consignment of 300 tonnes of matte was shipped from Canada at the beginning of August. In spite of the capitulation of Japan, the supply of nickel remained erratic, as there was a general lack of cargo space.²⁸⁵ In November 1945, Falconbridge stopped refining at INCO’s plants and after that the matte was sent to Kristiansand.

In December 1945, 750 tonnes of matte were shipped across the Atlantic, which marked a preliminary peak, as just before Christmas, the board of directors of Falconbridge resolved to cut production in the mine and the smelting plant outside Sudbury to half of full capacity. As nickel was used in the weapon industry, much of the demand had disappeared now that peace had been declared. The main shareholder, Lindsley, and the top management also feared a serious economic downturn, like the one after World War I. This would mean a decline in civilian demand. In addition, the situation in Falconbridge’s traditional markets in Europe was unclear. Few of the customers could pay in hard currency.²⁸⁶

Falconbridge was not the only company with a somewhat pessimistic view of the situation. Finnish Outokumpu closed down its entire nickel production,²⁸⁷ whereas INCO cut production by 40%.²⁸⁸ However, Falconbridge managed to sell most of its production to UNRRA, a US financed European aid programme. The nickel was then distributed to industry in the war-torn countries. Falconbridge also sold some of its nickel on the open market, primarily to Sweden and the UK.²⁸⁹

For industrial policy reasons, the US authorities preferred Falconbridge's nickel to INCO's. In fact, the US Department of Justice was in the process of preparing an antitrust case against INCO, i.e., a lawsuit against the industrial concern because it had monopolised parts of the nickel market.²⁹⁰

In December 1946, Falconbridge resolved to resume full production, but it faced two problems. The first of these was mining. In its initial years, the company had used the richest parts of the deposit and now the nickel content of the mine was waning. In spite of record ore extraction, production of finished nickel remained lower than the record year in 1939. The company began to prepare to mine the McKim deposit outside Sudbury, but it took a long time before the mine opened.²⁹¹

The plant in Kristiansand was also not ready for full production. And the vulnerable refining process depended upon a number of special supplies. When the company eventually got a hold of cotton cloth for the electrolysis, it was not fine enough, and allowed impurities to slip through. This meant that much of the nickel had to be re-refined. The British textile factory that had previously made cotton cloth for Falconbridge, had changed to a different production during the war. It was also not possible to get a hold of the same special quality of Welsh coke, which before the war was used in the reduction furnace. Another, "lighter" type of coke caused constant interruptions in production. Supplies of electrical equipment, steam pipes and the like, also required more time, import permits, etc. Grønningsæter finally wrote that no sooner had a problem been solved, before another bottleneck appeared. It was therefore not until the autumn of 1947 that the plant almost reached full production.²⁹²

Chloride in Kristiansand

The original Hybinette process was based on a sulphate-electrolyte. However, the nickel anodes used a long time to dissolve in a sulphate solution. This limited capacity at the refinery and tied up a lot of valuable nickel in production. It was expected to take around three months from the time the matte was unloaded in Kristiansand until it was processed into finished nickel. Use of chloride electrolytes would increase the current density and thereby the capacity. In addition, metal losses could be reduced and noble metal production could be simplified and it was also possible to extract cobalt from the matte.

The idea to add chlorine in the electrolyte was launched in 1905 already. When Falconbridge took over in Kristiansand in 1929, Swedish engineer Torgny Torell proposed

using a chloride solution. Torell was Grønningsæter's assistant and close friend from in his time in KNR and BANC. The disadvantage with chlorine was that there would be increased corrosion damage. As we have previously seen, this was serious enough as it was. Grønningsæter feared quite simply that the refinery could come to a standstill and resolved therefore to continue with sulphate electrolyte. Any technical problems could easily destroy the new and far from financially sound company.²⁹³

New and more corrosion-resistant materials came onto the market during the 1930s. INCO began intensive research on the chloride process in 1938 and built a pilot plant in 1941. The following year, INCO started industrial use of the process. A total of nine different productions worked independently from each other at INCO's large refinery at Port Colborne. One of these could therefore be used in research without the consequences of any errors being too great. From 1947, the chloride process was universal in Port Colborne.²⁹⁴

INCO was the first off the mark and secured the patents. In order to get around INCO's rights, Falconbridge had to develop its own alternative production technology. Nickel competence was not a general "off-the-shelf" scientific or a technological commodity. There was only limited insight into nickel production at colleges, universities or other institutions.

This was due to the structure of the global nickel industry. Knowledge was primarily within the company. INCO, which still dominated the nickel markets, made sure to keep the most research and development work within its own walls. The company's comprehensive technological capacity was one of its main competitive advantages. The fact that this competence was not publicly available helped raise the establishment threshold for new competitors. Through protecting its know-how, INCO could secure its near monopoly.

It was therefore important for Falconbridge to build up independent know-how. Falconbridge had initially used the technical expertise and know-how from KNR and BANC. If Falconbridge was to be able to manage the transition to the chloride process, it had to take a step further. For this reason, this work was the start of something new in the company's history.

During the war, there had been extensive research activity in Kristiansand and therefore competence was assembled in Kristiansand in connection with the chloride process. Even though many people at headquarters wanted to build a new Canadian refinery, there was never really any question of moving parts of this research and development work to Toronto.

Wartime research had proved that Falconbridge's anodes were not suitable for a chloride electrolyte. Once the problem was solved in the summer of 1945, it was decided to build a pilot plant, but the project was postponed. The engineers were given more urgent

production tasks. And it was not until the beginning of 1947 that Grønningsæter finally arrived in Kristiansand to manage commissioning of the plant.

Grønningsæter was in favour of a long trial period. Due to the war's demand for more nickel, INCO had started using the chloride process after only one year of tests in the pilot plant, which resulted in major corrosion problems.²⁹⁵ Falconbridge was not in such a hurry. On the contrary, the company used four whole years of testing. This difference in time was hardly due to the war alone. As we have seen, Falconbridge's owners allocated less money and engineering resources to expansion and development work than INCO.

The transition to chloride electrolyte required a full review of the process and much of the chemistry was changed. It had to be found what temperature, pH value and current density was optimum in order for electrolyses to function as best as possible. Suitable production equipment also had to be purchased. INCO played its cards close to its chest as regards dealing with the corrosion problem and using chlorine resistant material. Due to certain technical differences in process, Falconbridge also had to use a more aggressive electrolyte than INCO. The refinery tested different corrosion-resistant alloys in the pipelines, cranes, etc. The material in the filter presses and diaphragms also had to be replaced and the plant searched in Germany for new synthetic materials to replace the traditional cotton cloth. Falconbridge ordered from Stavanger Staal special alloys for pumps and mechanical parts exposed to corrosion. The work was challenging and Stavanger Staal was delayed by more than one year. The American company that supplied the filter presses was similarly delayed.²⁹⁶ And when the products finally arrived, they were not resistant enough.

The refinery employed more engineers, but due to the pressure on the production side, it was difficult to set aside enough time for the pilot plant. Engineers Fridtjov Grøntoft, John Valen and Ludvig Dundas were given responsibility for the development work. Kjell Nielsen was responsible for planning and co-ordinating reorganisation of the process.

Development of the chloride process reflected the breadth of the nickel work's corporate competence. The engineers' scientific and experimental approach has also been mentioned. In addition to this, there is what could be called engineering competence as regards adapting the plant and putting theoretical insight into practice, which also included engineering design work. Moreover, hundreds of "small" technical problems were to be solved in the construction phase, when the company depended upon the efforts of its electricians, lead burners, pipe fitters and mechanics.

The point here is quite simply that the prerequisite for conducting nickel refining is to master a whole range of industrial competence. This encompasses everything from scientific

insight in process chemistry to material know-how, design technology and the professional skill of the workers. It was impossible to purchase a turnkey new process. Toll refining from others, i.e., from INCO, would mean that most of the profit was end up in their pockets. There was therefore an obvious industrial logic behind Falconbridge's investments in R&D in Kristiansand.

The concise monthly reports from commissioning the chloride process in 1952 inform about corrosion and other challenges.²⁹⁷ The quality of the nickel fell for a while and due to leaks, much of the profit literally ran into the sea. The nickel refinery had to adjust and improve the equipment itself and a separate rubberizing workshop was built so that exposed production parts could be covered with rubber.²⁹⁸

During the transition phase, all the engineers and chemists were put on 24-hour shifts. After one month already, production was greater than before the reorganisation. Therefore in the correspondence between Steen and Grønningsæter not much attention was paid to the difficulties. Their main concerns were on a different level.

The battle with Lindsley

"Director Brindley has major problems with Thayer Lindsley, who is not in good vigour. Lindsley wants to spend Falconbridge's money on other things. [...] Lindsley doesn't trust anyone [...] and will travel to Norway to make his mind up about the expansion. Even if we get it, it may mean that we lose a whole year." Grønningsæter to Steen 25/04/1947

As in the 1930s, the allocations to Kristiansand depended upon a number of political, financial and internal matters. Falconbridge's dominant owner, Thayer Lindsley, feared a new depression like the one that followed World War I. Sales to UNRRA would end in the summer of 1947 and therefore Lindsley was sceptical about making significant investments and wanted to use Falconbridge's profit for dividends to the shareholders. Lindsley had constant liquidity problems in conjunction with his many other mining projects. He was therefore cautious as regards Falconbridge all the way up to the end of the 1940s.

Introduction of the new chloride process was synchronised with the rest of Falconbridge's expansion programme. The process would increase capacity in the electrolysis by around 30%. In order to achieve full effect of the reorganisation, the rest of the production

plants had to be expanded correspondingly. Otherwise, it would not be possible to take out full dividend from the investments. Therefore, investments had to be made in the mines, the concentration plant, the smelting plant and the refinery.

Falconbridge's new manager, L. K. Brindley, fought to realise these expansions²⁹⁹ and Grønningsæter tried to convince Lindsley that the nickel market offered great opportunities. Firstly, Grønningsæter did not believe that there would any serious downward economic trend. He believed that the European currency and payment crisis in 1947-48 was a passing phase. His optimism was linked, among other things, to the Marshall plan, which was being drawn up. This was the new American aid programme to rebuild war-torn Europe. Grønningsæter believed that the plan would lead to an economic recovery, which in turn would increase civilian demand for nickel.

Secondly, Grønningsæter saw immediately the business potential that lay in the Cold War between the Soviet Union and the western powers. Rearmament would undoubtedly benefit Falconbridge. If the nickel was to fail, Grønningsæter believed that INCO would do the same as it had done in 1930-31, when it reduced production to maintain the price of nickel. Grønningsæter believed therefore that Falconbridge could expand without running any great risks.³⁰⁰

But Lindsley had the last word and 85% of the net profit between 1946-49 was paid out as dividend. This policy was hardly due to declining confidence in Falconbridge, Lindsley's main interest and enthusiasm was always focused on new projects, not on "old" plants, which had reached a stable phase of production.

In the case of Falconbridge, the dividends were rather excessive. At the end of 1949, liquidity reserves had fallen to 13,000 Canadian dollars. This was a rather modest amount for a company that had almost 11 million dollars in turnover and a profit of 1.4 million dollars in the same year.³⁰¹ Though many investments were still "concealed" in the operating budgets, the total investment programme was rather poor. Preparation of the McKim mine, expansion of the smelting plant and the upgrades in Kristiansand were postponed or reduced to a minimum.

In addition, the Norwegian and Canadian authorities disagreed about how the expansions in Norway should be financed. The problem was that the equipment had to be imported from the US. Canada had a trade deficit with the US and had to ration its reserves of US dollars. The authorities in Ottawa demanded therefore that as much as possible of Falconbridge's dollar revenues should go to Canada, while the Norwegian authorities reluctantly allowed the company to use Norwegian currency reserves to import equipment.

Falconbridge's office manager, Trygve Holme, wrote to Minister of Trade Brofoss that the nickel refinery earned so much currency for Norway that it had to be able to use some of this in new investments and Falconbridge were eventually successful with this request.³⁰²

In March 1948, the US Congress adopted the Marshall plan. This aid package helped the European countries to solve their acute payment problems so that exports, among other things, of nickel could go more smoothly. At the beginning of April, Thayer Lindsley decided to invest in the chloride process. He was possibly already aware that nickel was to be part of the aid programme. In doing so, he secured Falconbridge a market and a steady income of dollars. In the next few years, significant volumes of nickel were purchased at the expense of the Marshall plan and were packed into barrels marked with the US flag and sent from Kristiansand, among others, to Italian and German recipients.³⁰³

Initially, Falconbridge was to invest 4 million NOK in Kristiansand. However, the prerequisite was that the money was to be raised on the Norwegian loan market.³⁰⁴ Lindsley did not want to use Falconbridge's current profit. However, such a loan required the consent of the Norwegian authorities, but this was not so easy to get. By this time the currency reserves were almost exhausted.³⁰⁵ Therefore, the authorities also wanted Falconbridge to inject fresh dollars. And so the uncertainty continued as regards whether Falconbridge should invest in Kristiansand alone or whether it should also build a Canadian refinery. The outcome depended upon finances, politics and the situation in the company's management and upon framework conditions.

The strengthening of Toronto

Falconbridge maintained its distinctive decision-making structure for a long time. In the 1930s, power was diffusely shared between the owner and the management. In addition, Falconbridge's management was geographically divided between New York and Toronto. After the war, the Toronto office was given new tasks and more influence. The new manager L.K. Brindley moved to live in Toronto after taking over the helm in 1945. Now that the management and the main shareholders were located in different places, the management's position in the company was eventually strengthened.

The New York office was closed in 1947 and the only employee who remained in the metropolis was Grønningsæter. I am "too old to move" he claimed,³⁰⁶ and he subsequently

retired in 1950. Even though he continued as a consultant "extraordinaire", Grønningsæter's influence was obviously on the wane.

Brindley joined Falconbridge from sales company Brandeis & Goldschmidt in London. In the 1930s he had been in charge of the company's nickel sales and this was the reason why had been chosen as Hardy's successor. Brindley provided important market insight to the Toronto office and after a few years, sales to North America and Japan were managed from here.

At the same time as this, the number of technical personnel in headquarters was increased. Around 1950, the engineers here could propose – and be successful with – other process solutions than Grønningsæter had proposed for the smelting plant outside Sudbury. And gradually, refining expertise was also strengthened in Toronto. In the long run, this meant that the top management could make more independent assessments of the needs in Kristiansand.

Acquisition of the Fahlroy foundries was also another important move for Falconbridge. Fahlroy produced special steel, including nickel alloys. This meant that Falconbridge had now taken a step into nickel processing and in so doing integrated yet another link in the value chain in the group. However, Falconbridge's processing business was still modest in comparison with INCO's, but the trend was clear. Falconbridge developed in the same direction as INCO.

All this played an important role as regards Kristiansand's place in the company. In the 1930s, Hardy had controlled Falconbridge from New York. It was not so important to him whether refining was done in Canada or Norway; the main thing was that it was done cost-effectively. However, Grønningsæter suspected all along that the staff in Toronto wanted to concentrate its business in Ontario. This was due to personal preferences and because the people in Toronto were more exposed to pressure from Canadian politicians with regard to this issue.

While Grønningsæter was retired, he remained a vocal defender of what he perceived as Norwegian interests. He lived in the same city as Lindsley, he used Hardy to front his points of view when needed and he had a large network both within and outside the group. Last but not least, he put up-and-coming Norwegian engineer, Jan Reimers, in the Toronto office. Initially, Grønningsæter wanted Reimers to take over as manager in Kristiansand when Steen retired. He also suggested that Reimers should take over his own role within the company, but none of this happened as Reimers left Falconbridge in 1952.³⁰⁷ Norwegian

influence in the company was reduced even further and the rest of the staff at headquarters became more and more in favour of a Canadian solution.

Where should the nickel be refined?

During the war, Falconbridge had to refine its nickel at INCO's plants. As a result, much of the profit ended up in INCO's pockets. Many people in Falconbridge's headquarters in Toronto feared that history would repeat itself. If the Soviet Union occupied Norway, the company could lose its refinery once again.

However, weighty financial considerations still tipped the scales in Kristiansand's favour. Electricity cost three times as much in Ontario as in Kristiansand. The wage level was 130% higher in Sudbury than at Kristiansand and the trade unions were more harmonious and co-operative in Norway than in Canada. But this is something we will come back to later. The price of other types of supplies such as chemicals, industrial services, etc. was more or less the same in total. On the whole, Grønningsæter calculated that refining would cost 60-80% more in Canada. It was even profitable to refine the nickel to be sold in the US in Kristiansand, in spite of having to pay the cost of transport back and forth across the Atlantic.³⁰⁸

Another advantage, paradoxically enough, was that unlike Canada, Norway did not have a "hard" currency. Falconbridge sold most of its nickel to the European market and the European customers preferred to pay parts of the purchase price in local currency, but the problem was that the European currencies could not be exchanged freely into Canadian dollars. This was easier with the Norwegian krone. In addition to this, from 1950 the European currencies were mutually convertible. In this way, it was easy to cover Falconbridge's costs in Norway, but this was a little more difficult for the Canadian-based operations.

In the 1930s, Grønningsæter had convinced everyone that refining would be much more expensive in Canada. However, ultimately, such technical calculations were a question of discretionary assessment and this was different on the two sides of the Atlantic. If Grønningsæter and Reimers praised the advantages of Kristiansand, the Toronto office placed emphasis on how to improve the efficiency of the process in a new refinery on a flat plot of land in Canada. By introducing new and less energy and labour intensive process technology,

the cost differences could also be reduced. Lindsley and the top management in Falconbridge had to live with the uncertainty of the calculations.

Foreign ownership in the age of social democracy

In the autumn of 1945, the Labour Party won a clear majority in the Norwegian Storting and held onto power up to 1965, with only a brief interruption in 1963. The Labour Party prioritised investments and economic growth over welfare and economic redistribution. Growth was instrumental in order to create a better and fairer society.³⁰⁹

The government wanted accelerated industrial modernisation. As cheap hydroelectric power was Norway's primary comparative advantage, the authorities focused on hydroelectric power development and energy intensive industry. State secretary Arne Drogseth in the Ministry of Industry was among those who strongly supported the development of energy intensive industry.³¹⁰ As a newly educated engineer, Drogseth had worked under Grønningsæter's management at KNR and therefore knew the nickel industry from the inside.

The most well-known state-owned industrial projects were the new steel mill in Mo i Rana and the aluminium smelter at Årdal and Sunndal.³¹¹ A partly state-owned company such as Norsk Hydro also enjoyed the benefit of the authorities' blessing.

During the years between the wars, the nickel refinery had been one of many foreign-owned companies. However, the significant German ownership interests in Norwegian industry, including Norsk Hydro, were confiscated in 1945. After that, Falconbridge became the largest foreign-owned company in Norway. Around 1960, the nickel refinery alone was responsible for a fourth of the production value (gross) in such companies.³¹²

Attitudes to foreign ownership have varied in Norway. The legal framework dated from 1906-17 when the so-called Concession Laws were introduced. Foreign ownership was, at least initially, strictly curtailed. However, regulatory practice varied considerably over time. The postwar Labour governments encouraged foreign investments and foreign ownership. Norway did not have enough capital or the necessary technological capacities to exploit its resources. Creating economic growth was the government's primary objective. Ownership was of secondary importance. In 1947, Prime Minister Gerhardsen stated that: "the result of production is more important than the type of ownership." When foreign ownership in Norwegian industry was subsequently debated in the Norwegian Storting, Labour

representatives claimed that it had served the Norwegian society in a positive way: “Not one single example of a bad effect can be proved”.³¹³

Hydropower politics

Grønningsæter and Steen did their best to obtain as good conditions as possible for the Kristiansand refinery. The single most important issue was the supply and price of hydroelectric power. In the summer of 1945, Steen contacted Kristiansand’s municipal electricity company (KEV) to renegotiate the price of electricity. He informed that metal prices had fallen and that other costs had increased. Consequently, Falconbridge needed cheaper electricity than before.

KEV offered an electricity price of 75 NOK per kilowatt-year and the agreement was to apply to the end of 1959. The price for additional power was set at 0.8 øre per kilowatt-hour. This was cheaper than in the 1930s, in spite of 50% inflation during the war. KEV’s director, Axel Oftedahl, claimed that the municipal electricity company would lose money on the supplies to Falconbridge, but that social considerations indicated a low price.³¹⁴

Both the management of the electricity company and the city’s political authorities know what Falconbridge meant to Kristiansand and they wanted the company’s future expansion to take place there. However, neither Steen nor Grønningsæter was satisfied with the offer and tried to force the electricity price down even further. After long negotiations, they gave up as regards the price, but in return Falconbridge was allowed to terminate the contract with two years notice.

New negotiations took place in 1948. KEV’s new power station at Iveland was almost finished and Falconbridge needed more power. Director Oftedahl felt that he was under hard pressure from the nickel refinery. In October 1948, he reported on how the management of Falconbridge had received his price proposal of 95 NOK per kilowatt-year: “Steen ... declared immediately to Grønningsæter that Canada should be notified that the planned expansion in Kristiansand could not be realised. Steen also called one of his engineers in my presence and ordered him to stop the commenced expansion of the plant immediately”.³¹⁵

This was a greater political and financial risk than the municipal electricity company wanted to take. After renewed negotiations KEV and Falconbridge reached a compromise. Falconbridge was to pay 90 NOK per kilowatt-year in the first few years, which was then to be increased to 95 NOK.³¹⁶ The matter illustrates Steen and Grønningsæter’s negotiating

skills, as a few months earlier, Grønningsæter had pointed out to Steen that 95 NOK was a completely acceptable electricity price.³¹⁷

Obtaining enough electric power was probably more important to Grønningsæter and Steen than the price of electricity. Otherwise, Falconbridge could not expand – at least not in Norway. The problem was that the nickel refinery was not the only company that needed more electricity. The demand for electricity was much larger than the supply.

Grønningsæter had firsthand knowledge of the hydropower potential in the region around Kristiansand. He had been a member of KEV's board between 1914-19. He was also politically well connected. During the war he came in contact with leading people among Norwegian exiles in England and the US, primarily through the so-called "Industrial Committee in New York", where he was a member. The mandate of this committee was to study American technology with a view to Norway's industrial future.³¹⁸ Steen was also involved in Norwegian industrial policy, among other things, through positions of trust in the National Industrial Union, the Norwegian Employers' Association and in the state appointed committee that was to assess industrial development in Årdal.

In 1948-49, Steen discussed Falconbridge's needs directly with Director Fredrik Vogt in the Executive Council of the Norwegian Water Resources and Energy Administration (NVE).³¹⁹ He argued that Falconbridge's currency generating ability meant that KEV had to be given priority". It was important therefore to accelerate the second building phase at KEV's power plant at Iveland. Steen was successful with his points of view and Falconbridge got its electric power.

In the spring of 1953, Steen and personnel from KEV visited NVE to get consent for yet another development. The south of Norway and the Kristiansand area in particular had developed more hydroelectric power (measured per capita) than almost any other region and therefore should have been at the back of the queue. But once again consideration for Falconbridge did the trick. With the help of the Ministry of Trade and Industry, KEV was given a concession and government loan financing for the development of a new power station at Steinsfoss.³²⁰

Thus, Falconbridge obtained enough electricity to expand to an annual capacity of almost 30,000 tonnes of nickel in Norway. The feat was that the price remained low. In 1957, electricity from the new power station at Steinsfoss cost the same as the electric power purchases in 1945, if we take the inflation into account.³²¹

Foreign capital through the backdoor?

Falconbridge had probably achieved as much as was altogether possible. In 1948, former Labour Party Mayor of Kristiansand, Karl Rosenløv, advised against the municipal electricity company selling power at less than full cost price. At board meeting in KEV, he mentioned that the city council had received criticism of this confidentially.³²² Editor and newly elected Mayor, Johannes Seland (V) discussed the problem in an editorial in the “Fædrelandsvennen” newspaper in 1953. In this article he warned that: “foreign capital sneaked its way in through the backdoor (and) regulated prices in the publicly-owned electricity companies.” Falconbridge was not mentioned by name, but was obviously the target of the criticism. Seland concluded that: ”The industry has no right to require that the taxpayers and individual power consumers shall finance large-scale industry’s power consumption.”³²³

Steen suspected that KEV’s new director (from 1950), Halfdan Tangen, “did not understand the importance” of Falconbridge. He ”would rather hold onto the Steinfoss power and share this out, as people build houses and install electric heaters”, Steen wrote. ”When (County Governor) Lars Evensen comes home, we have planned with his and (chairman of the board of KEV) Salve Salvesen’s help to do some softening up work.” Steen was partly right with his assumption, as Tangen indicated that “private homes” should indeed benefit more from the increased supply of hydroelectric power.³²⁴

Steen could presume on influential people. Evensen was a former Minister of Industry and Salvesen was a member of the Norwegian Storting from Vest-Agder (Labour Party) and a keen industrial politician. The criticism of or scepticism about Falconbridge had no significance. The nickel refinery purchased 39% of KEV’s available power in 1945/46 and 50% in 1960. The percentage was even higher measured in kilowatt hours, because the company mostly used maximum output 24 hours a day, the whole year round, whereas other subscribers had more variable power consumption. At the same time, Falconbridge only contributed to 14% of KEV’s income in 1945-46 and 21% in 1960.³²⁵

The reason why Steen and Grønningsæter achieved such a good result was that Falconbridge and the Kristiansand politicians had coinciding interests. The latter wanted an industrialised and wealthy urban society and Falconbridge was the city’s industrial locomotive. The company’s needs also meant that state authorities gave Kristiansand priority with regard to developing more hydropower.

The supplies to Falconbridge also gave KEV important scale advantages. Expansion at the nickel refinery was co-ordinated with the electricity company’s developments in Otra.

This meant that KEV avoided being left with a lot of unsold power when a waterfall had been regulated and waiting for general consumption to grow slowly or that people “installed electric wall heaters”. The power could be led directly to the electrolysis halls at the nickel refinery instead. In this way, the electricity company could develop a large waterfall, which in the long run also gave cheaper hydroelectric power to ordinary consumers. Other customers mainly used electricity during cold periods in the middle of winter, i.e., when it was most expensive for KEV to supply them with electricity. Falconbridge, on the other hand, had an even consumption, day and night, summer and winter, which it was easy for the electricity company to take into consideration in its planning. In addition to all this, it must be remembered that it was cheaper to supply electricity to a large customer than to many small customers, as this did not require development and maintenance of expensive distribution networks.

However, it must be said that the price of electricity was forced down. The nickel refinery received help here from Director Vogt in NVE and from the Ministry of Industry. In a letter from the Ministry to KEV and the county’s electricity company VAE in 1955, it was underlined with a blue pen that “the government authorities welcome expansion of nickel production. This is important as regards trade policy and currency.” Each kilowatt-hour that was sold to Falconbridge generated 22 øre in currency income. This figure also included the company’s current investments in Norway. No other electro-chemical company was close to such currency earnings. The Ministry concluded that “it is assumed that the honourable electricity company will be willing to help with future” power supplies to Falconbridge.³²⁶

”Our task for the refinery, the city and the nation”

For Grønningsæter and Steen it became almost a lifelong project to secure the interest of the Kristiansand refinery. Both were Norwegian patriots and also deeply loyal to Falconbridge. In their world, these issues were fused together. They believed that a rich and free Norway depended upon having a well-functioning industrial sector. In the nickel industry there was quite simply no viable alternative to foreign ownership. There was no other way of securing supplies of nickel ore.

While they felt loyal towards Falconbridge they were not always loyal towards Lindsley or the Toronto management. Grønningsæter comes across as the most independent of the two and he had his own – and quite strong – perception of the company’s interest. He

passionately believed that a strong and profitable Falconbridge depended upon refining where this was cheapest and where there was the best expertise – and that was in Kristiansand.

After having expressed his dissatisfaction with the management in Toronto in May 1947, Grønningsæter closed a letter to Steen as follows: "I repeat that our task for the plant, the city and the nation is to establish as modern a refinery as we are capable of doing and as quickly as possible so that we can say that there is little that separates us from a capacity of 16-18.000 short tonnes."³²⁷ By this he meant that the company should start expansions in secret and that these investments should be charged against production. According to Grønningsæter, Steen and the Kristiansand staff could not sit quietly and wait for decisions to be made in Toronto. In 1948, he wrote: "It is important for us in Kristiansand to get the copper plant and the rest of construction underway so that there is no way back."³²⁸ Similar points of view were expressed in the next few years:

*We must do what we believe is right and profitable for the company [...] and charge the (investments) either against production or against a new plant.*³²⁹

*(We must) upgrade the works as best as possible with our current know-how and not be afraid of cost overruns. This concerns, among other things, the roasting area, the gas purification plant and the SO₂ plant ... We must do whatever can be done for production without new allocations, either by charging against production or on a new building account and then we can fight for such things as shears, a carpenter workshop, relocation of salt tanks, etc, which require allocations.*³³⁰

If this did not help, Grønningsæter was willing to go one step further. If the Toronto office put a stop to further expansion in Norway, he and Steen should raise the matter with the Norwegian authorities and the US Marshall plan administration to try to force their own company to invest more in Norway.

At the end of 1950 or beginning of 1951, CEO Horace Fraser had more or less decided to build a new refinery in Canada. However, there was some uncertainty with regard to financing and Thayer Lindsley's poor liquidity. It was also an open question whether this new plant should refine all or only parts of the production. The Canadian management were aware that they were about to step into a political minefield. Therefore, Steen was instructed not to get in touch with the Norwegian authorities. He was also asked to make senior metallurgist, Fridtjov Grøntoft and two of the other engineers available to the new plant in Canada. This

must have been a bitter pill for Steen to swallow and to help sweeten the taste, he was given a two-month vacation trip together with his wife in the US and Canada as a gift from the company.³³¹

However, Steen told Toronto that the Norwegian authorities already knew about the matter and he still did not intend to hand over Grøntoft, who was needed in Kristiansand in conjunction with commissioning of the new chloride process. This tells us something about Steen's position within the Falconbridge system, where he could object without risking his job. Falconbridge still depended upon him and the competence of the Norwegian personnel. However, Steen was careful about emphasising his loyalty to the company. At the same time, he wrote that building a new Canadian refinery would be a hard blow to Kristiansand and Norway. If this was to be realised, he asked Fraser to explain the matter personally to the Norwegian authorities.³³²

However, Grønningsæter did not conform and he wrote to Steen in exasperation that it was Steen and the Norwegian board's moral and legal obligation to inform the Norwegian authorities about the planned refinery, so that they could discuss the matter with Washington. Steen agreed with this. We do not know whether things got that far, but at least the matter shows that the two Norwegian leaders were passionately concerned about the welfare of the subsidiary and that if necessary they were prepared to use the authorities against the company's top management and owner.³³³

For this reason, it is not surprising that Grønningsæter was concerned about cultivating relations with the Norwegian authorities and the public. We have previously seen that he was concerned about the pollution problem as early as in 1931. At the beginning of the 1950s, he and Steen fought to raise money for a gas purification plant. They argued that a number of complaints had been received. "The gas purification plant (must be) complete and efficient. We must never give in as regards this...", Grønningsæter wrote. The money was allocated, in spite of the fact that pollution was considerably worse around the smelting plant outside Sudbury than in Kristiansand, a fact that Grønningsæter was aware of.³³⁴ As such, the matter is an interesting example of a multinational company that imposed more stringent requirements in its host country than in its own native country, i.e., the opposite of what one often would expect.³³⁵

Grønningsæter also argued that the company had to loyally follow the tax arrangements agreed with the Norwegian authorities. In 1953-54, he discussed this matter with Steen and Fraser in Toronto. Falconbridge had followed the agreement to the letter and had increased tax in step with production. Neither the nickel refinery nor the tax authorities

had adjusted the payments because of inflation. Therefore, the company actually did not do too badly out of this and the company's tax burden was significantly lighter in Norway than in Canada. According to Steen, the plant in Kristiansand paid less tax than any other company "of a similar size had to pay." Grønningsæter believed that Falconbridge at least had to remedy the imbalance that inflation had caused and he added that at some time in the future the Norwegian authorities would investigate the matter carefully.³³⁶

Falconbridge expands

In 1949, pilot production began at the McKim mine and full production started around two – three years later. An increasing volume of ore required greater smelting and refining capacity and this meant that the Canadian management were eager to build a new Canadian refinery. Grønningsæter wrote a frustrated letter to Steen in which he referred to the new CEO Horace Fraser as an "anti-European", who wanted to "assemble everything in Canada". However, Grønningsæter had respect for Fraser's intelligence and pointed out his ability to listen to advice.³³⁷

Fraser, who was born and raised in Canada, had graduated from Harvard and worked in INCO 1932-35. After this, he was a professor at the California Institute of Technology. During the war, he worked at the Directorate for economic warfare in Washington DC. In 1945, Fraser became the manager of Falconbridge's plant in Sudbury.³³⁸ Two years later he took over from L. K. Brindley as CEO and Vice President. Brindley came in acute conflict both with Lindsley and most of Falconbridge's management (including Grønningsæter) and was given his notice in 1947.

Fraser and his Financial Director Reginald Campbell also had to deal with Lindsley's dividend policy and they did as Hardy and Brindley's before them. Grønningsæter wrote to Steen that "Fraser and Campbell try to avoid asking TL (Lindsley) for allocations and (they) do what they can to charge the investments against production. However, it is perhaps important to tread carefully as regards the Canadian auditors".³³⁹

Some of the actual expansion costs were therefore hidden in the accounts, but there were of course limits to how far the administration could go. Lindsley probably did not have much financial freedom of action either. As an investor he went ahead at "full speed" in boom periods, but for liquidity reasons had to slam on the brakes as soon as the economic trend began to turn downward.

During the brief depression in 1949, INCO cut production by almost 40% in order to keep the nickel price high. However, Falconbridge increased production by almost 20%.³⁴⁰ Grønningsæter's prophecy from 1947 came true and Falconbridge could expand without any great risk. INCO took the brunt and Falconbridge could now be, as before, a "non-paying passenger" as regards INCO's attempts to stabilise the market. However, the depression did not curb Lindsley's willingness to invest.

Lindsley's wish for high dividends policy and the Falconbridge management's attempts to avoid this may have been a blessing in disguise for the refinery in Kristiansand. By charging parts of the costs of the new plant against production, the plant could be expanded and improved slowly but surely, without requiring major allocations. At the same time, it was impossible to enter a new Canadian refinery in the operating budget.

In the end, Falconbridge decided to expand in Kristiansand. This partly due to the goodwill of the Norwegian state and local authorities. Kristiansand had not only an adequate supply of cheap electricity, the company was also allowed to borrow 4 million NOK in Norway. This was not as much as the company wanted, but it was enough to help Lindsley with the financing.

11. FALCONBRIDGE AND THE STRATEGIC STOCKS 1952-62

In January 1953, Grønningsæter wrote to Steen that: "Thayer Lindsley is so full of optimism".³⁴¹ Demand for nickel rocketed as a result of the Korean War and the tense global situation, the US also decided to build up large strategic stocks of important raw materials. Falconbridge became a main supplier of nickel to the US strategic stocks.

However, for the refinery in Kristiansand, the expansion represented a threat as well as an opportunity. It revived the Canadian demand to refine in Canada and it also gave the parent company more liquid reserves than it had ever had before.

The strategic stocks

World War II had drained the US' raw material reserves. At least that is how it appeared. Many key decisionmakers in the US feared that there would be a shortage of raw materials in the country, almost on the same lines as Germany, Italia and Japan: Three countries, which had just been crushed, among other things, due to their poor access to natural resources. In 1945, the US State Department resolved that the US should import raw materials and metals in order to build up strategic stocks. The country would then be equipped if a new major war should break out. At the same time, the US would avoid emptying its own reserves. As an additional benefit, such purchasing policy could strengthen the economy in US-friendly countries.³⁴²

However, there was disagreement regarding this raw material policy. According to historian, Alfred Eckes, US mining companies fought hard to secure sales to the strategic stocks. These companies rejected point blank that the US lacked such resources within its own borders. Besides, it was difficult to find money. Year after year, the strategic stocks lost the budget battle, but some money was allocated, among other things, towards purchasing nickel.³⁴³ As there were no important domestic nickel producers, there was no disagreement about purchasing this metal from abroad. In 1948, Falconbridge was awarded a long-term contract for 40 million pounds (18,000 tonnes) of nickel, which equalled around two years full production.³⁴⁴

It was not until 1950 that the stockpiling really got underway. A series of events led to this, among others, the coup in Czechoslovakia in 1948, the communists' victory in the

Chinese civil war in 1949 and especially the outbreak of the Korean War the following year. The communist threat was assessed as being acute and it was now regarded as being decisive to secure raw materials and supplies. Two of the metals that the US had the smallest stocks of were nickel and cobalt.³⁴⁵

Just like before, nickel was used in armour steel, armour-piercing grenades, guns and torpedoes. However, the most pressing military needs were in the aircraft industry. Due to the ability of nickel to withstand strong heat, it was used in large quantities in jet and rocket motors. In addition to this, nickel was also important in the nuclear arms programme and civilian consumption was also on the increase. Car factories were the largest customers, but a lot of nickel was also used in the machinery and construction industry.³⁴⁶

Demand increased so much that the US Government requested INCO to increase nickel production. A similar request was probably also made to Falconbridge. Though this probably did not help very much in the short term, as it took time to build up new production capacity. Instead, from June 1950, INCO limited on a voluntary basis its sales to civilian customers, as defence purposes were to be given priority. The Korean War broke out in June and a few weeks later nickel achieved a price of 1.75 USD on the black market, which was around three times the ordinary price.³⁴⁷ In December the same year, the US authorities introduced official nickel rationing. No civilian customers were able to buy more than 65% of their previous nickel consumption.³⁴⁸

In September 1950, the US Congress resolved a crisis programme to build up strategic stockpiles of important metals. This also included loans and subsidies to foreign mining companies so that they could increase production as quickly as possible. However, stockpiling of metals that were already in short supply would not take place until production capacity was increased.³⁴⁹

Falconbridge's opportunity

The situation could hardly have been better for Falconbridge and the holding company Ventures Ltd. Firstly, Thayer Lindsley's many mine investments came into their own. He had found and acquired a number of ore deposits, which it had previously not been realistic to exploit. These rights now made it possible for the company to take a giant leap forward.

Secondly, the US Government wanted to find alternative nickel suppliers to INCO.³⁵⁰ As mentioned previously, during World War II Falconbridge had lost its Norwegian refinery

and French companies Le Nickel and Ballande were located within the German-controlled area. In practice, this meant that INCO had a monopoly. This was not very popular both in the US Government and in the military, especially as INCO had failed to meet its production targets. US politicians had an objective to help other nickel producers succeed.³⁵¹

The third positive thing for Falconbridge was that the strategic stockpiling would take place over several years. In other words, this was more than just a short-term war boom. Falconbridge was thereby able to ensure that the production capacity would not stand idle when the war ended in Korea. The stockpiling did not begin until the end of the war. Before that time, it was not possible to spare any nickel to the stockpiles.³⁵²

In the autumn of 1952, Falconbridge entered into a contract with the US Government regarding supply of 50 million pounds of nickel. 6 million USD were paid in advance. In comparison, the annual turnover was around 20 million USD. In the New Year of 1953, the company entered into an even more gilt-edged contract. Falconbridge was to supply a further 100 million pounds of nickel at a price of 1 dollar per pound over a nine-year period. The usual price then was 60 cents. This meant that Falconbridge received a subsidy or bonus of 40 million dollars, which was to be used towards increasing production capacity. The total corresponded to almost two years turnover. In addition, the company was given an option to sell an additional 85 million pounds of nickel. The condition was that Falconbridge was to at least triple its production capacity.³⁵³

In 1952, Falconbridge also began to refine cobalt. This became possible when the company began using the new chloride process. Grønningsæter had not had great expectations for profitability in cobalt refining, but it turned out that the US authorities prioritised cobalt even higher than nickel. Initially, the production volumes were small at 30 tonnes in the first year and 170 tonnes in the two following years. The company still only managed to extract around 30% of the cobalt content from the ore, and most followed with the slag in the smelting plant in Sudbury. However, a high cobalt price meant that the company still achieved a good profit.³⁵⁴

With all these events, it was perhaps not so strange that Lindsley was "full of optimism". The total sales of nickel to the strategic stockpiles were ten times higher than Falconbridge's production in the record year of 1952. In addition to this, the company also received payment in advance and a premium price for its nickel, record prices for its copper and new income from cobalt.

Better than INCO?

Lindsley had tried to position Falconbridge with the US authorities since 1952 and no other nickel producers were as active.³⁵⁵ One of Lindsley's strategic moves was to employ key personnel who had a good political network of contacts. During the war, the company's president, Horace Fraser, had worked in Washington DC with the matter of raw materials and metals. In 1951, his second-in-command, Frederick Archibald, was headhunted from the same part of the US administration.³⁵⁶

Falconbridge was not the only company to profit from building up the stocks of nickel. The US Government also paid to build up nickel producers Freeport Sulphur in Cuba and Sherritt-Gordon in Alberta, Canada. Though Sherritt-Gordon did not receive as big a subsidy as Falconbridge, because production was not due to start there until 1958.³⁵⁷ Even the French nickel production on New Caledonia received US support. Production had been at a standstill here after war, but the plan was to increase production to 11,800 tonnes in 1952/53, around 60% above the pre-war level.³⁵⁸

In comparison, INCO was awarded contracts for 120 million pounds of nickel.³⁵⁹ If the US Government was to increase its stocks of nickel quickly, there was no way around using INCO. However, the volumes of nickel were only six months of production INCO in 1952. Sales to the strategic stockpiles came to mean far less for the nickel giant than they did for Falconbridge and the other nickel companies.

Val Ross wrote in an article about INCO, that the company was not focusing in the right place and was still concentrating on the success strategy from the inter-war years, i.e., on research and the civilian markets and became aware of the new political opportunities too late.³⁶⁰ INCO also had a weaker position from a purely political point of view, but eventually managed to strengthen this position when the previously mentioned antitrust case against the company was dropped. The US competition authorities had wanted to separate the rolling mills from INCO in order to reduce its dominant market power. The matter was stopped in 1948, when the company promised to change its sales practice and also to supply other rolling mills with nickel.³⁶¹ INCO was not split up into several companies, but the processing market was opened to new players.

INCO's position strengthened when President Eisenhower took over after Truman in 1953. The Republican Party was generally more positive to conglomerates such as INCO than the Democrats were. In addition, Eisenhower's foreign minister, John Foster Dulles, had been a former board member in and senior lawyer for INCO. However, when the Eisenhower

administration took over in January 1953, negotiations for the contracts with Falconbridge were already more or less concluded.

New owners and strategies

Throughout his entire career, Thayer Lindsley had operated on the edge of what was financially possible and his primary interest was to develop new projects. His main new projects in the 1950s were the Eureka Silver Mine in Nevada and an ambitious project to develop mining and smelting industries in the Yukon in northwestern Canada. The latter had a cost framework of around 800 million dollars.³⁶²

Before Christmas in 1954, Grønningsæter wrote to Steen that Lindsley was a very difficult man to deal with. He had had to sell shares both in Falconbridge and in the holding company Ventures in order to cover costs incurred in the Yukon. During the summer of 1955, he lost control of Ventures and thus also of Falconbridge. New people joined the board of directors of both companies. They showed little consideration “towards the older members” and at the end of the year Lindsley was quite simply kicked out of the board of directors of Falconbridge. Lindsley’s exit from the board of directors was the end of an era in the company’s history. He was a founder, dominating owner and geological expert in one and the same person.

According to Grønningsæter, General Motors was among those who began to pull on the strings in the Venture’s system. The car company was one of Falconbridge’s important customers. In addition to General Motors, Texan oil interests and New York and Toronto banks also acquired interests in Ventures and Falconbridge.³⁶³

In August 1955, Robert B. Anderson was appointed new director of Ventures. Grønningsæter regarded this as a wise choice. Anderson’s job was to change focus from ore exploration and project development to increased profitability. Anderson had a background from the oil and cattle business in Texas and probably acted as a representative of the Texan owners. However, it was his political contacts that mattered to Ventures and Falconbridge. He had worked in President Eisenhower’s administration, first as Undersecretary in the Defence Department and then as Secretary of the US Marines. He was also a close, personal friend of the President. Eisenhower tried to persuade Anderson to be his Vice President candidate in 1956 and hoped for a long time that he would be his own successor in the White House. But Andersen wanted to work in industry and commerce.³⁶⁴

With Anderson in the driving seat, there was no longer any fear that INCO would begin to win the political battles again. As the US Government was still Falconbridge's largest customer, it went without saying that Anderson's network of contacts and political insight was very useful. However, Anderson's stay in Canada was short. In 1956, he became US Secretary of the Treasury. In spite of this, he was very important to Ventures and Falconbridge. The process of splitting Ventures into several companies began under Anderson. The main idea behind Ventures had been that the company should be Lindsley's instrument for gaining control over other companies. When Lindsley was outmanoeuvred, there was no longer any obvious reason for keeping Ventures as a separate holding company.

Lindsley's departure and the splitting up of Ventures were of great significance to Falconbridge. The ownership structure changed. The Canadian gold mining company McIntyrePorcupine became the largest shareholder. McIntyrePorcupine was partly owned by Texan interests. This company remained the most important shareholder in Falconbridge for almost 25 years and ensured stability among the owners.³⁶⁵

In practice, the new owner situation strengthened the position of the top management in Falconbridge and especially of Director Fraser. In 1962, the remainder of Ventures was merged with Falconbridge and as a result the nickel company acquired a number of mineral deposits and ore exploration projects. Falconbridge developed into a more professional and management-dominated company. In this way, the nickel company became more alike the standard pattern within US and Canadian industry and commerce.

As a person, Fraser is described as a far more production and result-oriented than project-oriented Lindsley. Fraser ensured that a much larger portion of the profit was used in new investments within the Falconbridge group than in Lindsley's time. At the same time, Fraser had a background as a geologist and he continued the tradition of allocating significant resources toward ore exploration and acquisition of deposits. Following integration of Ventures, Falconbridge remained dominated by geologists, a situation that prevailed in the company for a long time.

Killing two birds with one stone

In 1954, Falconbridge prepared for production in six new mines in the Sudbury area. Three of these started production in the same year: Hardy, East and Mount Nickel Mine. In addition,

Falconbridge purchase ore from three independent mining companies. The plans for future large-scale production were primarily based on the rich Fecunis deposit. It had originally belonged to INCO, but INCO had forgotten to secure its rights, so that Lindsley and Falconbridge got hold of the deposit almost through a coup. With all this, Falconbridge had enough ore to increase production. However, the question once again was, where would the refining take place?

The Americans' hunger for nickel gave Falconbridge a possibility to kill two birds with one stone. The management hoped to receive enough subsidies both to expand the mining and smelting plant capacity and to build a new refinery in Canada. This would solve one of the company's headaches. The law in the province of Ontario required that the ore from Falconbridge's new mines was refined in Canada. As we have mentioned previously, ore found after 1917 could not be exported without special dispensation. The Falconbridge deposit was registered before 1917, but the company's other ore fields were found a long time after this. Therefore, the expansion raised the refining question once again.

Ontario's demand was not from being exceptional. It was the order of the day that public authorities intervened in private companies. The nickel refinery in Kristiansand was not the only metallurgical company in Norway to be hit by such a policy. "Det Norske Zinkkompani" in Odda was in a similar relationship with the Spanish authorities, who refused export of zinc ore from Spain.³⁶⁶ The reason was the same as in Ontario, processing of Spanish raw materials and the most possible value creation was to take place in the country of origin.

The special thing about Falconbridge was that the nickel refinery was so closely linked with the Cold War. In 1950, Defence Committee in the US Senate resolved that Falconbridge should build a new refinery in North America. This would secure nickel supplies in case of war. The committee proposed that the plant should be paid through the strategic stockpiling programme or through direct financial aid.³⁶⁷

However, the US government was not willing to subsidise building a new Canadian refinery. Fraser indicated in a letter to Grønningsæter that the US authorities were concerned about Norwegian reactions.³⁶⁸ The Norwegian balance of payments was already under strong pressure and the country needed all the export income it could get. It is important, however, not to exaggerate the role of Falconbridge. The company's share of Norwegian commodity export was less than 1%.³⁶⁹ But during the Cold War period, the Americans wanted to support

Norway rather than the province of Ontario, especially when this alternative was much cheaper.

There was otherwise no other means of financing a Canadian refinery and a new campaign towards Washington in the summer of 1952 also failed.³⁷⁰ After that, the door was closed. The ongoing expansion of Falconbridge was partly financed through sale of bonds on the US finance market. The bondholders were not willing, either directly or indirectly, to pay for building an extra refinery, which they regarded as unnecessary and price raising. The province of Ontario gave in and granted a twelve-year postponement of the demand for secondary processing in Canada.³⁷¹

Nevertheless, most of the company's expansion would be in the Sudbury area, where the mines and smelting plant were located. According to the annual reports from 1952-60, 72 million Canadian dollars were invested in Sudbury. This equalled 85% of Falconbridge's total investments. In comparison, 13 million dollars was invested in Kristiansand.

12. EXPANSION AND INDUSTRIAL CO-OPERATION

The 1950s was an unparalleled period of growth. Production was more than tripled. It was also a decade of organizational and cultural change at the refinery. In 1955, Ragnar Jahnsen succeeded as manager after Sverre B. Steen. Jahnsen came from outside the company and he represented a different industrial culture.

Social democracy flourished in Norway in the 1940s and 1950s. We have previously seen that Labour governments were positive to foreign investment and to foreign-owned companies. At the same time, the government and the Norwegian Federation of Trade Unions wanted to ensure industrial workers more influence in the companies. The long-term objective was to introduce a so-called industrial democracy. This would be a giant step for Falconbridge, where the management had been fairly autocratic under Steen's leadership.

This chapter also explores the relationship between the subsidiary in Kristiansand and the parent company in Canada and will gather all the threads from the first three decades. How did multinational Falconbridge conduct itself in Norway? To what extent did the company manage to adjust to national and local conditions? And what freedom of action did the local management in Kristiansand have?

Choosing a new General Manager

The 1950s was a decade of generational change in the refinery management. Grønningsæter retired in 1950 and Steen followed in 1955. Engineer Jan Reimers was the first candidate as a new manager in Kristiansand. He had been employed in the Norwegian aluminium industry and had done British war service. After this, Reimers worked in the Canadian aluminium giant Alcoa up to 1948, when Grønningsæter recruited him to Falconbridge. With his experience both from Norwegian and Canadian industry and his outstanding technical skills, Grønningsæter viewed Reimers as an ideal successor to Steen.

Reimers had a long stay in Kristiansand in 1949, but his wife would not move to Europe. In addition, he had a strained relationship with several of the engineers at the refinery, among others, with Steen and senior metallurgist, Fridtjov Grøntoft.³⁷² After this

Reimers was relocated to the head office in Toronto, where Grønningsæter probably hoped that Reimers could take over his own role.³⁷³ But this was not to be, as Reimers returned to Alcoa.

Steen had health problems and needed relief. Fraser indicated that they could perhaps employ a Canadian, but Steen rejected this point blank. He believed that a foreign general manager would lack the necessary local knowledge and be less well equipped to handle negotiations with Norwegian authorities. Steen also informed Fraser that none of the other Canadian or American owned companies in Norway used foreigners in top management.³⁷⁴

In 1950, 35 year-old Kjell Nielsen was recruited as production manager and potential general manager. Nielsen had been educated as an engineer in Strasbourg and had a doctorate from Paris. He had worked for ten years in Norsk Hydro, which was one of Norway's largest and most advanced industrial companies. Nielsen had, among other things, been employed in Norsk Hydro's chlorine factory at Herøya, which was absolutely relevant, as Falconbridge was about to start using the new chloride process.³⁷⁵

It was Steen who chose Nielsen, but Grønningsæter was sceptical and their first meeting did not go well. Grønningsæter believed that Nielsen was too social democratic. Nielsen had a few ideas about "worker and salaried worker matters, which were in strong contrast to our American director's views. For example ... to give shift workers a fixed wage and make them salaried workers". Grønningsæter also characterised Nielsen's view of piecework issues as "completely utopic. It's clear that he is very much influenced by the current Norwegian environment."³⁷⁶ For his part, Nielsen was much more visible on the shop floor than Steen and the engineers of the day. He also had an ability to communicate with the employees and if needed, he was not afraid to lend a helping hand.³⁷⁷

Grønningsæter pointed out to Fraser in Toronto that Nielsen was a very skilled engineer with a good ability to organise production, but he warned that he had "... a young person's view of the welfare state and its lack of respect for profit making for the shareholders and for the orthodox view of financial issues." Steen defended Nielsen and pointed out his work with the ongoing expansion in Kristiansand. Judging by the correspondence, this was actually the first time that there was a clear difference of opinion between Steen and Grønningsæter.³⁷⁸

Grønningsæter got his own way and in June 1953, mechanical engineer Ragnar Jahnsen was employed as assistant general manager and two years later, he took over the helm from Sverre B. Steen. Jahnsen had been senior engineer in the planning department in Norsk Hydro. Nielsen on the other hand was exiled. Grønningsæter stated rather bluntly that a

person "who is not qualified to be no. 1 ... (is) also not qualified to be no. 2".³⁷⁹ Nielsen subsequently became general manager at Bremanger Smelteverk.

Within Falconbridge, Jahnsen was perceived to a more natural leader than Nielsen. He was born in the US, where his father was an engineer in the steel industry in Gary, Indiana. His father was subsequently employed at Ulefos Jernverk, where young Ragnar followed life in the foundries and his father's research work at the ironworks.³⁸⁰ Ragnar's upbringing, education and career were all linked to engineering culture and the process industry.

Jahnsen brought with him some of the corporate culture from Norsk Hydro to Falconbridge.³⁸¹ Norsk Hydro was a prosperous company, which had never been in the same financial need as the nickel industry. Hydro had a tradition – and you could say a conscious strategy – to spend money on things that were not directly related to production. As regards focus on planning, research, working environment and building mass, etc., Norsk Hydro differed from most of the other Norwegian industrial companies. In this respect, Falconbridge was the exact opposite to Norsk Hydro. Falconbridge had been established and had survived the depression more or less using minimum solutions. Even though Falconbridge's finances eventually improved, thriftiness was still "engrained" in the walls.

Jahnsen began to change this and he subsequently told that he had got quite a shock the first time he visited the nickel refinery.³⁸² Everything was dusty and done in the cheapest possible way. At the same time, the planned expansion programme offered significant challenges and he felt that he could hardly say no to the job. One of the first things he did – almost symbolically – was to paint a few of the plant's unpainted sheds and buildings. Jahnsen also hired architect Wilhelm Reinhardt to design the expansions that were in progress.³⁸³ Kristiansand's leading architects, Sannes and Steen, were subsequently hired. The older parts of the building mass were also to be given modern facades. Falconbridge was gradually given a more representative and less temporary appearance.

Jahnsen's spending irritated Grønningsæter and he asked Steen to keep a hand on the helm, which the latter refused to do. The expansions were costly and Grønningsæter believed that the calculations had not been thoroughly prepared. In the spring of 1957, he wrote that "... the technically perfect, is often, perhaps too often, too expensive, and there must be a compromise between a financial and the technical ideal."³⁸⁴

By then Jahnsen had requested the head office in Toronto for an extra allocation of two million NOK toward the investment programme and also for one million NOK to other projects.³⁸⁵ Grønningsæter was flabbergasted and argued that the company's requirement of a 20% return could no longer be met. He complained both to Steen and to the head office

without success. Grønningsæter was afraid that Jahnsen would ruin his lifework. In his view, it was the low capital costs in Kristiansand, which made it possible to avoid building a Canadian refinery.

Jahnsen opted for solutions that could also function in the long term, even if the investment costs were higher. He knew that Falconbridge had managed to postpone the requirement to build a new Canadian refinery until 1966. Therefore, it was important for him to modernise the plant in Kristiansand as much as possible so that it would be also be competitive in the future. Jahnsen had the support of the rest of the engineers in this quest.³⁸⁶

Jahnsen was referred to as an industrial strategist and in Toronto he was also perceived as and appreciated for this.³⁸⁷ In Kristiansand he was concerned about building lines, about making internal transport more efficient, etc. Engineer Realf Høy-Petersen has described how Jahnsen “opened up” the plant landscape.³⁸⁸ He wanted more space around the production equipment so that it was easier to inspect and maintain. Dismantling equipment was to be as easy as possible so that heavy maintenance could be done in the workshops and not in the poor working environment of the production halls.

This required that the dimensions of the new buildings had to be increased. When roasting furnace 2 was removed in the autumn of 1953, Jahnsen made sure that the area was properly cleared up. All intermediate floors, where dust could gather, were demolished. Transport capacity was doubled so that production did not need to be interrupted when large objects required moving. Ventilation was also improved. In this way, the working conditions and efficiency at the new roasting furnace were improved.³⁸⁹ In the long term, the old production areas were also refurbished or modified.

All these measures cost money and the extra allocations made in 1957, among others, were spent on such improvements. The willingness to incur such high costs led to a breakdown in communication with Grønningsæter, but with Steen’s help,³⁹⁰ Jahnsen gained support for his dispositions at the head office in Toronto.

The expansion

In the 1950s, both military and civilian demand for nickel increased substantially. The western European countries had never before experienced so strong economic growth and

orders for nickel flooded in. Falconbridge had to limit itself to selling nickel to old customers and could not even fully meet their requirements.

During the summer of 1953, the refinery in Kristiansand began to look more and more like a building site – as well as being a high-tech production company. All areas were to be expanded. Unfortunately, few sources from this period remain. The minutes of board meetings and the annual reports does not yield much information, other than that the copper and cobalt units and the electrolysis area, etc. were expanded. A new smelting plant was built and the roasting building was expanded. Mechanics, pipe fitters, electricians and carpenters were given new workshops. In addition, a completely new rubberising workshop was built to help reduce corrosion damage. One challenge was the lack of space and the hilly site. Major blasting work was carried out to level out the site and a few adjacent properties in Hannevika were acquired.³⁹¹

Production increased significantly each year and exceeded 30,000 tonnes in 1960, which was a tripling of production within a decade. At the same time, the number of employees only increased by 50%, which indicates that productivity per employee was doubled. Much of the improvement in productivity was due to the change to the chloride process in 1952 and more money being spent on technical aids than before. Electric motors replaced raw muscle power, use of rubber gave less corrosion damage and internal transport was rationalised. The expansions meant that the nickel refinery could finally benefit from new scale economies.

No major improvements were made in the process after 1952, though attempts were made to improve the efficiency of the roasting process. German company Lurgi was given the responsibility to test a "fluid-bed-furnace". This technology functioned well in other smelting plants, but had never been used for roasting nickel matte. But the project was shelved when Fridtjov Grøntoft decided that the results were not good enough, because the furnace "built up", blocking the discharge port. The test furnace was probably too small, but Falconbridge was in a hurry, it did not have time to continue the tests.³⁹²

The main challenge in conjunction with the expansion was that the process consisted of so many different stages and therefore it was easy for serious bottlenecks to develop if there were commissioning problems in one of the new production units. This meant that it was better to choose well known technical solutions than on more uncertain, but potentially promising changes. It must be said that the employees actually did a very good job, as there were no serious technical problems and the budgets and deadlines were met.

The Canadian annual reports mention repeatedly that the refinery in Kristiansand was ahead of the smelting plant at Sudbury, where a new furnace was not installed and in use until 1957. As the nickel refinery was ahead of schedule, it was always possible to have margins to go on. Jahnsen ensured that all the units were thoroughly test run before they were put into operation. This meant that any bottlenecks could be cleared without creating complications for the smelting plant or the mining activities.

The Hardy Mine was the only new mine with enough ore for a long-term production period. Purchase of ore from other companies soon came to an end when the mines were emptied of nickel ore. The problem was that the work with Falconbridge's large deposit at Fecunis was seriously delayed, this mine did not start full production until 1959. After capacity was increased at the smelting plant, access to nickel ore became the limiting factor.

The spare capacity in Kristiansand was used to refine large volumes of scrap nickel. The task was technically fairly complex, but it was successful, which again demonstrated the competence of the staff in Kristiansand.

Expansion, personnel turnover and working conditions

The expansion created an acute need for personnel. The number of employees increased from 880 in 1950 to 1480 in 1956. Due to high turnover, however, a far larger number of employees had actually worked at the plant. In 1952, almost 1,000 people started work in and resigned from the plant. During the 1950s boom period, people changed jobs frequently, as there were more than enough vacant jobs to choose from.

At the same time, Falconbridge had a large group of workers who had worked at the plant for years. Some of these remained here their whole working life. More than 300 of the people who worked at Falconbridge in 1950 were still there 20 years later.³⁹³ These stable workers usually had a multifaceted relationship with the company. It was at the refinery they made their livelihood and had found their identity as Falconbridge workers. It was here that they received reward for their skills and process competence. Friendships and sometimes even family ties linked them to other workers. It was this core of employees that kept the company's holiday accommodation and brass band going. They also formed the core of the trade union and fronted the workforce's demands to the company.

At the other end of the scale, many workers only worked at the nickel refinery for a few weeks or months. Milton Hartveit, who was shift foreman at the time, told how this created challenges.³⁹⁴ Having many workers that were unfamiliar with the work meant that training, supervision and inspection was important, especially in the smelting plant where errors would have the greatest consequences. Even in the electrolysis area, which require the least knowledge or experience, Grønningsæter complained about the problems this created.³⁹⁵ It was in the nature of things for the management to be concerned about the workers' efforts. However, the results indicated that the difficulties could be solved and both the building programme, product quality and production volume achieved the targets that were set.

The wage level was one of the reasons for the turnover of workers at the nickel refinery. The metallurgical industry had (like other industry) been wage losers during the war and this was not remedied afterwards. However, nickel workers were still well paid compared with many other workers in Kristiansand, but the differences were not as great as they had been before the war.

At the same time, the nickel workers now had an easier working day. During the 1950s, hundreds of electric motors and conveyor belts were installed and ventilation was improved. The work was less laborious and there was less dust and discomfort. The changing room facilities were improved and several lunchrooms were provided, in addition to opening a new large canteen that served hot food.

However, the Hybinette process remained, fundamentally speaking, the same with its combination of wet and dry chemical processes, handling large volumes of fine-grained mass that generated dust, etc. Not all tasks could be mechanised to any great extent and the dust could not be eliminated, only reduced. Many of the operations were still the same as they had been before the war, apart from the fact that everything took place on a much larger scale and with better equipment than before. Paradoxically, the only significant change in the process aggravated the working environment, at least for an interim period. As mentioned previously, introduction of chloride electrolyte in 1952 resulted in chlorine poisoning and discomfort.

In 1957, there were 152 injuries which resulted in sick leave. This corresponded to one injury for every ninth person. This prompted purchase of better personal protective equipment for the roasting and smelting plant. After Reidar Holum initiated systematic preventive work, the number of lost time injuries fell to 55 in 1963.³⁹⁶ Though there was still much to be done, the nickel refinery had become a safer work place.

Increased employment and union power

In the 1930s, most of the nickel workers came from the Kristiansand area. New employees were usually relations or friends of other employees, which helped to bond people together. In the 1950s, the company had to look further a field for employees. The new manager for human resources, Jan Sand, sent representatives to Denmark and Northern Norway to find labour. Many of the newcomers had no connections with the rest of the employees and a significant number of these disappeared again after a few weeks.

Many "short-term employees" did not bother to join the union and in many cases people worked in the company for more than a year without becoming a member of the union. Others left the union without anyone reacting. The group committees in the various sections of the company did not function for long periods at a time. In other words, the union was not very active. In this regard it differed from its sister unions in the Norwegian Chemical Workers' Association. There were few places where the trade unions were stronger and more active than in the electrochemical industry.

This was the time when the Norwegian labour movement was in its prime with consecutive labour governments and some of this strength rubbed off on the workers' union at the refinery. It was injected with a new political power. So it was probably of little significance that many short-term employees failed to join.

As mentioned previously, a core of stable and usually radical workers were responsible for trade union activity. Radicalism was primarily expressed in involvement in safety policy and not as opposition to the management. Though the rhetoric toward the employer could be hard at times, the bones of contention were usually settled without open dispute or strike.

Industrial collaboration

Willingness to collaborate was a general characteristic of the Norwegian labour movement. As we have seen in previous chapters, this collaboration was well established in the 1930s, when the leadership of the Norwegian Federation of Trade Unions (LO) moderate its demands in order not to make things difficult for the new labour government. As the government had stemmed from the same movement, there were strong common interests and ties of loyalty.

In the 1940s and 1950s there was even stronger influence from central sources in the labour movement. The leadership of the national trade unions underlined that *labour peace* was a general objective. Immediately after the war, the trade union newspaper “Fri Fagbevegelse” stated in an editorial column that whereas the strike-breaker “used to be the biggest criminal”, the reverse was now the case. A striking worker was labelled as being unsocial. Strikes were a thing of the past, because the situation had changed now that the Labour Party had achieved absolute majority in the Norwegian Storting.³⁹⁷

Wage settlements were managed centrally and the wage increases were moderate. There were protests against this, especially from branches of the Norwegian Chemical Industry Workers’ Association. One of those who complained was the union at the nickel refinery, but it supported the government’s economic “stabilising policy” and underlined that it did not consist of communists.³⁹⁸ The union also achieved quite a lot in the local settlements. Though wages at refinery were below average for the electro-chemical industry in the 1930s, they were higher twenty years later.³⁹⁹

The logic of the post-war wage settlements was as follows: the Norwegian Confederation of Trade Unions secured substantial wage increases for low-wage groups and general welfare benefits such as more vacation and a shorter working week. In return, the trade union gave up large wage increases to the best-paid industrial workers, for example, in the metallurgical industry. The employers managed to achieve a generally moderate wage settlement in return for accepting relatively large wage increases for low-paid workers. The government helped to secure a moderate settlement by subsidising normal consumables and regulating the prices.⁴⁰⁰

Improving efficiency and co-operation

The labour movement encouraged productivity increases. The idea was that the workers would benefit from improving efficiency. This would give room for raising the general prosperity and welfare level.

One of the measures was introduction of so-called time and motion studies, where the engineers analysed the various work operations. This meant, among other things, that the workers were followed with a stopwatch to measure how long the various tasks took. Working and lifting positions were also analysed and the knowledge acquired was to be used

to make the production process more efficient. However, the workers usually experienced these studies as an intrusion on their domain that threatened their job independence.⁴⁰¹

In 1954, the shop stewards at the nickel refinery were in favour of introducing time and motion studies, but they demanded consideration should be made for older workers and piece-workers. Subsequently, the recommendation was more reserved: according to the history of labour movement " ... the stopwatch was not particularly popular, even though a few increased their hourly earnings".⁴⁰²

Now and then, there were a few minor disputes, which illustrated that the management could not do what they wanted. In January 1957, one of the foremen believed that a worker was deliberately working too slowly during the time and motion studies. So he tried to take over the workers' tools to get a more realistic measurement, but was chased away.⁴⁰³ The time and motion studies were accepted, but had to be adapted to the workers' interests. In some cases the workers also demanded time and motion studies in order to get an objective measurement of the workload. In this way, they could avoid what the foremen dictated and put a curb on their exercise of power.⁴⁰⁴

These time and motion studies also had another dimension that is worth mentioning. Jahnsen was in favour of toning down the power of the foremen. He wanted to transfer some of the management functions to the engineers. Through the time and motion studies, the engineers had far better insight into the production processes and work methods. The dividing line was extra clear in the electrolysis area, where senior foreman Knut Larsen had "ruled" the roost. When he retired in 1953, young production engineer, Jostein Brunborg, took over the management role.

Sudbury and Kristiansand: two different industrial cultures

In Norway, the relations between the company and the trade union was relatively easy and predictable. The trade union at the refinery also had useful political contacts in the city council, on the board of the municipal electricity company and with the government via the Norwegian Confederation of Trade Unions (LO).

In Kristiansand, the union guaranteed labour peace during the tariff periods and there were also no sudden strikes by various groups of employees. Canadian working life was more

like that of the British with so-called demarcation disputes, where different occupational groups in a company fought about who should do certain tasks.

At Sudbury, there were a lot of disputes, at least seen through Norwegian eyes. In the inter-war years, neither INCO nor Falconbridge allowed their employees to be trade unionists. INCO in particular used hard-handed methods to quash various trade unions. Those who were suspected of being trade unionists were fired on the spot. It was not until 1942 that Ontario's province government forced the mining companies to accept free trade unions, as they needed the support of the labour movement in the war effort. At that time, however, there was deep bitterness and mistrust among many nickel workers that lasted for several decades afterwards.⁴⁰⁵ In addition, Canada and Ontario's authorities followed a more passive labour market policy than the Norwegian authorities⁴⁰⁶ and contributed little to bringing the parties together. The trade unions remained dispute-oriented and placed less emphasis on establishing formalised co-operation with the employers.

The Falconbridge top management was fully aware that labour relations in Norway and Canada differed widely. In 1951 this resulted in a symbolic gesture as Fraser allocated money to the trade union's brass band with an explicit reference to the good relationship between the parties.⁴⁰⁷

Large gifts were given the following year. At the trade union's 25th anniversary, the company donated 50,000 NOK to a holiday place and more money followed later.⁴⁰⁸ The gifts may be interpreted as philanthropy and as a strategic investment in the working environment and the climate of co-operation. The management found that it was well worth spending money on the employees and their union. Joint holidays and voluntary work at the holiday place at Krossholmen in Blindleia strengthened the ties between the company and the employees and strengthened the core workers' sense of belonging to Falconbridge.

An attempt at industrial co-operation

In 1945, the national trade union and the national employers' federation agreed to set up production committees in large companies. The idea was to democratise industry and commerce by including the workers in the decision-making processes.

Like most similar work places, Falconbridge was organised in a fairly authoritarian way. The production committee was the first co-operating body in the company and consisted of representatives from the management, salaried employees and workers. The committee did

not have any formal power, but it at least gave the employees a better opportunity to communicate with the management.

The management was not particularly enthusiastic about this co-operation, but they behaved contractually correct towards the new committee.⁴⁰⁹ Steen was used to managing the company in his way, without much interference. In 1952, the shop stewards complained that the committee functioned "... far from satisfactorily ... Our members have several times submitted proposed improvements, but little has been done and in 1949 they (the worker representatives) threatened to resign from their posts."⁴¹⁰ At the same time, the trade union was wary about their representatives becoming "hostages" of the management and also accused one of their own for having "acted disloyally" in the committee.⁴¹¹

The production committee acted to a great extent like an information channel, where Steen and subsequently Jahnsen informed the employees of the company's plans and needs. Communication was usually one-way rather than two-way, but the committee did probably help to change management culture in the company. As a fixed "meeting place" had been set up, decisions could no longer be made over the heads of the employees' representatives, at least not to the same extent as before. In the first few years especially, the committee discussed a number of technical matters. But towards the end of the 1950s the focus was more on important environmental issues such as sanitary conditions, a canteen and changing rooms.⁴¹²

There was possibly less pressure from the employees in Falconbridge than in other unions in the metallurgical industry. In Kristiansand, the representatives on the production committee had a weaker union to lean on, especially when the group committees did not function. The nickel workers did not attempt to use the production committee as a platform for making demands. The management controlled the agenda, and in the real sense there was no industrial democracy.

It must be added that the production committees did not meet expectations in other companies either. Historian Trond Bergh wrote in his book on the labour movement history that this was mainly due to the employers' scepticism. At the same time, many people within the trade unions felt that the workers were not ready to have more say and responsibility. Among other things, the shop stewards lacked knowledge about business administration matters.⁴¹³ Therefore, many feared that far-reaching co-operation would take place on the management's terms.

The nickel refinery and Kristiansand

In the peak year in 1956, Falconbridge had 1,480 employees, which was more than the other three large companies in Kristiansand: Fiskaa Verk, cross veneer factory Lumber and Kristiansands mekaniske verksted, had altogether.⁴¹⁴ Falconbridge made its mark on Kristiansand, both visually and financially. More than 20% of all employees in the trade and industry sector in Kristiansand worked at the nickel refinery. If we include all the sub-contractors' employees and all the students that had a summer job at the nickel refinery, the figure was even higher.

The nickel refinery was Kristiansand's industrial locomotive and it helped the city to become the fastest growing city in Norway in the 1950s. This took place in spite of the fact that the city had lost a lot of jobs in the textile and tobacco industry. Heavy industry thus assumed a dominant place in the city's industry and commerce.

The refinery also became a gateway back to Norwegian society for many who were convicted for treason after the war. One of the reasons for this was that the company could not afford to close anyone out, as it had enormous need for workers. But this was probably not the full explanation. Steen took in former members of the Norwegian nazi party NS in 1945 already, both on the shop floor and among salaried employees, even though this resulted in some protests from the workforce.⁴¹⁵

The combination of lack of workforce and a general housing shortage led to Falconbridge allocating money for lodgings. In 1948, the nickel refinery acquired a German barrack, which could accommodate 40 people. In 1954-55, a better and more permanent block of bed-sites in Vågsbygd replaced this. In addition, the company gave loans to employees who were building a house and supported establishment of a housing association for its own people. However, considering the significant housing shortage in the Kristiansand area, the amounts allocated were relatively modest and totalled 200,000 NOK in the 1950s.⁴¹⁶

In 1957, a personnel welfare office was established and was run for and by the employees. The office took care of social and financial issues, provided house loans, etc. The company paid a clerk to take care of this, but Jahnsen was otherwise happy to transfer responsibility for the office to the employees.⁴¹⁷

Freedom of action at the refinery

As long as the budget limits were followed, all technical and organisational issues were decided locally at the nickel refinery, or after consultation with Grønningsæter or his successor Frederick Archibald. Steen and Jahnsen had of course an obligation to report, so that the head office was well informed about what went on in Kristiansand. The reporting was necessary in order to be able to co-ordinate the business in Canada and Norway. However, it is worth noting that the subsidiary in Kristiansand mastered the relevant refining technology, whereas the head office lacked such know-how. This gave Steen and Jahnsen extra freedom of action.

In this respect, the nickel refinery differed from many of the other foreign-owned process companies in Norway. The management at the refinery also had more freedom of action than the local management at the aluminium smelters in Sunndal and Årdal or at the steel mill in Mo, which were all controlled in detail from their head offices in Oslo. At Sunndal it was even claimed that the general manager in Oslo determined the colour of the toilet paper.⁴¹⁸

As regards financial issues, we have seen how Steen and Grønningsæter worked to introduce different measures into the budgets. For example, due to their influence, Kristiansand was given higher priority than Sudbury with regard to pollution matters. Steen was also free to spend up to 10,000 NOK without obtaining prior approval from Toronto. Correspondence with the head office could take time and in urgent matters Steen overstepped his authority, but made sure that his dispositions were approved afterwards. Steen also took liberties. As we have seen several examples of, neither the owner nor the Canadian top management had full control over the investments made in Norway. At the refinery the investment costs were almost systematically charged against income in the operational accounts.

The head office did not try very hard to control the Norwegian side of the business and in the 1950s, Fraser, his second-in-command, Reginald Campbell and senior metallurgist Frederick Archibald rarely visited Kristiansand more than once a year. Visits from other representatives from Canada were also a rare event. After the war, investor Thayer Lindsley

only paid two brief visits to the refinery, whereas Steen travelled every other year to Canada. However, the visits did become more frequent as the transatlantic flights improved.

In many ways, it was Grønningsæter who married the Canadian and Norwegian side of the business, both before and after he retired. He had authority and trust on both sides and travelled back and forth on a regular basis between the US and Norway. He crossed the Atlantic more than 100 times,⁴¹⁹ which at that time must have been a Norwegian record for someone who was not a seaman.

The fact that the Norwegian accounts were audited in Oslo for many years also illustrates that the formal control mechanisms were not particularly strong. In addition, there was an internal audit in the company, but this does not appear to have been particularly thorough, at least not enough to discover the traces of rather curious bookkeeping. It was not until 1952 that an arrangement was made where Norwegian auditor Boman and firm of auditors Clarkson in Toronto (which audited the Canadian business) entered into an agreement. The reason for the change was that Falconbridge had to adjust to the American accounting routines as a result of the major and subsidised contracts with the US government.⁴²⁰ As we have seen previously, the change meant that Grønningsæter asked Steen to be more careful about entering investments in the operational accounts. However, the practice was continued well into Jahnsen's period of leadership, but possibly to a lesser extent.⁴²¹

There were several reasons why the Norwegian management could operate so freely as it did. Excising control cost money and from the outset, Falconbridge had a fairly modest administration at the head office. Production in Kristiansand ran very well on its own. There were never any acute crises, major budget overruns, etc. that provoked action by the management. Falconbridge also did not need to exercise any strong control over its Norwegian subsidiary. The business in Kristiansand was completely dependent upon matte supplies from Canada, as there were no other major raw material sources. There was therefore no risk that the subsidiary or its management would break free and use technology and competence for its own ends.

The literature about multinational companies usually describes the business from the parent company or the head office's point of view and the subsidiaries are overshadowed. This means that we know little about management mechanisms in this type of multinational business. However, it has been pointed out that subsidiaries, which are technologically "independent", usually have relatively significant freedom of action in relation to the head office. If this is the case, Falconbridge falls neatly into such a pattern.⁴²²

However, the autonomy must not veil the real power situation in the company. Even though managers at the refinery had considerable influence, all important decisions were made in Toronto.

A Canadian company “in Norwegian clothing”?

How did the foreign ownership influence the nickel refinery’s business activity? In short: Did Falconbridge conduct itself as a Canadian or a Norwegian company?

The answer will vary depending on the situation the company was in. The management in Kristiansand took care of relations with the Norwegian authorities, business organisations and the trade union. Formally speaking, decision-making responsibility for such matters also rested with the Toronto office, but both Hardy and Fraser followed the advice they received from Steen and Grønningsæter. The Canadian management even allowed themselves to be persuaded to install a more expensive purification system in Kristiansand than at the plants outside Sudbury.

Falconbridge acted with considerable skill in negotiations with Norwegian authorities, among other things, in negotiations regarding hydroelectric power and tax. The company acquired cheap hydropower and paid low taxes. The Norwegian management made active use of the threat to move the business to Canada. Apart from the argument about moving out, there is no reason to assume that a Norwegian owned company would have been an easier negotiating party or less concerned about protecting its own financial interests. In fact, this was perhaps, quite the contrary: according to a calculation made by economist Arthur Stonehill, foreign-owned companies paid slightly more tax on average than Norwegian owned companies.⁴²³

In the 1950s, Falconbridge made a conscious effort to strengthen the ties between the company, the employees and the local community. In the 1930s, it was enough to provide jobs, as after the war it was necessary or at least strategically wise to appear to be a socially responsible company. We have already mentioned the gifts to the holiday home at Krossholmen. In addition, the nickel refinery started giving contributions to organisations outside the company, among others, to Kristiansand Red Cross and various Christian organisations.⁴²⁴

However, as a rule, Falconbridge kept well away from party political activity. The company was perhaps more cautious in this area than many similar Norwegian-owned companies of the same size. At the end of the 1940s, however, the refinery donated money to the non-socialist action group, *Libertas*. Steen required approval for this from Toronto and he argued that it concerned preventing socialisation of Norwegian industry and commerce. On this issue, Steen was also on the same footing as other business leaders in the Electro-Chemical Employers' Federation.⁴²⁵

A few years later, Falconbridge gave a large donation to the Norwegian Institute of Technology (NTH) in Trondheim. In order to ensure competent and adequate recruitment, resources had to be supplied to education of civil engineers. This was also part of a joint donation from the Norwegian metallurgical industry.

As regards workforce, the nickel refinery was Norwegian through and through. As you will remember, Steen rejected Horace Fraser's proposal to put a Canadian in charge at Kristiansand. With the exception of Jan Reimer's brief stay, there was no one besides Grønningsæter who had worked both at the head office and at the refinery. In this respect, Falconbridge did the same as other foreign-owned companies in Norway. Only a few employed foreigners in Norway or used Norwegians in their businesses outside Norway.⁴²⁶

As previously mentioned, one of the reasons why the Norwegian authorities welcomed foreign companies was that they wanted access to their technology and management competence. In the case of Falconbridge, this was rather modest, as the parent company had little to offer. Grønningsæter had a vigilant eye on the technical development in the US and had a large personal network that he could use. Falconbridge was in no way first in line as regards introduction of modern organisational techniques. For example, time and motion studies, which were common in the US during the inter-war years, were not used at the plant in Kristiansand until the beginning of the 1950s, i.e., around the same time as in other Norwegian industry.

Multinational companies usually located their research and development units in their native country.⁴²⁷ Falconbridge focused very little on these fields in its initial years. Some of the first development work of importance was actually carried out in Kristiansand, and involved Richard Løken's work with extractive metallurgy. Trials were later started at the refinery in conjunction with extraction of cobalt and the transition to the chloride process. But when Falconbridge finally built up its own research unit from 1953, it did so in Toronto.

Research into the refining process was also implemented there. In this way, Falconbridge also followed the normal pattern for multinational companies.

However, it must be added that the laboratories in Toronto never had the same extent of experience about the refining process as the subsidiary in Kristiansand. Falconbridge continued therefore to benefit from, and continue to invest in, the competence and research work at the refinery. In 1956, obtained support for building a small pilot plant in Kristiansand and the research and development unit was established nine years later.

On the whole, it must be said that foreign ownership functioned well, though it could be argued that the share dividends primarily ended up in the US and Canada. On the other hand, the nickel matte would probably not have allowed to be exported to Norway without Canadian ownership. In this way, the foreign owners ensured access to raw materials and thus production and an advanced technological environment in Kristiansand.

At national level, Falconbridge's ability to earn foreign currency was most important. No other Norwegian companies were as good to convert kilowatt-hours into USD. It was of secondary importance that the nickel refinery was Canadian-owned.

13. RIPE FOR CHANGE, FALCONBRIDGE IN THE 1960s

Falconbridge conducted business in a maelstrom of international events, where World War II made its mark on the 1940s and the cold war on the 1950s. Global capitalism was liberalised in the 1960s and Falconbridge was one of the companies that pounced on the new opportunities that arose, with the aim of creating a worldwide mining company.

Time seemed to be running out for the plant in Kristiansand. As you will remember, politicians in the province of Ontario pressured Falconbridge to build a new refinery in Canada. In the short term, however, this led to hectic research activity in Kristiansand, a new refining process was to be developed as the old Hybinette process was unsuited to Canadian conditions.

At the end of the decade, the employees in Kristiansand stood on the threshold of a new era. The new “matte leaching- process” represented the first major leap in refining technology since 1910. The pilot plant also introduced much less hierarchical organisational structure than the old Hybinette plant. But it remained uncertain whether this modernisation would take place in Norway or in Canada.

Not only nickel

Around 1960, the management of Falconbridge had reasons to be concerned. Sales to the US government’s military stockpiles were coming to an end. At the same time, established producers, such as INCO, Falconbridge and Le Nickel, produced more nickel than ever before. In addition, the Americans had helped three other nickel companies to get started: Freeport Sulphur with plants on Cuba and in New Orleans, Hanna Mining Co. in Oregon and Sherrit Gordon in Alberta, Canada. In addition to this, Finnish mining company Outokumpu had opened a new refinery in 1960. In Japan, four companies produced four different kinds of nickel, based on raw material from Canada and New Caledonia.⁴²⁸ The question was whether there was a market for all this nickel and whether the producers could still dictate the prices? Or would there be a repeat of the situation in the 1920s with competition and low prices?

A warning of turbulent times had already been given. During the brief depression in 1957-58, civil demand for nickel fell drastically, but Falconbridge and the other small producers were lucky. INCO, which still produced two thirds of the global production, was hit

by a long strike in Sudbury. This meant that Falconbridge could continue expansion without any setback.

In the years that followed, much of Falconbridge's profit was channelled to other businesses. Through different subsidiaries, the company engaged in mining copper, gold, zinc and magnesium. This was a logical extension of Falconbridge's old ties with Thayer Lindsley's holding company, Ventures Ltd. The remains of this holding company were merged with Falconbridge in 1962. In this way, Falconbridge gained access to a number of promising ore deposits and especially to an experienced ore exploration and project development organisation. In addition, Falconbridge acquired interests in oil and gas company Alminex Ltd. This activity was close to the business interests of Falconbridge's new main shareholder, Texan oil investor Howard Keck.⁴²⁹

Falconbridge's largest investment in the nickel segment was made in the Dominican Republic in the Caribbean. The nickel ore on this island was of another type (laterite) than the sulphurous ore found in the Sudbury area. Laterite ore was not suitable for refining using the Hybinette process and other methods had to be found. During the 1960s, Falconbridge's laboratory in Toronto developed a processing method, which produced ferronickel from the Dominican ore, i.e. a ferroalloy containing nickel was produced instead of pure nickel.⁴³⁰

Most of the nickel was used in alloys, which did not require the level of purity obtained in traditional refining. Several competitors had invested in similar projects. The Ferronickel plant in the Dominican Republic started full production in 1972 and was among the most efficient in the industry. Some of the engineers and workers from Kristiansand, helped to build and run the new plant.

Falconbridge's next investment within the nickel segment was a Nickel Iron Refinery outside Sudbury.⁴³¹ In the tailings from the concentration plant at the Strathcona mine there was a lot of iron sulphide containing nickel that was not used and consisted of sulphur, iron and 1.5% nickel. The aim was to create a saleable nickelferrous iron alloy. But this project was costly and was constantly being delayed by technical difficulties. However, neither of these two nickel-projects led to increased activity in Kristiansand. Both of the new units were to produce saleable end products that did not require refining in Kristiansand.

Strategy and structure

Falconbridge had two objectives in the 1960s. One of these was to continue the traditional nickel business, which was still the company's core area, but the company also wanted to spread the activity. The aim was to use the organisation and competence in several related fields. Even though most of the activity was in Canada, Falconbridge was moving in the direction of becoming a global company within the mining and oil sector.

The new businesses were organised as separate subsidiaries where Falconbridge owned around 50% of the shares. Falconbridge provided know-how and usually mineral rights, while external investors injected most of the capital. From being a subordinate part of a holding company (Ventures Ltd), Falconbridge itself became such a company.

On its journey out into the world, Falconbridge was an example of the trend in international capitalism. The western economies were liberalised and multinational companies were given greater leeway. Restrictions in capital movements were eased.⁴³² For an investor such as Howard Keck, Falconbridge became a means of exploring for and exploiting raw material deposits in other countries and parts of the world. The company began, among other things, with a major ore exploration programme in Norway. At the beginning of the 1970s, Falconbridge also tried to get involved in oil exploration in the North Sea. By finding more than one leg to stand on, Falconbridge reduced its dependence on the nickel market and thus its vulnerability.

The head office in Toronto co-ordinated the activity and was responsible for resource allocation, planning, research, project development, etc., while the various production units organised the daily operations. Delegation of responsibility to the subsidiaries was in line with the trend in US and Canadian industry and commerce after the war. Falconbridge seems to have developed a more "modern" organisational structure than INCO, which according to historian Alfred D. Chandler remained very controlled from the top and still focused on the nickel industry.⁴³³

Profitable years

The nickel market developed better than the pessimists had feared. One of the reasons for this was the revolution in Cuba. The communists' assumption of power and the subsequent Cuban crisis raised the level of tension between the eastern block and the western powers and helped to maintain the military demand for nickel. In addition, Fidel Castro's left-wing regime nationalised the US-owned nickel mines on the island. The Cubans eventually delivered their

production to the communist east block countries. The loss of the Cuban nickel from the western markets reduced the risk of overproduction.

Around 1960, Falconbridge kicked off an energetic sales campaign in the US in order to replace the US defence contracts. Up until then, the company had had most of its civilian customers in Europe. The US alone represented half of the free world's nickel consumption. In the short term, however, the company did not completely manage to fill the void after the deliveries to the strategic stocks. In 1962-63, production had to be limited, but things took a turn for the better from 1964 onwards.

Following several delays, Falconbridge's new nickel mine Strathcona started full production in the summer of 1969. The smelting plant and the refinery were already expanded so that the company's annual production capacity exceeded 40,000 tonnes of pure nickel, which was an increase of 30% since 1960. However, growth was modest compared with the expansion period in the 1950s, when production tripled in ten years.

In 1967 the US began to reduce its stocks of strategic raw materials. President Lyndon B. Johnson needed money, among other things, for the war in Vietnam and for the welfare benefits in his Great Society programme. It was much easier politically to acquire money through such sales than by imposing new taxes.⁴³⁴

Naturally, these sales limited growth in the affected raw material markets and this concerned nickel in particular. INCO stopped expansion after having increased production by almost 40% from 1960 to 1966. For INCO, which still dominated the markets, it was more important to maintain a high nickel price than to produce as much as possible. INCO also tried to pressure the other nickel companies to limit their growth. In 1970, INCO's annual production was 225,000 tonnes of nickel, almost six times more than Falconbridge's.⁴³⁵

However, the seven French and New Caledonian companies that conducted mining in New Caledonia resisted. Le Nickel was definitely the largest of these companies and produced 42,000 tonnes of nickel in 1970 and therefore was the second largest producer in the world. Japanese nickel production was also growing fast. Access to ore from Australia and New Caledonia gave the business in Japan an extra push forward.⁴³⁶ In addition, mining and refining had also been started in Rhodesia (now Zimbabwe) and there was also production of ferronickel in Greece.

Although Falconbridge lost market shares within the nickel area, its financial results were very good. Profits fluctuated between 15 million Canadian dollars in 1963 and 46 million in 1969. The results were noticeably better than in the 1950s and were especially good in the latter part of the 1960s. Thanks to a high copper price, Falconbridge earned a lot from

its investment in copper mines, but it was still the nickel division that earned the most money.⁴³⁷

Almost half of the profit was paid out to the shareholders as dividend. However, there was still enough money left in the company to make it both well off and dynamic. At the end of 1969, the company's debts were less than 10% of its total equity, while liabilities amounted to 29 million dollars and book equity was around 307 million.⁴³⁸ Due to depreciation, the actual assets in the company were even higher. However, for the plant in Kristiansand the access to liquid reserves was a double-edged sword as it finally gave Falconbridge the means to build a Canadian refinery.

Developing the matte-leaching process

The old Hybinette process had been a pioneering process around 1910, but in the fifty years since then, it had become outdated. This was due to several factors. Competition from cheap ferronickel has been mentioned already. This alloy was just as good as pure electrolytic nickel for many purposes. The Hybinette process was labour-intensive and was not well suited for automation. This became a problem as wages increased. Secondly, transport and handling resulted in large quantities of finely grained material that created dust and a poor working environment. Thirdly, the process was inefficient in the sense that much of the nickel solution had to be treated several times. This meant that the process had to be repeated, which resulted in a need for more space, process equipment, labour and of course higher consumption of chemicals.⁴³⁹

The search for alternatives was linked to the political pressure to build a Canadian refinery. The wages in Sudbury were twice as high as the wages in Norway, so it would be difficult to start by using such a labour-intensive refining method as the Hybinette process. Besides, the Hybinette process was also based on cheap Norwegian hydroelectric power. In Ontario the electrochemical industry had to pay around three times as much per kilowatt-hour as in Norway.

Political pressure to build a Canadian refinery increased during the 1960s, especially from the trade unions and from the new left-wing party, The New Democratic Party. Falconbridge also suspected that its competitor INCO provided fuel for the political fire. The development of a new refinery would cost Falconbridge a significant amount of money, which in turn could weaken its attacking strength in the nickel markets.⁴⁴⁰

A Canadian refinery was therefore contingent upon a new process. In 1955, the development work got underway at the company's laboratories in Sudbury. According to the group's future research manager, Philip Thornhill, the idea was to "invert the process". The matte was to be dissolved in hydrochloric acid, whereupon the components were separated and extracted. The aim was to create a wet chemical or hydro-metallurgical process and therefore casting of the anodes was avoided. Using this process it was possible to avoid the Hybinette process' mixture of smelting processes and wet chemical processes. The need for internal transport was minimised. In the so-called ML-process the solution could be pumped from one area to the next, which also limited the dust problems.

Ragnar Jahnsen became involved in the development work and in the summer of 1956, he was successful in organising that the test plant be built in Kristiansand, and not in Sudbury, as was first intended. Jahnsen argued that the necessary expertise was already available in Norway. In this way, Jahnsen ensured that most of Falconbridge's refining competence remained in Kristiansand.⁴⁴¹

The work with matte leaching or the ML-process paved the way for a change in generation among the engineers, though initially, two veterans, Fridtjov Grøntoft and Per Brekke, were given main responsibility. But Grøntoft was approaching retirement age, while Brekke had been appointed to the newly established position of Technical Manager, so this opened the door to new blood: Gus van Weert, Eivind Wigstøl, Kjell Frøyland and John Valen. Gus van Weert travelled back and forth between Toronto and Kristiansand and was Canada's representative in the project. Wigstøl also had good connections with the parent company after working several years in Canada. In this way the development of the ML-process linked the nickel refinery and its staff more closely to Canada. As the initial experimental work had been carried out in Sudbury, the Canadian researchers, led by Phil Thornhill, had ML-expertise upon which the nickel refinery depended.

Development of a slightly larger pilot plant with an annual capacity of 100 tonnes began in Kristiansand in 1960.⁴⁴² The extremely corrosive hydrochloric acid created significant problems and special structural materials had to be found. The equipment also had to be partly designed at the refinery. This trial phase lasted for several years. Realf Høy-Petersen has reported how the pumps had to be equipped with so-called double mechanical seals.⁴⁴³

The researchers had originally planned to use the electrolysis in the last stage of the ML-process in order to reduce nickel chloride to pure nickel. But this was changed, following pressure from the marketing division in Toronto. By using a converter and a reduction

furnace, it was possible to produce nickel granulates or Nickel 98, as it was called. The idea was that it would be easier to sell granulate with a diameter of around two millimetres to steel companies and the ferroalloy industry than the coarser pieces of nickel from the electrolysis. This meant, among other things, that energy carriers had to be changed from electricity to the petroleum product naphtha. It took the engineers John Valen and Nils Henrik Smith Øverland almost a year to develop a well-functioning converter. Naphtha and air were to be blown into the converter in a mixture that was explosive and one of the challenges was to prevent the flame turning back through the nozzles.⁴⁴⁴

It might be added that it was unusual to allow market considerations to decide technological development, at least in a Norway. In Norsk Hydro, which invested more money in R&D than any other Norwegian company, market considerations were not involved until a later stage of the development processes.⁴⁴⁵

Establishment of an R&D unit

In the spring of 1965, Jahnsen was given the go-ahead from Canada to establish a research and development unit in Kristiansand to work on the ML-process.⁴⁴⁶ Jahnsen also hoped that the Hybinette process could be made more efficient and at the same time, a new cobalt process was to be developed. Presumably, he argued that Falconbridge had to link its researchers closer together with production. If research into refinery issues were to be located in Canada, there would be a huge distance between the laboratories and the plant in Kristiansand.

In January 1966, Leif Hougen was appointed manager of the R&D unit. Hougen graduated as a chemical engineer from the Norwegian Institute of Technology (NTH) in 1946. After that he worked for a year at a US research institute. From 1952, Hougen built up the SINTEF foundation's Department of Chemical Engineering in Trondheim.⁴⁴⁷

It could be said that scientific development met the industry half way after the war. The new field of chemical engineering combined insight from machine design and chemistry and it shortened the path from the laboratory to industrial production.⁴⁴⁸ In this way, research was more useable for companies like Falconbridge. In the nickel refinery's case, the link with chemical engineering and science was a two stages process. Initially, SINTEF was used for consultant work and then researchers Hougen and Erling Stensholt were recruited to the Kristiansand plant.

By virtue of his own and his personnel's skill, Hougen soon won recognition in Canada,⁴⁴⁹ which ensured him financial resources and considerable freedom with regard to research. In Kristiansand, Hougen built up a unit comprising 20 people, of which 11 were engineers and the rest were technicians and laboratory assistants. Establishment of the R&D unit marked the start of a new era in the history of the nickel refinery. The unit created a more scientific-based approach to process development and production. Using the new chemical engineering methods, the research staff began to optimise the various process stages. Efficiency was to be improved through systematic research and mathematical calculations.

Many companies have found it difficult to marry research, development and production. These have partly been separate worlds with different people, a different approach to the problems and physical difference between the units. In the case of Norsk Hydro, the company's historians have written that there was a huge gap between the production and research engineers at the beginning of the 1960s.⁴⁵⁰ This made it difficult for the researchers to find good projects and especially to realise new production ideas.

In Kristiansand the people and the units were closer together, but the research personnel soon found out here that they had to stay in with the company's powerful foremen, otherwise it was difficult to get anything carried through.

The computer Nikkeline and introduction of electronic control

In the Hybinette process, the various process stages were more or less physically separate from each other and the process flow was manually regulated. In the ML-plant the flow was to be automated. The metal solutions were to be pumped directly from one stage to the next. The challenge was to find good ways of co-ordinating the process flow.

Analogue control had been used in the pilot plant, i.e., that each control loop was electronically controlled or monitored separately. They were not controlled by a computer that could co-ordinate the different process stages, as this required around 200 measuring points and almost 100 control functions, this was rather cumbersome.

At NTH, professor Jens Glad Balchen and his control engineering team were on the look-out for industrial customers. In the autumn of 1963, he invited Jahnsen to visit an electronic process control pilot plant at Dalen Portland Sementfabrikk in Brevik. This system was partly based on digital circuits.

Jahnsen saw the potential for Falconbridge and the ML-process⁴⁵¹ and he engaged Balchens team, i.e. Norway's leading cybernetic experts. The researchers at NTH and SINTEF had worked on developing computerised control systems since the beginning of the 1950s. Early in the 1960s they had created systems that could be used in industrial production and Falconbridge was their first major customer.⁴⁵²

This was the first time that such a complex process control system was to be made for Norwegian industry.⁴⁵³ The refinery was also among the international pioneers and was ahead of the parent company in Canada. Subsequently, the refinery transferred some of its computer expertise to Falconbridge's plants on the other side of the Atlantic.

The reason why the team in Kristiansand attempted such an ambitious project was that the company needed a control or monitoring system for the ML-process. In addition, it was normal that new process technology had to be specially developed for the refinery's purposes. The project was therefore an extension of the established knowledge tradition in the company.

But not everyone was in favour of computerisation. Eivind Wigstøl, who led the work with the ML-plant, believed that the company was taking an unnecessary technical risk. There were enough vulnerable elements in the new ML-process already. Besides, Wigstøl did not believe that the computer system would justify the costs. He would rather have had a system based on analogue circuits and there is no doubt that this system would also have worked. So the company was in a situation where it had to choose a technology.

Jahnsen believed that the future lay in digital and automatic control systems and argued that high short-term costs were of secondary importance. Falconbridge had enough money. This view resonated with CEO Horace Fraser, who was also fascinated with new technology.⁴⁵⁴

Installation of the "Nikkeline" computer and the control system began in 1967. Two of the system developers, Hans Jørgen Hansen and Arne Svalheim, moved from SINTEF in Trondheim to Kristiansand.⁴⁵⁵ Most of the process could be remote controlled from the control room and it was no longer necessary to go out into production to control valves or to measure or regulate fluid level, pH, temperature, etc. If anything was wrong, an alarm bell rang automatically.⁴⁵⁶

Automation had its limits, however, and in practice, the control system was extremely vulnerable to lightnings, corrosion, etc., and there were a number of production stoppages in the first few years.⁴⁵⁷ It did not necessarily pay to be a technological pioneer, but the system did provide unforeseen possibilities. Over time, access to electronic measuring data gave

completely new insight into how the process actually worked, and thereby formed a platform of knowledge for future improvements.

A new production system

The new ML-plant was put into operation in 1968. The new plant was primarily a large pilot plant with a capacity of 6,800 tonnes of nickel per year, i.e., almost 20% of the total production. Even though the dimensions were not very large, the work on the ML-process and the new plant introduced important innovations to the Kristiansand refinery. Firstly, it resulted in establishment of the R&D unit, which meant that there was more systematic competence building and a more scientific approach to production.

Secondly, production flow was changed and a number of tasks were automated. As the ML-process mainly comprised hydro-metallurgical processes, internal transport was much easier in the new unit. The metal solutions were pumped around the plant and this eliminated heavy lifting and manual tasks and the dust problems were also drastically reduced. In other words, industrial working life became easier.

Thirdly, the work was organised in a new way in the ML-plant. In the Hybinette process, engineers or powerful foremen led the business and each worker did not have much say in the matter. In the electrolysis halls in particular, the manual tasks required few qualifications. People rarely had any knowledge about anything other than their own tasks.

The ML-process changed this. Eivind Wigstøl decided that "ordinary" workers should operate "Nikkeline", and that it was not necessary to use engineers for this work. It was not necessary to know how a computer worked in order to be able to use it. However, the operators had to know the whole process that the computer controlled, plus a little about control engineering and computers. Otherwise, they could learn from practical experience.⁴⁵⁸

Therefore, the company established a separate training unit, which provided courses for the employees. The aim was to improve practical skills, to increase focus on safety and to increase the workers' theoretical understanding of the production.⁴⁵⁹ The unskilled nickel worker became a process operator, who was difficult and expensive to replace. A wide range of courses was eventually established under human resource manager Jan S. Sand's leadership. Subsequently, the company joined forces with Fiskaa Verk, Lista Aluminium, Hunsfos Paper Mill and Kristiansand Vocational College to prepare training programmes.

Former shop steward Bjørn Enes wrote in an article that the transition to a new and more knowledge-based production system aroused opposition. The new system assumed that people had knowledge about the whole process and therefore was based on job rotation. However, many employees felt that a “permanent job” was the same as carrying out one and the same individual operation. “It was only beginners and unstable slovenly workers that changed tasks the whole time. A man’s honour was linked to his jobs. Enes wrote that: “introduction of the system meant that a worker was eventually paid according to how much he *knew* and not according to how unpleasant the job was or the length of service he had or how quickly he executed piecework.”⁴⁶⁰

The new ML-plant was designed by young engineers, who were open for organisational change. Eivind Wigstøl wanted to get rid of the rather authoritarian production system at the refinery and the new plant saw the further demise of the traditional foreman role. Wigstøl also tried to avoid recruiting active trade unionists to the new plant. The aim was to break up the traditional power and thought structures and to reduce the class barriers. A more level structure was to be established, where people were given more responsibility and where the work was done in teams.

The ML-plant became a kind of laboratory for new kinds of organisation and new social relations. It resulted in larger investments in the education or training of each individual worker. Turnover had to be reduced in order to make full benefit of this. There was not much point in training the employees if they left the company after a short time. The refinery introduced a number of measures to entice people to stay. Human resources manager Jan S. Sand started to change the wage systems, tried to strengthen the company culture and introduced measures to improve job satisfaction.

The staff in Kristiansand could trade on the experiences of others. The Employers’ Association, the Norwegian Confederation of Trade Unions and the Institute for Industrial Relations (Industriell miljøforskning) at NTH in Trondheim had a joint venture, which among other things, involved breaking up old types of organisation and introducing more team work. In 1964, the paper mill at Hunsfos north of Kristiansand was chosen as a test company and this meant that Falconbridge could follow the results in a company that was close by.⁴⁶¹

Demand for change

At Falconbridge, the stevedores and the production workers were at the bottom of the company hierarchy. "The colour and design of the work clothes, the changing room facilities and even a different soap smell emphasised which step on the "nickel ladder" each person stood."⁴⁶²

On the one hand, people accepted that this was just the way things were in large-scale industry, but the other hand it was a strong contrast to the relatively egalitarian society in southern Norway. This region was probably one of the least class divided in whole Western Europe. Dissatisfaction at the refinery grew through the 1960s and people were no longer willing to be dictated to by arbitrary management.

As previously mentioned, the company introduced time and motion studies at the beginning of the 1950s. The aim of these was to analyse each work operation in a "scientific" way in order to achieve improved work methods, but they were far from popular. Jahnsen did not back off however, and with the wage increases in the 1960s, he was forced to increase productivity and therefore he established a rationalisation unit led by Fridtjof Rasmussen.

In the mid 1960s, Jahnsen also hired a Swedish consulting company, which introduced an extensive system called UMS (Universal Maintenance Standards). The aim was to find out exactly how long each work operation took and what kind of equipment and materials were required to carry out the operation. There were extensive maintenance tasks and the engineering unit at that time employed around 300 people. The idea was to make better use of capacity and to streamline and standardise the various tasks. Maintenance costs were actually around 12-13% of the nickel refinery's total costs.⁴⁶³

A central planning office was established to keep an eye on the work schedule of the in-house workshops. If they had too much to do, the office was to order workers from outside. The office was also given responsibility for preventive maintenance, such as lubrication, inspection and periodic overhauling of equipment.

In addition, each work operation was given a separate code. All maintenance was to be reported to the planning office before it could be carried out. In this way, it was possible to prepare better work plans and to prioritise tasks better. The management also wanted to avoid using arbitrary piecework, where the pay was often based on whether "the foreman liked your face or not".⁴⁶⁴

The problem was, however, that the workers got even less autonomy than before. All tasks had to fit into standard procedures. In addition, the UMS system was cumbersome and bureaucratic. If anything unforeseen occurred, the foreman was to decide what was to be done, and there was not much room for independent initiative.

The electricians were the first to react. Elsewhere in society they were set to do a task and given responsibility for material calculation, ordering equipment and installation. At Falconbridge the work was planned in the drawing office, sent to a foreman who determined the details and then handed the work over to the electrician. Team foreman Jacob Sørensen protested against the arrangement and argued that in their private life, electricians had managed to acquire a home, cabin and car, but at the refinery they were not even allowed to order a screw without the foreman's approval.⁴⁶⁵

When the trial agreement for the UMS piecework expired at the end of 1969, the skilled workers turned down the arrangement. Following difficult negotiations, the company and the trade union agreed upon new methods of co-operation, more delegation of responsibility and a gradual transition to a fixed wage system for the skilled workers.⁴⁶⁶

Jahnsen tried to improve the efficiency of the company through better management from above, but this caused protests. Eivind Wigstøl found another solution for the ML-plant. By delegating responsibility further down the hierarchy, the company was to draw more benefit from each worker's competence and creative ability.

M/S Falcon and the new transport system

Since 1929, the nickel matte had been transported from Sudbury to Kristiansand in old liquor barrels. The barrels were transported by train to the nearest port and sent as general cargo to Kristiansand. In the autumn of 1946, Anton Martin Grønningsæter wrote that Falconbridge should consider changing to bulk transport.⁴⁶⁷ Instead of loading the crushed matte into barrels, whole train and shiploads could be transported at one time. Grønningsæter had perhaps got this idea from Einar Rasmussen, who had joined the Norwegian board of directors of the nickel refinery. Rasmussen was the most successful ship owner in Kristiansand and had originally only had tankers, but had eventually acquired bulk vessels.

Bulk transport became an increasingly more common means of transport during the 1950s and 1960s. But the Canadian management were hesitant. Nickel matte was expensive and only a little extra loss would mean that it did not pay. A change to bulk transport also meant that the entire transport system had to be reorganised.

Purpose-built railway hopper cars had to be built. In the summer months, the matte could be loaded aboard ship at Parry Sound on Lake Huron, which was around 60km from Sudbury. The lake froze in winter, so that the matte had to be transported by train to Quebec,

where yet another lading plant had to be built, while a discharging plant had to be built in Kristiansand.⁴⁶⁸

By 1965 it had come to the stage that discussions about technical details and sailing schedules with the various ship owners were finally off the ground. Einar Rasmussen's shipping company was given operational liability and shipments with M/S Falcon finally began in 1968. This resulted in a significant reduction in transport costs.⁴⁶⁹

Ten years waiting for change

The history of the Kristiansand plant in the 1960s may be told in at least two ways. In comparison with the previous and following decades it was rather tranquil. There was no war nor crisis, no accelerated expansion nor major accidents. The company was making progress in small, but well-planned steps.

By the 1970s most of the plant buildings had been given modern and architect-designed facades. Falconbridge looked much better than it had done before. A gardener was hired to landscape the area with lawns and flowerbeds. Inside the factory halls, ventilation, internal transport, etc. had all been improved, but fundamentally most of the plant was pretty much the same as it had been at the beginning of the decade.

The increase in production was also more modest than it had been in the previous decade. The number of employees increased slightly from 1,350 in 1960 to 1,535 ten years later, but most workers had the same job content. Only a minority of the employees worked in the new ML-plant and the old Hybinette-plant still represented more than 80% of production.

The other story is the one told on the previous pages. This is the story of a company waiting for change, about a nickel company that stood on the threshold of becoming a world-wide mining firm, about the development of a new and far more efficient process, about ground-breaking research with computerised control systems and new methods of organising the work. However, process development was tailored to Falconbridge's new refinery in Canada. This was because the politicians in Ontario did not want to refine the province's nickel in Norway. At the beginning of the 1970s, the future of the Kristiansand refinery was hanging in a thread.

PART 4. CRISES AND EXPANSION 1973-2004

The 1970s were a watershed in the modern history of the Western world. Rapid growth in the post-war years culminated in a speculative boom period early in the 1970s. The turning point came in the autumn of 1973. OPEC had quadrupled its oil prices and inflation and unemployment were on the way up. In a number of raw material markets there was an imbalance between production and demand and a number of raw material cartels collapsed. This resulted in greater price fluctuations than had been experienced since the 1930s.⁴⁷⁰

The nickel market was also hit. For Falconbridge, it happened at a particularly awkward moment, as the company was in the middle of a busy expansion period. Within a few years, all the requisites had been changed. Demand fell, nickel prices fell and costs rose alarmingly. Although there were also noticeable economic revivals in the 1970s, at the beginning of the 1980s, Falconbridge found itself fighting for its survival.

Economic trends were not the only things that took a turn for the worse for the refinery in Kristiansand. In 1973, construction work started at the new Canadian refinery in Becancour, Quebec. Initially, around 15,000 tonnes of nickel a year were to be produced at this plant and eventually, at least half of the Falconbridge's nickel was to be refined there. As the economic trend continued to spiral downward, construction was eventually stopped in 1974. However, there was no stop to the political demands to move refining to Canada, the deadline was merely postponed a few years.

In addition, the Kristiansand refinery had to clear up a few serious problems in the working environment. An alarming number of employees had developed cancer and the company was also criticised for polluting the external environment. In Chapter 16 we will look at how the plant management tackled these matters and how this changed the relationship between the company and society during the 1970s and 1980s.

The Norwegian industrial system was going through a period of change and energy-intensive industry was no longer regarded as the gateway to the future. From the beginning of the 1970s, it was being questioned whether hydroelectric power was being sold too cheaply. As cheap electricity was one of the advantages of refining nickel in Norway, a rise in price could have significant consequences for the plant in Kristiansand, especially when other costs were also increasing at an alarming rate. After oil was found in the North Sea in 1969, Norway experienced a bout of inflation and the wage-level surged upwards. By the 1980s labour costs in Kristiansand were higher than in Canada.

Despite all its environmental and financial problems, the nickel refinery managed to be one of the industry's winners toward the end of the century and succeeded in generating new creativity. Yet another refining process was developed and this process was tailored to the local framework conditions in Kristiansand.

The so-called chlorine leaching-process (CL) would solve many of the environmental problems and also significantly improve production efficiency. However, the whole of the 1970s passed without Toronto giving the go-ahead to focus 100% on chlorine leaching. Restructuring would cost a lot of money that the ailing company did not have. In addition, there was the planned refinery at Becancour to be taken into consideration. The consequence of this was that for a while three processes ran parallel in Kristiansand: the Hybinette-, ML- and CL-process. And it was not until 1983 that Falconbridge focused solely on the latter process.

Another advantage of the CL-process was that it could easily use nickel matte from other companies, i.e., matte with another chemical composition than the matte that came from Falconbridge's own plant in Sudbury, and this provided new opportunities. Over-establishment of companies and overexpansion led to deep crises in the nickel industry in the 1970s and 1980s, though in the long run, the new companies also provided new opportunities. Some of these new nickel companies did not have a refinery and consequently, needed to hire these services from others. Falconbridge and the workforce at Kristiansand succeeded better than any of the competitors in this market. Through providing toll refining for external customers, the plant in Kristiansand became the Western world's largest nickel refinery during the 1990s.

The question in the following chapters is therefore not only *why* the plant and its staff survived the crises, but is just as much *how* they managed to turn the situation to its own advantage.

14. SURVIVAL AND INNOVATION IN A CHANGING MARKET

Optimism prevailed in the nickel industry at the beginning of the 1970s and OECD expected an average consumer growth of 7% per year.⁴⁷¹ With such growth, nickel consumption would double every tenth year and the trend after 1945 supported these forecasts.

With such a promising future outlook, all the "old" nickel companies began extensive expansion work. As the growth rate in the nickel industry was higher than for most other metals, this attracted other mining companies into the nickel market. New deposits were found and put into production in Australia, Greece, and Rhodesia and on the Philippines. In addition, nickel became an important by-product from the expanding platinum industry in South Africa.⁴⁷²

Previously, newcomers had been excluded from the nickel industry due to lack of own deposits and difficulties refining the nickel. Both of these drawbacks were more or less eliminated during the 1960s. A number of new nickel deposits were found to be viable, especially those containing so-called laterite ore. The US Bureau of Mines had also implemented large research projects in order to exploit this ore.⁴⁷³ The Americans had two political objectives: They wanted first of all to increase the supply of armament metal nickel and secondly to break INCO's market dominance. Therefore, the new methods were made available to new players.

Laterite ore could be used to produce ferronickel, i.e., a ferrous nickel alloy, and the production process was simpler than in traditional refining. Thus the ferronickel threshold for entering the nickel market was lowered. A consequence of this was that the number of competitors increased. In addition, ferronickel squeezed high quality products (from, inter alia, the refinery in Kristiansand) out of the least quality-demanding areas of application.

Previously, the nickel companies had guarded their refining technology. However, in the 1960s Finnish company Outokumpu sold its process to conglomerates Anglo-American and Rio Tinto, which both started producing nickel in Rhodesia (now Zimbabwe). Canadian Sherritt-Gordon also sold its process to Australia.

The consequence of this was that the total global nickel production increased significantly higher than 7% per year. A number of new plants started production up to 1975. Of a total Western capacity of around 600,000 tonnes of nickel (in different forms) INCO had 265,000 tonnes, Falconbridge 75,000 tonnes and Le Nickel 60,000 tonnes. The remaining capacity was divided among 16 smaller and mostly new companies. At the same time as all

the new plants started production, demand began to fall. In 1975 alone, global consumption fell by 25% to 422,000 tonnes. After a slight improvement the following year, consumption fell to 400,000 tonnes in 1977.⁴⁷⁴

Previously, market power had been highly concentrated. INCO had quite simply decided the price of nickel. The “unity” of the nickel industry was put to the test in the 1960s already. French Le Nickel expanded quickly and “stole” customers from INCO. At the same time, the French company complained that INCO had arbitrarily dictated the prices. Instead, Le Nickel wanted to establish price co-operation where all the producers had a say, something which INCO rejected and which was also illegal under US law. The result of this was that a price war almost broke out in 1968.⁴⁷⁵

During previous recessions in 1949 and 1957, INCO had unilaterally reduced production. The conglomerate had such a dominant position at that time that it was better for it to limit its activity rather than to risk a price fall and permanent competition. In addition to this, the recessions had been short-lived. But the situation was different in the 1970s and due to all the newcomers, INCO’s market share had fallen to below 50%. There was also a bigger gap between supply and demand and the INCO was no longer willing to carry the whole burden itself.⁴⁷⁶

In 1975, some of the nickel producers limited their activities.⁴⁷⁷ Overproduction would only mean that the customers could play the various producers off against each other. Through a united stand, the nickel producers kept control of the market. In the middle of the crisis year the price of nickel increased 10%, a price increase that at least limited the financial losses. However, the restrictions had consequences for the business at the refinery in Kristiansand. For the first time in peacetime, it had to introduce a shorter working week for all employees. Temporary employees were given their notice and some of the permanent workers had to be laid-off.⁴⁷⁸

Whether the US competition authorities intervened or whether some of the nickel producers exploited the situation as “free riders”, we do not know. During the next recession in 1977, the collaboration was creaking at the joints and the “official” producer prices were dropped and the prices fell. The nickel companies then limited production and regained control for a while. In the spring of 1979, however, nickel was to be listed on the stock exchange in London and by 1981-82, the nickel companies’ control of the market and pricing was a thing of the past. Competition was tough and prices were forced down.⁴⁷⁹

Within a few years, two of the foundations on which Falconbridge had been based, i.e., quick and almost continuous consumer growth and stable and high prices, had crumbled.

In this respect, the nickel industry followed the same trend as in most other metal cartels, where the market power had also disappeared.

Of course, customers welcomed the competition, but for producers and their employees it meant uncertainty and rounds of job cuts. It also meant that Falconbridge experienced its first ever deficit. But the new market situation would also come to affect the refinery in Kristiansand in a rather unexpected way. And in order to understand this, we must take a trip to the St. Lawrence River in Canada.

Becancour

Ontario's Mineral Act from 1917 banned export of ore for secondary processing outside Canada. The original Falconbridge deposit was found before 1917 so that it did not come under this provision. However, Falconbridge's new mines from 1950s had been discovered after this time, but the company had been given dispensation up to 1966 to ensure financing from the US Government. From 1966 Falconbridge applied for a new postponement while waiting for the new ML-process to be ready. The authorities' patience eventually began to wear thin.

Falconbridge began to plan a Nickel Iron Refinery in Sudbury, partly to satisfy the authorities' requirement of Canadian processing and partly to make better use of the nickel ore. As mentioned in the previous chapter, the unexploited iron sulphide from the mines contained around 1.5% nickel and there was both financial and political potential in processing this. The preliminary research work gave promising results, but Falconbridge could not get the process to work on an industrial scale. When the work was abandoned in 1972, the loss amounted to 75 million dollars. This was described as a "terrible psychological, technological and financial defeat" for the company.⁴⁸⁰

The new ferronickel plant in the Dominican Republic started production in the same year. It became a technical success, but when the OPEC countries quadrupled the oil price in 1973, profitability disappeared, as ferronickel production was very energy-intensive. The plant barely managed to pay instalments and interest before the nickel price plummeted in 1977. On top of this, Ontario's authorities demanded that Falconbridge had to reduce pollution in Sudbury. Large areas around the smelting plant resembled a lunar landscape and investments of around 95 million Canadian dollars would be required to remedy this.

In 1973, construction started on the new refinery at Becancour. Initially, the intention was to refine nickel from the new Ungava deposit, i.e., 15,000 tonnes per year. In the long term, the requirement was to process 51% of the matte from Sudbury. In other words, around half of the raw material basis would disappear from Kristiansand.

However, the construction was stopped temporarily in 1974. Liquidity had become strained following the losses at the Nickel Iron Refinery, the emission requirements at Sudbury and the poor results in the Dominican Republic. In addition, Falconbridge had planned to use natural gas as a source of energy in Becancour. The price of gas rocketed in the wake of the oil crisis in 1973.

Ontario's authorities agreed to a postponement. However, in 1975, Falconbridge was threatened with an extra tax of 11-12 million Canadian dollars per year because the company refined nickel outside Canada.⁴⁸¹

Changes in Norwegian industrial policy

Cheap electricity had helped Norwegian energy-intensive industry and this had also been one of Kristiansands advantages within Falconbridge. In Ontario, similar industry paid at least three times as much for electricity.

In the 1950s, energy-intensive industry was regarded as a national growth driver, but at the beginning of the 1970s this conception came under fire. Firstly, major Norwegian investments in energy-intensive industry had yielded less than the authorities had hoped. Secondly, small-scale industry expanded strongly in the 1960s and captured market shares abroad. In addition, oil revenues from the finds in the North Sea were looming on the horizon. Thus the electro-metallurgic industry meant less to the balance of trade than before. Thirdly, there was resistance to further development of hydroelectric power. In order to protect the river systems, electricity supplies to energy-intensive industry could not be increased at the same rate as before.

At the beginning of the 1970s, the nickel refinery paid on average 2 øre per kWh. A few old contracts with Kristiansand Elektrisitetsverk (KEV) had very low prices, but even in the newer contracts, the plant management achieved lower prices than the rest of the Norwegian energy-intensive industry had to pay to the state-owned power stations.⁴⁸²

In 1973, the Norwegian Ministry of Industry proposed raising the prices to the metallurgical industry to 4.25 øre per kWh and also proposed that an increased electricity tax

be paid to the state. The whole way of thinking from the 1950s changed completely. Expert economists had joined the electricity debate and the planning. Their way of thinking represented a clear break with the prevailing price and investment criteria in the electricity sector. The aim was no longer to rapidly expand energy-intensive industry, but rather to achieve a satisfactory financial return on the new energy developments. The marginal cost was to be charged, instead of the average price for power from old and new plants.⁴⁸³

Initially, the policy change was of very little significance to Falconbridge and the price was 2.34 øre per kWh when a minor contract was renegotiated in 1975. However, three years later municipally owned KEV obtained approval to use the state electricity price at the time of 5.6 øre plus 0.8 øre per kWh to cover the transmission costs and electricity loss.⁴⁸⁴

In this way, the electricity company secured increased income. However, this did not cover its marginal costs, i.e., what it cost to develop new energy sources. At that time, KEV had planned major developments in Øvre Setesdal or Øvre Otra, as the developments were called. In the electricity company's calculations the next stages of development would cost almost 12 øre per kWh. If marginal costs were to be covered, the electricity price would have to have been doubled again. In this respect, it could be said that KEV acted fairly defensively at a time when Norwegian energy policy was in the process of being changed.

The reason for this was that Falconbridge was struggling and that the refinery in Kristiansand was at risk. In this situation, neither KEV nor the city council wanted to increase the electricity price more than necessary, as it was important to secure 1,200 jobs in the city's largest company.

The chlorine leaching-process

In January 1966, Leif Hougen was appointed in charge of Falconbridge's newly established research and development unit in Kristiansand. He saw quickly that the new ML-process was not ideal for Norwegian conditions. This was due to the final stages of the nickel process, after separation of sulphur, iron, copper and cobalt. After this the nickel chloride was fed into a converter, which used butane or naphtha as a source of energy. At a heat of 850°C the nickel chloride was split into nickel oxide (NiO) and hydrochloric acid gas. The nickel oxide was then reduced to pure nickel metal using hydrogen.⁴⁸⁵

The reason for choosing to use a converter instead of traditional electrolysis lay both on a technological and market-related level. From a purely technical point of view, it was

probably difficult to obtain stable anodes, as the process was developed in the mid 1960s. As previously mentioned, the marketing department was concerned about expanding Falconbridge's product range. A converter could help produce nickel granulate, a production that hopefully would be easy to sell to the alloy industry.

However, use of a converter and subsequent use of hydrogen to reduce the nickel oxide was costly. Naphtha was already a significant cost item before the price rise in 1973 and production of hydrogen was energy-intensive. The result was that the ML-process used too much naphtha and too much electricity. In addition, a lot of steam was needed to "strip" the metal solutions from the hydrochloric acid and this was also energy-intensive.

Jahnsen, Hougen and Stensholt saw these weaknesses in the ML-process. Therefore, they used the research unit's resources to develop what later came to be called the CL-process, a refining technology that was more suitable for the conditions in Kristiansand. One of the aims was to use electrolysis instead of the converter. This meant that neither naphtha nor hydrogen was required.

Hougen and his team managed to combine and develop a few of the best elements from the ML-process with the best from the Hybinette-process. As in the ML-process, he started by dissolving the matte and allowed the metal solutions to circulate around in the system in liquid form. As in the Hybinette-process, he used electrolysis and cheap electricity to produce pure nickel.

Permanent titanium anodes (DSA anodes) were introduced in the electrolysis. These were developed in Sweden and were almost a prerequisite for the CL-process to work. These permanent anodes replaced anode casting at the refinery: a part of the process that was both labour-intensive and created an extremely bad working environment.

In the ML-process, the nickel matte was dissolved in concentrated hydrochloric acid on arrival at the refinery. The CL-process used chlorine gas instead to dissolve and oxidise the matte. This was far more efficient per volume unit, which reduced the need for space and capital costs. This was very important to the plant in Kristiansand, where space was already at a premium. However, use of chlorine gas was technically complicated and based on smart use of the difference in the redox potential with the various components in the matte.

In this field, the research and development unit was able to employ experience from the ML-process. Through electronic control and monitoring, it was possible to analyse and control the various stages of the processes even better than before. The new elements in the CL-process were also based on even more thorough instrumentation than in the ML-process. And the pressure, temperature and pH required more accurate control in order for the process

to work. However, it took a long period of development work to achieve this. The laboratory work lasted from 1966 to 1969 and the process was tested in a pilot plant from 1970 to 1972. Kjell Frøyland, John Valen and Hans Zachariassen assisted Hougen in this work, which succeeded in producing consistently high-quality nickel.

Development of the CL-process was not a matter of course, as there was some scepticism in Canada toward using resources on this. The research unit in Toronto was convinced for a long time that "their" ML-process was superior. Wigstøl also believed that this process should be developed further. Without Jahnsen's strong position in the Falconbridge and Hougen's ability to procure promising results, the new CL-process would probably not have seen the light of day.

Falconbridge was not the only company to be involved in development work. In 1973, INCO opened a new refinery in Sudbury for its new high-pressure carbonyl process. In 1980, the company began using a more advanced cobalt process and four years later introduced a new noble metal process.⁴⁸⁶ Subsequently, Le Nickel and Japanese Sumitomo also developed refining methods that resembled the CL-process. Both were familiar with the results from Kristiansand, but the system was different as it used other types of nickel matte.⁴⁸⁷ Other competitors also made progress. Even though Falconbridge was in the forefront technically in relation to many of its competitors, it had to work hard to maintain this lead and a terrible setback hit the refinery right in the middle of this work.

The cobalt process and the fire at the cobalt refinery

The old cobalt process from 1952 was complex and comprised many process stages and involved a high consumption of chemicals. In this field, Falconbridge traded on experience from the uranium industry. During the 1950s, this industry had developed separation methods based on so-called solvent-extraction. In connection with development of the ML-process, it became an objective for the researchers in Falconbridge to use the same principles in extraction of iron, cobalt and copper from the nickel solution.⁴⁸⁸

The earliest work was carried out at the laboratories in Toronto, but eventually the R&D unit in Kristiansand took over an increasing number of the tasks. A lot of time and energy was spent on finding a suitable solvent for extraction. From extraction, the cobalt solution was sent to so-called ion exchangers for further purification before it was reduced to pure metal through electrolysis. Ludvig Dundas led this project and together with his

colleagues he succeeded so well that Falconbridge moved straight from laboratory tests to full-scale production without using a pilot plant first. The cobalt refinery started production in the summer of 1967, without suffering any serious "teething" problems.⁴⁸⁹

The new cobalt plant marked the rejuvenation of Falconbridge in two ways. One of these was on a process level, where there was increased use of scientific insight and systematic research. The other concerned the working environment. Ever since his arrival at Kristiansand in 1953, Jahnsen had been keen to improve the internal environment. The cobalt refinery satisfied his requirements regarding open and clean premises and good working conditions.

Tragically enough, it was this openness that was to be the plant's nemesis. During maintenance on 4 May 1972, welding sparks ignited the paraffin solution used in extraction process. The fire spread like lightning and with unexpected intensity. Three employees were killed and four were seriously injured in what was the most serious accident in the history of the plant. The material damage amounted to 12-15 MNOK and production loss was estimated at 100,000 per day.⁴⁹⁰

The fire was a wake-up call to the Falconbridge organisation and resulted in stronger focus on safety work and risk management. Elements of risk were analysed and minimised as much as possible when the plant was rebuilt. Firewalls were built, sprinkler systems were installed, drainage systems were made for flammable liquids and several emergency exits were also made. Similar improvements were also made in the company's other units.⁴⁹¹ The refinery's own fire department was also strengthened. After one year the cobalt plant was in production again.

Transition to the CL-process

The transition started in the late autumn of 1974. The first ten electrolysis tanks with DSA anodes (stable anodes) were put into operation in December under the management of Erling Stensholt, Kjell Frøyland and Ed Henriksen. The nickel produced had a good quality and therefore the go-ahead was given to continue to the transition. In the spring of 1975, almost 45% of the matte passed through the CL-plant and the transition progress without major technical difficulties.⁴⁹²

The CL-plant was a continuation of the ML-plant both technical and organisationally. The flat structure was maintained where people worked in teams, thus avoiding the traditional

role of foreman. The shift should be able to manage difficult tasks themselves without having to summon extra help. Each worker was assigned responsibility and paid for his / her know-how. According to Arne Johan Finne, it was not until the CL-plant came into operation that the new type of organisation and wage system were really accepted at the refinery.⁴⁹³

The problem was that demand fell and the producers withheld nickel from the market to avoid a price fall. In August, Falconbridge had 2-3 months of production of both nickel and cobalt in stock. This represented around 400 MNOK and threatened the company's liquidity.⁴⁹⁴

This situation could not continue, and production was cut several times. The continued transition to the CL-process was also postponed. Construction of a new roasting plant was given priority for environmental reasons,⁴⁹⁵ which we will come back to later. In addition, the development work showed that the workforce in the roasting plant could be significantly reduced. Kåre Andersen, Eivind Thune and Nils Henrik Smith Øverland were given responsibility for planning and implementation and the plant was put into operation in October 1978.

However, the research units in Canada had never given up the ML-process. They had continued to develop this and had built a small pilot plant in Sudbury. They believed that they had caught up with the CL-process.⁴⁹⁶ The CL-process was best suited for Norway where there was cheap hydroelectric power and understanding for this was eventually found with Falconbridge's Technical Manager and subsequent President Pete Berry. The Canadian researchers were too late, as the CL-process had proved its feasibility, but no one knew how an improved ML-process would work on an industrial scale.

Development of the CL-process was resumed and completed in October – November 1978 and the Hybinette-process was now history. The change to the CL-process was partly self-financed, as it released large quantities of metals that had previously been tied up in the process.

Mechanisation, efficiency improvement and reduction of maintenance

As we have seen, process development was increasingly more research and science based. One could however argue that the key to progress and survival still lay in the company's ability to combine theoretical with practical insight.

In 1970, around 250 men still worked in the engineering department in Kristiansand. Some of the workforce was involved with new building work. However, very many were occupied with normal maintenance. Due to extensive corrosion problems, the production equipment had to be continuously renewed. At the beginning of the 1970s, polyester was used in pipes and pumps. But eventually the company changed to using titanium. The workers experienced this as an even better improvement than when the pipes and pumps were rubberised in the 1950s. The results can be read from the company's cost picture: In 1975, maintenance was 7% of the total costs, compared with 12-13% ten years earlier.⁴⁹⁷

At the same time as this, a number of tasks in production were mechanised or automated. Two examples of this are: In 1975 the semi-automatic filter presses were put into operation. The function of these was to separate solids from the liquid metal solutions. Most of the filter cake (the collected solids) was now cleaned out automatically, collected in a silo and then transported away on a conveyor belt. These operations used to be done manually.

Manual stripping of nickel from the cathode plates was also automated. Up to 1975, this task required 8-10 men and each cathode plate weighing 25-30 kg had to be lifted into place by hand. This resulted in many small cuts and was wearing on the skin. Few jobs in the electrolysis area had a greater turnover.⁴⁹⁸

Automation helped to reduce the production costs per tonne, even though wage costs increased drastically. There was even more extensive efficiency improvement in the 1980s when the refinery fought for its survival. These improvements were based as much on the mechanics, the pipe fitters and the electricians' insight and creativity, as on the insight and creativity of the engineers and the researchers'.

All in all, mechanisation and the initial automation were probably equally as important as the historic process changes. This illustrates one of the technological characteristics of running a nickel refinery, as the company had to have an unusually wide range of competence and expertise, from craft and process related to scientific.

Ragnar Jahnsen, Eivind Wigstøl and the change of general manager

In January 1976, Ragnar Jahnsen retired after 21 years as manager. In many ways, he was the creator of the modern Falconbridge. In the 1950s, he had led the strong expansion process and in the 1960s he had focused on extending the refinery's technological capabilities. Development of electronic control and the CL-process was the culmination to this. The

conversion of the old Hybinette-plant to the CL-process started just before he retired. Just like his predecessor Sverre Steen, Jahnsen had fought strategically on Kristiansand's behalf within Falconbridge. Like Steen, Jahnsen had entered the investments in the operating budget. This had gone well, as long as Horace Fraser was the company's president, but under his successor Marsh Cooper (1969-82) relations with head office became strained.

Eivind Wigstøl was Jahnsen's successor. He had studied at Oslo Technical College and then at the University of Birmingham and joined the nickel refinery as soon as he finished his education. However, he soon moved to Canada where he worked both in the production division in Sudbury and at the research centre in Toronto. He returned to Kristiansand to take part in building up the ML-process, and was eventually put in charge of this work.⁴⁹⁹

Wigstøl belonged to a new generation of industrial leaders. He opened the business to the outside community and accepted the new corporate democracy that was introduced at the beginning of the 1970s; a reform that Jahnsen had great problems with. Wigstøl believed strongly in delegating responsibility. At the same time, he warned against the corporate democracy if this involved people having influence on things "which they knew nothing about". Wigstøl also took the problems with pollution and cancer risk very seriously. He soon saw that these would be some of the company's greatest challenges.⁵⁰⁰

Just as Grønningsæter in his time became dissatisfied with Jahnsen, Jahnsen gradually became sceptical of Wigstøl. In Jahnsen's eyes the latter was very much "Canada's man". Since his time in Toronto, Wigstøl had stood high in favour at the head office. In 1971, following Per Brekke's death he was promoted to technical manager and he took over as manager in 1976.

During Wigstøl's time as manager relations between the subsidiary and head office were much closer than before, which was partly due to his personal contacts with Toronto. Other factors were also in favour of the units being linked more closely together. Since the days of the ML-process, Kristiansand and Toronto had become more technologically dependent upon each other. At the same time, communication technology had brought the head office and the refinery closer together. Air travel had become much cheaper so that more personnel could be sent across the Atlantic on courses and to meetings. A similar fall in the prices of fax and telephone calls, also made it easier to keep in touch.

It became easier for the head office staff to follow what was happening in Kristiansand and it was no longer possible to work from a separate agenda, like Grønningsæter, Steen and partly Jahnsen had done. In order to protect the refinery's interests, this had to be done in different ways than before and a key to this was to have head offices' trust.

Wigstøl succeeded with this and in 1979 he was elected onto the executive board of Falconbridge, where he sat for more than 10 years. Apart from president Marsh Cooper and his successor Bill James, Wigstøl was the only employee in the whole of Falconbridge who was given such a post. This gave him greater influence than any other manager in Kristiansand had had before him and therefore, the subsidiary was directly represented in Falconbridge's supreme decision-making body.

Industrial democracy

The change in leadership was not the only thing that brought new times to the refinery in Kristiansand. In 1972, the Norwegian Storting (Parliament) resolved to introduce corporate democracy and the employees' representatives were given a place in the boardroom and at corporate assemblies.

Like many older industrial leaders, Jahnsen disliked the arrangement. He asked the trade union whether the refinery, as a foreign-owned company, could be excused from introducing the reform,⁵⁰¹ which foreman, Salve Sløgedal, blankly refused. The Falconbridge workers had been in favour of such democratisation for some time. In 1963, the union demanded to be allowed to elect representatives to the board of directors.⁵⁰² The reform gave the employees two representatives on the board of directors and also a third of the members in the corporate assembly. However, Jahnsen obtained support that head office, not the subsidiary's Norwegian directors, should appoint a new managing director.

In Falconbridge the reform helped give shop stewards more insight into the company's development and challenges. The employees' representatives had little influence on the board work itself. One exception to this, however, was shop steward Jacob Sørensen, who raised matters that did not usually concern the trade union. However, it is important not to over-exaggerate the importance of the Norwegian board of directors or their influence, as major issues were decided in Canada.

Wages and disputes

All in all, the workers did well in the 1970s. During the period 1970-1973 the average worker's real wages increased around 20% and by a further 60% in the following three years.

Inflation has been taken into consideration in both cases.⁵⁰³ The following two years were leaner and a nationwide wage and price freeze was eventually introduced.

At the refinery the trade union, and especially its radical shop stewards, reacted strongly to the wage freeze. After several lean years, Falconbridge was again making a profit and the workers also wanted to take their share of this. In 1979, the union initiated a short unlawful strike as well as refusal to work overtime and go-slows. The union also worked actively to spread this type of action to other metallurgical companies. Relations with the management became strained. In addition, The Norwegian Electrochemical Employers' Association refused for a long time to recognise the young maoist Bjørn Enes as a shop steward.⁵⁰⁴

The strike in 1979 is in fact the most serious local dispute in the history of the refinery and it is worth noting that even then, the strike only lasted no more than a few hours. The next few years passed without incident. Falconbridge was again struggling to survive and it was clear to the employees that the company could not offer any generous wage increases.

The wage system was changed during the 1970s and the lines of dispute were more within the trade union than between the union and the company.⁵⁰⁵ Wage differences between different groups of workers were evened out. In 1973 a relatively high percentage of workers had an hourly wage of 13 NOK per hour, while the best paid workers received 22 NOK per hour. Consequently, the lowest wages were raised most in the next few years.

In addition, an increasing number of workers were paid a fixed wage instead of an hourly wage and piecework. More responsibility was also delegated down the line. The company trusted to a greater extent than before that the workers did their job instead of paying them for each completed task. This took place at the same time as the workers were given more independence in their daily work. The organisation became flatter and less hierarchical. Thus, the development at the plant mirrored the trend within Norwegian industry as a whole.⁵⁰⁶

There is hardly any doubt that the reforms within the organisation and the wage and management system helped strengthen the company. It would have been difficult to maintain the rather authoritarian type of organisation. In spite of the hick-up in 1979, co-operation with the trade union also became one of the company's strong points, especially if the refinery was compared with Falconbridge's more strike-prone plant in Sudbury.

A strengthened position?

The 1970s was one of the most turbulent decades in Falconbridge history. Growth had stagnated and less nickel was produced at Kristiansand in 1980 than in 1970. Business during this period was full of ups and downs, but despite this the plant set a production record in 1974. Four years later, the plant produced less nickel than in any year since the 1950s and the main concern was to try and survive in an unstable market.

The picture was not all black for the refinery in Kristiansand. Ontario's authorities had finally realised that the nickel industry had problems and they were afraid that Falconbridge would buckle under. This would also have consequences for the mines and the smelting plant at Sudbury. It was important, therefore, not to put more strain on the company than it could tolerate and the requirement regarding Canadian refining was put on hold. It no doubt helped that Falconbridge had deliberately located its planned refinery in Quebec, in other words, outside the province of Ontario. Ontario's politicians were not interested in weakening a local company in order to secure jobs in the neighbouring province.

In addition, the oil crises in 1973 and 1979 had strengthened the Norwegian refinery. The increased price of petroleum products made Falconbridge's planned refinery at Becancour less competitive compared with Kristiansand and it was also more expensive than before to produce ferronickel. This product had taken significant market shares from pure nickel, which was what the Kristiansand produced. As mentioned, ferronickel production was very energy-intensive and the competitive conditions tipped in Kristiansand's favour. In Kristiansand the municipal electricity company continued its industry friendly line well into the 1980s and the refinery continued to receive cheap hydroelectric power.

The price of nickel rose in 1979 and copper, cobalt and noble metal prices also began to climb. An 8-month long strike in competitor INCO in Canada and a bad fire at Le Nickel's refinery in Le Havre removed the surplus of nickel from the world market.

All in all, these three external factors were favourable, but it was the refinery's own competence that made it possible to survive in a more exposed world. The new CL-process helped reduce costs per tonne nickel by more than one third.⁵⁰⁷ Jahnsen's focus on establishing a local R&D unit bore fruit. At the same time, the key to success lay in the company's ability to combine the skilled workers, the process operators, the engineers and the researchers' skills and know-how. The company improved in this field during the 1970s, when under Wigstøl's management it focused on delegating responsibility and training the workforce.

The refinery had strengthened its position within Falconbridge and in relation to many of its competitors. But the upturn in the nickel market in 1979 proved to be short-lived and a new, deep crisis, deeper than ever before, followed.

15. CANCER AND THE EXTERNAL ENVIRONMENT, FALCONBRIDGE'S NEW CHALLENGES

In May 1972, the cobalt refinery burnt down and three people died. In August the same year, it was announced that there was an alarmingly high incidence of cancer among the employees. At the same time, there was increasing pressure on the company to reduce pollution of the external environment.

In the 1970s, environmental protection and the working environment became priority items on the political agenda, and this eventually changed the framework conditions of the industry. It was no longer enough to create safe, well paid jobs or to secure the country substantial export revenues. Norwegian industrial companies also had to satisfy increasingly more stringent environmental requirements. How did the nickel refinery, its owners, managers and the union tackle these challenges?

Risk of cancer identified

In 1967, Arne Chr. Høgetveit took over as company physician in Falconbridge. He soon noticed that there was an alarming incidence of cancer among the employees. In 1970, it was approved that he could ask the Cancer Registry of Norway for help in carrying out a thorough study.

The report from the Cancer Registry was finished in August 1972. Lists of employees from 1911 onwards were checked against information about deaths from cancer since 1953. A total of 67 people, compared with the statistically expected 12, had been diagnosed with cancer in the respiratory organs. In addition, in the county of Vest Agder, Falconbridge workers represented around 20% of the total number of cases of cancer. It was found that the risk of developing cancer increased with length of employment and the workplace. Workers in the electrolysis plant, the roasting furnaces and areas where there was nickel-contaminated dust were particularly at risk.⁵⁰⁸

There had been dissatisfaction about the working environment for some time. The union had complained about unfavourable conditions from the start in 1910-11. In 1950, doctor Aagot Løken at Rikshospitalet (the National Hospital) indicated that there could be a link between exposure to nickel and lung cancer. At that time, however, there were so few

cases that it was impossible to find conclusive evidence. It was known that a link had been established at INCO's refinery in Clydach, Wales, but the production process in Kristiansand was completely different, so that it was impossible to make a direct comparison. At the time, it was thought that nickel-carbonyl, a nickel compound that didn't occur in at the Kristiansand refinery, was the cause of cancer in Clydach. However, we know that in the mid 1950s, the workers in the matte crushing plant were concerned about the risk of cancer and reported this to the Labour Inspectorate.⁵⁰⁹

The trade union had complained about the working environment for some time, but it had never been a main issue, not even for the Norwegian Union of Chemical Industry. For a long time, workers took it for granted that industrial work could be dirty, dusty and noisy. There was also very little exact knowledge about the elements of risk. Arthur Svenson, a subsequent leader of the Norwegian Union of Chemical Industry, also pointed out the wind of co-operation that was blowing after the war. The aim was to create fast production growth and therefore the working environment took second place.⁵¹⁰ The initiative for improvements eventually came from above and outside.

In 1955, Karl Wülfert from the Labour Inspectorate in Oslo inspected the refinery in Kristiansand. Most of his criticism focused on the conditions in the roasting and smelting plant. Several of the workers complained of damage to the wall of their nasal cavities and that their sense of smell and taste was impaired. "Tobacco tasted like straw". Workers in the roasting furnace were troubled with nosebleeds and the "Kolsdal cough" became a standard expression, named after the factory site.⁵¹¹ Wülfert also noticed that 7-8 workers, who had been working with crude matte or in the roasting plant, had died of cancer in the respiratory organs.⁵¹²

In his report, Wülfert described the ventilation systems as "completely useless" and "half-witted". In most of the plant, there were many things that required immediate remedying. Following the change to the chloride process in 1952, there had been a significant increase in the occurrence of chlorine poisoning.⁵¹³

Karl Wülfert was critical about the company physician at the time, Guttorm Haaversen. In those days, there were usually close ties between the company physician and the management. The company health service was primarily a "welfare measure" for the employees and had no "watchdog function". As Haaversen was also the local medical officer in Kristiansand and the Labour Inspectorate's local representative in the town, it was difficult for any outsiders to do anything about the working environment in Falconbridge.

Improvements were already being made, however, when Wülfert visited the company. As newly appointed director, Ragnar Jahnsen was keen to remedy the working environment – with the help of Haaversen. Jahnsen agreed to improve ventilation, prevent accidents, provide more space around machinery and reduce the dust problems. When Wülfert returned in 1962, he found that conditions had significantly improved.

Two years later, Jahnsen asked dr. Jon Glømme at the Institute of Occupational Health to make a thorough inspection of the refinery. In spite of Jahnsen's efforts to clean up the plant, researchers believed that the chlorine gas and nickel-contaminated dust were still a significant environmental problem and levels were above the recommended safe limits in several areas. Glømme proposed use of masks, improved ventilation and better cleaning.⁵¹⁴

In May 1969, the contents of the "Glømme"-report were published in the socialist weekly newspaper "Orientering". It was reported that the safe limits had been exceeded at a number of places in the plant and it was claimed that the elements of risk had been minimised. The newspaper wrote that the whole situation was akin to "unscrupulous exploitation of workers", where their health was sacrificed for the good of the company. Jahnsen refused to comment and he subsequently managed to edit a TV report on the matter. It took until February 1970 for the newspapers in Kristiansand to be summoned to a press conference, at which Jahnsen claimed that the findings had been distorted and that the situation had been improved since the studies were published.⁵¹⁵

But in its report, the Institute of Occupational Health had been cautious with regard to one area: It was assumed that nickel was not carcinogenic. However, as mentioned, there were medical studies, which indicated such a link, but there were no clear signs of a cancer risk. Historian Øivind Bjørnson concludes, therefore, in his summary of the matter: "As is often the case, the exposed workers did not have the benefit of the doubt".⁵¹⁶

However, the new company physician, Høgetveit addressed the matter and obtained approval to ask the Cancer Registry for help in carrying out a study of the matter.

The study

The findings came as a shock in 1972. The risk of developing cancer was seven times higher at the refinery than for the average population. The risk of cancer of the sinuses was 40 times higher among those who had been employed more than five years. The management had been aware that there was some risk of cancer, but they were not prepared for such a magnitude.

When the management became aware of the preliminary findings, the company health service was immediately strengthened. In the autumn of 1972, the company health service was able to move into new premises with new analysis equipment.⁵¹⁷

The company had some relevant expertise already and in the analysis work Falconbridge was able to use experts from its own laboratories. With regard to the cancer problem, the refinery also received help from its main shareholder Howard Keck. He sent his personal physician, cancer specialist Dr. Richard Barton, to Kristiansand. At Barton's request, Keck paid for advanced analysis equipment from his own pocket.⁵¹⁸

A new medical examination was initiated to find out whether it was possible to detect early signs of cancer in the nose and sinuses. Atypical changes in the mucous membrane in the nose were found in almost a quarter of the tests from employees in the roasting, smelting and electrolysis plants. The doctors believed that this was linked to exposure to nickel, but it was still not known whether this was an initial stage of cancer.

Doctor William Torjussen, who was in charge of the study, was shocked about what he had found. In 1973, he wrote that the "status of health at Falconbridge is much worse than the impression given by the corporate management's comments, the safety work, the union's view and the Labour Inspectorate's statements". At that time, almost 100 workers had developed cancer in the lungs or respiratory organs.⁵¹⁹

From 1953 to 2000, 34 cases of cancer in the nose and sinuses were diagnosed, in addition to 267 cases of lung cancer among the nickel workers. The figures have been based on information from almost 5,300 men who had worked for at least one year at the refinery since 1910/11. Aage Andersen and Tom Grimsrud at the Cancer Registry and company physician Steinar R. Berge were responsible for the studies. One of the conclusions was that a combination of nickel and smoking significantly increase the risk of lung cancer.⁵²⁰ Around 140 of these cases of lung cancer could probably have been avoided if the employees had not been exposed to nickel and around 240 if they had never smoked.

Exposure to nickel was significantly reduced following reorganisation of the chlorine-leaching-process (CL-process) in 1978. However, a new study from 2003 has shown that there is also a higher incidence of lung cancer in people employed after 1978. Tom Grimsrud at the Cancer Registry writes, however, that so far there have been so few identified cases (5) that these may be due to chance variations.⁵²¹

The cancer issue confronted the refinery-management with quite a different scale of working environment problems. The company also had to learn to live with the fact that both its own employees and "outsiders" interfered in the corporate management's decisions.

Company physician Høgetveit initiated the studies and subsequently, among others, the Labour Inspectorate, the Institute for Occupational Health, the press and the trade union became important players in the matter.

It is important to note that Falconbridge was not the only company to uncover serious problems with its working environment. At the same time, almost similar conditions were found in a number of industrial plants in Norway, including Slemmestad Eternittfabrikk, Norsk Hydro and Årdal & Sunndal Verk.⁵²²

The battle against cancer

Falconbridge invested considerable resources into the work of improving the working environment and avoiding new cases of cancer. The company decided that it could not live with such conditions, as this would be impossible from a human and political point view and with regard to possible compensation.

When the cancer report was published in 1972, the management took immediate action to combat the dust problem. Extra hatches were installed in the roasting plant to prevent dispersion of dust and work on elimination of dust leaks was intensified. In a subsequent report, however, Safety Engineer Finn Resmann wrote that new technical problems prevented a reduction in nickel content in the air.⁵²³ Use of a mask became compulsory in the most hazardous areas. Working hours and thereby length of exposure, were reduced for certain employees. Company physician Høgetveit ensured that many of the workers in the most exposed jobs, were transferred to other jobs in transport and outside work.⁵²⁴

In the days of the Hybinette-process, there was a high nickel content in the air in several places in the plant. It happened all too often that the safe limit of 1 mg nickel per m³ was exceeded during the dustiest work operations. In conjunction with the cancer study, the Labour Inspectorate required that masks must always be worn if the nickel content in the air exceeded 0.1 mg/m³. After lengthy discussions with the company, the limit was raised to 0.4 mg/m³ up until the CL-process was introduced, after which it was set at 0.1 mg/m³.

The cancer findings came at a time when Falconbridge was facing hard times financially. However, the change to the far less hazardous CL-process was accelerated, though not as much as the Labour Inspectorate had originally wanted. The CL-process involved much less melting and roasting and in addition, a new fluid-bed roasting furnace was introduced in 1978. This furnace was completely enclosed, which meant that the dust problem

was almost completely eliminated. Pending implementation of these measures, production in the most exposed areas of the plant was either shutdown or reduced.

Internally, company physicians and the trade union have fought for lower safe limits with regard to nickel content in the air. The Labour Inspectorate has also forced the company to take action, while the management has continuously requested higher safe limits and more time to implement the orders. The measures have been costly and partly difficult to implement from a practical point of view.

Following pressure from the trade union and the company physician, Falconbridge introduced an internal limit of 0.05 mg/m³ in the mid 1990s. In conjunction with revision of the safe limit for a number of substances in 1999, the Labour Inspectorate proposed that the safe limit for nickel be lowered to 0.02 mg/m³. The company opposed such a drastic reduction and gained support from the international nickel industry's research organisation NIPERA. During the final processing by the Labour Inspectorate's executive committee, representatives from the Norwegian Federation of Labour (LO) and the Employers Association (NHO) ensured that the safe limit was set at 0.05 mg/m³, which was also the limit recommended by the local union, the "Falconbridge Arbeiderforening".⁵²⁵

The union, the working environment and damages

Up to the 1970s, the trade union in Falconbridge adopted a relatively cautious attitude with regard to working environment matters and was more concerned with wage and labour issues.⁵²⁶ However, there was increasing focusing on this area and a special environment shop steward (subsequently a senior safety delegate) monitored the environment work full time. A radical wing, spearheaded by representatives from AKP (Workers' Communist Party of Norway), also put pressure on the union to be more aggressive in working environment matters as in other matters, but this group never comprised more than three-four activists.⁵²⁷

At the end of the 1970s, a retired worker suffering from cancer claimed damages. After some internal debate, the trade union decided to raise the matter through the Norwegian Union of Chemical Industry Workers. Suing for damages was an unusual course of action at that time, both in Falconbridge and in Norway as a whole. Many trade unionists also felt an instinctive loyalty to Falconbridge and did not want to involve the union in any lawsuits against the company.⁵²⁸

It took almost two years before the case was dealt with, as both the Norwegian Union of Chemical Industry Workers and LO (Norwegian Federation of Trade Unions) had to find out they should deal with such matters. After that, LO's solicitor, Karl Nandrup Dahl, became heavily involved in the matter and made conscious use of the media to turn public opinion against Falconbridge. It is said that Wigstøl was sometimes so angry with Nandrup Dahl that he refused to sit in the same room as him.⁵²⁹

Karl Nandrup Dahl was already working on a similar case at Slemmestad Eternittfabrikk and a court settlement in this case was reached in October 1983. Tor Are Johansen wrote in the anniversary edition of the history of the Norwegian Union of Chemical Industry Workers that this created a precedent for other companies. In February 1984, the union entered into negotiations with Falconbridge, and the shop stewards had the impression that Wigstøl wanted to reach a settlement, but that President Bill James was afraid of the action for damages that might be raised in North America. However, an agreement was reached in 1985, though Falconbridge admitted no blame, but gave an ex gratia payment to the injured parties.⁵³⁰

Accidents and limitation of injuries

As most industrial plants, Falconbridge had a history of accidents. A great deal of manual labour was carried out in areas where there was acid, chlorine gas, high temperatures, etc. and workers had to learn to tackle the hazards. In addition to this, there was some reluctance to use of too much personal safety equipment. Skilled workers managed without; "you looked stupid if you wore a helmet". But the most important reason for workers not using such equipment was that it was too cumbersome. Face masks made it difficult to breath, safety goggles fogged up and if anything happened in one of the furnaces it took time to put on a helmet.⁵³¹

A high turnover of personnel was also a disadvantage. After analysing accident figures, J. H. Christiansen found out that new employees were three times more vulnerable to accidents.⁵³² It took time for new personnel to master the risk. At the end of the 1950s, the company had one accident that resulted in long-term sick leave per year for every ninth employee. One of the management's goals was to reduce these figures and Reidar Holum began systematic work to limit the number of injuries and within a few years the number of accidents was significantly reduced.

Around 1970, the refinery increased its focus in this area and consulting company "Vern og velferd" was called in to help. The number of safety delegates was increased from 13 to around 50 and the company appointed its first full time senior safety delegate. Company physician Høgetveit made regular checks of the company and was strict about use of safety equipment. However, there were limits to what could be achieved as long as the Hybinette-process was in use. The number of injuries started to rise in the mid-1960s and around 1970 it had reached between 80-100 injuries. Accidents occurred frequently in the electrolysis plant in conjunction with lifting the remains of the anodes from the tanks. The anodes weighed up to 100kg, were very fragile and could give nasty foot injuries if they broke during lifting. There were also many burn injuries in the roasting and smelting plant, in addition to various cut and compression injuries.

Introduction of the ML- and CL-process and the new roasting furnace eliminated many of the old hazards and the number of manual tasks was significantly reduced, although a few new problems arose. Arnulf Grønvold informed that in the ML-plant, many workers suffered burns due to flushing and cleaning with almost boiling water, whereas chlorine poisoning was a problem in the CL-plant's electrolyte purification area. It took the workers time to learn where the new elements of risk were.⁵³³

At the beginning of the 1980s, the number of lost time accidents was halved to around 40 per year and the so-called H-value, i.e., injuries per million working hours, fluctuated between 20 and 30, which was on a par with comparable industry. An increasing number of accident-prone areas were gradually automated. For example, many workers had received cuts while stripping the cathodes or while putting "ears" on the anodes. In year 2000, the number of lost time injuries dropped to 2 and the risk associated with industrial work was significantly reduced.

Damaged car paint and damaged washing

In the 1970s people thought that it was in the nature of things that industry was a source of pollution. At Falconbridge, however, the management had tried to limit pollution since the 1930s. As we have seen, Falconbridge actually used more resources on limiting emissions in Kristiansand than in the Sudbury area.

In Kristiansand, Falconbridge primarily polluted the neighbourhood and it was obviously in the best interests of the company to limit these emissions, as it relied on the

goodwill of the local population and politicians, among other things, to ensure a power supply from the town's municipal electricity company. The plant kept itself more or less within the limits of what was considered acceptable at that time. However, the occasional acute emission of sulphurous smoke and dust did damage people's washing and car paint. Many employees remember the chaos that arose in the car park every time the loud speaker warned off fallout and that everyone had to drive through the special flushing rig.

Slowly but surely, the authorities began to realise that pollution was a problem and in 1961 the Smoke Control Council was established. From 1970 the company had to apply for a special discharge permit.⁵³⁴ The Norwegian Ministry of the Environment was established two years later, followed by established of the State Pollution Control Authority in 1973 (SFT).⁵³⁵

Environmental protection was also given higher priority in Canada. At the smelting plant outside Sudbury, the company was ordered to radically reduce emissions and the measures had a cost limit of 95 million Canadian dollars. When Falconbridge received its first public orders, these were much more costly in Canada than in Norway.⁵³⁶

Although it must be added that the pollution problems were much greater in Sudbury. In Kristiansand, the problems with the company's working environment and risk of cancer overshadowed this problem. In the 1970s and beginning of the 1980s, the nickel refinery was therefore allowed to concentrate on improving the internal environment.

A more environmentally friendly company

Even though state environmental regulations were not particularly stringent around 1970, the company's emissions were significantly reduced. From 1971 to 1973, the losses of hydrochloric acid were reduced by around 75% from around 8 kg per day to around 2 kg. Chlorine gas emissions were more than halved in the years up to 1975 and the same applied to discharges of nickel, copper and cobalt. Even in 1971, almost one tonne of metals were discharged into the sea every day. The improvements were due to process changes and reorganisation of work routines. Installation of an improved purification plant also halved emissions of sulphur dioxide from 1971 to 1975.⁵³⁷

Falconbridge was also ordered to stop discharging iron slurry into the sea. This concerned relatively large quantities, around 20 tonnes per day, so that disposal on land would be expensive. Therefore, the company conducted "delaying tactics" for several years. It was

also difficult to find a suitable area, as no one wanted the slurry. From 1982 it was deposited in the municipal site on the hill behind the plant.⁵³⁸

Improvements early in the 1970s were profitable in the sense that they limited metal and chemical losses. However in 1975, this phase was over and from then on there were fewer discharge reductions. Resources were invested in reducing the far more serious working environment problems. The change to a new roasting process in 1978 eliminated the acute emissions of sulphur smoke. At the same time, the refinery also improved wastewater monitoring and a common wastewater system was installed in 1984. As one of the few projects in the company's history, this functioned better in full scale than in the laboratory. Drainage of nickel, copper and cobalt was limited to below 100 kg per day and in 1990 was reduced to 20 kg. In 1981-82, the company stopped using sulphur-rich fuel oil, which halved sulphur dioxide emissions. For chlorine gas and hydrochloric acid, however, the reduction in emissions did not come until 1989-91.

Increased awareness about and combating pollution were closely linked to improved measuring equipment, which also showed *how* polluted Byfjorden was. At the same time, installation of online measuring equipment allowed the company to have a far better idea of the discharges, thus making it possible to find appropriate remedies.⁵³⁹

In the early 1980s a study of Byfjorden showed that fish and other organisms contained large quantities of organic environmental toxins. Initially, it was thought that the cause was previous discharges from the ML-plant. But an extensive analysis programme showed that the company was still discharging significant quantities of organic compounds. Eventually, the company managed to eliminate most of these discharges.⁵⁴⁰

In the second half of the 1980s the alarm was raised with regard to dioxins. These substances are accumulated in living organisms and break down very slowly and therefore are hazardous to health even in small quantities. People were again warned not to eat fish from Byfjorden, and one of the polluters was Falconbridge. Therefore in 1989, the company installed a new gas purifying plant in the melting furnace for noble metal-rich matte. Following the change in the noble metal process in 1992, discharges were reduced further to 0.5 gram per year, i.e. one tenth of the level from 1988. In 2003, the seabed was also covered with sand from construction of the E-18 highway in order to prevent old discharges from contaminating the food chain.

Internal and external criticism

In 1987, Falconbridge was repeatedly criticised for its pollution of Byfjorden, which also became one of the main issues on the agenda of the local elections that autumn. Leader of Venstre (the Liberal Party), Arne Fjørtoft, televised his fishing trip on Byfjorden, where he fished up dead flounders from the sea. Even though some people wondered how he managed to get these fish to bite the hook, the matter was a great PR stunt for him and a correspondingly bad publicity for Falconbridge.⁵⁴¹

Greenpeace demonstrated against the company in 1990, when it was discovered that the company had applied to State Pollution Control Authority (SFT) to raise the level of the slurry dump by 7 metres. A neighbourhood protest against this was already underway and for the first time, the refinery had to relate to organised protests from groups outside the company. Greenpeace's demonstrations were a futile effort, but in the autumn of 1990, the matter attracted the interest of the Norwegian environmental organisation Bellona, who used quite different tactics from Greenpeace. The company initially believed that Bellona was only out to get media coverage and to sway public opinion in their environmental battle. However, Bellona wanted to establish co-operation to increase awareness among the management and the employees. Bellona claimed that 90% of the slurry was relatively harmless, but that 10% should be separated out and dealt with properly. The organisation set tough requirements and was a master in handling the media. At times, the management felt that Bellona's work and request for money was on the verge of extortion.⁵⁴²

Meanwhile, in the trade union, the external environment did not really become an item on the agenda until the mid 1980s and several of the environmental matters were controversial. For example, many employees were against building a sulphuric acid plant (see chapter 16), because it would result in a loss of jobs. Initially, the co-operation with Bellona was also very controversial, but this improved when the organisation told local (Labour Party) newspaper "Sørlandet" that it was "impressed with the company's environmental work."⁵⁴³

The trade union leaders believed that eventually public opinion would object to companies that polluted the environment. Therefore, it was in the interest of the refinery and the workers to remedy matters. Shop steward, Leif Gusland, also pointed out that union members not only were Falconbridge workers, but also citizens of Kristiansand. Like everyone else, they wanted to be able to eat fish from the fjord and use this as a recreational area.⁵⁴⁴

In 1990, the trade union contacted SFT. Falconbridge was in the process of applying for a new discharge permit. According to historian, Synnøve Danielsen, the union found out that the company wanted to maintain the limits from the previous permit from 1980, which were far higher than the actual discharges. Surprisingly enough, the union proposed that significantly more stringent requirements should be set.⁵⁴⁵

SFT set even lower discharge limits than the union had requested, but Bellona still complained about the terms and in 1992 the requirements were tightened. Falconbridge was also refused permission to expand its slurry dump. The neighbourhood protest finally succeeded and all iron slurry had to be stored in mountain halls under the plant instead.

A new industrial climate

The industrial climate changed in the 1970s and 80s and large, export-oriented businesses lost most of their position as pillars of society. The growth optimism of the 1950s and 60s had definitely come to an end. From the 1970s, the industry was just as often associated with polluting factories as with value creation and regulations were no longer just a two-sided relationship between the company and the government authorities. Such matters required increased consideration for public opinion, the media, environmental activists, neighbours and the trade union.

The problems with cancer was therefore a watershed in the company's history. For the first time, external pressure and orders had had a decisive influence on the internal affairs of the company. Criticism with regard to the company's emissions grew in the 1970s, but it was not until the new environmental protection wave at the end of the 1980s that Falconbridge was actually forced to change its plans, such as in the case of the slurry dump. It is perhaps wrong to overestimate the importance of the environmental organisations. Finn Resmann, senior engineer at Falconbridge, places greater emphasis on the role of SFT, the state environmental agency.⁵⁴⁶ It was SFT that issued orders and it was they who set the discharge limits. At the same time, it is important to remember that the new environmental activism gave SFT extra political cover when it required environmental protection measures.⁵⁴⁷

New fields were regulated, but important parts of Norwegian administrative standards were continued. Requirements were tightened step-by-step, but care was taken not to destroy the company's viability. For its part, Falconbridge complied with the orders and the Labour Inspectorate and SFT eventually regarded the company as a serious player.

The way in which the environmental problems were dealt with reflected one of the hallmarks of the Norwegian industrial system, which was one of broad collaboration between companies and the authorities. However, the company and the authorities had to put up with new groups interfering with decision-making process. And this eventually became one of corporate management's main challenges.

16. CREATING A COMPETITIVE REFINERY

In 2000, the nickel refinery in Kristiansand was the largest in the world outside Russia, with a capacity equivalent to around 7% of the global production. In addition to Falconbridge's own nickel matte, the company refined raw material for several other producers, as the staff had developed competence that was among the worlds best.

However, the path of progress had been a bumpy one. At the beginning of the 1980s Falconbridge had been struggling to survive and ten years later, a new slump hit the nickel market. It was important, therefore, for Kristiansand to keep its costs under control. The Norwegian cost level had been rising at a rapid rate and by the 1980s was higher than in Canada. In addition to this, a new energy law was introduced in 1990, which implied more expensive electricity to energy-intensive industry.

At the same time, the Norwegian industrial system maintained fundamental flexibility. The nickel refinery was able to streamline the business with the help of the trade union and the authorities. In the long term, this also provided new opportunities within the global nickel industry. In this chapter, we will look at how Falconbridge and the nickel refinery managed to respond to these changes.

There were also significant changes of ownership. During the 1980s and 1990s, the global mining and metal industry was restructured. Falconbridge was in the forefront of this and was also involved in acquiring and selling other businesses. At the beginning of the 1990s, Falconbridge itself was taken over by financially strong players. But before we come this far, we must return to Falconbridge's and the Kristiansand refinery's deepest crisis.

The crisis in 1982

1981 was a bad year for Falconbridge and unfortunately, this was only just the beginning. At the beginning of 1982, nickel prices plummeted, sales stagnated, and the company produced for stock. Business on the Dominican Republic was shut down on 30 January and investments in Canada and Norway were reduced.⁵⁴⁸

During the spring it became clear that the crisis would last longer than first expected. Liquidity was strained and the company stopped production for 11 weeks. As "many as

possible” of the employees were to be laid off at the refinery and only business that was commercially based was allowed to continue.⁵⁴⁹

In 1982, the Falconbridge had a loss of 450 MNOK, which was almost 20% of the turnover. Such results were quite simply incompatible with continued operations and therefore, production stop was considered a suitable emergency solution and a short-term measure to reduce costs and stock. But the stop in production did not help Falconbridge become more competitive.

In Canada, William James was appointed president and ”reorganiser”. He concluded that almost half of the employees at head office had to go. James also closed down the research centre in Toronto and research was continued at Sudbury instead, though on a much smaller scale. Furthermore, he reduced Falconbridge’s ore exploration and development programme. Focus, in other words, was set on surviving. The aim to be a leading international mining and metal company was put on hold for the time being.⁵⁵⁰

The crisis changed the way of thinking. It has been said that previously, ”Falconbridge had earned money in order to search for ore, but now it was searching for ore to earn money”. In line with this, economists were given greater influence in the company’s organisation and geologists no longer had the same dominance as they had had before.⁵⁵¹

In Kristiansand, Wigstøl had seen the need to restructure before the crisis kicked in and had begun to prepare for cost cuts. This helped the subsidiary to be able to manage much of the downsizing itself. Immediately before the crisis, the plant had had 1,228 employees and the aim was to reduce this number to 1,050 by March 1983, and then to below 1,000. Activity within R&D, planning and documentation was cut to the bone and it was resolved that 35 jobs in this field would be axed. Such drastic steps were primarily due to pressure from head office. In production, 80 workers were offered early retirement and the rest of the reduction in workforce was implemented through natural resignation.⁵⁵²

In Canada, Falconbridge took a firmer line and several hundred jobs were axed. As in the US, working life in Canada was mainly based on a ”hire and fire” principle with low job security. In the subsidiary in Kristiansand, Falconbridge adapted to the normal procedure in Norwegian industry and dismissals were avoided wherever possible. The system in Norwegian industry and commerce was more negotiation-oriented, which probably benefited Falconbridge in the long run. The trade union realised the need for downsizing, but demanded that the company had to take each individual into consideration and help these to find other work or to achieve early retirement or disability pension.

However, the employees' representatives on the board of directors of the nickel refinery, Birger Larsen and Jacob Sørensen, voted against the speed of the workforce reductions. However, there was no question of any dispute or strike. In Sudbury the trade unions reacted far more aggressively to the job cuts and were not willing to co-operate. In conjunction with previous job cuts, Falconbridge's competitor INCO was actually paralysed by a nine-month long protest strike.⁵⁵³

Abandonment of the ML-process and the RDP improvement programme

The Kristiansand refinery had missed out on significant scale economies, as two production processes, the matte-leaching and the chlorine-leaching-processes (ML and CL), had to be run parallel. The consequence of this was that the costs per tonne nickel were higher than necessary.

There was a lot of support for the ML-process at the head office in Toronto and in Kristiansand Wigstøl also defended use of the ML-plant. This technology was relevant for use in a possible Canadian refinery. For this reason, it was important to keep the process going in order to hold onto the necessary competence. Some customers also wanted the special nickel qualities that the ML-plant produced. However, with such catastrophic financial results, it was obvious that it was not possible to have two parallel processes. The ML-process was shut down for good in the summer of 1983.

On a corporate basis, Falconbridge implemented the so-called RDP project (Result-Development-Project). This may be used as an example of how head office tried to change the organisation using modern management policy and hired consultants. According to project manager, Wiggo Svendsen, RDP had two objectives.⁵⁵⁴ It was to be made clear that the times of stable, high prices had gone for good and in order to survive, everyone had to be prepared for drastic changes.

The other objective was to improve the efficiency of the business. In each unit, people were put together in groups to come up with proposed improvements. The purpose of this was to mobilise creativity and knowledge in as many as possible. As mentioned previously, production still had a somewhat hierarchical style of leadership, which had limited the flow of ideas from the workers on the shop floor. The intention was to tear down the pyramids within the nickel refinery.

These ideas were based on the socio-technical corporate theories of the 1960s and 1970s. Japanese “quality circles” were also a model, where small groups were set up to prepare the change. The aim was to overcome traditional slowness or resistance to change, which always exists in large organisations. However, Lars Erik Lyngdal, a hired consultant, wrote in a book about the project that some people felt that RDP was being “forced upon them”. One of the reasons for this was that RDP was more or less being forced upon the nickel refinery from Canada and initially, the project was implemented according to a Canadian model. Many people feared that improving efficiency through RDP could endanger their jobs. To begin with, therefore, the trade union took a back seat.⁵⁵⁵

After about one year, the project was tailored to suit Norwegian conditions and the trade union became involved and was allowed to appoint a full-time RDP-shop steward. A common understanding developed between the management and the employer organisations regarding workforce reductions. Dismissals were to be avoided wherever possible, but people had to accept being moved to new jobs, which was quite a different procedure from the one used in Canada. One of the more symbolic things was that the method of awarding good suggestions was changed. In Canada, an individual could be awarded large sums of money, whereas in Kristiansand this was usually given to the employees as a group. Money was given to trade union’s holiday home at Krossholmen and to two new company cabins in the mountains. But in spite of good individual results: RDP could not return Falconbridge to profitability.

Seven lean years

The price of nickel continued to fall in 1983, though the company’s loss was only 100 MNOK, which was far less than the previous year. The drastic streamlining measures had worked, but not enough to make the company profitable.

The slump at the beginning of the 1980s was extra strong in the nickel industry and many of the producers responded to the price fall by producing for stock in the hope of better times. When this nickel eventually came on the market, it forced prices down even further. Instead of the least competitive producers being forced out, they continued to produce nickel, which aggravated the situation for Falconbridge and INCO.

Falconbridge’s problems also showed that the western economies had entered a new phase and consumption of steel and other metals had stagnated. The rate of development of

infrastructure such as railways, pipelines and power stations, etc. slowed down and this meant that there was less need for nickel as an alloy. The trend was noticeable in the 1970s, but did not become acute until the 1980s. Rapid growth in South-East Asia only compensated for this to a certain extent. In addition, nickel was no longer important for military use, as there was less need for heavy armour containing nickel, as a result of the development in arms technology.

On the other hand, there was increased demand for nickel in the household sector, among other things, for use in stainless steel kitchen equipment, household equipment, etc. In year 2000, around 65% of all nickel was used in stainless steel. Nickel was no longer primarily an armament metal nor a heavy industrial factor input, but had become a household metal. In this way, the history of nickel also mirrored a few fundamental characteristics of the trend in society as a whole.

This was music to the ears during the crisis year in 1982, but the nickel market did not improve until 1984-85. However, prices fell again in 1986 and remained low in 1987. In spite of the new fall in prices, the business in Sudbury and Kristiansand generated small profits and it seemed that streamlining had borne fruit. Falconbridge suffered however significant losses in the Dominican Republic and other mining activities were also not particularly profitable. Therefore, the seven years from 1981 to 1987 were a lean period. The company survived, but the price of Falconbridge shares never reached former heights. This had serious consequences.

A stable subsidiary in an ownerless company

From 1967, Texan oil magnate Howard Keck and his family were the dominant shareholders in Falconbridge, i.e., they were the main shareholders in Superior Oil, which in turn owned shares in Falconbridge. However, the company's poor results meant that Keck lost interest and he eventually withdrew from the board of directors in 1983. The following year, he sold his holding company, Superior Oil, to oil giant Mobil.⁵⁵⁶

Keck had tried to use Falconbridge as a means of access to the North Sea. Through his family company, Superior Oil, he was involved in the first licensing round on the Norwegian continental shelf in 1965, without success. Superior Oil made several new advances during the 1970s and as a result of this Falconbridge became involved in various industrial projects. Together with Horten Verft, the company injected money into the Pusnes shipyard in Arendal,

so that it could resume business after a bankruptcy. Furthermore, the nickel refinery worked together with the major Norwegian metallurgical company ELKEM in creating a hydrometallurgical copper process. Falconbridge also initiated the largest ore exploration programme that any private company had carried out in Norway, but without finding viable deposits. With a view to future oil activity, Wigstøl planned for a while to expand the administration building at the refinery with a whole floor. Superior was eventually assigned a 5% stake in the gas field that later was called Troll. The field turned out to be gigantic, but the rights were assigned to Mobil without creating any activity in Kristiansand.⁵⁵⁷

Keck had a complex business empire, with cross-ownership between the different companies. Falconbridge was an important shareholder in Superior Oil and did well from selling these oil shares to Mobil. The money came in very handy at a time when finances were strained. At the same time, Mobil joined the owners of Falconbridge, but the oil giant had no ambition of holding onto the nickel shares for very long. Consequently, Falconbridge became a company without active owners.

A combination of high risk and strong cyclical fluctuations meant that acquisitions and divestments in companies were almost the order of the day in the Canadian mining industry. For Falconbridge, which had liquidity problems, the situation was uncertain as long as the company had no stable owners.

Two things happened: Mobil sold its shares to gold mining company Dome Mines, which held onto these for a few years. At the same time, Falconbridge made an exchange of properties with the publicly owned development company Canada Development Corporation (CDC). Falconbridge took over their mining company Kidd Creek and CDC was given a large shareholding in Falconbridge. Significant streamlining benefits could be achieved in ore exploration, project development and administration through co-ordinating the activity.

In 1988, Dome Mines signalled that it wanted to sell its shares in Falconbridge and the Canadian state was all in the process of reducing its involvement in industry and commerce. Mining company Noranda quickly stepped forward as a potential buyer, but the management of Falconbridge were not too happy about this and looked for alternatives. They did not succeed, however, and in the same year Noranda, together with Swedish Trelleborg (Boliden), took over all the shares in Falconbridge.⁵⁵⁸

Apart from the ambitions in the North Sea being shelved after Keck's time, the changes in ownership seem to have limited significance to the business in Kristiansand. Development continued on its established track: streamlining, process development and the hunt for new sources of income.

Toll refining, a growing business area

In 1984, Falconbridge entered into an agreement regarding refining nickel matte from Bamangwoto Concessions Ltd. (BCL) in Botswana. Previously, BCL had refined its nickel at AMAX outside New Orleans. However, the AMAX process was inefficient, with significant metal loss and serious environmental problems. And with the low nickel price after 1982, production became unprofitable.⁵⁵⁹

Therefore, BCL needed a new partner and chose Falconbridge. This gave the nickel refinery access to up to 50,000 tonnes of extra matte without Falconbridge needing to develop expensive mining facilities or expand smelting plant capacity. With more matte it was also possible to draw on greater scale economies in refining. In Kristiansand the capacity was increased by 35%.⁵⁶⁰

The investments totalled 222 MNOK and with Alf Hjortland as project manager, the new plants were ready in 1987. The money was not invested readily, as the Falconbridge had recently been on its knees financially speaking. However, Eivind Wigstøl fought hard for the project and finally succeeded. The expansion was relatively inexpensive, considering the increase in capacity. And much of the old ML-plant could be used without major adjustments.⁵⁶¹

It must be added here that toll refining was not new. From the outset in 1910, the plant has refined other companies' ore at various times. This activity increased at the beginning of the 1970s, among other things, due to the demand to build a new refinery in Canada, which meant that Falconbridge looked for alternative raw material sources for Kristiansand.

In addition, the nickel industry had changed as the degree of vertical integration was significantly reduced. Previously, the nickel companies needed to control the entire value chain from deposit to smelting plant and refining in order to achieve a good profit. Companies that only mined for nickel ore usually achieved a low price for their raw materials. However, a whole lot of new players had entered the market in the 1960s and 1970s. There were more suppliers of ore and matte and also some producers had extra refining capacity, which meant that there was a certain market both for the raw materials and the refining services. In other words, it was less necessary to control the whole value chain.

The refinery in Kristiansand became the biggest "winner" in this change in structure. The company had world-class expertise and a head office that actively tried to exploit new

opportunities that arose. The new CL-process also gave the nickel refinery increased technological flexibility. It could process matte with a different chemical composition than it received from Sudbury. In addition, the plant had a favourable location. It was easy to transport matte to Kristiansand by sea and the company could release saltwater into the sea without any environmental consequences.

In the 1970s, the nickel refinery received matte from several producers. South African Western Platinum was the most important of these, but INCO also delivered matte and residues to Kristiansand. It says something about refinery's expertise and competitive ability that the latter INCO, which had its own refinery, chose to use the plant in Kristiansand. Though, it must be added that most of these contracts concerned relatively small volumes.

In this respect, the scope of the BCL contract represented something new. By 1989, "only" 60% of the matte came from Sudbury, 25% from BCL, 10% from Russian Norilsk and 5% from other sources.⁵⁶² The toll refining gave the refinery more than one leg to stand on. It became less vulnerable to political pressure from Ontario's politicians as it was no longer totally dependent upon Canadian matte.

CLA and a new sulphuric acid plant

When the CL-process was put into operation, the company was already aware that its efficiency could be improved and that certain stages could be omitted and others could be changed.⁵⁶³ Not all the nickel was dissolved during chlorine leaching and the undissolved solids contained around 15% nickel and these had to pass through new process stages in order to extract the nickel. Autoclaves (pressure cookers) were installed in 1985-86 to leach these solids and thereby reduce the nickel percentage to 5-6%, which eliminated some of the subsequent process stages. The engineers in Kristiansand got the idea from INCO, which used autoclaves in its sulphate process. However, the arrangement was quite different from Falconbridge's CL-process.

Development of the new CLA plant (A for autoclave) began in the second half of the 1970s, but hard times meant that the investments were postponed. It was not until the BCL contract was signed that the head office finally gave the go ahead. The CLA project cost 24 MNOK. As less nickel was "recycled" or tied up in the system, this released metals worth around MNOK 10. In addition to this one-off benefit, annual costs were reduced by 10 MNOK.⁵⁶⁴ The fact that such a profitable investment was postponed for so long, tells

something about how drastically Falconbridge had changed after the crisis in 1982. All projects were now subject to thorough profitability analyses and the investments were weighed up against the company's liquidity reserves.

The BCL-expansion also provoked the need to build a new sulphuric acid plant, as the BCL matte contained a lot of sulphur. Falconbridge used to sell all its sulphur as liquid sulphur dioxide, but sales were slow. The market for sulphuric acid, on the other hand, was much larger and the production plant was ready in 1987.

Øyvind Hushovd: first Norwegian to make it to the top in Falconbridge

One of the interesting features of Falconbridge's subsidiary at Kristiansand has been that several of its leaders have played key roles in the life of Falconbridge, also outside Norway. Anton Martin Grønningsæter was the first and Eivind Wigstøl sat on the executive board for a decade. However, Øyvind Hushovd was the first from the refinery to make it to the top in Falconbridge.

Hushovd joined Falconbridge in 1974. He had a degree in business administration Norwegian School of Economics and Business Administration. The financial turbulence paved the way for a more business-oriented management culture. Hushovd was appointed financial manager in 1978 and was involved in streamlining the organization at the refinery in the 1980s. In 1986 he became chief financial officer at the head office in Toronto and three years later took over as general manager in Kristiansand when Wigstøl retired. In 1995, Hushovd became one of the vice presidents of Falconbridge before he took over as president the following year.⁵⁶⁵

It was a general phenomenon in the industry that managers with degrees from business schools challenged the dominance of the engineers in management positions in the 1980s and 1990s, as there was often just as much economic potential in improving financial management as in technical restructuring, and management recruitment reflected this. However, it must be mentioned that the next general managers of the refinery, Erling Stensholt and Ed Henriksen, were both engineers. Hushovd's career was also exceptional. He was for a long time the only Norwegian to achieve such a top position within international industry and commerce.

Hushovd also helped to strengthen the ties between the refinery and the parent company. When he took over as general manager at the refinery in 1989, he already had

management experience from the head office. When he became president, he had firsthand knowledge of the competence and potential in the Kristiansand refinery.

On a practical level, the control measures were reduced. When Hushovd became chief financial officer in Toronto, he phased out the company's regular accounting audits in Kristiansand. For several years, there had been detailed audits of expenses and individual vouchers. As the refinery generally managed to follow the budgets, the head office only intervened occasionally in the daily operations. Eventually, it was enough that the refinery sent monthly reports regarding the number of employees, health, environment and safety and also about costs on a summarised level.⁵⁶⁶

Glasnost and Raglan

Øyvind Hushovd was manager at Kristiansand during troubled times. In 1990-91, the break-up of the Soviet Union shook the nickel market. The Soviets had produced 250,000 tonnes of nickel a year, which was mainly used within the eastern block. In comparison, global production was around 900,000 tonnes. After 1990 Russian consumption fell to around 10-15,000 tonnes the rest was thrown onto the world market, causing prices to plummet.

The Russians also sent significant volumes of nickel matte to Kristiansand, as the refinery could offer a higher degree of nickel and cobalt extraction. For several years, this toll refining constituted around 5% of the raw material supply. In order to utilise the Russian raw material supply, Falconbridge also considered building a refinery at Monchegorsk together with the Norilsk Group. The Russians believed that the CL-process was absolutely the best process for their nickel-cobalt matte. So much so that major planning work was started in Kristiansand,⁵⁶⁷ but in the end the Falconbridge top management found the Russian refinery project to be too risky.

Falconbridge was better prepared for the price fall in the early 1990s than it was in 1982. No extraordinary measures were required this time, but efficiency improvement and automation continued. The trade union praised Hushovd for his ability to obtain appropriations from the Toronto head office despite adverse times, and each year, Falconbridge invested 50-100 MNOK in the refinery. In order to even out employment, Hushovd also used the plant's own people to carry out major demolition projects.⁵⁶⁸

From 1994, the nickel division generated a significant profit once again. By this time, Falconbridge was already in a major expansion phase. The company acquired a 44% stake in

the Collahuasi copper field in Chile, which was the world's largest mining project in the 1990s. Soon after, the Falconbridge implemented the Raglan development. Raglan was a large nickel deposit in northern Canada. It had been known about since the 1960s, but it took time to exploit this, among other things, due to permafrost, extremely difficult climatic conditions and costly transport routes. And before development could start, Falconbridge had to come to an agreement with the Inuit population in the area.⁵⁶⁹

The Raglan development involved investment of 480 MNOK in Kristiansand. With Jan Børge Andersen as project manager, capacity increased from 67,000 to 85,000 tonnes of nickel a year, when the new facilities were ready in 1998. The expansions were carried out without stoppage in the ongoing production and within the budget and time limit that had been set.

Certain process improvements were also made. All development and significant parts of the engineering work were carried out by the company's own personnel, as it was neither possible nor desirable to hire external specialists. The refinery still required very specialised expertise, which was not available on the open market.⁵⁷⁰

A number of automation measures were also implemented, including the lifting operations in the electrolysis halls. This actually meant that there were fewer employees after the expansion. Looking at the period between 1980-2000, the nickel refinery achieved an annual increase in productivity of 7-8%. This was due to a combination of process improvements, scale economies through increased production and a number of gradual improvements in the production process. Both energy and chemical consumption was halved per tonne finished nickel. In addition, the nickel refinery managed to increase income, reduce metal losses and exploit capacity. This meant that the plant remained one of the world's most efficient refineries and that the business was surprisingly stable at a time when the framework conditions changed quickly.

New owners

As mentioned before, Trelleborg and Noranda took over all the shares in Falconbridge in 1989. Each company acquired a 50% ownership interest. Swedish Trelleborg was involved in the mining and metal industry through its subsidiary Boliden. Noranda was a large Canadian mining company.

The new owners know a lot about the mining and metal business, but they had no experience with nickel and cobalt. Therefore, Noranda and Trelleborg allowed Falconbridge to continue as an independent company. After a brief interlude, Falconbridge was given a new manager, Frank Pickard, from among its own ranks.⁵⁷¹ This change of owners meant little to the nickel division and to the refinery, except that Noranda found it more favourable to refine some of its noble metals in Kristiansand.⁵⁷²

As mentioned previously, the nickel prices fell drastically at the beginning of the 1990s. At the same time, Falconbridge planned major investments at Collahuasi and Raglan and therefore needed an injection of more share capital in 1994. However, Trelleborg was not too keen on this,⁵⁷³ and eventually sold off its shares in Falconbridge.

New shareholders came in and Falconbridge became an exchange-listed company once again and Noranda remained a dominant owner with 46% of the shares. At the end of the 1990s, Noranda began buying up more Falconbridge shares. In 2002, the top administration in the two companies was integrated, which led to Falconbridge's president, Øyvind Hushovd, resigning from his post. At the time of writing this book, it seems that Falconbridge will remain a nickel division within Noranda.

One of Falconbridge's most competitive subsidiaries

During the 1980s and 1990s, the nickel refinery had managed to survive two deep slumps and emerged fortified from these crises due to three factors: It could make use of commercial competence at the company's offices in Toronto and Brussels, which opened new market opportunities. In addition the plant had its own world-class expertise and it had established what may be called a "constructive industrial culture."

There is no doubt that the company and the trade union have had their differences of opinion. But compared with competing refineries or other parts of Falconbridge, there is a high degree of co-operation in Kristiansand. Strikes and disputes were more frequent and extensive at the plants in Sudbury. In Kristiansand the parties negotiated how to improve efficiency and downsizing.

As we have seen, the employees were involved in the work of improving production efficiency. The refinery tried to make use of the experiences and insight in all parts of the organisation. This was by no means unique in Norwegian industry, but within the

international competition, the resulting flexibility and prowess helped compensate for the high domestic wage levels.

The company's unique refining competence also made it possible to receive "foreign" matte without causing significant technical problems. In this way, Falconbridge could refine far more nickel than the groups extracted from its own mines. The result of this was that the refinery in Kristiansand grew to become the largest in the Western world.

In addition to the new CLA process, the company also developed an improved noble metal process. The plant and its noble metal specialist, Hans Zachariassen, were also among the best in the world as regards the latter and toll refining of residues containing noble metals has grown in importance. The research unit has also developed methods of refining laterite ore. At the beginning of its anniversary year, there is also a good possibility that the company will win a new major toll refining contract for a South African company.⁵⁷⁴

During the 1980s, the Norwegian wage and cost level rose alarmingly and eventually exceeded that of Canada. However, the refinery managed to improve production efficiency so much so that the costs per tonne nickel were reduced. The introduction of a free electricity market in 1990 threatened for a while to undermine one of the refinery's competitive advantages, i.e., cheap electricity. But the price rise turned out to be moderate for a large customer such as Falconbridge. In order to reduce the risk of price changes, the company entered into a number of fixed price agreements, which had different terms.

To sum up, the nickel refinery in Kristiansand strengthened its position during the 1980s and 1990s. It had been one of the world leaders in its field, both as regards costs, quality and production volume. The demand to move refining to Canada also seems to have been shelved and the refinery entered its anniversary year on an optimistic note. The fluctuating nickel market means though that you can never be completely sure what the future will bring.

17. NICKEL AND KNOWLEDGE,

FALCONBRIDGE NIKKELVERK 1910-1929-2004

It may seem surprising that nickel is still being refined in Kristiansand, almost 60 years after Norway's last nickel mine was closed. The raw material sources are located thousands of miles away, deep in the heart of the Canadian woods, on the Tundra and in the desert of Botswana. The company's head offices are in Toronto and Falconbridge has never had any Norwegian major shareholder. On top of all that, there has been tremendous political pressure to move the business to Canada.

This book tells how industrial production was maintained at the refinery in Kristiansand. The history of Falconbridge is a prime example of what historians call "path dependence". When a path has first been laid, this path is usually followed, even if it does not lead directly to the objective. And when Falconbridge acquired a Norwegian refinery in 1929 and the expertise that went along with it, it was only natural to continue to invest in this. Apparently, it was always easier and cheaper to "follow the path" than to break new ground in order to build a new refinery in Canada.

The previous chapters have shown us that the story was not quite that simple, as there was no clear path nor predetermined development. Development in Kristiansand was dependent upon a number of financial and technological choices, with politics on different levels and with the emergence of a local industrial culture. We have tried to describe the influence of all these forces in this book. Finally, we will concentrate on a few of the long lines in the life of the company.

Industrial capitalism in four eras

The nickel refinery has experienced good times and bad, owners have come and gone, the refining process is changed and the building mass has been replaced. Today, there is nothing left of the original plant from 1910.

Roughly speaking, there have been four phases in the company's history. The business in Kristiansand stemmed originally from Evje Nikkelverk's need to process nickel matte into pure nickel, which achieved a much better price. The investors, led by Admiral Jacob

Børresen and Sam Eyde, and young production engineer Anton Martin Grønningsæter, decided to use on the pioneering Hybinette process, which had still not been tested on an industrial scale. In this way, the relatively modest Kristiansands Nikkelraffineringsverk (KNR) became a pioneering company in the world's nickel industry.

KNR also spearheaded the largest foreign investment made by Norwegian industry. The company invested heavily in mining, a smelter and a refinery in Canada. KNR needed more raw materials, and it was not possible to get hold of these without making overseas investments. In addition to this, the company wanted to use the Hybinette technology in Canada and to exploit the war-demand for nickel as an armament metal. However, the project went completely wrong and resulted in KNR going bankrupt.

Three companies completely dominated the nickel industry at that time: American INCO, British Mond and French Le Nickel. These had control of the richest raw material deposits, which were located around Sudbury in Ontario, Canada and on New Caledonia in the Pacific Ocean. Following the merger of INCO and Mond in 1929, the new giant controlled almost 90% of global production.

The next phase of the Kristiansand refinery's history began in the same year. Investor Thayer Lindsley had taken over the Falconbridge deposit outside the mining town of Sudbury the previous year and he needed an inexpensive refinery. He found this, with Grønningsæter's help, in Kristiansand. The nickel refinery had competent personnel and both payroll and electricity costs were less than half of those in Canada. The low refining costs in Kristiansand weighed up for the fact that Falconbridge had poorer mines than INCO.

Canadian raw material resources were once again linked to Norwegian refining technology, only this time under US-Canadian ownership. In practice, Grønningsæter was given the role as a kind of technical manager in the Ventures-Falconbridge-group, while the young engineer Sverre Steen became manager in Kristiansand. The rearmament in the 1930s led to a growing demand for nickel year-by-year. Falconbridge became extremely profitable, but the main shareholder, Lindsley, wanted to take out as much as possible of the money as dividend, which limited the rate of investments and expansion. In spite of this, the nickel refinery became one of the largest industrial workplaces in Southern Norway, with almost 600 employees in 1939.

The Cold War lifted Falconbridge to new heights. Sales to military stockpiles boosted the huge expansion of the 1950s. The American Government paid much more than the official market price and the company's new affluence allowed for extensive industrial modernisation in the 1950s and 1960s. Thayer Lindsley was eventually forced out and Falconbridge became

a more management-dominated company, which stood on the threshold of becoming a global player within the mining industry, where nickel was only one of its business areas.

The fourth, and so far, final phase in the history of Falconbridge and the nickel refinery started in the 1970s. The international nickel market collapsed, and other metal prices fell drastically in its wake. From now on, Falconbridge had to live with strong price fluctuations and tough competition and there was significant cut in the workforce in Kristiansand. During this decade there was new criticism both from outside and inside the company regarding working conditions, pollution and trade with the apartheid state of South Africa, etc. Due to toll refining, Falconbridge was actually South Africa's largest Norwegian trading partner. The connection with the apartheid state led to a huge amount of criticism, both in Canada and Norway.⁵⁷⁵

The new CL-process was put into operation in the 1970s. This process increased efficiency and solved many of the company's acute environmental problems. The CL-process could also use many types of nickel matte and therefore toll refining for others increased. The subsidiary became one of the Falconbridge's strongest links. Following the expansion in the 1990s, the nickel refinery in Kristiansand actually became the largest in the western world.

A complex metal

Refining nickel is complex, as the ore contains a number of bimetals, which are partly difficult to extract. As the quality of the finished products – nickel, copper, cobalt, etc. - are *almost* identical, regardless of the process used, the element of competition is primarily to develop as efficient production methods as possible. This meant that the nickel producers kept their process secrets closely guarded. Know-how and technological development remained within these companies. This type of competence was simply not available from the universities or independent technology suppliers.

A consequence of this was that it was difficult for newcomers to establish themselves. Not only was it difficult to get a hold of rich deposits, it was also difficult to process the ore. Another consequence was that first KNR and later Falconbridge had to stand on their own legs, technologically speaking. During the World War I, KNR started an extensive development programme, but the subsequent crisis soon brought this to an abrupt halt. Falconbridge began with very limited financial resources. Focus was on surviving and the

company only established a minimum organisation. However, by getting hold of key specialists from KNR, Falconbridge was able to secure necessary nickel competence.

A more systematic focus on research and development was not achieved until during the World War II. As most of the production had been shut down, the refinery's specialists could be set to do such long-term tasks. The work led to the transition from a sulphate to a chloride process in 1952 and to extraction of cobalt.

The next phase in the refinery's technology history began with development of the so-called ML-process. The idea was originally conceived in the research division in Toronto, where the laboratory tests had started. Around 1960, Jahnsen achieved approval that the testing and industrial development should take place in Kristiansand and not in Sudbury, as originally planned.

As an extension of this, a new research and development unit was established in 1965. Significant resources were supplied to this unit and it became very important to the subsidiary's future development. It was here that the so-called CL-process was developed; a process tailored to Norwegian conditions. This process increased efficiency, solved several of the company's environmental problems and allowed use of raw materials from other sources.

There are two points worth noting here. One is that the knowledge structure in the industry forced KNR and subsequently Falconbridge to set aside significant resources internally in order to carry out process development. The second is that the Kristiansand plant remained the company's heart of refining technology. This was due to Jahnsen's strategic talents and the expertise of new research unit.

However, researchers and engineers alone do not create the nickel process. This requires a wide range of skills and competence and skilled workers such as electricians, mechanics and pipe fitters also make important contributions. During the 1970s and 1980s, the plant made more use of the whole range of its competence and to achieve this the entire production system had to be reorganised. The authoritarian leadership style was toned down in favour of a "flatter" organisational structure. The reorganisation started in the ML-plant, but was not fully implemented in the company until the transition to the CL-process. The process operators were given thorough training and were assigned more responsibility, while the skilled workers were given more freedom in their jobs.

The restructuring may illustrate how closely technological, social and human relations are woven together. The changes turned the traditional wage and status system upside down. Wage systems were reorganised so that more was paid for know-how than for length of service, amount of discomfort in the job or how quickly the piecework could be filled. The

restructuring of the wage system took a total of 20 years, but in return the nickel refinery had finally become a knowledge company in the right sense of the word – from the top to the bottom of the corporate hierarchy.

A rather special subsidiary?

*If Hardy asks, you must swear that roasting furnace 3 stood here already.*⁵⁷⁶

This was how Grønningsæter instructed engineer Mikael Buaas prior to president Hardy's visit in 1936 or 1937. Buaas had just designed and managed construction of the furnace.

The words were perhaps half said in jest, but nevertheless they may illustrate something important about Kristiansand's previous history. Canadian control of what happened at the nickel refinery was relatively lenient and Steen and Grønningsæter entered a number of investments in the operating accounts. As a rule, this was done with head offices' approval. Hardy tried to protect the company against Lindsley tapping it for money, but Steen and Grønningsæter went a step further than their superior and worked untiringly to ensure that future expansions would take place in Kristiansand.

The nickel refinery had a past as an independent company and it also had expertise upon which the head office depended. In addition, the plant in Kristiansand was located several thousands of kilometres away from the corporate management. All the way up to the 1950s, it took almost a week to travel from Toronto to Kristiansand.

Why didn't the top management introduce more stringent control measures? The Kristiansand branch functioned well, it kept costs down and it maintained quality. Up to the 1980s, the Kristiansand refinery was also completely dependent upon supplies of raw materials from Canada. In other words, there was no risk that the Norwegian personnel would leave to use their competence elsewhere and therefore, there was no pressing need to tighten the reins.

The result was that the management in Kristiansand had considerable elbowroom, which it knew to exploit. This also continued in Jahnsen's time as manager (1955-75). He managed to get development work transferred from Canada to Kristiansand and established a separate research unit. Later, he was involved in development of the new CL-process. Jahnsen also invested money in other things he believed were strategically important and which were priorities that did not always harmonised with those of head office.

The surviving source material available gives the best insight into how Grønningsæter and Steen thought. They were also Norwegian patriots and deeply loyal to Falconbridge. In their world, these values merged together. From their point of view, Norway's prosperity depended upon the country developing its own energy-intensive industry. And they were just as convinced that Falconbridge depended upon its efficient refinery in Kristiansand, on its Norwegian competence and on cheap Norwegian hydroelectric power.

Ontario's province politicians were the snakes in this paradise. They exerted pressure to have the whole or parts of Falconbridge's refining moved to Canada. They threatened to refuse the company a licence for export of nickel matte from Ontario to Norway. Falconbridge resisted, but belief in Canadian superiority was at times so prevalent among the management in Toronto that they did not want to admit Kristiansand's advantage. At least that is how Grønningsæter perceived the situation.⁵⁷⁷

At the beginning of the 1950s, the plant in Kristiansand barely kept its head above water and in 1973 Falconbridge began to build a new refinery at the mouth of the St Lawrence River. Jahnsen tried to avoid this and continued the Kristiansand practice of entering investment costs in the operating accounts. However, in his time the control measures were tightened. Following the death of his friend president Fraser in 1969, Jahnsen began to lose his standing in Toronto.

The next generation of management at Kristiansand instigated a new phase in relation to the corporate head office. All of the four subsequent managers had worked in the company's research units or at plants in Canada. They had neither ambitions nor illusions that the subsidiary could have its own policy or accounting standards. However, this did not mean that they passively followed directives from Toronto. Eivind Wigstøl (1975-1989) became a member of the executive board of directors and his successor, Øyvind Hushovd, became the president of Falconbridge.

The political pressure from Ontario's politicians to move the business to Canada had now disappeared. Therefore, the management in Kristiansand had little reason to cut corners, as had been the case before. On the contrary, the key to influence lay to a greater extent than before, in winning trust so much so that head offices' detailed control of the refinery's accounts came to an end around 1990. And, as before, the plant in Kristiansand acted independently as regards daily operations.

Multinational companies are usually described from head offices' point of view and the subsidiaries are overshadowed. This has also been the case in Norway, even though significant parts of the industry have been in foreign hands. What we do know is that the local

management at Union Carbide's plant in Sauda behaved much the same way as the managers in Kristiansand. However, Union Carbide started to assert centralized control around 1960, a decade earlier than Falconbridge. Apart from these two plants, we have little information about what control mechanisms have been normal and about the subsidiaries' ability to shape their own development. However, it has been pointed out that subsidiaries, which are technologically "independent", have usually had relatively significant elbowroom.⁵⁷⁸ If so, Falconbridge and the refinery in Kristiansand fall neatly into a larger pattern.

A Canadian company "in Norwegian clothing"?

Working environment requirements were tightened in the 1970s and in the following decade it was the turn of the external environment. Major investments were required in both cases. This underlined how Falconbridge, like all companies, was dependent upon the community around it and the political conditions. As a foreign-owned company, Falconbridge also had to live with the fact that Norwegian industrial and political culture was essentially different from Canadian.

In Canada, Falconbridge forbade its workers to belong to a trade union all the way up to 1942. In Norway, Falconbridge accepted the trade union from day 1, as well as the rules of the game of Norwegian industry and commerce. In this field, the Kristiansand plant conformed to Norwegian practice: foreign ownership did not make any noticeable difference. Eventually, top management in Toronto also realised that the negotiation-based Norwegian industrial culture had its advantages, as it avoided production shutdowns and "wild" strikes, something that occasionally hit the company on the Canadian side since the 1950s.

After the war, Falconbridge assumed a new role within both Norway and the Kristiansand area's political economy. In a national context, the nickel refinery had an important currency-earning role. No other company was as good at converting kilowatt-hours into US dollars. This helped Falconbridge to enjoy a lot of goodwill from the national authorities and it seemed to make little or no difference that it was a foreign-owned company.

Falconbridge came to Kristiansand in the nick of time. Both the municipality and the municipal electricity company were on the verge of bankruptcy at the end of the 1920s, but Falconbridge provided jobs and tax income and needed to purchase electricity. While Kristiansand was among the Norwegian towns hardest hit by the crisis of the 1920s, it became the fastest growing town in the 1930s.

A kind of local "energy-industrial complex" was created in Kristiansand and included the municipality, the regional electricity company and Falconbridge. The aim was to modernise the Kristiansand area using energy-intensive industry and extensive development of hydroelectric power. Kristiansand's authorities had supported such a policy since World War I, but lacked strong industrial partners until establishment of Falconbridge.⁵⁷⁹

Consequently, the nickel refinery was ensured large quantities of electricity at a low price and from 1946 to 1960 production increased six-fold. More than 1,000 new jobs were created in a region with little industry. Falconbridge became the authorities' business partner and the pride of the local community. Smoke from the stack became a symbol that post-war growth and prosperity had also reached the south of Norway.

From the 1970s, the subsidiary had to relate to the authorities, the media, the trade union, neighbours and the rest of society in a different way than before and its position as an irreproachable pillar of society was lost. Public authorities, such as the Labour Inspectorate and the State Pollution Control Authority (SFT), instructed the company to improve the working environment and to reduce pollution and the requirements were increasingly tightened. Along the way, Falconbridge was forced to open its gates and to accept more transparency into what went on at the plant. If the subsidiary was to succeed it must take into consideration that society had changed.

In Canada, Falconbridge received perhaps even more criticism. As it refined the nickel outside Canada, the company had never enjoyed the same goodwill as in Norway. There were also significant pollution problems in Sudbury, where it seems the top management have taken longer time to adjust.⁵⁸⁰

The relationship between company and Norwegian society has changed significantly from the pioneering period in 1910, the depression in the 1930s, the social democratic era after the World War II and up to our own era of economic liberalism. All in all, Falconbridge has succeeded in adjusting to Norwegian conditions, especially during the period of social democracy. The nickel refinery became a Canadian company in "Norwegian clothing".

75 years for Falconbridge

Those who know their history often understand more of the age in which they live. In spite of the major changes that have taken place in the last decades, this may also apply to the nickel industry.

For a long time, INCO produced more than half of the world's nickel. From 1896 to the end of the 1970s, the company more or less determined the global market price alone, only interrupted by a short price war in the 1920s. The difference from today's splintered market, with 30-35 producers and a fluctuating nickel price, could not have been greater.

However, INCO's loss of market power was a result of a long historical process. At the beginning of the 1900s already, Ontario's provincial authorities tried to reduce the company's wilfulness. After World War II, the US Government spearheaded a campaign against monopolies and cartels that prevented fair trade and one of these was INCO. Other nickel companies were given support with favourable contracts to the US defence, including Falconbridge. INCO's high and stable prices also attracted a number of new competitors, especially after Finnish Outokumpu and Canadian Sherrit Gordon began to licence their process technology. In addition, the US authorities helped to find out about and then spread methods of producing ferronickel and laterite ore. This meant that the established producers lost control of the raw material supply and their technological hegemony was weakened. The consequence of all this was that production grew faster than the demand.

The subsequent collapse in the nickel market shook Falconbridge to the core. The break with the past was apparently fundamental and the company was never the same again. The reason why it survived was due to its long-established expertise, acquired mining rights and a professional sales organisation.

The close connection between past and present is perhaps most evident at the refinery in Kristiansand. There are historical reasons why Falconbridge refines its nickel in Norway, but this does not mean that the cards have been played once and for all. The process has been one of patient building of an industrial culture and competence. At each crossroads, the nickel refinery has strived to be more competitive and in its jubilee year the company has become one of the leading producers in the global nickel industry.

Endnotes

¹ Joseph Boldt jr., *The Winning of Nickel*, London 1967, p. 83.

² J.H.L. Vogt, *Nikkelforekomster og Nikkelproduktion*, Christiania 1892, p. 48. Report of the Royal Ontario Nickel Commission, Toronto 1917, p. 100.

³ J.H.L. Vogt, *Nikkelforekomster og Nikkelproduktion*, Christiania 1892. The Royal Commission on the Mineral Resources of Ontario (Toronto 1890) and The Royal Ontario Nickel Commission (1917) both believed that the Norwegian percentage was much higher around 1875, possibly up to 70%, but Vogt probably knew more about this.

⁴ This and the following paragraphs are based on; The Royal Ontario Nickel Commission (1917), p. 57ff. O. Main, *The Canadian Nickel Industry*, Toronto 1955, p. 7ff, 18ff and 61ff.

⁵ Matt Bray, "Eliminating the Competition: Price-fixing and Market-sharing in the Nickel Industry 1895-1929" in Ulf Olsson (ed.), *Business and European Integration since 1800*, Göteborg 1997, p. 131-140.

⁶ Einar Sundt, *Norges Handel og Industri, bd. 1*, Christiania 1907, p. 171-74.

⁷ Olav Arne Kleveland, *Flot nikkelgruve – Evje Nikkelverk*, Evje 2000, p. 9-10.

⁸ Jacob Børresen, *I storm og solgangsvær, erindringer*, Oslo 1936. Roald Berg, *Norsk Forsvarshistorie bd.2*, Bergen 2001, p. 255 and 282ff. S. C. Hammer, "Jacob Børresen", *Norsk Biografisk Leksikon bd. 2*, Oslo 1925. J. R. Heglund, *Sjøforsvarets minevesen 1870-1970*, Oslo 1970, p. 24.

⁹ The prospectus did contain a fairly significant typing error. It states that 10,100 tonnes smelting ore with a content of 1.68% would give a production of 1,700 tonnes nickel per year. The correct figure is of course 170 tonnes.

¹⁰ Geir Hestmark, *Vitenskap og nasjon, Waldemar Christopher Brøgger 1851-1905*, Oslo 1999. Anne Kristine Børresen, "Johan H. L. Vogt, Naturforsker, rådgiver og nasjonsbygger", in Ola Svein Stugu (ed.), *Historiske Fabrikasjoner*, no. 4 in the series from the "Fabrikken" research project, NTNU 2001.

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¹² Pål Thonstad Sandvik, "Anton Martin Grønningsæter", *Norsk Biografisk Leksikon, bd. 4*, 2001.

¹³ Letter to A. M. Grønningsæter i F.bridges arkiv 1905-18. This is based on letters to Anton between 1907-09, especially from his father Arne and brother Elias. The collection of letters does not contain Anton's reply, but based on the father's comments to his son's letters, we can form a picture of the conditions in Canada.

¹⁴ Lecture by Anton Martin Grønningsæter, manuscript in F.bridge's archive.

¹⁵ Same place.

¹⁶ This is based on Hybinette's presentation to the Royal Ontario Nickel Commission 1917, appendix s. 83-90. This is supplemented with information from the Nickel Commission, Grønningsæter and Carl Dahl's papers and also Rune Kjellanders article in *Svensk Biografisk Leksikon bd. 19*, Stockholm 1971-73. However, Kjellander does not mention any conflict with INCO. After Hybinette lost his wealth in the 1920s, INCO used him as a consultant, but he primarily carried out his own development work on new alloys.

¹⁷ D. J. MacKinnon, "The early history of electrorefining in Canada", *The Canadian Mining and Metallurgical Bulletin*, July 1989. *Engineering Mining Journal*, Sept 1900, p. 270 and April 1901, p. 428.

¹⁸ As note 14.

¹⁹ Royal Ontario Nickel Commission 1917, Appendix J, p. 120, Testimony of Mr. J.E. Mc Allister.

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²⁵ Information from Ketil Gjørme Andersen.

²⁶ Love for Kristiansands Nikkelraffineringsverk, Kristiania 1919.

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²⁹ Knut Larsen, "Noen erindringer fra det første nikkelraffineringsverk i Kristiansand", handwritten manuscript Kristiansand 16/9/1954.

³⁰ The following description of the first process has been based on memoirs and notes written by Carl Dahl, A. M. Grønningsæter, Knut Larsen and H. G. Martens and also H. Rykkelid, *Notes regarding the Hybinette process, Falconbridge Nikkelverk, especially regarding arsenic in the refining process*, Kr.sand 1995.

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- ³¹ Quotes from Grønningsæter's notes.
- ³² Presentation of the various nickel processes has been based on Grønningsæter's notes and Fridtjof Grøntoft, "Utvinningen av nikkel fra sulfidiske malmer", manuscript from F.bridge's archive and Carl Dahl, "I gamle dager", *Falcon no. 3*, 1974.
- ³³ Knut Larsen, "Noen erindringer fra det første nikkelraffineringsverk i Kristiansand", handwritten manuscript Kr.sand 16/9/1954.
- ³⁴ The Royal Ontario Nickel Commission 1917, appendix p. 86.
- ³⁵ Letter to Grønningsæter 1905-18 in F.bridge's archive. Letter from Børresen 03/08/1910 and 13/11/1911.
- ³⁶ Øyvind Bjørnson, *Arbeiderbevegelsens historie i Norge, bd. 2*, Oslo 1990, p. 59.
- ³⁷ For information about this type of challenge in the metallurgy industry refer to Jørund Falnes, *Driften av råjernsovner i Mo i Rana på 1950- og 60-tallet*, history thesis, Univ. of Trondheim 1994, p. 162ff.
- ³⁸ Grønningsæter's notes, F.bridge's archive. "Arbeidsforhold m.v."
- ³⁹ State archives in Kristiansand, F.bridge Arbeiderforening's archive 158-215, Minutes of proceedings 1910-17, meetings 1910-11.
- ⁴⁰ State archives in Kr.sand, F.bridge Arb.forening 158-215, minutes of meeting 1910-17, meeting 15/12/1911.
- ⁴¹ Kåre Odlaug, *Norsk Arbeidsmandsforbund gjennom 60 år, bd. 2*, Oslo 1956.
- ⁴² Statsarkivet i Kr.sand, F.bridge Arb.forening 158-215, minutes of meeting 1910-17, meetings 13/12/1911 - 08/02/1912.
- ⁴³ Grønningsæter's notes, F.bridge's archive.
- ⁴⁴ State archives in Kr.sand, F.bridge Arb.forening 158-215, minutes of meeting 1910-17, meetings 14/05/1913 and 25/05/1913.
- ⁴⁵ Record of employees KNR 1910-.
- ⁴⁶ This and the following have been based on; State archives in Kr.sand, F.bridge Arb.forening 158-215, minutes of meeting 1910-17, meetings 04/04.-02/05/1913.
- ⁴⁷ State archives in Kr.sand, F.bridge Arb.forening 158-215, minutes of meeting 1910-17, meetings 19/08/1915 and 15/09 and 03/10/1916.
- ⁴⁸ Record of employees KNR 1910-. Unfortunately, the record only contains the workers who still worked in the company in 1914 (and / or later). The information about place of birth is co-ordinated with the personal information in the trade union records.
- ⁴⁹ Annual report and accounts for KNR 1910.
- ⁵⁰ Annual report and accounts for KNR 1910 and 1911.
- ⁵¹ O. Main, *The Canadian Nickel Industry*, Toronto 1955, p. 73.
- ⁵² A. Grønningæter, "Metallurgy since the beginning of the Century", special series of articles in *Canadian Mining Journal* Dec. 1960- Jan. 1961, p. 15.
- ⁵³ Supply of electricity and some machinery to Ringerike was seriously delayed. According to an article in *Oplandsposten* 13/12/1912 production had started. The 1913 annual report for KNR informs that this same thing took place in February 1913. The latter source probably refers to the start of ordinary production. Arne G. Dahl has given me the reference to the newspaper article.
- ⁵⁴ In 1924, Grønningsæter informed that KNR received 31 cents per pound for their nickel before the 1st World War. Letter to G. Simonsen 26/09/1924 in an envelope marked "Simonsen". The extract of accounts as at 30 June 1914 confirms this. Main states that INCO's average nickel price was 28 cent per pound in 1914, but the company's official price on the European market was 37.5 cents. O. Main, *The Canadian Nickel Industry*, Toronto 1955, p. 66.
- ⁵⁵ Annual report and accounts for KNR 1910-1914.
- ⁵⁶ Annual report and accounts for KNR 1910-1914. Production figures for Ni and Cu from 1914 are from H. Rykkelid, *Notes concerning the Hybinette process, Falconbridge Nikkelverk, Especially regarding arsenic in the refining process*, Kr.sand 1995.
- ⁵⁷ F.vennen 03/09/1914. A shortage of coal and coke was at least the reason given to the press. Another possible explanation is that the owners were afraid for a low demand and stopped production but put the blame on the shortage of raw material. Nickel giant INCO stopped production for 3 months after the start of the First World War due to the sales outlook. H. V. Nelles, *The Politics of Development, Forests, Mines & Hydro-Electric Power in Ontario*, Toronto 1974, p. 348-49.
- ⁵⁸ Roald Berg, *Norge på egen hånd 1905-20, Norsk utenrikspolitikkens historie, bd. 2*, Oslo 1995, p 202.
- ⁵⁹ Jacob Børresen, *I storm og solgangsvær, erindringer*, Oslo 1936, s. 121-24. Advokat J. M. Lund, missive to the Norwegian Government, p 8, published in *Stortingsforh. 1925, bd. 2*. Ole Kr. Grimnes, *Sam Eyde*, Oslo 2001, p. 384. James Colussi, *The Rise and Fall of BANC 1913-24*, Sudbury 1988, p. 52-54. (Colussi mentions the British offer of 220,000 Canadian dollars, but he believed incorrectly that this resulted in a British takeover of KNR.).

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- ⁶⁰ 1915 Annual Report for KNR. KNR had previously leased these facilities. However, Evje Nikkelverk had run the mines at Evje and Fæø outside Haugesund on its own.
- ⁶¹ 1915-19 Annual Reports for KNR.
- ⁶² The Nickel Commission, p. 5.
- ⁶³ Grønningsæters memoirs. Letters from Giertsen to Grønningsæter between 1920-22, in an envelope marked "BANC, various letters from KNR, Vogt and Giertsen". There is a picture of Hole's gas generator in F. bridge's photo archives, but this is not mentioned in the written sources from this period.
- ⁶⁴ This is based on information in O. Alstad, *Trondhjemsteknikernes matrikkel*, Trondhjem 1915. Bjarne Bassøe, *Ingeniørmatrikkelen 1901-55*, Oslo 1961.
- ⁶⁵ Attachment to the Nickel Commission's minutes of meeting. Meeting with Eyde, p. 2. F. bridge's archives. Also refer to Ole Kr. Grimnes, *Sam Eyde*, Oslo 2001, p. 306-07.
- ⁶⁶ Duncan McDowall, *Steel at the Sault*, Toronto 1984, p. 102-03. James Colussi, *The Rise and Fall of BANC 1913-24*, Sudbury 1988, p. 30-31. H. V. Nelles, *The Politics of Development, Forests, Mines & Hydro-Electric Power in Ontario*, Toronto 1974, p. 352-54.
- ⁶⁷ Royal Ontario Nickel Commission 1917, p. 87-89 and especially Appendix J, p. 131 of the report, a "Letter from William Carlyle to Commissioners Regarding the Hybinette Process".
- ⁶⁸ Jacob Børresens explanation to the Nickel Commission, dated 03/04/1922, p. 5-6. Ole Kr. Grimnes, *Sam Eyde*, Oslo 2001, p. 264-65 and 307-09.
- ⁶⁹ O. Main, *The Canadian Nickel Industry*, Toronto 1955, p. 45, 68, 72, 128. Main writes that Pearson tried 12-15 times to finance BANC without success. Whether the abortive attempts were due to Morgan alone (as Main claims) or whether Pearson wanted to secure himself too much of the profit, is, however, an open question.
- ⁷⁰ The Nickel Commission, p. 8-9. Ole Kr. Grimnes, *Sam Eyde*, Oslo 2001, p. 308-09.
- ⁷¹ The Nickel Commission, p. 4-5.
- ⁷² KNR continued alone with the BANC project, but Elkem also got involved in nickel production. In 1919, the company owned shares with a nominal value of 533,000 NOK in Bamble nikkelverk (of a total capital of 2 MNOK) and had provided guarantees for 285,000. Elkem also owned 20% of Haglund's production method that the works used. Haglund was one of the engineers sent from Norway to Canada in 1914. I would like to thank Knut Sogner for this information.
- ⁷³ The Nickel Commission, p. 9-10. Royal Ontario Nickel Commission 1917, p. 88.
- ⁷⁴ H. V. Nelles, *The Politics of Development, Forests, Mines & Hydro-Electric Power in Ontario*, Toronto 1974, p. 228-29.
- ⁷⁵ The Nickel Commission, p. 14-15.
- ⁷⁶ The Nickel Commission, p. 16.
- ⁷⁷ BANC issued three types of securities: Debenture bonds (bonds), Debenture Stocks (debentures) and Common stocks. Debenture bonds were fixed interest-bearing bonds with mortgage right in the company's property and these had priority over Debenture Stocks. The latter were also mortgage bonds, but these only gave interest if BANC operated at a profit. It was this type of security that KNR sold onwards on the Norwegian market in 1916. Common Stocks were shares and the owners of Common Stocks received the first part of the profit when the interest on bonds and debentures was paid. If the profit was as high as expected, Common Stocks could also give a good return. Everyone who purchased newly issued debentures received common stocks into the bargain. As we will see later, free common stocks were also given to a few key personnel in KNR and BANC.
- ⁷⁸ Jacob Børresen's explanation to the Nickel Commission, 03/04/1922, p. 25-26. The Nickel Commission, p. 21 and 39.
- ⁷⁹ The Nickel Commission, p. 32-38.
- ⁸⁰ Francis Sejersted, "Veien mot øst, Et norsk bidrag til den økonomiske imperialisme", in *Demokratisk kapitalisme*, Oslo 1993, p. 107ff.
- ⁸¹ E. P. Mathewson, "BANC's new Works in Ontario", in *Engineering and Mining Journal*, no. 8 1917.
- ⁸² James Colussi, *The Rise and Fall of BANC 1913-24*, Sudbury 1988, p. 69, 77ff and 104-05.
- ⁸³ Wilhelm Keilhau, *Norge og verdenskrigen*, Oslo 1927, p. 350ff and 356.
- ⁸⁴ The prices are based on the stock exchange lists in Farmand.
- ⁸⁵ Roald Berg, *Norge på egen hånd 1905-20, Norsk utenrikspolitikkens historie*, Oslo 1995, p. 193ff and 229ff.
- ⁸⁶ Dagbladet 12/01/1961. The value of such a late newspaper article as a source may be doubtful, but later on Grønningsæter told Halvor Rykkeliid "that there was a lot of truth in the article". Moreover, Dagbladet wrote that Hybinette had contacted Vogt to get him to buy shares, as it was impossible for him and Grønningsæter to cooperate any longer with Børresen. The same matter is mentioned in a letter from Vogt to Hybinette, dated 31/05/1922. At that time, however, Hybinette had fallen out with Vogt and was co-operating with Børresen and Eyde. The letter is included in the material from Grønningsæter in an envelope marked "Letters from Simonsen, Børresen, Vogt, Giertsen, Martens & F. Dahl", F. bridge's archive.

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- ⁸⁷ Johs. Tønnessen, *Kristiansands historie 1914-45*, Kr.sand 1974, p. 48-51. Kåre Rudjord, *Oddernes bygdebok*, Kr.sand 1974, p. 495-97. The plan was to build a large cross veneer factory in Brazil. Half of the capital was injected by Oslo company Det Oversøiske Compagni. Another person active in the raid against KNR was the deputy chairman of the board of directors of Lumber & Veneer, shipowner Emil Stray from Kristiansand.
- ⁸⁸ Halvor Rykkelid, *Notater vedr. Hybinette-prosessen, Falconbridge Nikkelverk, Spesielt angående arsen i raffineringsprosessen*, Kr.sand 1995, p. 10-11. Rykkelid has used the mining statistics as a source. However, these do not give the copper production in Kristiansand in 1919, but Rykkelid has estimated this based on the Cu:Ni ratio in the matte supplied in 1918-19. Rykkelid emphasised that the estimated is uncertain.
- ⁸⁹ Statsarkivet i Kr.sand, F.bridge Arb.forening 158-215, minutes of meeting 1910-17, meetings 14/12/1915 and 03/03/1916.
- ⁹⁰ Grønningsæter's memoirs.
- ⁹¹ State archive in Kr.sand, F.bridge Arb.forening 158-215, minutes of meeting 1910-17, meetings 10/05 and 25/06/1915 and 25/09, 02/10 and 30/10/1917.
- ⁹² Reference is made to strikes taking place elsewhere, but no one spoke up for a local strike.
- ⁹³ Markku Kuisma, *A History of Outokumpu*, Jyväskylä 1989, p. 8-23. Wilhelm Keilhau, *Norge og verdenskrigen*, Oslo 1927, p. 153ff and 251-52. Roald Berg, *Norge på egen hånd 1905-20, Norsk utenrikspolitikk historie, bd. 2*, Oslo 1995, p. 202ff. 1918 and 1919 Annual Reports for KNR.
- ⁹⁴ The Nickel Commission, p. 73-75.
- ⁹⁵ Invitation to subscribe for new shares in KNR 16/04/1919, F.bridge's archive. The issue was formally 14 MNOK, but 6 of these were exchange of dividend certificates to shares and therefore did not inject fresh capital to KNR. See also the Nickel Commission, p. 78ff for financing of BANC.
- ⁹⁶ The Nickel Commission, p. 83.
- ⁹⁷ The Nickel Commission, p. 21, 46 and 84-85.
- ⁹⁸ These free shares were so-called "common stocks", see endnote 77.
- ⁹⁹ Stortingsforh. 1925, bd. 2, Missive dated 20/7/1923 to the Norwegian Government from Solicitor J. M. Lund, p. 24-25. Opinion from the Nickel Commission, p. 84-85.
- ¹⁰⁰ The Nickel Commission, p. 92ff. By this time there was so much Norwegian money involved in BANC that it was on the verge of becoming a national problem. For this reason, Norges Bank became one of KNR's guarantors for 1 MNOK of the loan.
- ¹⁰¹ This concerned engineers Ivar Hole, Rikard Løken, Gunnar Schjelderup and Torgny Torell and foreman Knut Larsen. One more foreman and possibly several engineers were sent to Canada.
- ¹⁰² James Colussi, *The Rise and Fall of BANC 1913-24*, Sudbury 1988, among others, p. 81-82.
- ¹⁰³ Report from R. L. Peek to President E. N. Rhodes, in an envelope marked "BANC, various letters and reports." F.bridge's archive. The Nickel Commission, p. 135-40. Norwegian banks guaranteed for 850,000 dollars of KNR's loan to BANC, the debenture owners for the same amount and the members of KNR's management and board of directors for 300,000 dollars.
- ¹⁰⁴ James Colussi, *The Rise and Fall of BANC 1913-24*, Sudbury 1988, p. 96-97, 106-07, 117 and 125.
- ¹⁰⁵ James Colussi, *The Rise and Fall of BANC 1913-24*, Sudbury 1988, p. 139.h
- Ole Kr. Grimnes, *Sam Eyde*, Oslo 2001, s. 384-86. Nic. Rygg, *Norges Bank i mellomkrigstiden*, Oslo 1950, p. 69-71.
- ¹⁰⁶ The Nickel Commission, p. 140ff. Invitation to subscribe for bonds in BANC 21/02/1921 and the Agreement between the Norwegian Central Bank, the Committee for the Debenture Owners and KNR 03/02/1921 and the British America Nickel Corporation, (Scheme for the Reconstruction), in an envelope marked "BANC, various letters and reports".
- ¹⁰⁷ The trade union's minutes from negotiations during the period 1918 – 26 has not been found. Information about the strike and wage increases is based on Grønningsæter's unpublished reminiscences, F.bridge's archive. See also to 1919 Annual Report for KNR and Sørlandets Social-Demokrat 04/06, 05/06, 06/06, 16/06, 18/06 and 23/06/1919. However, the newspaper did not mention the strike in July and August, other than a few paragraphs about the dispute around 10/08/1919.
- ¹⁰⁸ F.vennen 05/05, 01/09 and 17/09/1920.
- ¹⁰⁹ Markku Kuisma, *A History of Outokumpu*, Jyväskylä 1989, p. 24-35. Grønningsæter's memoirs.
- ¹¹⁰ 1920 Annual Report for KNR. The ordinary shares were written down to 5% of their original value, while the preference shares remained unchanged.
- ¹¹¹ At the time, Jebsen, Giertsen and Vogt were called the "brothers-in-law". Vogt was first married to Giertsen's sister and then to Jebsen's daughter. Jebsen was married to Giertsen's cousin.
- ¹¹² Bjarne Bassøe, *Ingeniørmatrikkelen 1901-55*, Oslo 1961. Letter from Giertsen to Grønningsæter 1920-22, in an envelope marked "BANC, various letters from KNR, Vogt and Giertsen".
- ¹¹³ F.vennen 01/02, 05/02, 08/02, 09/07, 12/07, 13/07 and 14/07/1923. Letter from David Vogt to Grønningsæter 21/10/1921, in an envelope marked "BANC, various letters from KNR, Vogt and Giertsen".

¹¹⁴ 1923 Annual Report for KNR. The preference shares were also written down and converted to ordinary shares. The share capital was now 780,000, i.e. only 4% of the nominal value in 1919.

¹¹⁵ The minutes from the board meetings in KNR from 16/12/1920 to 27/01/1923 have survived. The minutes are not particularly informative, but the reduction in wages for management and workers is clear. The wage level was almost halved for those who kept their jobs. F. bridge's archive.

¹¹⁶ Letter from E. A. Cappelen Smith to INCO's chairman of the board Charles Hayden, New York 13/09/1923. Copy in Norges Bank's archive, management archive B-1-43.

Norwegian – American engineer Cappelen Smith (CS) in the Guggenheim group was hired by the creditors to help BANC out of its crisis. CS believed that BANC's production price was only half of a (cartel-secured) sales price. Considering the market and the supply of capital, CS did not believe that BANC could have independent production. CS was therefore in favour of a merger between BANC and INCO.

¹¹⁷ Matt Bray, "Eliminating the Competition: Price-fixing and Market-sharing in the Nickel Industry 1895-1929" in Ulf Olsson (ed.), *Business and European Integration since 1800*, Göteborg 1997, p. 131-140. 1922 and 1923 Annual Reports for KNR.

¹¹⁸ James Colussi, *The Rise and Fall of BANC 1913-24*, Sudbury 1988, p. 169 and 194.

¹¹⁹ Letter from N. Rygg in Norges Bank to Christianssands Sparebank, dated 18/08/1924 with attachment: "Agreement between Norges Bank & The Canadian Bank of Commerce and INCO 25.07.1924" in envelope marked "BANC Sparebanken".

¹²⁰ James Colussi, *The Rise and Fall of BANC 1913-24*, Sudbury 1988, p. 197-99.

¹²¹ A. M. Hall, *Nickel in Iron and Steel*, New York 1954, p. 2 and 379ff. E. J. Hergenroether, "Nickel in the Automotive Industry", Memorandum prepared for the Nickel Book, Nov. 21, 1955. Unpubl. manuscript in F. bridge's archive. A. Grønningsæter, "En oversikt over utviklingen av nikkellindustrien til i dag", special publication of lectures in Metallurgical Companies. 19/03/1956.

¹²² O. Main, *The Canadian Nickel Industry*, Toronto 1955, p. 93.

¹²³ Matt Bray, "Eliminating the Competition: Price-fixing and Market-sharing in the Nickel Industry 1895-1929", in Ulf Olsson (ed.), *Business and European Integration since 1800*, Göteborg 1997, p. 131-140. Matt Bray and Angus Gilbert, "The Mond-Inco Merger in 1929", *Can. Historical Review* 1995, p. 19-42.

¹²⁴ O. Main, *The Canadian Nickel Industry*, Toronto 1955, p. 90ff. Matt Bray, "Eliminating the Competition" in Ulf Olsson (ed.), *Business and European Integration since 1800*, Göteborg 1997, p. 131-140. M. Bray and A. Gilbert, "The Mond-Inco Merger in 1929", *Canadian Historical Review* 1995, p. 19-42. O. Main, *The Canadian Nickel Industry*, Toronto 1955, p. 90ff.

¹²⁵ H. H. Breien, *En oplandssekt gjennom et kvart årtusen*, Oslo 1933, p. 405. *Hvem er hvem 1930 og 1948*.

¹²⁶ Letter between Grønningsæter and G. Simonsen 1924-26, especially a letter from Simonsen to Grønningsæter, dated 25/08/1925 and from Grønningsæter to Simonsen, dated 10/06/1926 in an envelope marked "Simonsen". Mistrust in Giertsen is apparent here and in correspondence between Grønningsæter and S. Steen. F. bridge's archive.

¹²⁷ Halvor Rykkelid, *Notater vedr. Hybinette-prosessen Falconbridge Nikkelverk*, Kr.sand 1995, p. 13 and tables 1 and 2.

¹²⁸ Minutes of meeting "Raff.verkets" workers' assoc. 1927-, member meetings 17/11 and 19/12/1927. State Archive in Kr.sand.

¹²⁹ Same place. Board meetings and member meetings in the autumn of 1927 and winter of 1927/28. The union's annual report 1927. Håkon Hamre and Randulf Fjermeros, *10-årsberetning Falconbridge Nikkelverks Arbeiderforening*, Kr.sand 1937.

¹³⁰ Told by Hagbarth Aanensen and Arne Johan Finne 02/06/2003.

¹³¹ Minutes of meetings, "Raff.verket's" workers' union 1927-, board meetings and member meetings in the autumn of 1928. State archive in Kr.sand.

¹³² Carl Dahl, "Tilblivelsen av Raffineringsverket A/S", note in F. bridge's archive. "Raffineringsverket" is also mentioned in several places in Grønningsæter's correspondence with Sverre Steen.

¹³³ A. Grønningsæter, *Some notes taken at the time of the receipt of the Inco medal*, 25/05/1960.

¹³⁴ Same source

¹³⁵ Rune Kjellander, "Victor Hybinette", *Svensk Biografisk Leksikon*, bd. 19, Stockholm 1971-73.

¹³⁶ S. Moore, *American Influence in Canadian Mining*, Univ. of Toronto Press 1941.

¹³⁷ Business Week 08/10/1955.

¹³⁸ Carl Dahl, History of Falconbridge, unpubl. manuscript, p. 31.

¹³⁹ Grønningsæter til Hardy 13/09/1929, in folder marked "Beregning over pengeforbruk, omkostningsoverslag".

¹⁴⁰ Letter from Steen to F. bridge's historian George Stock, dated 25/03/1964, in folder marked "Fraser 1947-51", in box 495: Steen's correspondence.

¹⁴¹ D. M. LeBourdais, *Sudbury Basin, The Story of Nickel*, Toronto 1953, page 161-64.

¹⁴² Grønningsæter to Hardy 02/06/1930, in file marked "Driftsrapporter 1929-31/12/1933".

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- ¹⁴³ Grønningsæter to Hardy 07/06/1930, in file marked "Driftsrapporter 1929-31/12/1933".
- ¹⁴⁴ Various production reports from Grønningsæter and Steen to Hardy between July-December 1930, in a file marked "Driftsrapporter 1929-31/12/1933".
- ¹⁴⁵ This is based, among other things, on Jørund Falnes, "*Jomfruer*" i maskulint miljø, *Driften av råjernsovner i Mo i Rana på 1950- og 1960-tallet*, history thesis, Univ. of Trondheim 1994, p. 162ff.
- ¹⁴⁶ Jørgen Skeie m.fl., *Falconbridge Nikkelverk A/S i 60 år*, Kr.sand 1989, p. 56.
- ¹⁴⁷ State archive in Kr.sand, Minutes of meeting F.bridge workers' union 1929-32, membership meeting 10/10/1930.
- ¹⁴⁸ The welfare fund's minutes of meeting 1928-40. Several meetings 1928-30.
- ¹⁴⁹ State archive in Kr.sand, Minutes of meeting F.bridge workers' union 1929-32, board meetings 09/12/1929 and 05/06/1930.
- ¹⁵⁰ State archive in Kr.sand, minutes of meeting F.bridge workers' union 1929-32, membership meetings 15/12/1929, board meetings 22/01, 24/01, 16/05 and 10/10/1930.
- ¹⁵¹ State archive in Kr.sand, minutes of meeting F.bridge workers' union 1929-32, membership meetings 20/10/1930 and 05/01/1931 and annual meeting 25-26/01/1931.
- ¹⁵² George Stockings & Myron Watkins, *Cartels in Action*, New York 1947, p. 3-13.
- ¹⁵³ H. Cordero and L. Tarring, *Babylon to Birmingham*, London 1960, p. 150, 158 and 160.
- ¹⁵⁴ Letter from Grønningsæter to Steen 06/02/1932 in a file marked "letters1929-32" in box 496, Steen's correspondence with Grønningsæter.
- ¹⁵⁵ Copy of letter from Hardy to Brandeis & Goldschmidt 10/05 and 03/06/1932 in file marked "Nikkelsalg 1929-32".
- ¹⁵⁶ Report 15/11/1930 in file marked "Sales reports Nov. 1930-31/12/1932".
- ¹⁵⁷ Letter from Gordon Hardy to Steen 09/01/1931 in file marked "Nikkelsalg 1929-31/08/1932".
- ¹⁵⁸ Letter from Grønningsæter to Hardy 27/09/1932 in file marked "Nikkelsalg 1932-33". Copy of letter from Parkinson to Hardy 04/10/1934 in file marked "Salg av nikkel 1934-35".
- ¹⁵⁹ O. Main, *The Canadian Nickel Industry*, Toronto 1955, p. 112-13.
- ¹⁶⁰ Letter from Grønningsæter to Steen 14/12 and 23/12/1930 in box 496, Steen's correspondence with Grønningsæter.
- ¹⁶¹ Annual Report 1931. O. Main, *The Canadian Nickel Industry*, Toronto 1955, p. 113.
- ¹⁶² O. Main, *The Canadian Nickel Industry*, Toronto 1955, p. 113.
- ¹⁶³ Letter from Grønningsæter to Steen 06/02/1932 in file marked "Nikkelsalg 1929-31/8/32". Letter from Steen to Hardy, dated 15/07/1932 in file marked "Nikkelsalg 1929-31/08/32". Copy of letter from Hardy to Brandeis & Goldschmidt, dated 03/10/1932 in file marked "Nikkelsalg 01/09/1932-31/12/33".
- ¹⁶⁴ Letter from Grønningsæter to Steen, dated 25/02/1931 in box 496, Steen's correspondence with Grønningsæter.
- ¹⁶⁵ Same place. Letter from Grønningsæter to Steen, dated 29/01/1932. The failure to pay resulted in a lawsuit between "Raffineringsværket" and Falconbridge regarding their internal settlement. Falconbridge won the case.
- ¹⁶⁶ O. Main, *The Canadian Nickel Industry*, Toronto 1955, p. 114-16. In the US the nickel price was noted in dollars, and in GBP in the rest of the world. The reason for the increase in price following the devaluation of the pound was that INCO wanted to maintain the old nickel price in its main market the US. The price (calculated in GBP) then had to be raised as much as the pound had fallen in value. For Falconbridge, which mainly sold nickel in Europe, the price rise was almost a gift, as costs did not rise correspondingly.
- ¹⁶⁷ Annual Report Falconbridge Nickel Mines 1932.
- ¹⁶⁸ O. Main, *The Canadian Nickel Industry*, Toronto 1955, p.109.
- ¹⁶⁹ J. Jäger, *Die wirtschaftliche Abhängigkeit des Dritten Reiches vom Ausland*, Berlin 1969, p. 82ff. O. Main, *The Canadian Nickel Industry*, Toronto 1955, p. 110.
- ¹⁷⁰ Archive folders marked "Salg av nikkel", "Nikkelsalg" and "Salgsrapporter" 1930-40.
- ¹⁷¹ Neil Forbes, *Doing Business with the Nazis: Britain's Economic and Financial Relations with Germany 1931-39*, London 2000.
- ¹⁷² O. Main, *The Canadian Nickel Industry*, Toronto 1955, p. 110 and 120.
- ¹⁷³ O. Main, *The Canadian Nickel Industry*, Toronto 1955, p. 111.
- ¹⁷⁴ Letter from G. Hardy to Grønningsæter and Steen, dated 11/08/1932 in folder marked "Beregninger av pengeforbruk, omkostningsoverslag 1929-1933".
- ¹⁷⁵ Letter from Grønningsæter to Steen, dated 14/1/1933 in box 496, Steen's correspondence with Grønningsæter.
- ¹⁷⁶ Estimate by Endre Refsnes 20/11/1932 and 11/05/1933, letter and estimate from Grønningsæter and Steen to Hardy, dated 11/05/1933, letter from Hardy to Lindsley, dated 16/05/1933 in folder marked "Beregninger av pengeforbruk, omkostningsoverslag 1929-1933".

¹⁷⁷ Letter from Grønningsæter to Hardy, dated 08/10/1933 and Hardy's reply per telegram, dated 23/09/1933 in the folder marked "Beregninger av pengeforbruk, omkostningsoverslag 1929-1933".

¹⁷⁸ Letter from Grønningsæter and Steen to Hardy, dated 24/01/1936 in a folder marked "Beregninger av pengeforbruk, omkostningsoverslag 1936-1937".

¹⁷⁹ This and the following have mainly been based on the folder marked "Beregninger av pengeforbruk, omkostningsoverslag 1929-33".

¹⁸⁰ Letter from Grønningsæter and Steen to Hardy, dated 26/07 and 02/08/1937 in the folder marked "Beregninger av pengeforbruk, omkostningsoverslag 1936-1937".

¹⁸¹ Jørund Falnes, *Jomfruer i maskulint miljø, Driften av råjernsovner i Mo i Rana*, history thesis NTNU 1995 has been used as a basis. Falnes has looked at the vulnerability of a metallurgical process and how production was based on a combination of theoretical and empirical knowledge and co-operation between engineers and workers.

¹⁸² Grønningsæter to Steen, dated 21/01/1931 in box 496, Steen's correspondence with Grønningsæter.

¹⁸³ Halvor Rykkeliid, *Notater vedr. Hybinetteprosessen*, Kr.sand 1995, tables 9 and 10.

¹⁸⁴ "Operating Summary 1931-1936", undated list of production costs in folder marked "Beregninger av pengeforbruk, omkostningsoverslag 1936-1937". Interpretation of the source requires further explanation. The costs have been broken down into 25 items. The total costs per tonne nickel seem to be relatively stable. However, the source contains a systematic source of error. Many of the investments were charged against income, something that we will come back to in the next chapter. In 1936 this applied to investments totalling NOK 700,000, i.e. around 20% of the production costs. In addition to this, there were costs in connection with the newly established precious metals unit. If these are deducted, the costs per tonne nickel were clearly lower in 1936 than in 1931.

¹⁸⁵ Letter from Steen to Hardy, dated 05/04/1939 with attachments, prepared by Carl Dahl 25/02/1939, "Extension of Refinery in Norway to 12.000 tons", in folder marked "Beregninger av pengeforbruk, omkostningsoverslag 1938-1939".

Carl Dahl compared the production costs per tonne at the refinery with a capacity of 4,000, 8,000 and 12,000 tonnes respectively. The calculation was carried out to illustrate that it would pay to expand in Kristiansand rather than build a new 4,000 tonne refinery in Canada. This possibly affected the calculations. The pure production cost for the 4,000 tonne alternative was set far higher than what it actually would have cost six years previously, when Kristiansand only produced this volume of nickel. The conclusion was that it would cost NOK 608 in the first alternative, 475 in the second alternative and 428 in the third alternative.

¹⁸⁶ Productivity per employee has been based on: Halvor Rykkeliid, *Notater vedr. Hybinetteprosessen*, Kr.sand 1995, table 9 and 10.

¹⁸⁷ Letter from Steen to Hardy, dated 3/01/1934 in folder marked "Driftsrapporter 1.1.34-31.12.35". Letter from Steen to Torell, dated 17/12/1936 in folder marked "Torell" in box 495, S. B. Steen's letter dated 1929-69. Letter from Steen to Grønningsæter, dated 25/11/1938 in box 496, Steen's correspondence with Grønningsæter.

¹⁸⁸ Letter from Grønningsæter to Steen, dated 15/08/1955 in box 496, Steen's correspondence with Grønningsæter.

¹⁸⁹ Letter from Grønningsæter to Steen, dated 05/06/1931 and 27/04/1936 in box 496, Steen's correspondence with Grønningsæter. Quote from Martens has been obtained from Halvor Rykkeliid, *Notater vedr. Hybinetteprosessen*, Kr.sand 1995, p. 8.

¹⁹⁰ Letter from Steen to Grønningsæter, dated 27/4/1936 in box 496, Steen's correspondence with Grønningsæter.

¹⁹¹ State archive in Kr.sand, Minutes from negotiations F.bridge trade union 1932-35, account from statement at members' meeting on 27/4/1934.

¹⁹² State archive in Kr.sand, Minutes from negotiations. F.bridge trade union 1929-32, membership meetings 23/04 and 24/06/1930 and 05/01/1931.

¹⁹³ J. Laite, "Capitalist development and labour organisation: hard rock miners in Ontario", in Culver and Greaves (eds.), *Miners and Mining in the Americas*, Manchester 1985, p. 82ff. John B. Lang, *A Lion in the Den of Daniels, A History of the International Union of the Mine, Mill and Melter Workers in Sudbury 1942-1962*, Univ. of Guelph 1970. C.M. Wallace and Ashley Thompson, *Sudbury, Rail Town to Regional Capital*, Toronto 1993, p. 138ff.

¹⁹⁴ State archive in Kr.sand, Minutes from negotiations F.bridge trade union 1932-35. Meetings on 12/05.-26/07/1935. Barbala, Finne and Hallstrøm (eds.), *Falconbridge Nikkelverks arbeiderforening, 50-års jubileum*, Kr.sand 1977, p. 22-24.

¹⁹⁵ Per Maurseth, *Gjennom kriser til makt 1920-35, Arbeiderbevegelsens historie i Norge bd. 3*, Oslo 1987, p. 464-68. Tore Pryser, *Klassen og nasjonen 1935-46, Arbeiderbevegelsens historie i Norge bd. 4*, Oslo 1988, p. 102ff.

¹⁹⁶ State archive in Kr.sand, Minutes from negotiations. F.bridge trade union 1935-39, meetings on 04/08 - 24/08/1935.

¹⁹⁷ Same place. Meetings on 21/02, 05/03, 20/03, 24/03, 25/03 and 21/04. Barbala, Finne and Hallstrøm (eds.), *Falconbridge Nikkelverks arbeiderforening, 50-års jubileum*, Kr.sand 1977, p. 24.

¹⁹⁸ "Protokoll Arbeiderbok" 1932 and 1935. These payroll records show the wage drift, approximately 10-15%, which was mainly due to better piecework contracts.

¹⁹⁹ State archive in Kr.sand, Minutes from negotiations. F. bridge trade union 1935-39, meetings between June – Oct. 1937. Se også *Norsk kjemisk industriarbeiderforbund gjennom 25 år 1923-1948*, Oslo 1948, p. 139-40 and Jorunn Bjørgum, *Norsk Kjemisk Industriarbeiderforbund 50 år*, Oslo 1973, p. 274-77.

²⁰⁰ Correspondence between Steen, Grønningsæter and Hardy Sept.- Oct. 1937 in folder marked "Hardy" in box 495, S. B. Steen 1929-69.

²⁰¹ Knut Kjeldstadli, *Jerntid*, Oslo 1989, p. 464-66.

²⁰² State archive in Kr.sand, Minutes from negotiations. F.bridge trade union 1935-39, meeting on 19/10/1937 and subsequent meetings. Negotiations from meeting. F.bridge trade union 1939-47, meeting on 05/01/1940.

²⁰³ State archive in Kr.sand, Minutes from negotiations. F.bridge trade union 1929-32, meetings on 20/10/1930 and 05/01 and 07/09/1931. Minutes from negotiations. F.bridge trade union 1932-35, meetings on 05/09, 20/09 and 03/10/1932, 05/01/1933, Minutes from negotiations. F.bridge trade union 17/02/1937. Quote from Grønningsæter is from Carl Dahl's obituary for Knut Larsen in in-house magazine *Falcon* no. 3, 1971

²⁰⁴ The letters have been obtained from Steen's collection of letters. The letters from Grønningsæter to Steen have probably been entirely or almost entirely preserved. The collection also contains a few letters to and from Hardy. However, Steen has not kept nor copied all the letters he sent to Grønningsæter, only a selection of these. We can only speculate whether the "missing" letters contained informed that Steen regarded as being more controversial or whether the letters are missing for other reasons.

Even of the letters are mostly about business matters, they also touch on family matters and other private aspects. Steen and Grønningsæter were very close. Parallel investments in new Norwegian mining projects (which were subsequently sold to Lindsley) and purchase of shares in Falconbridge / Inco, etc. were also discussed. Wine was also a topic. Steen functioned as a kind of wine agent for Hardy.

²⁰⁵ In 1938 H. S. Munroe took over Halstead's place as Vice President, but Halstead continued as a board member until 1944. Source: Annual Reports Falconbridge.

²⁰⁶ D. G. Paterson, *British Direct Investments in Canada 1890-1914*, Toronto 1976, p. 80-102.

²⁰⁷ Letter from Grønningsæter to Steen, dated 05/01/1930 in Box 496, Steen's correspondence with Grønningsæter.

²⁰⁸ Letter from Grønningsæter to Steen marked personal, dated 28/12/1934 in folder "Driftsrapporter 1929-31/12/1933".

²⁰⁹ Annual Reports Falconbridge 1929-33. O. W. Main, *The Canadian Nickel Industry*, Toronto 1955, p. 114.

²¹⁰ Stewart Myers, "The Capital Structure Puzzle", p. 148-49, in Joel Stern and Donald Chew, *The Revolution in Corporate Finance*, Oxford 1992.

²¹¹ It must be added that it was normal that this type of company used its current profit to finance further expansion. Alfred Chandler, "The Growth of the Transnational Industrial Firm", *Economic History Review* 1980, p. 397. Harm Schröter, *Aufstieg der Kleinen*, Berlin 1993, p. 251.

²¹² Annual Report Falconbridge 1929.

²¹³ Letter from Grønningsæter to Steen, dated 28/03/1939 in box 496, Steen's correspondence with Grønningsæter.

²¹⁴ Same place. Letter from Grønningsæter to Steen, dated 11/04/1939. Letter from Sverre Steen to Hardy, dated 04/05/1939.

²¹⁵ Letter from Steen to Hardy, dated 10/03 and 18/04/1939 in box 496, Steen's correspondence with Grønningsæter.

²¹⁶ H. V. Nelles, *The Politics of Development, Forests, Mines & Hydro-Electric Power in Canada*, Toronto 1974, p. 83ff. The ban only applied to timber sawn in "crown lands", but as most of the area was in public ownership, in practice, this actually corresponded to an export ban. See also W. Marr and D. Paterson, *Canada, an Economic History*, Toronto 1980, p. 364ff.

²¹⁷ H. V. Nelles, *The Politics of Development, Forests, Mines & Hydro-Electric Power in Canada*, Toronto 1974. Christopher Armstrong and H. V. Nelles, "Private Property in Peril, Ontario Businessmen and the Federal System 1898-1911", i Glenn Porter and R. Cuff, *Enterprise and National Development*, Toronto 1973. Karl Froschauer, *White Gold, Hydroelectric Power in Canada*, Vancouver 1999, p. 3ff and 55ff.

²¹⁸ H. V. Nelles, *The Politics of Development, Forests, Mines & Hydro-Electric Power in Canada*, Toronto 1974, p. 326-35. O. W. Main, *The Canadian Nickel Industry*, Toronto 1955, p. 76-91.

²¹⁹ Letter from Grønningsæter to Steen, dated 14/01/38 in box 496, Steen's correspondence with Grønningsæter.

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- ²²⁰ Letter from Hardy to Grønningsæter, dated 30/09/1938 in folder marked "Beregning over pengeforbruk, omkostningsoverslag 1938-1939".
- ²²¹ Letter from Grønningsæter to Steen, dated 28/11/38 in box 496, Steen's correspondence with Grønningsæter.
- ²²² Letter from Grønningsæter to Steen, dated 06/02/1932 in box 496, Steen's correspondence with Grønningsæter" and a letter from Lous to Steen, dated 26/02/1935 in box 495, S. B. Steen, folder marked "Advokat Lous".
- ²²³ Folder marked "Georg Lous" in box 495, among other things, a letter from Steen to Lous, dated 20/03/1936 and a subsequent (unsigned) letter from Lous to Hardy, dated 24/03/1936. Folder marked "Gordon Hardy" in box 495, among other things, "Memorandum regarding Wages and Salary Conditions in Norway 01/08/1932".
- ²²⁴ Folder marked "Georg Lous 1938-39", especially a letter from Steen to Lous, dated 13/06/1939. There have most likely also been similar folders for the period before 1938, the contents of which could have explained Lous' role for the company.
- ²²⁵ Letter from Hardy to Grønningsæter, dated 27/08/1929 in folder marked "Beregning over pengeforbruk, omkostningsoverslag".
- ²²⁶ KEV's archive, minutes of board meeting 1928, item 81 and 89, minutes of meeting 1929, items 16, 46 and 92. Pål Thonstad Sandvik and Espen Andresen, *Kristiansand Energiverk i elektrisitetens århundre 1900-2000*, Kr.sand 2000, p. 90.
- ²²⁷ Kristiansand city council's negotiations 1917, p. 169.
- ²²⁸ Same place, p. 90-91.
- ²²⁹ Same place, p. 70-73.
- ²³⁰ Same place, p. 99-101.
- ²³¹ Pål Thonstad Sandvik, "Kommunale e-verk og store industrikunder", in Lars Thue and Harald Rinde, *Samarbeidets kraft, Elforsyning og bransjeorganisering 1901-2001*, Oslo 2001, p. 214ff.
- ²³² Alfred D. Chandler, *The Visible Hand, the Managerial Revolution in American Business*, Cambridge, Mass. 1977. Alfred D. Chandler, *Scale and Scope, The Dynamics of Industrial Capitalism*, Harvard Univ. Press 1990.
- ²³³ Alfred D. Chandler, *Scale and Scope, The Dynamics of Industrial Capitalism*, Harvard Univ. Press 1990. For INCO's history: J. F. Thompson and N. Beasley, *For the Years to Come, A Story of International Nickel Company of Canada*, Toronto 1960. O. W. Main, *The Canadian Nickel Industry*, Toronto 1955. M. Bray and A. Gilbert, "The Mond-Inco Merger in 1929", *Canadian Historical Review* 1995, s. 19-42. M. Bray, "Eliminating the Competition, the Nickel Industry 1895-1929", in Ulf Olsson (ed.), *Business and European Integration since 1800*, Göteborg 1997, p. 131-140. INCO's annual reports from the period give further information about the company.
- ²³⁴ Jørgen Skeie, etc., *Falconbridge Nikkelverk A/S i 60 år*, Kr.sand 1989, p. 57-58.
- ²³⁵ Falconbridge Nickel Sales 1938 and Nickel Deliveries 1st Quarter 1939 in folder marked "Nikkelsalg 1938-39".
- ²³⁶ Neil Forbes, *Doing Business with the Nazis: Britain's Economic and Financial Relations with Germany 1931-39*, London 2000.
- ²³⁷ Letter from Hardy to Steen, dated 05/04/1939 in folder marked "Nikkelsalg 1938-39".
- ²³⁸ Letter from Hardy to Steen (air mail), dated 24/08/1939 and a telegram from Brandeis & Goldschmidt, dated 24/08/1939 in a folder marked "Nikkelsalg 1938-39".
- ²³⁹ Copy of letter from Hardy to Brandeis & Goldschmidt, dated 02/10/1939 in folder marked "Nikkelsalg 1938-39".
- ²⁴⁰ Letter from Hardy to Steen, dated 22/09/1939 in folder marked "Nikkelsalg 1938-39".
- ²⁴¹ Letter from Hardy to Steen, dated 10/10 (air mail) and 12/10/1939. Letter from Steen to Hardy, dated 09/10/1939 and also telegrams in the same period, all in a folder marked "Nikkelsalg 1938-39".
- ²⁴² Telegram from Grønningsæter to Steen, dated 17/11/1939. Letter from Hardy to Steen, dated 05/12/1939 in folder marked "Nikkelsalg 1938-39".
- ²⁴³ This paragraph has been based on a series of letter between Giertsen, Hardy, Brandeis & Goldschmidt and Steen in the autumn of 1939 in a folder marked "Nikkelsalg 1938-39".
- ²⁴⁴ Copy of telegram from Hardy to Georg Lous, dated 31/05/1940 in box 495, Steen's letter, folder marked "Gordon Hardy".
- ²⁴⁵ Interview with Ole Kristian Asbjørnsen in *Falcon* no. 1 1977. Radio contact went via an intermediary. Annual Reports Falconbridge 1941-44 give the impression that the top management had certain information about what was going on at the subsidiary in Norway.
- ²⁴⁶ INCO offered to take over refining in the autumn of 1939 already, in case anything should happen to Falconbridge's Norwegian plant. However, Falconbridge considered building a new Canadian refinery in the summer / autumn of 1940. Falconbridge Annual Report 1939. Letters from Grønningsæter to Steen in the summer / autumn of 1940.

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- ²⁴⁷ General Report from Steen to Hardy, dated 11/05/1945, in folder marked "Driftsrapporter 1940-47". Folder "Adv. Georg Lous 1940-1942", among other things, letter from Lous to Steen, dated 25/04 and 14/05/1940.
- ²⁴⁸ Stephan Lindner, *Das Reichskommissariat für die Behandlung feindlichen Vermögens in Zweiten Weltkrieg*, Stuttgart 1991. General Report from Steen to Hardy, dated 11/05/1945, in folder marked "Driftsrapporter 1940-47".
- ²⁴⁹ Trond Bergh and Even Lange, *Foredlet virke, Historien om Borregaard 1889-1989*, Oslo 1989, p. 188. Erik Vea m. fl., *Den Norske Amerikalinje 1910-1960*, Oslo 1960, p. 254.
- ²⁵⁰ Jørgen Skeie, etc., *Falconbridge Nikkelverk A/S i femti år*, Kr.sand 1989, p. 25 and 58-61. About security, letter between Wehrwirtschaftsoffizier Kristiansand and Steen, dated 28/09 and 19/10/1942 in folder marked "Tyske myndigheter 1942". Interview with Hagbarth Aanensen 15/05/2003.
- ²⁵¹ Telegram from Steen to Hardy, dated 24/05/1945, in folder marked "Driftsrapporter 1940-47".
- ²⁵² Jan Didriksen, *Industrien under hakekorset*, Oslo 1987, p. 73ff and 177-78.
- ²⁵³ Alan Milward, *The Fascist Economy of Norway*, Oxford 1972, p. 67ff.
- ²⁵⁴ Same place, p. 265 and 267.
- ²⁵⁵ J. Jäger, *Die wirtschaftliche Abhängigkeit des Dritten Reiches vom Ausland*, Berlin 1969, p. 123 and 224-25.
- ²⁵⁶ Markku Kuisma, *A History of Outokumpu*, Jyväskylä 1989, p. 131-35.
- ²⁵⁷ Markku Kuisma, *A History of Outokumpu*, Jyväskylä 1989, p. 106 and 136-37.
- ²⁵⁸ J. Jäger, *Die wirtschaftliche Abhängigkeit des Dritten Reiches vom Ausland*, Berlin 1969, p. 231-33.
- ²⁵⁹ The Metal Bulletin 12/02/1946. The magazine informs that it had received information from allied intelligence sources. Falconbridge's archive, Carl Dahls papers, report from visit by dr. Ing. Leo Schlecht 17/10/1942.
- ²⁶⁰ J. Jäger, *Die wirtschaftliche Abhängigkeit des Dritten Reiches vom Ausland*, Berlin 1969, p. 83-84.
- ²⁶¹ General Report from Steen to Hardy, dated 11/05/1945, in folder marked "Driftsrapporter 1940-47".
- ²⁶² J. Jäger, *Die wirtschaftliche Abhängigkeit des Dritten Reiches vom Ausland*, Berlin 1969, p. 233. Olav Arne Kleveland, *Flot nikkelgruve – Evje nikkelverk*, Evje 2000, p. 28. Halvor Rykkelid, *Notater vedr. Hybinette-prosessen*, Kr.sand 1999, table 6b.
- ²⁶³ General Report from Steen to Hardy, dated 11/05/1945, in folder marked "Driftsrapporter 1940-47". According to Rykkelid (refer to note 30), the Petsamo ore was also melted at Evje.
- ²⁶⁴ Same place.
- ²⁶⁵ The Metal Bulletin 12/02/1946.
- ²⁶⁶ The need to increase the nickel price is mentioned in the letter from Steen to Reichskommissariatet, dated 16/10/1941 in folder marked "Tyske myndigheter 1940-41". The price issue is also mentioned in a few letters between Steen and Lous, inter alia in a letter dated 26/03/1942, folder marked "Adv. Georg Lous 1940-1942" and in a letter from Eugen Lenkering to the nickel refinery, dated 30/09, 09 and 11/10/1941 in folder marked "Lenkering 1941-1942". Correspondence with Lous, the German authorities and Lenkering does not appear to have been kept for the period after 1942.
- ²⁶⁷ The financial results have not been mentioned in any of the minutes from the directors' meetings during the war. Cash in bank and loans have been mentioned briefly in Steen's first telegram to Hardy in May 1945, but only changes in the nickel price are mentioned in his General Report from 11/05/1945, and not other financial data. The authorities probably quickly covered the loss. None of the other source material mentions anything. General Report from Steen to Hardy, dated 11/05/1945 and telegram from Steen to Hardy, dated 24/05/1945, in folder marked "Driftsrapporter 1940-47". Annual Report 1945 Falconbridge Mines Ltd.
- ²⁶⁸ Svein-Yngve Madssen, *Den klareste flammen i "ildens by"*, *Norzink AS 1924-84*, Haugesund 1984, p. 40.
- ²⁶⁹ State archive in Kr.sand, minutes of meeting of board meetings. F. bridge trade union 1939-47, meetings 26/04, 3-4/05.
- ²⁷⁰ Same place. Tore Pryser, *Klassen og nasjonen 1935-46, Arbeiderbevegelsens historie i Norge*, Oslo 1988, p. 268-69.
- ²⁷¹ General Report from Steen to Hardy, dated 11/05/1945, in folder marked "Driftsrapporter 1940-47". Extra rations are mentioned in: Minutes of board meetings. Falcon. trade union 1939-47, meetings on 26/01, 12/05 and 17/06/1941. Annual report Kolsdalen Trade Union 1941.
- ²⁷² Tore Pryser, *Klassen og nasjonen 1935-46, Arbeiderbevegelsens historie i Norge bd. 6*, Oslo 1988, p. 341-42. Jorunn Bjørgum, *Norsk Kjemisk Industriarbeiderforbund 50 år*, Oslo 1973, p. 301-03.
- ²⁷³ State archive in Kr.sand, minutes of directors' meetings, F. bridge trade union between 1941-44. Arne Johan Finne, "Falconbridge Arbeiderforening gjennom krigsårene", note 2003.
- ²⁷⁴ Alfred Skar, *Fagorganisasjonen i Norge under okkupasjonen*, Oslo 1949, p. 494-95.
- ²⁷⁵ Johs. Topstad, *Falconbridge Nikkelverks Arbeiderforening 1927-52*, Kr.sand 1952, p. 17-18.
- ²⁷⁶ State archive in Kr.sand, minutes of board meetings, F. bridge trade union 1939-47, meetings on 19/05 and 28/05/1943.
- ²⁷⁷ Arne Johan Finne, "Falconbridge Arbeiderforening gjennom krigsårene", note 2003.

²⁷⁸ Informed by Knut Sogner.

²⁷⁹ Summary of Research Work Accomplished 1940-1945, report from Steen to Hardy, dated 11/05/1945, in folder marked "Analyser og tekniske meddelelser 1940-47".

²⁸⁰ Ketil Gjølme Andersen and Gunnar Yttri, *Et forsøk verdt, forskning og utvikling i Norsk Hydro gjennom 90 år*, Oslo 1997, p. 137ff.

²⁸¹ Letter from Steen to Falconbridge's company historian George Stock, dated 25/03/1964 in folder marked "Fraser 1947-51" in box 494, Steen's correspondence.

²⁸² Ketil Gjølme Andersen and Gunnar Yttri, *Et forsøk verdt, forskning og utvikling i Norsk Hydro gjennom 90 år*, Oslo 1997, p. 136ff.

²⁸³ Letter from Steen to Brindley, dated 11/06/1945 in the folder marked "Driftsrapporter 1940-47". Translated by the author.

²⁸⁴ Letter from Brindley to Steen, dated 26/06/1945 in the folder marked "Driftsrapporter 1940-47".

²⁸⁵ Exchange of correspondence between Brindley and Steen Aug.- Dec.1945 in the folder marked "Driftsrapporter 1940-47".

²⁸⁶ Annual Report Falconbridge 1945. Letter from Brindley to Steen, dated 17/12/1945 in the folder marked "Driftsrapporter 1940-47".

²⁸⁷ Markku Kuisma, *A History of Outokumpu*, Jyväskylä 1989, page 158.

²⁸⁸ O. W. Main, *The Canadian Nickel Industry*, Toronto 1955, page 121.

²⁸⁹ Attachment to a letter from Brindley to Campbell, dated 03/06/1946, "Nickel Forecast 1946", in folder marked "Driftsrapporter 1940-47".

²⁹⁰ O. W. Main, *The Canadian Nickel Industry*, Toronto 1955, pages 121-22.

INCO owned its own rolling mill, which gave it a strong grip on part of the nickel processing industry.

²⁹¹ Information about content and the start of McKim in Annual Reports Falconbridge 1938-47.

²⁹² Letter from Steen to Brindley, dated 01/10 and 02/12/1946 and 24/03 and 02/08/1947, letter from Grønningsæter to Brindley, dated 04/02/1947 in the folder marked "Driftsrapporter 1940-47".

²⁹³ Letter from Grønningsæter to Brindley, dated 02/01 and 15/08/1946. Memorandum "Historikk" 23.10.1952, in box 496, Steen's correspondence with Grønningsæter.

²⁹⁴ P. Quenau and INCO staff, "Metallurgical Improvements in the Treatment of Copper-Nickel Ores", *The Canadian Mining and Metallurgical Bulletin*, Montreal June 1948.

²⁹⁵ Same place.

²⁹⁶ Letter from Steen to Fraser, dated 27/07/1951 in folder marked "Fraser 1947-51" in box 494, Steen's correspondence.

²⁹⁷ Monthly Reports Falconbridge Nikkelverk 1951-53. No monthly reports from the first trial period.

²⁹⁸ The production committee, meeting on 28/08/1952. Letter from Steen to Fraser 26/03 and 04/04/1952 in the folder marked "Fraser 1947-51". Letter from Steen to Fraser, dated 03/09 and 29/11/1952 in the folder marked "Fraser Jan.- July 1952" in box 494, Steen's correspondence.

²⁹⁹ Letter from Grønningsæter to Steen 25/04 and 28/05/1947 and 30/12/1948 in box 496, Steen's correspondence with Grønningsæter.

³⁰⁰ Letter from Grønningsæter to Steen, dated 30/12/1948. Copy of letter from Grønningsæter to Fraser, dated 14/09/1949 in box 496, Steen's correspondence with Grønningsæter.

Grønningsæter's argument in 1948 to increase Falconbridge's investments due to the Marshall plan is interesting in itself. Historians have discussed to what extent the Marshall plan contributed toward increasing economic growth in Europe. Alan Milward has claimed that the Marshall plan meant far less than generally assumed. He believes that the European recovery was primarily due to internal matters in this part of the world. However, Milward has made a few reservations, among other things, one about corporate managements' reactions to the Marshall aid. If the aid triggered new optimism and investment activity in industry and commerce, it might be necessary to reassess the significance of the aid. Alan Milward, *The Reconstruction of Western Europe 1945-51*, London 1992. For the traditional view on Marshall aid, refer to Michael Hogan, *The Marshall Plan*, Cambridge 1987. Milwards theory has been widely disputed.

³⁰¹ Annual Reports Falconbridge 1946-49.

³⁰² National Archive, Ministry of Trade's archive, the Foreign Currency Office, j.no. 14-14, Falconbridge Nikkelverk.

Only records from 1947 have been kept. The reason why there are no records about Falconbridge from later years may be because the material has been misplaced, but also because the company achieved acceptance for its view that it create more currency than it used, so that currency licences were subsequently given (after the currency crisis was over) without extensive processing.

³⁰³ Informed by Hagbarth Aanensen, dated 14/08/2002.

³⁰⁴ Letter from Steen to Grønningsæter, dated 03/04 and 14/04/1948 in box 496, Steen's correspondence with Grønningsæter.

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- ³⁰⁵ Lars Fredrik Øksendal, *En fast kurs - norsk betalingspolitikk 1945-1958*, history thesis, NTNU 2001.
- ³⁰⁶ Letter from Grønningsæter to Steen, dated 30/09/1946 in box 496, Steen's correspondence with Grønningsæter.
- ³⁰⁷ Folder marked "Jan Reimers 1948-51", in box 495, Steen's letter. Exchange of correspondence between Steen and Fraser 1948-49, in folder marked "Fraser 1947-51" in box 494, Steen's letter.
- ³⁰⁸ Copy of letter from Grønningsæter to Fraser, dated 21/07/1950 in folder marked "Fraser 1947-51" in box 494, Steen's correspondence.
- ³⁰⁹ Trond Bergh, *Storhetstid 1945-65, Arbeiderbevegelsens historie, bd. 5*, Oslo 1987, page 20ff.
- ³¹⁰ Lars Thue, *Elforsyning og kraftutbygging som etterkrigshistorisk forskningsfelt*, Bergen 1994, page 22.
- ³¹¹ For example, refer to Tore Grønlie, *Statsdrift, staten som industrieier*, Oslo 1989.
- ³¹² Arthur Stonehill, *Foreign Ownership in Norwegian Enterprises*, SSB Oslo 1965, page 109. Foreign-owned businesses in this case means businesses with 50% or more foreign ownership interest.
- ³¹³ St.forh. 1947 7a, page 409. St.forh. 7b 1954, page 3090. Quoted from Reidar Vaage, *Politiske haldningar til import av utanlandsk kapital 1945-63*, history thesis, Bergen 1977, page 82.
- ³¹⁴ Agder Energi's archive, KEV's minutes of meeting 1945-46, case no. 28, 43, 51 and 84. For further discussion of KEV's energy sales to Falconbridge refer to P. T. Sandvik og E. Andresen, *Kristiansand Energiverk i elektrisitetens århundre, 1900-2000*, Kr.sand 2000, page 125ff.
- ³¹⁵ Agder Energi's archive, KEV's minutes of meeting 1948-49, case no. 99.
- ³¹⁶ Agder Energi's archive, KEV's minutes of meeting 1948-49, case no. 99.
- ³¹⁷ Letter from Grønningsæter to Steen, dated 18/05/1948 in box 496, Steen's correspondence with Grønningsæter.
- ³¹⁸ Rolv Petter Amdam, "Industrikomiteen i New York", *Historisk Tidsskrift nr. 1 2000*.
- ³¹⁹ Letter from Steen to Grønningsæter, dated 04/10/1948 and 24/01/1949 in box 496, Steen's correspondence with Grønningsæter.
- ³²⁰ Agder Energi's archive, KEV's minutes of meeting 1952-53, item 127, minutes of meeting between Vogt, Steen, Vinje and Tangen, dated 10/04/1953. See also endnote 314.
- ³²¹ E. Andresen and P. T. Sandvik, *Kristiansand Energiverk i elektrisitetens århundre, 1900-2000*, Kr.sand 2000, pages 126-29.
- ³²² Agder Energi's archive, KEV's minutes of meeting 1948-49, item 98. Full price was calculated at the time to be 96 NOK per kW-year. Falconbridge paid 92 NOK.
- ³²³ F.vennen 03/01/1953.
- ³²⁴ Letter from Steen to Grønningsæter, dated 12/12/1955 in box 496, Steen's correspondence with Grønningsæter.
- Agder Energi's archive, KEV's minutes of meeting 1955-56, item 147, note to the board, dated 19/3/1956.
- ³²⁵ Agder Energi's archive, Annual Reports KEV 1945/46 and 1960.
- ³²⁶ The National Archive, Ministry of Industry's archive, Water Resources Dept., box 94, folder 427. Letter from the Ministry of Industry to KEV and VAE, dated 01/11/1955. Letter from Steen to the Ministry of Industry, dated 29/10/1955. Steen asked the Ministry to put pressure on the electricity works.
- Agder Energi's archive, KEV's minutes of meeting 1945-46, case no. 107, minutes of meeting 1952-53, case no. 127.
- Falconbridge's archive. Letter from Director Steen to the Ministry of Trade, dated 06/01/1953 regarding generation of currency income and to the Ministry of Industry regarding the company's energy needs. Copies of the letters were sent to the Ministry of Labour and Local Affairs.
- ³²⁷ Letter from Grønningsæter to Steen, dated 19/05/1947 in box 496, Steen's correspondence with Grønningsæter.
- ³²⁸ Letter from Grønningsæter to Steen, dated 30/12/1948 in box 496, Steen's correspondence with Grønningsæter.
- ³²⁹ Letter from Grønningsæter to Steen, dated 18/12/1950 in box 496, Steen's correspondence with Grønningsæter.
- ³³⁰ Letter from Grønningsæter to Steen, dated 18/01/1951 in box 496, Steen's correspondence with Grønningsæter.
- ³³¹ Letter from Fraser to Steen, dated 11/12/1950 and 18/01/1951, in folder marked "Fraser 1947-51" in box 494, Steen's correspondence.
- ³³² Letter from Steen to Fraser, dated 25/01/1951, in folder marked "Fraser 1947-51" in box 494, Steen's correspondence.
- ³³³ Letter from Grønningsæter to Steen, dated 03/02/1951 and draft telegram, dated 06/02/1951 in box 496, Steen's correspondence with Grønningsæter. Letter from Steen to Fraser, dated 23/02/1951, in folder marked "Fraser 1947-51" in box 494, Steen's correspondence.

³³⁴ Letter from Grønningsæter to Steen, dated 30/12/1948 and 24/11/1952 (with direct quote), from Steen to Grønningsæter, dated 10/10/1953 and a copy of the letter from Grønningsæter to Fraser, dated 04/05/1956 in box 496, Steen's correspondence with Grønningsæter.

In 1953, Falconbridge paid 800,000 NOK in tax to Norway and 3.2 million NOK to Canada. In relation to the company's level of activity in the two countries, the tax burden was definitely lighter in Norway. In Ontario much of the tax was linked to mining. Due to the depreciation possibilities, the tax varied greatly from year to year. Therefore, in certain years, Falconbridge paid far more than 3.2 million in tax. This means that Norway was even more favourable with regard to tax than the example in 1953 shows. Letter from Steen to Fraser, dated 28/07/1953 and from Fraser to Steen, dated 10/06/1953 in the folder marked "Fraser 1953-" in box 494, Steen's correspondence. Also refer to the information about tax in Annual Reports Falconbridge.

³³⁵ Production took place far closer to densely populated areas in Kristiansand than in Falconbridge outside Sudbury. However, damage to the environment was much worse at Sudbury.

³³⁶ Letter from Steen to Fraser, dated 12/04/1954 in folder marked "Fraser 1953-" in box 494, Steen's correspondence. Letter from Steen to Grønningsæter, dated 24/01/1953 and from Grønningsæter to Steen, dated 30/01/1953 and 02/02/1954 in box 496, Steen's correspondence with Grønningsæter.

³³⁷ Letter from Grønningsæter to Steen, dated 06/01/1948 in box 496, Steen's correspondence with Grønningsæter.

³³⁸ D. M. LeBourdais, *Sudbury Basin, The Story of Nickel*, Toronto 1953, page 179. Carl Dahl's documents, biographical information about Fraser.

³³⁹ Letter from Grønningsæter to Steen, dated 24/11/1952 in box 496, Steen's correspondence med Grønningsæter.

³⁴⁰ O. W. Main, *The Canadian Nickel Industry*, Toronto 1955, page 121. Production figures for Falconbridge obtained from; H. Rykkelid, *Notes concerning the Hybinette process*, Kr.sand 1995, table 9.

³⁴¹ Letter from Grønningsæter to Steen 14/01/1953 in box 496, Steen's correspondence with Grønningsæter.

³⁴² Alfred Eckes, *The United States and the Global Struggle for Minerals*, Univ. of Texas Press 1979, page 121ff. Robert A. Pollard, *Economic Security and the Origins of the Cold War 1945-50*, New York 1985, page 200. David Baldwin, *Economic Development and American Foreign Policy 1943-62*, Chicago 1966, page 72ff.

³⁴³ Alfred Eckes, *The United States and the Global Struggle for Minerals*, Univ. of Texas Press 1979, page 133-45.

³⁴⁴ US Senate, Committee on Armed Services, 4th Report of the Preparedness Subcommittee, *Nickel*, 27/12/1950.

³⁴⁵ Same place.

³⁴⁶ Same place, page 2.

³⁴⁷ Letter from Fraser to Steen 06/09/1950 in folder marked "Fraser 1947-51" in boks 494, Steen's correspondence.

³⁴⁸ US Senate, Committee on Armed Services, 4th Report of the Preparedness Subcommittee, *Nickel*, 27/12/1950, page 19-20.

³⁴⁹ Alfred Eckes, *The United States and the Global Struggle for Minerals*, Univ. of Texas Press 1979, page 165-67.

³⁵⁰ John Deverell, *Falconbridge, A Portrait of a Canadian Mining Multinational*, Toronto 1975, page 38. Alfred Eckes, *The United States and the Global Struggle for Minerals*, Univ. of Texas Press 1979, page 215.

³⁵¹ US Senate, Committee on Armed Services, 4th Report of the Preparedness Subcommittee, *Nickel*, 27/12/1950, pages 4ff, 10 and 18.

³⁵² The President's Materials Policy Commission, *Resources for Freedom, Vol. 1-5*, Washington 1952. US President's Cabinet Committee on Minerals Policy, Report 1954.

³⁵³ Annual Report Falconbridge 1952 and 1953. Val Ross, "The Arrogance of INCO", in *Canadian Business* 52, no. 5 (May 1979), page 122.

³⁵⁴ Copy of letter from Fraser to Grønningsæter 18/01/1951. Letter from Grønningsæter to Steen 27/05/1955 in box 496, Steen's correspondence with Grønningsæter.

³⁵⁵ US Senate, Committee on Armed Services, 4th Report of the Preparedness Subcommittee, *Nickel*, 27/12/1950, pages 10-12.

³⁵⁶ Formally speaking, Archibald was employed in the holding company Ventures.

³⁵⁷ O. W. Main, *The Canadian Nickel Industry*, Toronto 1955, pages 120-23. US Senate, Committee on Armed Services, 4th Report of the Preparedness Subcommittee, *Nickel*, 27/12/1950, pages 13-18. Canadian Mining Journal July 1954.

³⁵⁸ State archive, Ministry of Industry's archive, Undersecretary Arne Drogseth's archive j. no. 28 folder marked "Marshall-plan, Non Ferrous Metals Committee". Report of the French Committee 26/10/1948 and Non-Ferrous Metals Committee, Report on the Long Term Perspective 10/12/1948.

³⁵⁹ D. M. LeBourdais, *Sudbury Basin, The Story of Nickel*, Toronto 1953, page 174.

³⁶⁰ Val Ross, "The Arrogance of INCO", i *Canadian Business* 52, no. 5, (May 1979), s. 122.

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- ³⁶¹ O. W. Main, *The Canadian Nickel Industry*, Toronto 1955, pages 121-22.
- ³⁶² Business Week 14/03/1953 and 08/10/1955. John Deverell, *Falconbridge, A Portrait of a Canadian Mining Multinational*, Toronto 1975, pages 46-47.
- ³⁶³ Letter from Grønningsæter to Steen 17/12/1954 and 11/08 and 30/09/1955 in box 496, Steen's correspondence with Grønningsæter.
- ³⁶⁴ Stephen Ambrose, *Eisenhower, The President*, New York 1984, pages 221-22, 254, 289, 320-21, 546 and 560.
- ³⁶⁵ Annual Reports Falconbridge 1955-57. John Deverell, *Falconbridge, A Portrait of a Canadian Mining Multinational*, Toronto 1975, pages 48-52. New York Times 09/14/1955.
- ³⁶⁶ Svein-Yngve Madssen, *Den klareste flammen i "ildens by"*, *Norzink AS 1924-84*, Haugesund 1984, page 52.
- ³⁶⁷ US Senate, Committee on Armed Services, 4th Report of the Preparedness Subcommittee, *Nickel*, 27/12/1950, pages 10-13 and 21.
- ³⁶⁸ Copy of letter from Fraser to Grønningsæter, dated 18/01/1951. Letter from Steen to Grønningsæter, dated 11/01/1951 in box 496, Steen's correspondence with Grønningsæter. Letter from Fraser to Steen, dated 10/05/1951 in folder marked "Fraser 1947-51" in box 494, Steen's correspondence. Annual Reports Falconbridge 1952-60. Minutes of meeting for Falconbridge Nikkelverk.
- ³⁶⁹ The size of Falconbridge's contribution to the Norwegian currency income depends upon how it is calculated. Falconbridge spent around 30 million NOK in Norway in 1953 (besides investments), mainly on wages, electricity, chemicals, and purchases of goods and services. The total equalled the value of 0.8% of Norway's commodity exports. However, the currency income from Falconbridge was almost pure net income, whereas much of the remaining exports had a significant percentage of import, e.g., the aluminium industry imported all its bauxite. It is important to note that Falconbridge Nikkelverk never owned the nickel. It was refined on a custom basis for the Canadian parent company and therefore was not included in the amount of 30 MNOK.
- ³⁷⁰ Letter from Fraser to Steen, dated 21/07/1952 in a folder marked "Fraser jan.-juli 1952" in box 494, Steen's correspondence.
- ³⁷¹ Falconbridge Archive Sudbury, Box 56 Canadian Refinery -1969, Copy of Order of Council approved by Lt.-Governor of Ontario 14/01/1954. Copy of letter from Fraser to Grønningsæter, dated 18/01/1951. Letter from Steen to Grønningsæter, dated 11/01/1951 in box 496, Steen's correspondence with Grønningsæter.
- ³⁷² Various letters concerning Reimers between Sept. 1948 and June 1949 in the folder marked "Fraser 1947-51" in box 494, Steen's correspondence.
- ³⁷³ Same place. Letter from Fraser to Steen, dated 29/10 and 04/11/1949.
- ³⁷⁴ Same place. Letter from Fraser to Steen, dated 30/06/1949 and from Steen to Fraser, dated 05/07/1949.
- ³⁷⁵ Bjarne Bassøe, *Ingeniørmatrikkelen*, Oslo 1961.
- ³⁷⁶ Letter from Grønningsæter to Steen, dated 03/04/1950 in box 496, Steen's correspondence with Grønningsæter.
- ³⁷⁷ Talks with Odd Magnussen, dated 03/12/2001 and with Håkon Wilson, dated 05/12/2001
- ³⁷⁸ Letter from Grønningsæter to Steen, dated 03/10 and from Steen to Grønningsæter, dated 19/10/1951 in box 496, Steen's correspondence with Grønningsæter.
- ³⁷⁹ Letter from Grønningsæter to Steen, dated 12/11/1954 in box 496, Steen's correspondence with Grønningsæter.
- ³⁸⁰ Interview with Realf Høy-Petersen, 23/09/2002.
- ³⁸¹ Interview with Realf Høy-Petersen, 08/05/2002.
- ³⁸² Farewell interview with Jahnsen, *Falcon* no. 3, 1975.
- ³⁸³ Letter from Steen to Fraser 12/03/1958 in box 496, Steen's correspondence with Grønningsæter.
- ³⁸⁴ Undated draft from Grønningsæter from the spring of 1957 in box 496, Steen's correspondence with Grønningsæter.
- ³⁸⁵ Minutes of meeting, Falconbridge Nikkelverk, meeting 24/01/1957.
- ³⁸⁶ Interview with Halvor Rykkelid 15/08/2002.
- ³⁸⁷ Interview with Michael Sudbury and Phil Thornhill on 08/04/02, with Phil Thornhill 10/04/02 and with Gus van Weert 11/04/02.
- ³⁸⁸ Interview with Realf Høy-Petersen 08/05/2002 and 12/06/2003
- ³⁸⁹ Interview with Realf Høy-Petersen 08/05/2002 and 12/06/2003.
- ³⁹⁰ Letter from Steen to Fraser 12/03/1958 in box 496, Steen's correspondence with Grønningsæter.
- ³⁹¹ Annual Reports Falconbridge 1952-60. Minutes of meeting Falconbridge Nikkelverk.
- ³⁹² Falconbridge Archive Sudbury, Laboratory Reports, New Roaster 1953-54.
- ³⁹³ Interviews with Realf Høy-Petersen 23/09/2002 and with Milton Hartveit 24/09/2002.
- ³⁹³ *Falcon* no. 1, 1970.
- ³⁹⁴ Interview with Milton Hartveit 24/09/2002.

³⁹⁵ Copy of memorandum from Grønningsæter to Fraser 18/07/1955 in box 496, Steen's correspondence with Grønningsæter.

³⁹⁶ "Jubileumsbok", note by Arne Johan Finne 2003.

³⁹⁷ Paul Knutsen, "Statsbærende og opposisjonell reformisme", in *Tidsskrift for Arbeiderbevegelsens historie*, no. 2 1977, page 14.

³⁹⁸ State archive in Kr.sand, Minutes of Meeting F.bridge trade union 1947-48, meeting 22/05/1948.

³⁹⁹ Letter from Steen to Fraser, dated 18/11/1952 in folder marked "Fraser jan.-des. 1952", in box 494 Steen's correspondence.

⁴⁰⁰ Hans Otto Frøland, *Korporativt kompromiss og korporativ konsert, Tariff- og inntektspolitikk i LO-NAF-området 1950-65*, Univ. i Trondheim 1992, page 563ff.

⁴⁰¹ Regarding time and motion studies, refer to Tor Halvorsen, *Jern og metall 100 år, bd. 2*, Oslo 1990, page 224. Ingar Kaldal, *Arbeid og miljø ved Follafoss Tresliperi og Ranheim Papirfabrikk*, Univ. i Trondheim 1994, page 283ff.

⁴⁰² . State archive in Kr.sand, Minutes of Meeting in F.bridge trade union 1952-54, 1955-59 and 1962, meetings 10/11/1954, 19/03/1956, 29/01/1957 and 19/11/1962 Barbala, Finne and Hallstrøm (ed.), *Falconbridge Nikkelverk's trade union, 50th anniversary* Kr.sand 1977, pages 36-39.

⁴⁰³ State archive in Kr.sand, Minutes of Meeting. F.bridge trade union 1955-59, meeting 29/01/1957.

⁴⁰⁴ Informed by Arne Johan Finne 02/06/2003.

⁴⁰⁵ John B. Lang, *A Lion in the Den of Daniels, A History of the International Union of the Mine, Mill and Melter Workers in Sudbury 1942-1962*, Univ. of Guelph 1970. C.M. Wallace and Ashley Thompson, *Sudbury, Rail Town to Regional Capital*, Toronto 1993, pages 138ff, 168ff and 190ff.

⁴⁰⁶ Gerhard Lembruch, "Concertation and the Structure of Corporatist Networks" in J. Goldthorpe (ed.), *Order and Conflict in Contemporary Capitalism*, Oxford 1984.

⁴⁰⁷ Letter from Fraser to Steen 18/06/1951 in folder marked "Fraser 1947-51" in box 494, Steen's correspondence.

It was the trade union that took the initiative to form a brass band. Steen recommended the allocation of 16,000 NOK, but it was given by Fraser with the message that he wanted to maintain the good relations between the company and the union.

⁴⁰⁸ Minutes of the Falconbridge Nikkelverk board, meetings 15/09/1952, 25/11/1955 and 22/09/1960.

Jørgen Skeie m.fl., *Falconbridge Nikkelverk A/S i femti år*, Kr.sand 1989, page 61.

⁴⁰⁹ Minutes of meeting no. 1 for the Production Committee at Falconbridge.

⁴¹⁰ Johs. Topstad, *Falconbridge Nikkelverks Arbeiderforening 25 års jubileum 1927-52*, Kr.sand 1952, page 24.

⁴¹¹ State archive in Kr.sand, Minutes of Meeting F.bridge trade union 1947-48, meeting 22/10/1947.

⁴¹² Minutes of meeting no. 1 and 2 for the Production Committee at Falconbridge.

⁴¹³ Trond Bergh, *Storhetstid 1945-65, Arbeiderbevegelsens historie i Norge, bd. 4*, Oslo 1988, pages 218-19. For a more thorough assessment of the production committees' manner of operation, refer to Erling Sørli "Bedriftsdemokratiet som virkemiddel mot arbeiderkollektivet", i *Tidsskrift for Arbeiderbevegelsens historie*, no. 2 1977, pages 89-90.

⁴¹⁴ Pål Thonstad Sandvik, *Kristiansands historie 1945-1999*, Kr.sand 1999, page 125ff.

⁴¹⁵ State archive in Kr.sand, Minutes of Meeting F.bridge trade union 1939-47 and 1947-48, meeting 13/08/1945, AGM 1946, meeting 24/02/1948.

⁴¹⁶ Minutes the Falconbridge Nikkelverk board, meetings 24/06/1954, 11/05/1955 and 01/06/1959.

⁴¹⁷ Interview with Odd Magnussen 03/12/2001. Barbala, Finne and Hallstrøm (ed.), *Falconbridge Nikkelverks arbeiderforening, 50-års jubileum*, Kr.sand 1977, page 37.

⁴¹⁸ Anne Kristine Børresen, *Drømmer av stål*, Univ. i Trondheim 1995, page 293ff. Petter Innvik and John Kamsvåg, *Verket, Sunndal Verk gjennom 40 år*, Sunndal 1993, page 75, 141 and 152.

⁴¹⁹ Portrait interview with Grønningsæter in F.vennen 01/07/1955.

⁴²⁰ Letter from Fraser to Steen 20/11 and from Steen to Fraser 28/11/1952 in folder marked "Fraser jan.-des. 1952", in box 494 Steen's correspondence.

⁴²¹ About Jahnsen and bookkeeping investments: Informed by Hagbarth Aanensen 18/12/2001.

⁴²² Sverre Christensen, "Conceptualization of different sorts of subsidiaries", unpubl. manuscript 2001. Joseph D'Crutz, "Strategic Management of Subsidiaries", i H. Etemad and L. S. Dulude (ed.), *Managing the Multinational Subsidiary*, London 1986, page 134. Robert Pearce, "The evolution of technology in MNE, the role of creative subsidiaries", i *International Business Review 8-1999*, pages 125-28.

⁴²³ Arthur Stonehill, *Foreign Ownership in Norwegian Enterprises*, SSB Oslo 1965, pages 125, 137 and 141-42.

⁴²⁴ Various notes in the minutes of board meeting for Falconbridge Nikkelverk 1929-62. The reason why Christian organisations were probably chosen was that missionary friend, shipowner Einar Rasmussen, was a member of the company's Norwegian board.

⁴²⁵ Letter from Steen to T. Lindsley, dated 04/08 and telegram, dated 15/08/1947, letter from Lindsley to Steen, dated 08/08 and telegram, dated 18/08/1947 in the folder marked "Falconbridge Mines 1932-" in box 494, S. B. Steen's correspondence.

Falconbridge gave 3,000 Canadian dollars to Libertas via the Norwegian Electro-Chemical Employers' Federation. Lindsley approved this after Steen argued that the leaders in Norwegian industry wanted to mobilise against the socialist (Labour) government's nationalisation interest. Steen also said that other foreign-owned companies in the same industry contributed money to the same purpose. The letters also state explicitly that Falconbridge did not otherwise give money to any purpose that did not affect the company directly. A similar allocation was also given in 1949.

⁴²⁶ Arthur Stonehill, *Foreign Ownership in Norwegian Enterprises*, SSB Oslo 1965, pages 89.

⁴²⁷ Richard Caves, *Multinational Enterprise and Economic Analysis*, Cambridge Mass. 1996, pages 164-65.

Geoffrey Jones, *The Evolution of International Business*, London 1996, page 270ff.

⁴²⁸ Joseph Boldt and Paul Queneau, *The Winning of Nickel*, London 1967, p. 25ff, 370 and 392ff. Markku Kuisma, *A History of Outokumpu*, Jyväskylä 1989, p. 157-60.

⁴²⁹ Howard Keck's company Superior Oil owned 37% of mining company McIntyrePorcupine Mines Ltd. McIntyre owned 36% of Falconbridge. In addition, Falconbridge owned a major shareholding in McIntyre. Source: Presentation to a Select Committee of the Ontario Legislature by Falconbridge Jan. 4th 1978, Falconbridges archives, Toronto.

⁴³⁰ Annual Reports Falconbridge 1960-72.

⁴³¹ Conversation with Paul Lindon 11/04/2002.

⁴³² A. G. Kenwood og A. L. Lougheed, *The Growth of the International Economy*, London 1992, p. 250ff.

⁴³³ Alfred D. Chandler, *Strategy and Structure*, London 1976, page 324ff and 330. Regarding delegation of responsibility in Falconbridg refer to the interview with president Fraser in in-house magazine *Falcon* December 1967.

⁴³⁴ Alfred Eckes, *The United States and the Global Struggle for Minerals*, Univ. of Texas Press 1979.

Falconbridge's contracts with the US authorities state that the company was to be responsible for nickel sales, if the authorities wanted to reduce stocks. In this way, it would be easier for the company to prevent the extra sales from causing waves in the nickel market.

⁴³⁵ Annual Reports INCO 1960-70.

⁴³⁶ About production in New Caledonia, *The Metal Bulletin* 17/07 and 11/08/1970. The figure includes ferronickel and export of nickel matte to Japan.

⁴³⁷ Annual Reports Falconbridge 1960-70. In the comparison between 1950s and 1960s the figure has been adjusted for inflation.

⁴³⁸ Annual Report Falconbridge 1969, page 14. The expression "equity" has been used in the text instead of the term "total equity and liabilities".

⁴³⁹ P. G. Thornhill, E. Wigstol and G. van Weert, "The Falconbridge Leaching Process", in *Journal of Metals*, July 1971. E. Stensholt, H. Zachariassen and J. H. Lund, "Falconbridge Chlorine Leaching Process", in *Transactions of the Institution of Mining and Metallurgy*, Section C, Vol. 5 1986.

⁴⁴⁰ Interview with Philip Thornhill, Michael Sudbury and Sandy Allan 08/04/2002.

⁴⁴¹ Interview with Philip Thornhill 10/04/2002. Memorandum from Conversations with Fraser 06- 08/08/1956, written by R. Jahnsen 17/08/1956, handed over to author by H. Rykkelid.

⁴⁴² Minutes of meeting Falconbridge Nikkelverk, meeting 16/02/1960.

⁴⁴³ Interview with Realf Høy-Petersen 12/06/2003.

⁴⁴⁴ Interview with Realf Høy-Petersen 12/06/2003.

⁴⁴⁵ Ketil Gjølme Andersen and Gunnar Yttri, *Et forsøk verdt, forskning og utvikling i Norsk Hydro gjennom 90 år*, Oslo 1997, p. 307. About different degrees of market orientation between American companies on the one hand and European (German and British) on the other, refer to Alfred D. Chandler, *Scale and Scope, The Dynamics of Industrial Capitalism*, Cambridge, Mass. 1990.

⁴⁴⁶ Minutes of board meeting Falconbridge Nikkelverk, meeting 07/05/1965

⁴⁴⁷ *Falcon* no. 3, 1972.

⁴⁴⁸ Ketil Gjølme Andersen and Gunnar Yttri, *Et forsøk verdt, forskning og utvikling i Norsk Hydro gjennom 90 år*, Oslo 1997, p. 187. Jon Gulowsen, *Bro mellom vitenskap og teknologi, SINTEF 1950-2000*, Trondheim 2000, p. 109ff and 114ff.

⁴⁴⁹ Interview with Sandy Allan 08/04/2002.

⁴⁵⁰ Ketil Gjølme Andersen and Gunnar Yttri, *Et forsøk verdt, forskning og utvikling i Norsk Hydro gjennom 90 år*, Oslo 1997, p. 181ff and 304.

⁴⁵¹ Conversation with Jens Glad Balchen 12/09/2002.

⁴⁵² Per Østby, *Tilfellet Comtech*, history thesis, Univ. of Trondheim 1989, p. 97-98.

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- ⁴⁵³ Around 1960, SI in Oslo had made an electronic control system for cutting torches at the shipyard Akers mek. But outside the mechanical industry, Falconbridge was the first in Norway. The final contract between Falconbridge and SINTEF was entered into in June 1965. Sunndal Verk was the first aluminium plant in Europe to introduce electronic control of the smelting furnaces in January 1969, but this was after than Falconbridge. See also Jon Gulowsen, *Bro mellom vitenskap og teknologi, SINTEF 1950-2000*, Trondheim 2000, p. 218ff. Håkon W. Andersen, *Fra det britiske til det amerikanske produksjonsideal, forandringer i teknologi og arbeid ved Aker mek. verksted 1935-70*, Trondheim 1986. Petter Innvik and John Kamsvåg, *Verket, Sunndal Verk gjennom 40 år*, Sunndal 1993, p. 169-71.
- ⁴⁵⁴ Realf Høy Petersen, "Falconbridge Nikkelverk, oversikt over utviklingen 1953-75", manuscript 2002.
- ⁴⁵⁵ Interview with Arne Svalheim 16/09/2002. H. J. Hansen was originally a chemical engineer at Falconbridge, but was transferred to SINTEF to develop process control between 1965-67 before returning to Kristiansand. Hansen relocated later to Falconbridge's plant in Canada.
- ⁴⁵⁶ SINTEF report no. 67-53-C: Calculator controlled regulating system for the nickel process at Falconbridge Nikkelverk, 1967. Per Østby has given me a copy of the report.
- ⁴⁵⁷ Interview with Arne Svalheim 16/09/2002.
- ⁴⁵⁸ Bjørn Enes, "Sørlandsk maktskisse" in Jon P. Knutsen and Hege Skjeie (ed.), *Hvit stakitt og fiberoptikk*, Kr.sand 2002, p. 292.
- ⁴⁵⁹ *Falcon* no. 1, 1972.
- ⁴⁶⁰ Bjørn Enes, "Sørlandsk maktskisse", in Jon P. Knutsen and Hege Skjeie (ed.), *Hvit stakitt og fiberoptikk*, Kr.sand 2002, p. 293.
- ⁴⁶¹ Per H. Engelstad, *Teknologi og sosial forandring på arbeidsplassen, et eksperiment i industrielt demokrati* Oslo 1970, p. 112ff and 219ff. Einar Thorsrud and Fred Emery, *Mot en ny bedriftsorganisasjon*, Oslo 1969, p. 9ff, 78ff and 201ff.
- ⁴⁶² Bjørn Enes, "Sørlandsk maktskisse", in Jon P. Knutsen and Hege Skjeie (ed.), *Hvit stakitt og fiberoptikk*, Kr.sand 2002, p. 292.
- ⁴⁶³ Farewell interview with eng. Leif Røed, *Falcon* no. 1, 1977. Interview with Realf Høy-Pettersen 23/09/2002.
- ⁴⁶⁴ *Falcon* no. 1, spring 1967. Interview with Arne Korsmo 06/12/2001.
- ⁴⁶⁵ Interviews with Realf Høy-Pettersen 23/09/2002 and Jacob Sørensen 23/09/2002.
- ⁴⁶⁶ *Falcon* no. 1, 1972. Interview with Jacob Sørensen 23/09/2002.
- ⁴⁶⁷ Copy of letter from Grønningsæter to president Brindley 15/08/1946 in box 496, Steen's correspondence with Grønningsæter.
- ⁴⁶⁸ In-house magazine *Falcon* December 1967.
- ⁴⁶⁹ Minutes of meeting Falconbridge Nikkelverk, meeting 20/10/1965 and 27/09/1967. In-house magazine *Falcon* September 1968. Jørgen Skeie, etc., *Falconbridge Nikkelverk A/S i femti år*, Kr.sand 1989, p. 42.
- ⁴⁷⁰ Derek Aldcroft, *The European Economy 1914-2000*, London 2001, page 188f.
- ⁴⁷¹ OECD, Third Ministerial Meetings on Science March 1968, *Gaps in Technology, Non Ferrous Metals*, Paris 1969, page 38.
- ⁴⁷² Presentation to a Select Committee of the Ontario Legislature by Falconbridge Jan. 4th 1978. Falconbridge's archives, Toronto.
- ⁴⁷³ OECD, Third Ministerial Meetings on Science March 1968, *Gaps in Technology, Non Ferrous Metals*, Paris 1969, page 96.
- ⁴⁷⁴ Same place. The production capacity for the various companies has been obtained from *Falcon* no. 2 1977.
- ⁴⁷⁵ *Metal Bulletin* 25/10/1968 and 17/07/1970.
- ⁴⁷⁶ INCO still took greater "market responsibility" than the others. In the late summer 1977, INCO had 8-month's production in stock, while Falconbridge only had 4. This indicates that INCO assumed greater costs than Falconbridge to avoid a collapse in the market. Source: Minutes of board meeting Falconbridge Nikkelverk 01/09/1977.
- ⁴⁷⁷ Falconbridge Directors' Meetings 1975, Falconbridge's archives, Toronto. About production: Annual Reports Falconbridge and INCO 1975.
- ⁴⁷⁸ Minutes of Falconbridge Nikkelverk board, meeting 07/10/1975.
- ⁴⁷⁹ Annual Reports Falconbridge and INCO 1977-82. About exchanged listed nickel prices: Falconbridge Directors Meeting 04/06/1979, Falconbridge's archives, Toronto.
- ⁴⁸⁰ Interviews with Philip Thornhill, Toronto 08/04 and 10/04/2001. Interview with Paul Lindon 11/04/2002.
- ⁴⁸¹ Minutes from Falconbridge Nikkelverk board, meeting 23/05/1975.
- ⁴⁸² KEV's minutes of board meetings, item 168, 1970.
- ⁴⁸³ Stortingsprop. 85, 1973-74. Stortingsprop. 165, 1976-77.
- ⁴⁸⁴ KEV's minutes of board meetings 1975, item 9 and 71, and 1977, item 81 and 150.
- ⁴⁸⁵ This and the following are based on P. G. Thornhill, E. Wigstol and G. van Weert, "The Falconbridge Leaching Process", *Journal of Metals*, July 1971. E. Stensholt, H. Zachariasen and J. H. Lund, "Falconbridge

Chlorine Leaching Process”, *Transactions of the Institution of Mining and Metallurgy*, Section C, Vol. 5 1986. Interviews with Philip Thornhill, Michael Sudbury and Sandy Allan 08/04/2002, with Thornhill 10/04/2002 and with Erling Stensholt 15/08 and 19/11/2002.

⁴⁸⁶ Inco’s website, www.inco.com, ”Our history”.

⁴⁸⁷ Interview with Erling Stensholt 15/05/2003.

⁴⁸⁸ E. Wigstøl and K. Frøyland, ”Solvent Extraction in Nickel Metallurgy, The Falconbridge Matte Leaching Process”, pages 66-69.

⁴⁸⁹ Same place, page 71. Minutes of directors’ meeting in Falconbridge Nikkelverk, meeting 20/09/1967.

⁴⁹⁰ This and the following are based on Jørgen Skeie, etc., *Falconbridge Nikkelverk A/S i femti år*, Kr.sand 1989, pages 30-31 and on Realf Høy-Petersen, ”Falconbridge Nikkelverk, oversikt over utviklingen 1953-75”, Kr.sand May - June 2002.

⁴⁹¹ *Falcon* no. 3, 1972.

⁴⁹² Journal KL-bygg 21/12/1974 – 17/03/1975. See also Jørgen Skeie, inter alia, *Falconbridge Nikkelverk A/S i femti år*, Kr.sand 1989, pages 33-34.

⁴⁹³ Informed by Arne Johan Finne 02/06/2003.

⁴⁹⁴ Minutes of Falconbridge Nikkelverk board, meeting 04/10/1975.

⁴⁹⁵ Øyvind Bjørnson, *100 år for et bedre arbeidsmiljø, Arbeidstilsynet 100 år*, Oslo 1993, pages 208-09. Minutes of directors’ meetings in Falconbridge Nikkelverk, meetings 04/12/1975 and 01/03/1976.

⁴⁹⁶ Interview with Michael Collins 12/04/2002.

⁴⁹⁷ *Falcon* no. 1, 1975 and no. 1, 1977.

⁴⁹⁸ *Falcon* no. 2, 1976.

⁴⁹⁹ About Wigstøl’ view of the company and management, *Falcon* no. 1, 1972. Interviews with Erling Stensholt and with Øivind Hushovd 10/04/2002.

⁵⁰⁰ *Falcon* no. 1, 1972.

⁵⁰¹ Minutes of Falconbridge Nikkelverk board, meeting 17/11/1972.

⁵⁰² Tor Are Johansen, *Krafttak, Kjemisk Forbund 1973-1998*, Gjøvik 1999, page 95.

⁵⁰³ Information about wage growth is from interviews with Salve Sløgedal, *Falcon* no. 3, 1973 and *Falcon* no. 3, 1976. Adjustment for inflation is from SSB, *Historisk statistikk 1994*, table 12.4.

⁵⁰⁴ Minutes of negotiation meetings in Falconbridge Trade Union 1979-80. Interviews with Arnfinn Eikaas 24/01/2003 and with Bjørn Enes 12/02 and 13/02/2003. See also Tor Are Johansen, *Krafttak, Kjemisk Forbund 1973-1998*, Gjøvik 1999, pages 129-31.

⁵⁰⁵ Bjørn Enes, ”Sørlandsk maktskisse”, i J. Knutsen and H. Skjeie (eds.), *Hvit stakitt og fiberoptikk*, Kr.sand 2002, page 293.

⁵⁰⁶ Interviews with Salve Sløgedal, *Falcon* no. 3, 1973 and *Falcon* no. 3, 1976. Interview with Jacob Sørensen 23/09/2002.

⁵⁰⁷ Minutes of Falconbridge Nikkelverk board, meeting 01/03/1976. The minutes give the saving as regards the plants’ total production costs, i.e. 25%. As 20% of the matte went through the ML-plant (which remained unchanged for the time being), the total saving compared with the Hybinette-plant must have been almost 33%. In addition to this, there were the costs that were the same for the Hybinette-and the CL-processes: loading and unloading, refining noble metals, administration, etc. The saving for nickel and copper refining itself must therefore have been significantly higher than 33%.

⁵⁰⁸ E. Pedersen, A. Høgetveit, Aa. Andersen, ”Cancer of respiratory organs among workers at a nickel refinery in Norway, *International Journal of Cancer*, no. 12, 1973, p. 32ff. Se også Øyvind Bjørnson, *100 år for bedre arbeidsmiljø*, Oslo 1993, p. 201ff.

⁵⁰⁹ Aagot Løken, ”Lungecarcinom hos nikkelarbeidere”, *Tidsskrift for den norske Lægeforening*, nr. 70 1950, p. 376-78. Report by Karl Wulfert of the Labour Inspectorate (from the inspection of Falconbridge Nikkelverk 1955), copy from the medical office, Falconbridge.

⁵¹⁰ Tor Are Johansen, *Krafttak, Kjemisk Forbund 1973-98*, Gjøvik 1999, p. 88.

⁵¹¹ Samtale med Bjørn Enes 10.02.1998.

⁵¹² Report by Karl Wulfert 1955.

⁵¹³ Report by Karl Wulfert 1955. In the 1950s, Professor Leiv Kreyberg also warned about the risk of cancer at Falconbridge and he informed both the management and the Labour Inspectorate about this. Kreyberg later claimed that ”the company physician asked him to be careful when he mentioned these cases.” *Arbeiderbladet* 10/03/1984.

⁵¹⁴ Øyvind Bjørnson, *100 år for bedre arbeidsmiljø*, Oslo 1993, p. 203-04.

⁵¹⁵ Orientering 0/05/1969 and 07/02/1970, F.vennen 20/01 and 10/02/1970, *Falcon* no. 1, 1970. Pål Thonstad Sandvik, *Kristiansand bys historie 1945-99*, Kr.sand 1999, p. 427.

⁵¹⁶ Øyvind Bjørnson, *100 år for bedre arbeidsmiljø*, Oslo 1993, p. 205.

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- ⁵¹⁷ Minutes Falconbridge Nikkelverk board, meetings 19/09 and 17/11/1972. Meeting with Ivar Andersen 05/12/2001.
- ⁵¹⁸ Meeting with Ivar Andersen 05/12/2001.
- ⁵¹⁹ Øyvind Bjørnson, *100 år for bedre arbeidsmiljø*, Oslo 1993, p. 207.
- ⁵²⁰ Aa. Andersen, S. Berge, A. Engeland, T. Norseth, "Exposure to nickel compounds and smoking in relation to incidence of lung and nasal cancer among nickel refinery workers", *Occupational Environment Medicine* 1996, s. 708-13. Tom Grimsrud, "Lungekreft blant norske nikkelverksarbeidere", *Norsk Epidemiologi*, 2001, p. 171-76. Tom Grimsrud, "Nye undersøkelser av kreftrisiko blant nikkelarbeidere", *Falcon*, no. 1, 2003.
- ⁵²¹ Tom Grimsrud, "Nye undersøkelser av kreftrisiko blant nikkelarbeidere", *Falcon*, no. 1, 2003.
- ⁵²² Tor Are Johansen, *Krafttak, Kjemisk Forbund 1973-98*, Gjøvik 1999, s. 65ff. Petter Innvik and John Kamsvåg, *Verket, Sunndal Verk gjennom 40 år*, Sunndal 1993, p. 204. John Kamsvåg, *Kjemisk, Årdal Kjemiske Fagforening 1947-1997*, Årdal 1997, p. 97-101.
- ⁵²³ Finn Resmann, "Tidligere arbeidsforhold ved bedriften", rapport til E. Wigstøl 01.03.1984. Øyvind Bjørnson, *100 år for bedre arbeidsmiljø*, Oslo 1993, p. 206.
- ⁵²⁴ Arne Johan Finne, "Jubileumsbok", note 2003.
- ⁵²⁵ This and the previous paragraphs have been based on conversations with Finn Resmann 23/01/2003 and with Steinar R. Berge 21/02/2003 and per e-mail from Terje Næss 07/03/2003.
- ⁵²⁶ Minutes of meeting from Falconbridge Arbeiderforening 1975-82.
- ⁵²⁷ Conversation with Arnfinn Eikaas 24/01/2003 and e-mail from Terje Næss 07/03/2003.
- ⁵²⁸ Conversations with Bjørn Enes 12/02 and 13/02/2003.
- ⁵²⁹ Conversations with Arnfinn Eikaas 24/01/2003 and with Bjørn Enes 12/02 and 13/02/2003. *Arbeiderbladet* 12/03, 05/09 and 20/09/1984.
- ⁵³⁰ About the problems at Slemmestad refer to Øyvind Bjørnson, *100 år for bedre arbeidsmiljø*, Oslo 1993, p. 318ff. About the action for damages at Slemmestad and Falconbridge, refer to Tor Are Johansen, *Krafttak, Kjemisk Forbund 1972-98*, Gjøvik 1999, p. 78-81. Conversations with Arnfinn Eikaas 24/01/2003 and with Bjørn Enes 12/02 and 13/02/2003. *Arbeiderbladet* 16/03/1985.
- ⁵³¹ Conversations with Milton Hartveit 24/06 and with Arnulf Grønvold 24/06/2003.
- ⁵³² J. H. Christiansen, "Skader i tall og ord", *Falcon* no. 1, 1970.
- ⁵³³ J. H. Christiansen, "Skader i tall og ord", *Falcon* no. 1, 1970. Conversations with Arnulf Grønvold 23/06/2003.
- ⁵³⁴ Minutes Falconbridge Nikkelverk board, meeting 17/09/1970.
- ⁵³⁵ Bredo Berntsen, *Grønne Linjer, Natur- og miljøvernets historie i Norge*, Oslo 1994, inter alia p. 149ff. Øyvind Nøttestad, *SFT, Fra forkynner til forvalter*, Oslo 2002, p. 10ff.
- ⁵³⁶ Presentation to a Select Committee of the Ontario Legislature by Falconbridge Jan. 4th 1978. Falconbridge's archives, Toronto.
- ⁵³⁷ This and the following two paragraphs have been based on Finn Resmann, "Sikkerhet og miljø", in Jørgen Skeie, etc., *Falconbridge Nikkelverk 1929-89*, Kr.sand 1989, p. 49-51, and on a conversation with Finn Resmann 23/01/2003 and also written material given to the author by Resmann.
- ⁵³⁸ Conversation with Finn Resmann 23/01/2003.
- ⁵³⁹ Conversation with Finn Resmann 23/01/2003.
- ⁵⁴⁰ Finn Resmann, "Sikkerhet og miljø", in J. Skeie, etc., *Falconbridge Nikkelverk 1929-89*, Kr.sand 1989, p. 51.
- ⁵⁴¹ Pål Thonstad Sandvik, *Kristiansands historie 1945-99*, p. 426 and 510.
- ⁵⁴² Conversations with Finn Resmann 23/01/2003, with Bjørn Enes 12/02 and 13/02/2003 and with Erling Stensholt 05/03/2003. Synnøve T. Danielsen, *Røyk fra pipa = Vekst og velstand?, Offentlig miljøpolitikk og Falconbridge arbeiderforenings ytre miljøarbeid*, History thesis, Univ. of Bergen 1993.
- ⁵⁴³ Mail to the author from Terje Næss 07.03.2003.
- ⁵⁴⁴ Synnøve T. Danielsen, *Røyk fra pipa = Vekst og velstand?, Offentlig miljøpolitikk og Falconbridge arbeiderforenings ytre miljøarbeid*, History thesis, Univ. i Bergen 1993.
- ⁵⁴⁵ Same place
- ⁵⁴⁶ Conversation with Finn Resmann 23/01/2003.
- ⁵⁴⁷ Øyvind Nøttestad, *SFT, Fra forkynner til forvalter*, Oslo 2002, p. 192ff.
- ⁵⁴⁸ Minutes of Falconbridge Nikkelverk board 01/03/1982, information from President H. T. Berry.
- ⁵⁴⁹ Falconbridge, Directors meetings 1982-89, meeting 01/06/1982. Falconbridge's archives, Toronto. Minutes of board meeting Falconbridge Nikkelverk 14/05/1982.
- ⁵⁵⁰ Annual Report Falconbridge 1982. Interviews with Sandy Allan, Mike Sudbury and Philip Thornhill 08/04/2002.
- ⁵⁵¹ Interviews with Sandy Allan 08/04/2002 and with Øyvind Hushovd 10/04/2002. Quote from Hushovd.
- ⁵⁵² Minutes of Falconbridge Nikkelverk board, meeting 27/08/1982.
- ⁵⁵³ Interview with Jacob Sørensen 23/09/2002. Minutes Falconbridge Nikkelverk board, meeting 27/08/1982.

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- ⁵⁵⁴ Interview with Wiggo Svendsen 13/02/2003.
- ⁵⁵⁵ Lars Erik Lyngdal, *Organisasjonsutvikling i teori og praksis*, TANO 1992, p. 47-48. Information from Erling Stensholt and Realph Høy-Pettersen in the book committee meeting 12/03/2003.
- ⁵⁵⁶ This and the following paragraphs are based on information in Annual Reports Falconbridge 1983-89 and interviews with Philip Thornhill 08/04/2003 and with Øyvind Hushovd 10/04/2002.
- ⁵⁵⁷ Mail from Øyvind Hushovd 22/06/2003. Interviews with Erling Stensholt 02/06 and Jørn Jacobsen 17/06/2003. About ore exploration, refer to *Falcon* no. 1 1977.
- ⁵⁵⁸ Minutes of Falconbridge Nikkelverk board, meetings 08/03 and 13/10/1988.
- ⁵⁵⁹ Joseph R. Boldt jr, *The Winning of Nickel, Its Geology, Mining, and Extractive Metallurgy*, London 1967, p. 425ff. Mail from Philip Thornhill 08/11/2002. Interviews with Erling Stensholt.
- ⁵⁶⁰ Minutes of board meeting Falconbridge Nikkelverk, meetings 1984-87. Jørgen Skeie, etc., *Falconbridge Nikkelverk A/S i femti år*, Kr.sand 1989, p. 38-39.
- ⁵⁶¹ Interview with Erling Stensholt 11/02/2003.
- ⁵⁶² Annual report Falconbridge 1989.
- ⁵⁶³ E. Stensholt, H. Zachariassen, J. H. Lund and P. Thornhill, "Recent improvements in the Falconbridge nickel refinery", *Extractive Metallurgy of Nickel and Cobalt 1988*.
- ⁵⁶⁴ Informed by Jørn Jacobsen 19/03/2003.
- ⁵⁶⁵ Interview with Øyvind Hushovd 10/04/2002.
- ⁵⁶⁶ Interview with Jørn Jacobsen 19/12/2003.
- ⁵⁶⁷ Interview with Erling Stensholt 02/06/2003.
- ⁵⁶⁸ Arne Johan Finne, "Jubileumsbok", note 2003.
- ⁵⁶⁹ Articles about Raglan and Collahuasi in Falconbridge Annual Report 1997, p. 10ff.
- ⁵⁷⁰ Interview with Jan Børge Andersen 01/04/2003.
- ⁵⁷¹ Minutes of Falconbridge Nikkelverk board, meeting 27/03/1990 and 13/11/1990.
- ⁵⁷² Minutes of Falconbridge Nikkelverk board 22/05/1991.
- ⁵⁷³ Minutes of Falconbridge Nikkelverk board 21/06/1994.
- ⁵⁷⁴ Interview with Ed Henriksen 02/06/2003.
- ⁵⁷⁵ Falconbridge Directors Meetings 1974-82, meeting 28/02/1979, Falconbridge Archives, Toronto. *Arbeiderbladet* 17/08/1979.
- ⁵⁷⁶ Told by engineer Halvor Rykkelid. He heard the story from eng. Leif Røed, who was standing beside Buaas when this was said. However, Rykkelid is a little uncertain about whether the quote is completely correct or whether it was said in jest. He cannot imagine that Grønningsæter would seriously have encouraged anyone to swear. The author also finds it difficult to believe that the roasting furnace could have been built without Hardy's approval. However, the anecdote tells something about how the engineers at the refinery perceived the relationship with the head office.
- ⁵⁷⁷ Letter from Grønningsæter to Steen 12/12/1956 in box 494, Steen's correspondence with Grønningsæter.
- ⁵⁷⁸ Sverre Christensen, "Conceptualization of different sorts of subsidiaries", unpubl. manus. 2001. Joseph D'Crutz, "Strategic Management of Subsidiaries", i H. Etemad and L. S. Dulude (ed.), *Managing the Multinational Subsidiary*, London 1986, p. 134. Robert Pearce, "The evolution of technology in MNE, the role of creative subsidiaries", in *International Business Review 8-1999*, p. 125-28.
- ⁵⁷⁹ This has also been dealt with in P. Sandvik and E. Andresen, *Kristiansand Energiverk i elektrisitetsens århundre, 1900-2000*, Kr.sand 2000, p. 50-51, 127ff and 138-39.
- ⁵⁸⁰ For criticism against Falconbridge see John Deverell, *Falconbridge, A Portrait of a Mining Multinational*, Toronto 1975. For Falconbridge in Sudbury see C. M. Wallace and Ashley Thompson, *Sudbury, Rail Town to Regional Capital*, Toronto 1993. The indignation against external criticism is indicated now and then in the company's minutes from directors' meetings, Falconbridge Directors' Meetings 1974-1989, Falconbridge Archives, Toronto.