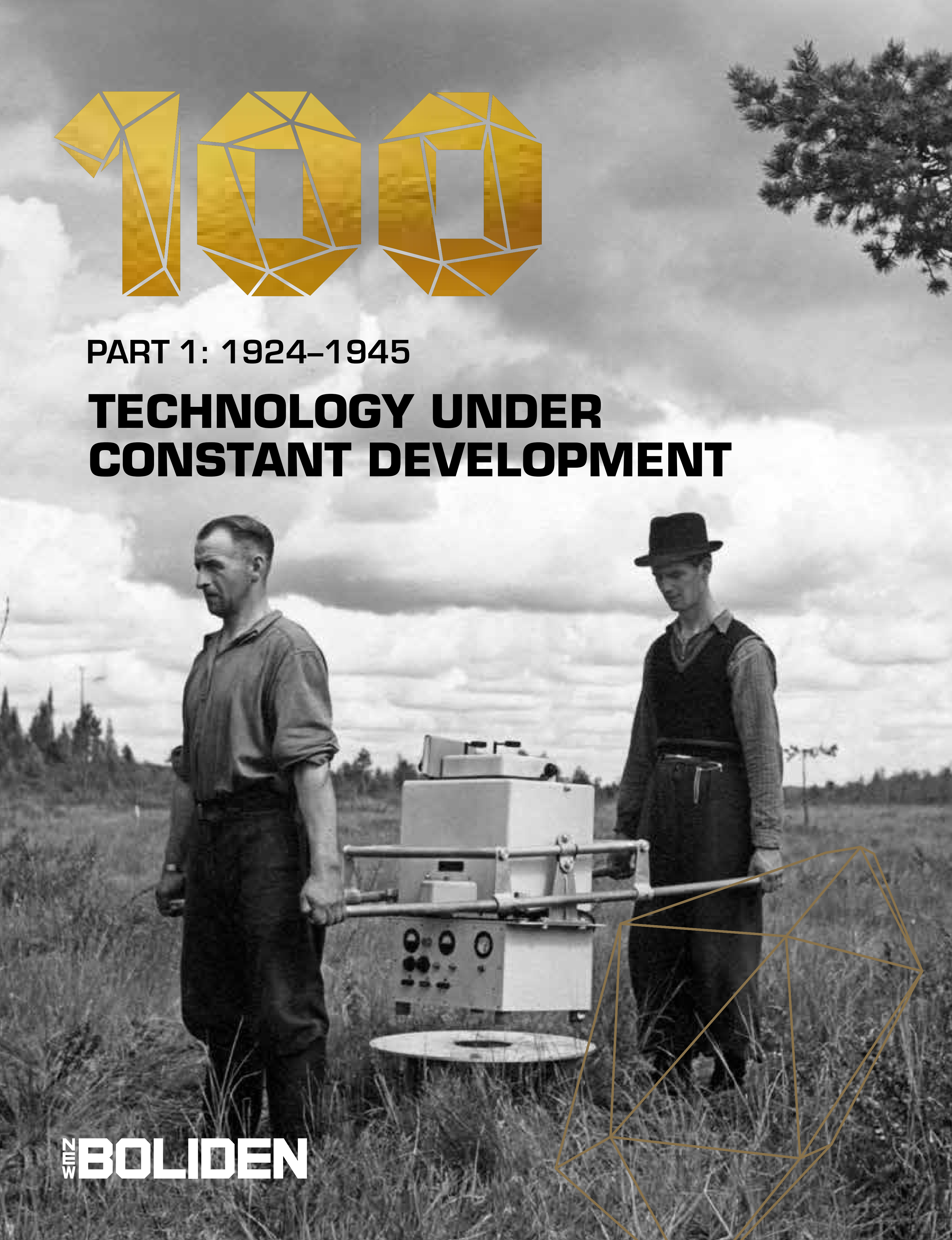

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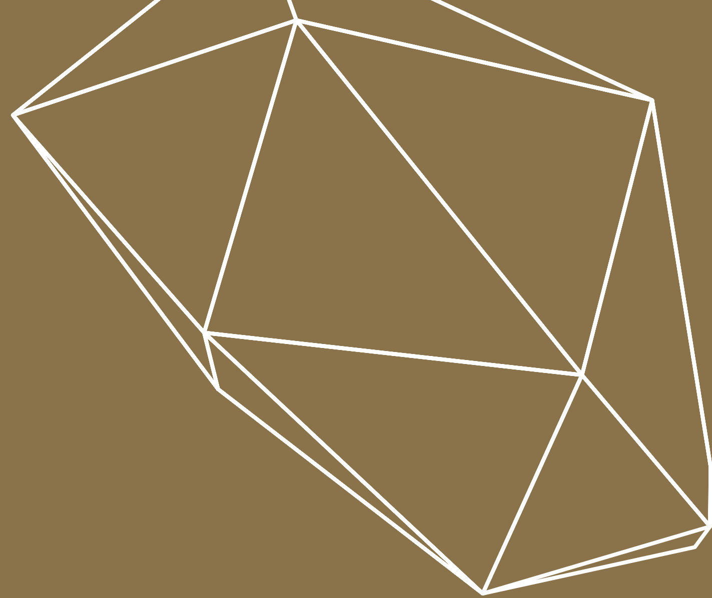
PART 1: 1924–1945

TECHNOLOGY UNDER CONSTANT DEVELOPMENT

NEW BOLIDEN



100
BOLIDEN 1924–2024

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Boliden 100 years, Part 1
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Our time is now

Humanity has used rock throughout the ages. The oldest gold objects discovered are more than 6,000 years old. Our history is naturally substantially shorter, but in our own times Boliden has had an enormous impact, especially in all the places where we operate and used to operate. One can hardly imagine Odda without zinc production, Harjavalta without its copper, Skellefteå without Boliden and all the other places that have flourished and developed thanks to Boliden's mines and smelters.

So let us summarize our 100 years of operation. Countless shifts began and ended, the rock's riches were harvested, and at the beginning of the value chain, the community benefited in various ways. We are part of the modern industrial history of Sweden, Finland, Norway and Ireland. In good times and bad, our employees at every level have been determined for our business to continue, and there was many a time when precisely that commitment gave our business new possibilities. Perhaps the most important reason for Boliden's being where it is today are the strong links we all have to the communities to which we have belonged. It's something to be proud of and continue developing.

This is also an occasion to look forward to all the shifts we have ahead of us. The world we operate in today is different from what came before, and in all likelihood, tomorrow's world will be different from today's. But our mines and smelters will continue to form an important part of developments and will continue producing metals that generations to come can use for the benefit of society. Just like we always have.

Mikael Staffas
President & CEO

Photo: Jeanette Hägglund

"

There cannot be many Swedish industrial companies that have had such unusual problems and outcomes as Bolidens Gruvaktiebolag.

Oskar Falkman, Boliden's first CEO
(Read more on page 56).

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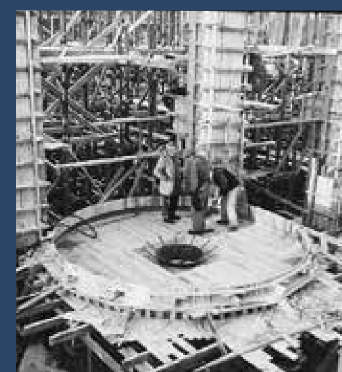
“How could I leave the laboratory when everything was so exciting?

Read more about Thelma Berggren on page 54.

The Boliden family

Because Boliden's mines and smelters were integrated into the Group at different points in time, their histories differ in length.



1924 1925 1930 1957

BECAME PART OF BOLIDEN

Boliden **Rönnskär** **Garpenberg**

FOUNDED

◄400 B CE Garpenberg

1942 Bergsöe

1936 Harjavalta

1924 Odda

1968
1979
2003
2016
2024

Aitik

Bergsöe

Harjavalta
Kokkola
Odda
Tara

Kevitsa

1969 Kokkola

1977 Tara

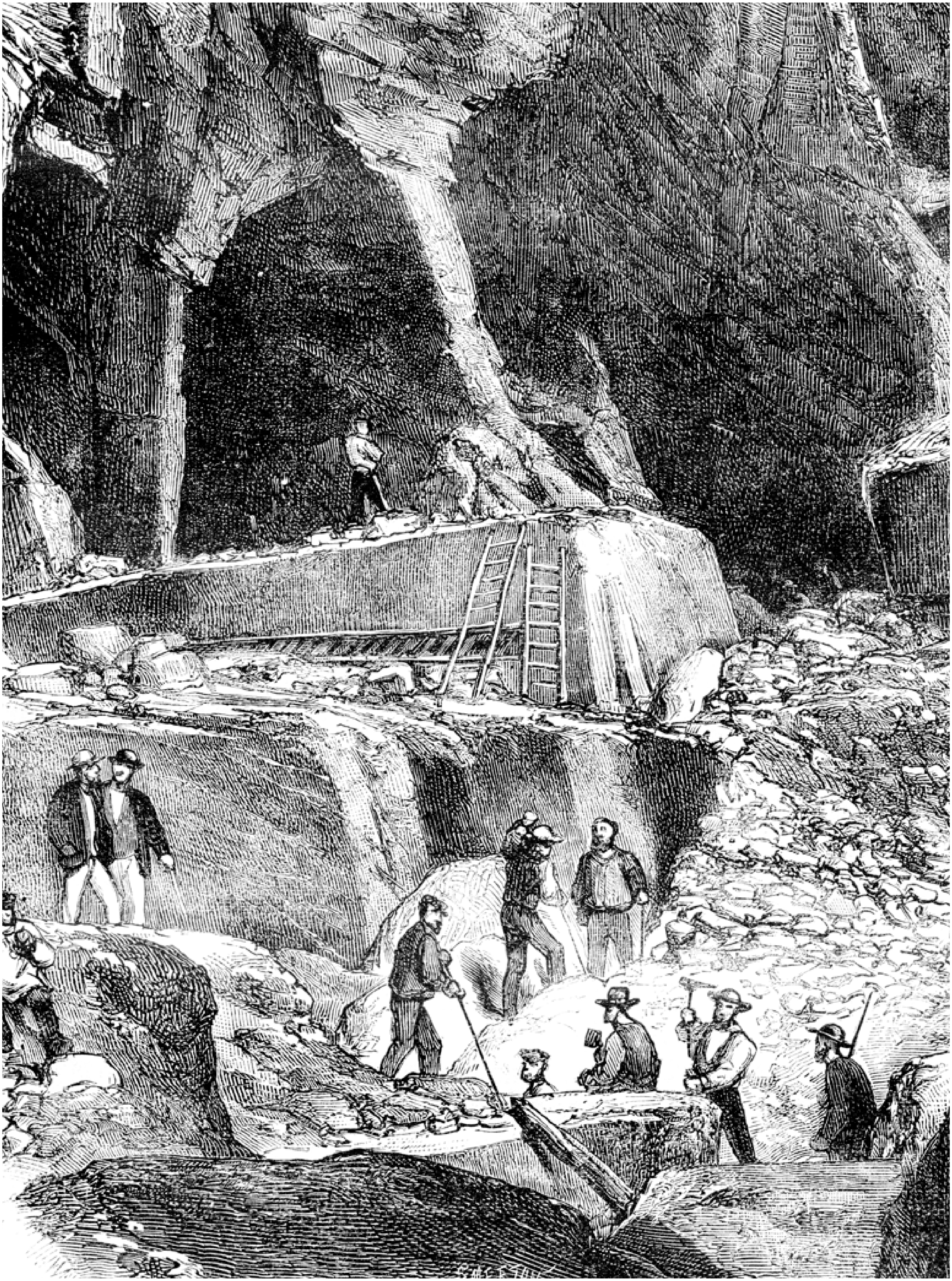
2012
Kevitsa

THE EMERGENCE OF METAL PRODUCTION

Text: Dag Avango, history professor at Luleå University of Technology

In Sweden, the industry we call mining can be traced back at least to the early 12th century. It's from this time that the earliest datings of blast furnish operations originate, from Lapphyttan in Bergslagen in southern Sweden. Rock ore mining was contingent upon blast furnaces, without which it was not possible to achieve sufficiently high temperatures to melt the predominant types of rock in Sweden and thereby separate rock and metal for further processing. The landscapes in mineral-bearing areas in the southern part of Sweden show traces of the mining industry that emerged during the Middle Ages. The traces take the form of many small open pits with the characteristic rounded rock shapes that occur when ore is extracted by loosening rock by heating it, before quickly cooling it to cause it to fracture.

The Swedish mining industry and metal processing underwent a rapid expansion during early modern times. Iron and steel production was developed and Swedish bar iron gradually gained a dominant position on the European market. At the same time, the government and the crown demanded copper and precious metals whose value could help create a strong state and fund wars in the Nordic countries and the European continent. The government not only took the initiative to begin mining, but also to control and develop the industry through legislation and the establishment of a Royal Mining Council in 1630. The ownership structure was changed during



Mining and metal production grew to become one of Sweden's most important industries.

the 17th century. Mining had long been run by independent miners organized into mining corporations, but was gradually taken over by more financially strong players. Mining and metal production grew to become one of Sweden's most important industries.

It was not limited solely to the area located within the borders of today's Sweden. Ironworks were also established in the eastern half of the country, in present-day Finland. Mining also emerged in Norway from the Middle Ages to early modern times, with mining communities that are well known today such as Röros.

The industrial breakthrough

The industry's long period of continuity and government involvement in it, meant that mining was in a strong position at the time of the industrial breakthrough in the middle of the 19th century. Industrialization was also the most important driving force behind the mining industry's evolution into one of Sweden's most important industrial sectors. With industrialization came an increasingly strong demand for metals, and the demand for steel and thus iron ore was especially great. But the demand for other base metals also increased with the industrial breakthrough. From the end of the 19th century this applied especially to copper. The increased demand for copper was driven by electrification, which formed an important part of the phase of industrialization usually referred to as the second Industrial Revolution. Thanks to its good qualities of electrical con-

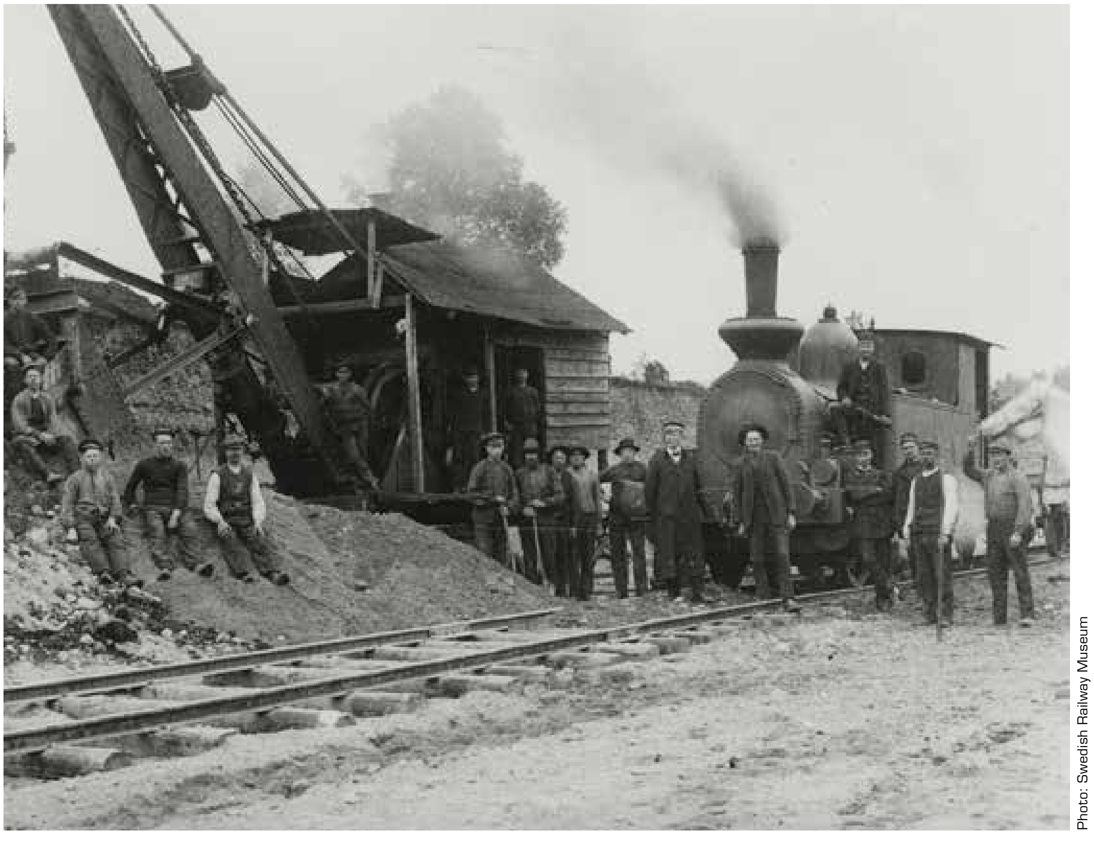


Photo: Swedish Railway Museum

Industrialization and the expansion of railroads in the middle of the 19th century is strongly linked to the development of the mining industry.

ductivity, copper became an important component in the major infrastructural systems built for telegraphy, telephony and for the generation and transmission of electricity. This development is one of the most important foundations for the expansion of mining in Sweden, of which the company Boliden formed part.

The increasing demand for metals in Sweden that industrialization brought with it was based on an equally dramatic increase in mining industry production. At the time of the industrial breakthrough, the mining corporations in southern Sweden were still the industry's core area. The iron ore mines and ironworks were located there. Foundries, copper mines and copper smelters were also located there. Older deposits such as Falu copper mine and the Dannemora mines were also of central importance. However, the increasing demand also led to an increased interest in mineralizations in other parts of the country, especially the northernmost. This was the beginning of a historic change process in which the mining industry's center of gravity was moved from the south to the northern part of Sweden. This change process was also an important condition for the establishment of Boliden.

Photo: Swedish Railway Museum

The establishment of Norrbotten's orefields also meant the founding of new communities such as Malmberget.

Knowledge building

A common characteristic for the early modern mining industry in the north was its small-scale nature. However, this promoted a view that the northern region was a raw materials repository whose job was to satisfy economic interests in the south. This perception was reinforced during the 19th century. In order to improve knowledge of the country's mineral occurrences, the government set up the Geological Survey of Sweden (SGU), which devoted significant resources to surveying the bedrock in northern Sweden. This knowledge-building along with the craze for the northern area contributed, in addition to profitability, to the rapid industrialization in the region in conjunction with the industrial breakthrough. From the middle of the 19th century, a large-scale forestry industry was established based on sawmills in the mouths of rivers and floatways from inland, and little-by-little also pulp and paper mills. From the 1880s onward, investments were made in the mining industry which at this time lacked comparison in Swedish history, leading to the establishment of the Norrbotten orefields. Towns were built for mine employees in Kiruna and Malmberget. To meet energy demand, the first hydroelectric station in the North was established in Porjus in 1915, allowing the ore railway to be electrified. In Boden, the government constructed Boden's Fortress, a large-scale defense system consisting of forts armed with heavy artillery, aimed at protecting the entire system against attacks from the east. These extensive investments laid the foundation for the continued expansion in the mining industry in which the company Boliden was established.

During this period, and driven by the same demand, the mining industry expanded in all mineral-bearing areas in the industrialized parts of the world. Interest in the potential of the northern area also increased. A gold-rush began in the Yukon and Alaska. A Danish company started a cryolite and copper mine on Greenland. Large-scale iron ore mining began in northern Norway, and in the Spitsbergen islands – today's Svalbard – companies from Europe and North America began coal mining.

1924–1945

THE BEGINNINGS OF A MINING COMPANY

The company Boliden has its roots in an issuing company known as the Centralgruppens Emissionsbolag. Much of the work during the company's first years concerned exploration, and the discovery that changed everything was made on December 10, 1924.

Text: Karin Jansson Myhr

The discovery of gold in Fågelmyran, just outside Bjurliden in Västerbotten County, enabled the start of the mine, which was given the name Boliden.

The company Boliden has its roots in an issuing company known as the Centralgruppens Emissionsbolag, which was formed in 1915 by the erstwhile Sveriges Privata Centralbank and 13 regional banks. A few years later, Sveriges Privata Centralbank merged with Skandinaviska Kredit (later Skandinaviska Banken). For the sake of simplicity, we will henceforth refer to this bank organization as Skandinaviska Banken.

Skandinaviska Banken was not only a shareholder in the issuing company, but also its creditor. The chairman of

Geologist Fritz Kautsky (center, in the dark coat) led many exploration projects. Seen here in Holmtjärn in 1924, a few months before the Fågelmyran discovery.

Centralgruppens Emissionsbolag was Skandinaviska Banken's CEO Oscar Rydbeck, and mining engineer Oscar Falkman was appointed the company's CEO when it was formed. The company had its head office on Västra Trädgårdsgatan in Stockholm.

An issuing company can be compared to a modern-day venture capital company. The company purchases a business (or in some cases starts one from scratch) to develop it and then sell it at a profit. On the initiative of Oscar Falkman, Centralgruppen began to show an interest in mines. The company's first mine acquisition, carried out in December 1916, concerned the Ädelfors-Kleva nickel mines, which were run on behalf of Centralgruppen until 1919, when the mines were sold.

During the final years of World War I, there was a shortage of metals in Sweden. Accordingly, after the war, the government began a campaign to invest in the country's base metal resources. The campaign was partially financed by Centralgruppen. Prospectors were trained who then began surveying the entire country. Following exploration investments by e.g. Austrian geologist Fritz Kautsky, the first gold discovery was made in Holmtjärn. Thanks to this discovery, the company could afford to continue exploration, and in December 1924 an even more important discovery was made in Fågelmyran. The location was 30 kilometers northwest of Skellefteå, immediately outside the community of Bjurliden – erroneously labeled as Boliden on the maps of the day. Specimens from the discovery were sent to the Centralgruppen laboratory in Ulvsunda outside Stockholm. Chemist Thelma Berggren not only found high grades of pyrite, copper pyrite and arsenic pyrite, but also a gold content of 15

▲▲ **Emissionsbolaget prospectors in the area of Bjurvattnet in 1923. From left to right: Magnus Widmark, Manfred Jonsson, John Nilsson, Bror Karlsson, Sten Lundgren, Manne Berglöv, Harald Burvall and Sven Stenman.**

▲ **One of the first regular trucks that hauled ore from Boliden.**

“ Because there was no other smelter in Sweden capable of concentrating the ore, the company was forced to send it to Germany or North America.

grams per metric ton. Fifteen grams is an incredible amount, given that ore that only contains three grams per metric ton is considered worth mining. This was extremely good news for Centralgruppen, which had certain financial weaknesses.

The owner of the land where Fågelmyran was located was one Margareta Lundberg. She was offered, and accepted, SEK 20,000 for the land. Centralgruppen could now begin the work of creating a mine, and in May 1925 they had demarcated the vertical orebody, which was 600 meters long and 40 meters across at its widest. Just under one year later, in March 1926, the first ore could be brought up from the mine.

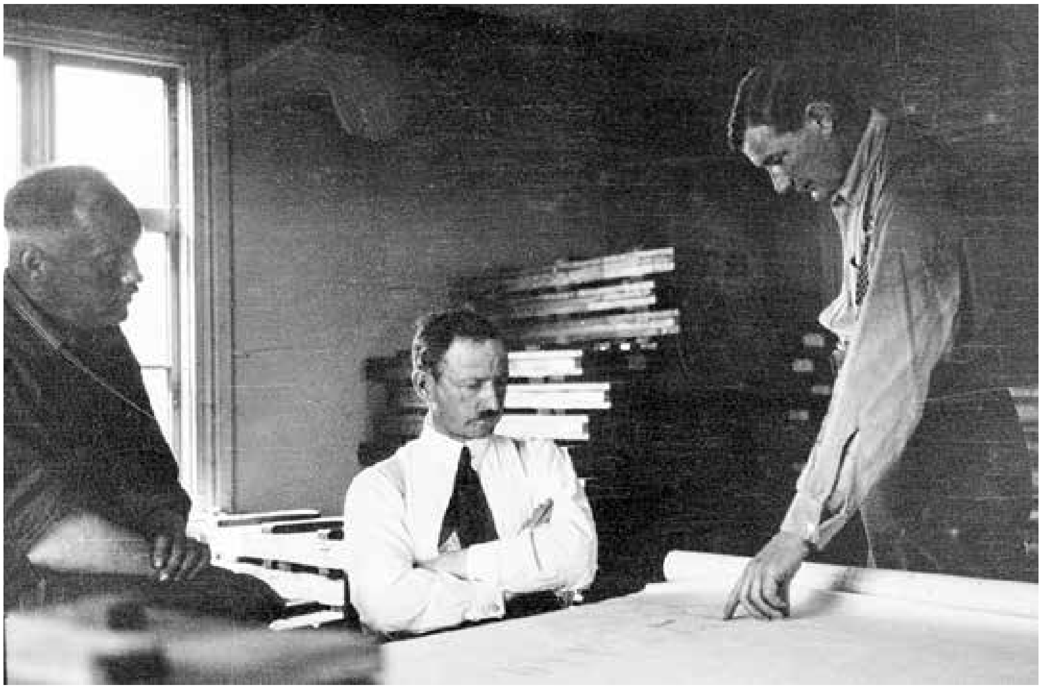
In 1925, Centralgruppen was taken over by Skandinaviska Banken, which then formed two mining companies, Västerbottens Gruvaktiebolag and Skellefteå Gruvaktiebolag. The companies had the same board and the same CEO – Oscar Falkman.

Haulage challenges

In common with many other mines, haulage was a challenge. The first loads were hauled by regular trucks, but this was not a sustainable solution. In the future, the ore would be hauled by railroad to the Port of Skellefteå for onward shipping. A railroad that the mining companies themselves constructed.

Because there was no other smelter in Sweden capable of concentrating the ore, the company was forced to send it to Germany or North America. Because this solution was also unsustainable, the mining companies resolved in 1928 to build their own smelter, which began operations two years later. On September 24, 1929, the first train departed for the company’s newly built smelter – the Rönnskär plant – which had been built outside Skellefteå.

Since then, Boliden has initiated several innovative haulage methods. The world’s longest cableway, inaugurated in



Chief geologist Olof Baeckström, director Oscar Falkman and mine manager Erik Wesslau in 1924.

1943, is one of them. The underground railroad in the Långsele mine is another. It was completed in 1955, and was then the world's deepest electric railroad for ore haulage.

In neighboring Finland, the state-owned mining company Outokumpu had been formed back in 1914 following the discovery of copper in Kuusjärvi four years earlier. They had already chosen to build a smelter close to the mine right from the beginning. However, because the smelter was not dimensioned for the amount of ore that could be mined, it was closed in 1929. Instead, Outokumpu, invested in the setup of several external smelters, e.g. in Imatra (the one that was later moved to Harjavalta).

Model community Boliden

A veritable gold-rush took place in northern Västerbotten following the major gold discovery. A new community had to be built to house the labor needed to exploit the deposit.

As early as 1925, the mining company began purchasing land in the vicinity of the mine, and the new community that began to emerge adopted the name Boliden. This became the first of many new rational communities established by the mining company when new mines went into operation. Other well-organized communities include Kristineberg, Laisvall and Laver.

Boliden was mainly established between 1925 and 1935 where the leading players were general manager Erik Wesslau, Oscar Falkman and the architect John Åkerlund. Located on a mountainside overlooking the mine, the garden town community of scattered wooden buildings was based on a town plan with streets, water mains, drains and lighting. At the very top of the slope

▲▲ Aerial photograph showing the community of Boliden in the 1930s.

▲ Boliden was built as a model community with homes of the highest standard. Finnforsvägen in 1946.

▲▲ Shaft tower in Boliden, 1934.

▲ Outokumpu's smelter in Imatra, Finland. It was dismantled and moved to Harjavalta in 1944.

was the mine manager's residence overlooking the community and the mine. A town square for public buildings and retail was built to the west of the mine manager's residence. The town streets proceeded below the square in the shape of a fan, where they purposely followed the slope's contours. Single-family homes for white-collar workers were built along the streets, with workmen's dwellings closer to the mine manager's residence. However, they were located in different areas, as was customary in company towns.

The workmen's dwellings maintained a high standard for the times concerned. They were certainly no workers' barracks. The homes were primarily duplex houses with two rooms and a kitchen on the first floor for one family. The second floor held two gable rooms, which the family could rent if they wished. But as a rule, they were used to accommodate bachelors who worked in the mine in order that they not gather in one place. The homes all came with piped heating, running water and drains. Pretty soon, newfangled electric stoves would be installed. However, while there were no bathrooms in the workmen's dwellings, there were in the owner-occupied homes.

Boliden was a modern rural industrial community with such things as a school, public baths, a civic center and a library. Residents gladly took part in various associations, politics and the temperance movement. At their most almost 3,000 people lived here.

The Kreuger Affair could have ended in catastrophe

As mentioned, the Emissionsbolag's business idea was to invest in a business, develop it and then sell it on. Accordingly, in December 1929, around 90 percent of the shares in the mining companies Västerbottens Gruvaktiebolag and Skellefteå Gruvaktiebolag were sold to financier Ivar Kreuger, who had built up an international match and finance empire. The year after the sale, the two companies merged, adopting the name Boliden.

Kreuger's plans for the Boliden ore was primarily to earn money. Fast. As the principal owner, he convinced the company board that the ore should be mined significantly faster than planned. It would mean exhausting the mine after just 12.5 years instead of 37. This would be devastating for the entire community that had grown up around the mine, as well as the smelter at Rönnskär. As pointed out by the company's CEO, Oscar Falkman, the decision was wrong in both socioeconomic and environmental terms. This fell on deaf ears. But on March 12, 1932, Ivar Kreuger committed suicide in a hotel room in Paris. Kreuger's Empire proved itself to be a giant with feet of clay, and it rocked the Swedish economy. However, this tragic event became Boliden's glimmer of hope. Kreuger's aggressive mining plans were consigned to the trash can.

And now Kreuger's Boliden shares were for sale. The official receiver had considered the possibility of selling the shares to a foreign company. But both the then social democratic prime minister Per Albin Hansson and the conservative leader Arvid Lindman (formerly the CEO of LKAB) agreed that this should not take place. Instead, a law known as Lex Boliden was introduced that limited the opportunities for foreign players to become owners of Swedish natural resources. Kreuger's Boliden shares were sold instead by public auction in 1934. The shares were pledged with Skandinaviska Banken, which now also became the owner. The bank would remain so until July 7, 1952 when Boliden was listed on the stock exchange.

More mines in times of crisis

Boliden was not the only place in Sweden where the company established mines. Boliden (or rather the Centralgruppens Emissionsbolag) began its geological ore survey in 1921 in the Skellefte ore field, and subsequently continued in the Västerbotten mountains. At the end of the 1920s, they also began exploring further south, on the border between the counties of Dalarna and Hälsingland.

Gold, silver and copper was extracted from the Boliden mine from 1925 until 1967. The mine in Kristineberg was opened in 1940, where copper, zinc, lead, gold and silver were extracted. The mine is still in operation. In Lainijaur, Boliden mined nickel and copper between 1941 and 1945, and in Laisvall lead, zinc and silver from 1943 right up until 2001. Boliden began mining copper, gold and silver in Laver in 1938, and did so until 1946.

One of the reasons for the increased interest in metals were the blockades associated with World War II. The Swedish defense industry needed copper, lead and nickel. Lead was essential, especially for ammunition. Hitherto, the government (through the Geological Survey of Sweden) and the Boliden company had each conducted their own ore exploration. They now began to collaborate instead.

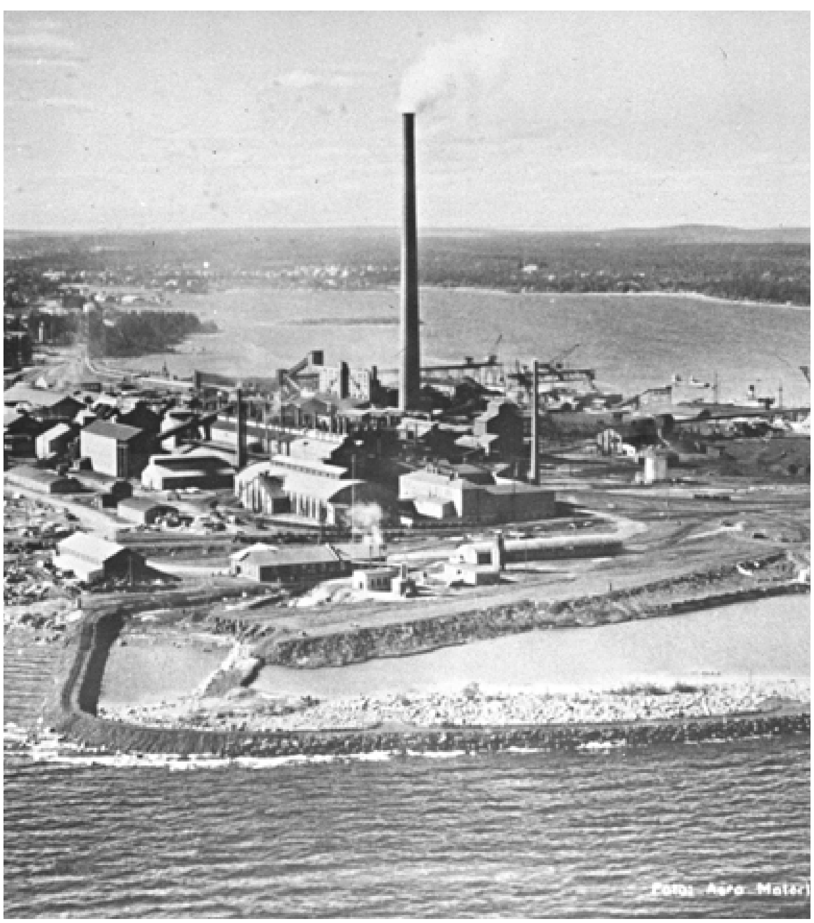
Workers could take the train all the way into the smelter area on Rönnskär. Image from 1946.

Previously, Sweden had imported all of its lead, but that possibility was now severely restricted. The year before the outbreak of war, Boliden had discovered the deposit in Laisvall, and in consultation with the Swedish government it resolved to begin mining ore there and to build a lead smelter on the island of Rönnskär. They also needed to build a power station in the vicinity to secure a power supply.

Because there was also a lack of coke during the war, Boliden created its own method by using electricity in the shaft furnace. Known as the Boliden Method, it was developed by Prof. Bo Kalling, inventor of the top-blown rotary furnace, and Boliden engineer Gustaf Tanner.

Companies such as Boliden, with mines and metal production, were especially important for Sweden during the war. The company itself had no control over the many production decisions, as they were taken on political grounds. Before the outbreak of war, Germany was one of Sweden's biggest trading partners, and Sweden was very dependent on imports from Germany. This exchange continued for several years into the war, and was subsequently widely criticized. This was a difficult balancing act for Swedish politicians and business leaders. But as the war wore on, this exchange grew ever smaller.

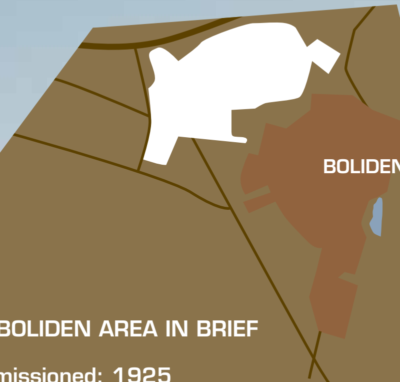
During the war, in 1943, Oscar Falkman retired and left Boliden, a company he had served for 28 years. He was succeeded by Erik Bengtsson. Bengtsson and Falkman did not see eye-to-eye, but on the other hand, Bengtsson was popular among the employees. And it was Bengtsson who moved Boliden's head office from Stockholm to Rönnskär.



◣ **Aerial photograph of Rönnskär in 1938.**

▼ **Workers by the big smokestack on Rönnskär in 1928.**

▼▼ **Electric trains were used in the Laisvall mine. Image from 1961.**



THE BOLIDEN AREA IN BRIEF

Commissioned: 1925

Operation: underground mining

Minerals mined: zinc, copper, lead, gold, silver and tellurium

Number of employees: 691 (2023)

Photo: Jonas Westling

In focus: Boliden Area

The Boliden Area in Västerbotten was created 100 years ago when the gold deposit lay the foundations for the business that continues to this day. It's a business that has provided gainful employment for generations, developed the mining industry and built several communities.

Text: Sara Johansson

Ore has been extracted from almost 30 different mines in the Boliden area since the beginning of production in the middle of the 1920s. Today, the area is home to the Renström, Kristineberg and Kankberg underground mines. The first two mines mentioned produce complex ore, which contains zinc, copper, lead, gold and silver. In addition to gold, tellurium, which is used for e.g. the manufacture of solar cells, is mined in Kankberg. The area also has a concentrator and a leaching plant for gold and tellurium production. The concentrate is then delivered to Boliden's own smelters, to lead smelters in Europe and tellurium customers in Asia.

Renström in the Boliden region is Sweden's deepest mine. In January 2019, it surpassed a depth of 1,500 meters. This is equivalent to just over four Eiffel towers on top of each other. However, Kristineberg is not far behind. Ore is currently being mined at a depth of 1,350 meters.

Gold fever and model communities

The discovery of gold in Fågelmyran in the Skellefte orefield on December 10, 1924 was the starting point for a long, successful mining operation. The discovery was Europe's biggest and led to gold fever in the region. But it was certainly not by chance that gold was found right

▼In the past, there was also an open pit in the Boliden Area. Image from the 1940s.

there. Exploration work had begun many years earlier and a number of good discoveries had been made that allowed the company to continue searching for gold-bearing ore. The land where the discovery was made was initially owned by a widow whose name was Margareta Lundberg. (You can read more about her in a separate article). Boliden's predecessor, Centralgruppens Emissionsbolag, purchased the land, and on March 16, 1926 the first barrel of ore could be hoisted to the surface. However, by then Centralgruppen had already formed two new mining companies, Skellefte Gruv AB and Västerbottens Gruv AB. Finally, in 1931, Boliden AB was formed through a merger of the two earlier companies.

As the mine was built up, people from many different places were attracted to the area. The community of Boliden rapidly developed close to the mine to house everyone who worked there. In 1926 a set of town plans was proposed, which showed the town laid out in the unique shape of a fan. The mining community took on the character of a well-organized, peaceful and idyllic residential area. Not only were major resources invested in homes, but also in schools, a bath house and other community buildings. Boliden's first CEO, Oscar Falkman, was the personification of what came to be known as The Boliden Spirit, which involved taking greater responsibility for things other than just business. You can read more about Oscar Falkman in a separate article.

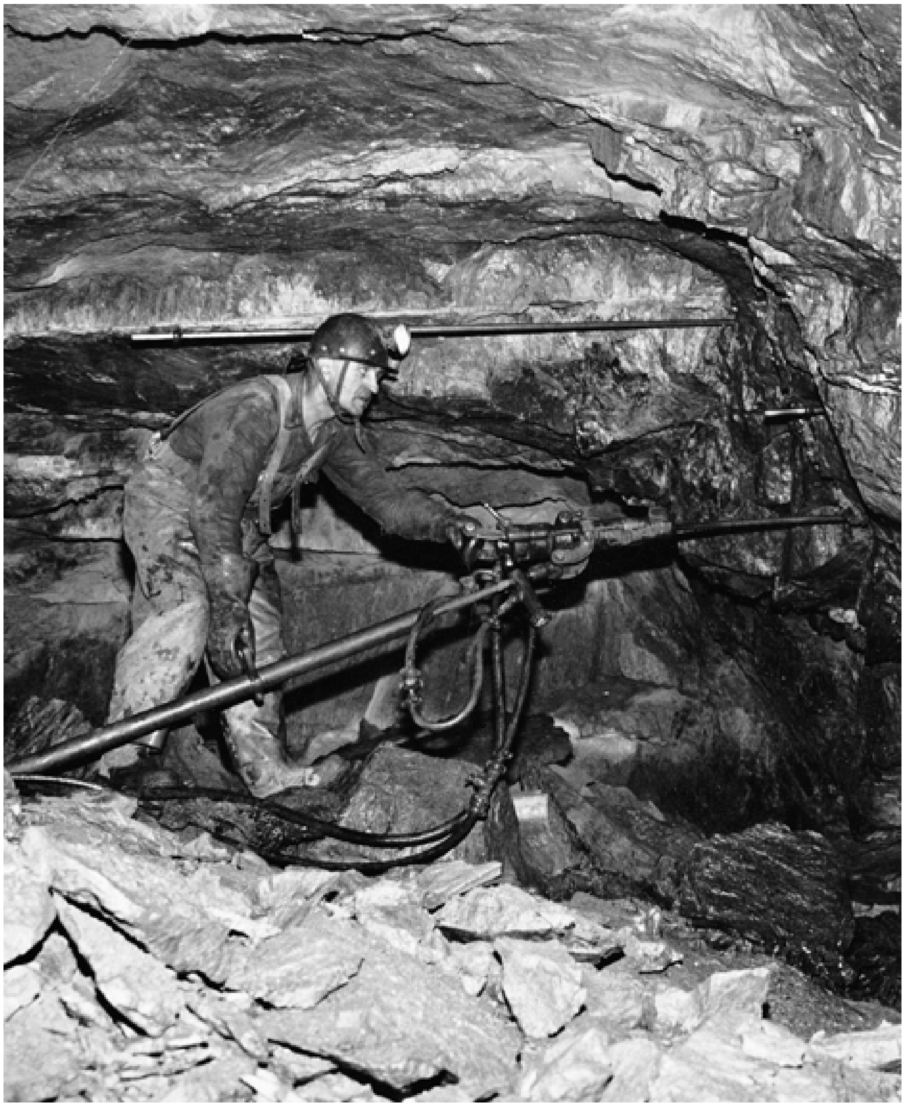
Operations in the original Boliden mine continued up until 1967. Over time, more deposits were discovered close to Boliden and more mines were opened. Similar model communities were built around other mines in the vicinity such as in Laisvall and Laver.

Complex ores, complex milling

When a company has as many different mines in operation in such a widespread geographical tract as the Boliden Area, it's not possible to build concentrators everywhere. There have been a few in close connection to the mines such as in Kristineberg, but these days, ore is hauled from across the entire area to one single location. Concentrator personnel there have learned to handle the various complex ore compositions. Because it's not possible to mix different types of ore, they work with campaigns, i.e. in periods where only one type of ore at a time is treated before they switch to the next. Also, because the ore extracted today

Having a large number of mines also involves meeting stringent reclamation requirements.

Drilling with a handheld unit in the Renström mine.



The large grinder in the concentrator.

contains lower mineral grades than those found 100 years ago, the concentration process must constantly become more efficient.

Having a large number of mines also involves meeting stringent reclamation requirements. The way we take care of closed mines has changed significantly over the years. Today, we take responsibility for the environment in ways that were not relevant in times past.

Innovations and positivism

Boliden has come through a number of crises. However, most of them were solved with the help of our enterprising, innovative employees at every level of the company. Our employees bear witness to a positivism and a we-can-fix-it mentality in the area. When there was a shortage of ore at the end of the previous decade, they figured it should be possible to process the concentrate that had been deposited in a tailings pond since the 1950s. But how would they extract the concentrate from the pond? They waited until the pond froze before carving out blocks of ice that were then crushed and milled.

Many innovations have arisen through exploration and the mining area. A typical example is the electromagnetic technology developed at the end of the 1970s that enabled prospecting for ore at greater depths (more about this in a separate article). A number of innovations born out of the mine have also led to successful spin-offs from Boliden.

Safer and more efficient

Today we use remotely controlled machines to an increasing extent for work underground. Operators maneuver them from a safe distance from the mine face and thereby avoid occupational risks. In addition to enhanced safety, efficiency is also improved. However, it places entirely different demands on today's miners. The image of the grubby, muscular miner continues to fade. Today's well trained operators come in every shape and size and an increasing number of women are attracted to the work (even though they remain a minority).

Life outside the mine has also changed. For employees in the Boliden Area, life no longer revolves solely around the mine and the community, the sports associations and other things built by the company following the 1924 discovery. In the middle of the 1960s, responsibility for the town of Boliden was transferred to the municipality, and today many people commute from Skellefteå or other surrounding towns.

In focus: Garpenberg

Garpenberg in Dalarna is one of the world's most modern mines. At the same time, the site of the mine is Sweden's oldest mining area where operations still continue.

Text: Sara Johansson

The mine in Garpenberg has a history that few others can equal. For a long time, people believed that mining began during the 13th century, but research by Umeå University has shown that some form of mining operations took place in Garpenberg as early as 375 BC. Thus Garpenberg is Sweden's oldest mine still in operation.

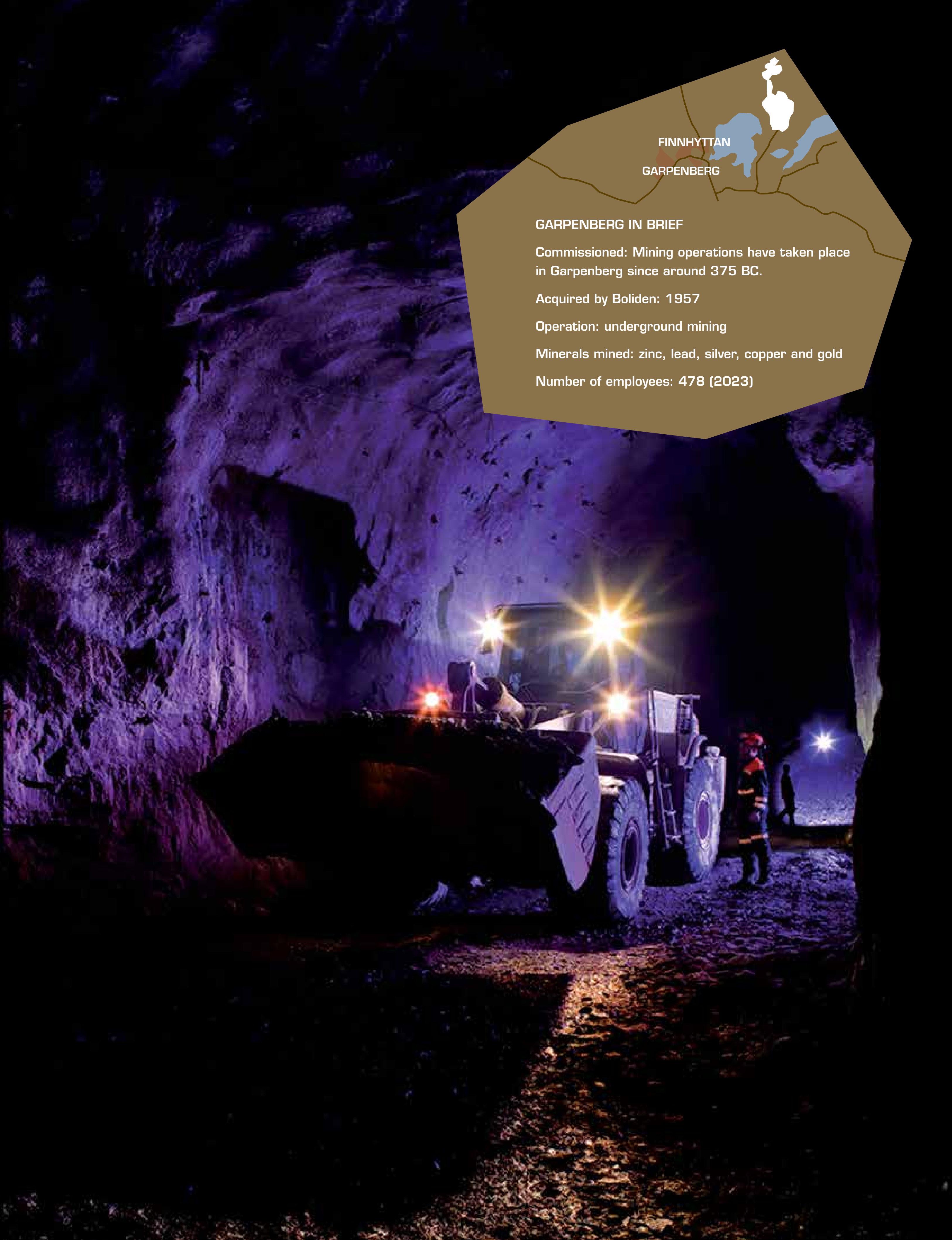
This creates a sense of pride beyond the ordinary and also gives today's owner Boliden a different perspective. Thus in modern times, we can look back across generations of miners, often within the same families.

The Germans were 'Garps'

During the 14th century, professional German miners were engaged to teach efficient mining methods. Local residents called the Germans 'Garps', which gave the village of Garpenberg its name.

When Gustav Vasa ascended the throne in 1523, he decided that Swedish mining should be developed, and as of 1553, the mine was run as a state-owned business. This changed at the end of the 1630s when mining was transferred to the merchant Thomas Funck from Stockholm. The Funck family ran the factory and mines until 1768, before it went bankrupt. Over the next 100 years, the mine would be operated by other families, and thereafter in the form of a company. Profits could be extracted from the operation by building fashionable manor houses, but the period was also characterized by many bankruptcies. In the late 19th century, ownership was restructured into three different groups, of which one, Rullshytte Zinc and Lead Mines, was later to become Garpenberg AB.

Garpenberg seen from the air in the 1940s.



GARPENBERG IN BRIEF

Commissioned: Mining operations have taken place in Garpenberg since around 375 BC.

Acquired by Boliden: 1957

Operation: underground mining

Minerals mined: zinc, lead, silver, copper and gold

Number of employees: 478 (2023)

▲▲In 1942, Garpenberg suffered a major rock fall and the entire operation had to be moved.

▲Part of Lake Gruvsjön in Garpenberg was drained following the rock fall in 1942, and the water level was lowered.

In 1942 one of the shafts suffered a major rockfall. As there was a major risk that water from Lake Gruvsjön would fill the mine, the northern part of the lake was drained. The aboveground infrastructure was also affected, and the entire operation was moved 500 meters north. In 1957, this new installation was purchased by Boliden.

Refusal to quit

In 1980, one of Europe's biggest silver discoveries was made just outside Hedemora. The deposit was named Dammsjö Mine, and the quantity or board was judged to be more than 5 million metric tons with a silver content of just over 200 grams per metric ton. It did not begin production until the 2000s, but it increased the interest for continued exploration in the region. The 1990s were tough with low metal prices. The turnaround came just before the turn of the millennium when no fewer than four new deposits were discovered, of which Lappberget was the biggest.

The ore deposit was discovered after many years' diligent prospecting under the management of Rolf Jonsson, the then head geologist at Boliden. The discovery in Lappberget came after general manager Bert-Ove Johansson and geologist Stina Danielsson and others had refused to quit searching. Complex ores containing zinc, lead, silver, copper and gold have been mined here ever since.

Automation

For a long while, the Garpenberg area was split into the northern (more recent) and the southern (older) parts, but in 2004 they merged to form a joint area.

A major investment in 2014 involved the development of, and investment in, industry-leading technological solutions that made operations more reliable, eco-friendly and cost-effective. Today's mining would not be possible, nor even profitable or as safe, had developments not proceeded so quickly toward modern technology and automation. Since the 1980s, the mine has gone from manual drilling to today's situation, where much of the drilling takes place automatically and the operator sits in a comfortable office controlling the drilling in the mine.

Methods have also advanced in the concentration process, despite the basic principles having remained the same since the end of the 19th century. We are

The mill hall in Garpenberg's concentrator.

"

Everything is done automatically and supervised from the control room, which is located in an office building next to the concentrator.

constantly fine-tuning everything from chemical additives to material flows in order to optimize processes and safeguard the quality of the end products. The contents of the flotation tanks are analyzed every six minutes. Everything is done automatically and supervised from the control room, which is located in an office building next to the concentrator.

Giant strides

The mine has also taken giant strides forward in other ways, especially when it comes to safety. Today, there are 70 rescue chambers with sufficient air to keep 500 people alive for at least 8 hours. Underground, there are an ambulance and two rescue vehicles equipped for lifesaving responses by the mine's guides. The guides are our internal rescue personnel and first responders in the case of accidents.

And it was also in Garpenberg where the very first women would work underground. Evy Mårtensson was employed as a hoist operator in 1967, but in 1980 she became a haulage worker down in the mine itself. It was absolutely forbidden for women to work below ground before 1978, and Evy was one of the pioneers in this field.

Through its incredibly long history, Garpenberg has developed into one of the world's most modern mines. It's a history to be proud of.

In focus: Odda

The zinc smelter in Odda in Vestland County began operations back in the 1920s. The beautifully situated smelter has since undergone major changes and is today a world leader in terms of climate efficiency.

Text: Sara Johansson

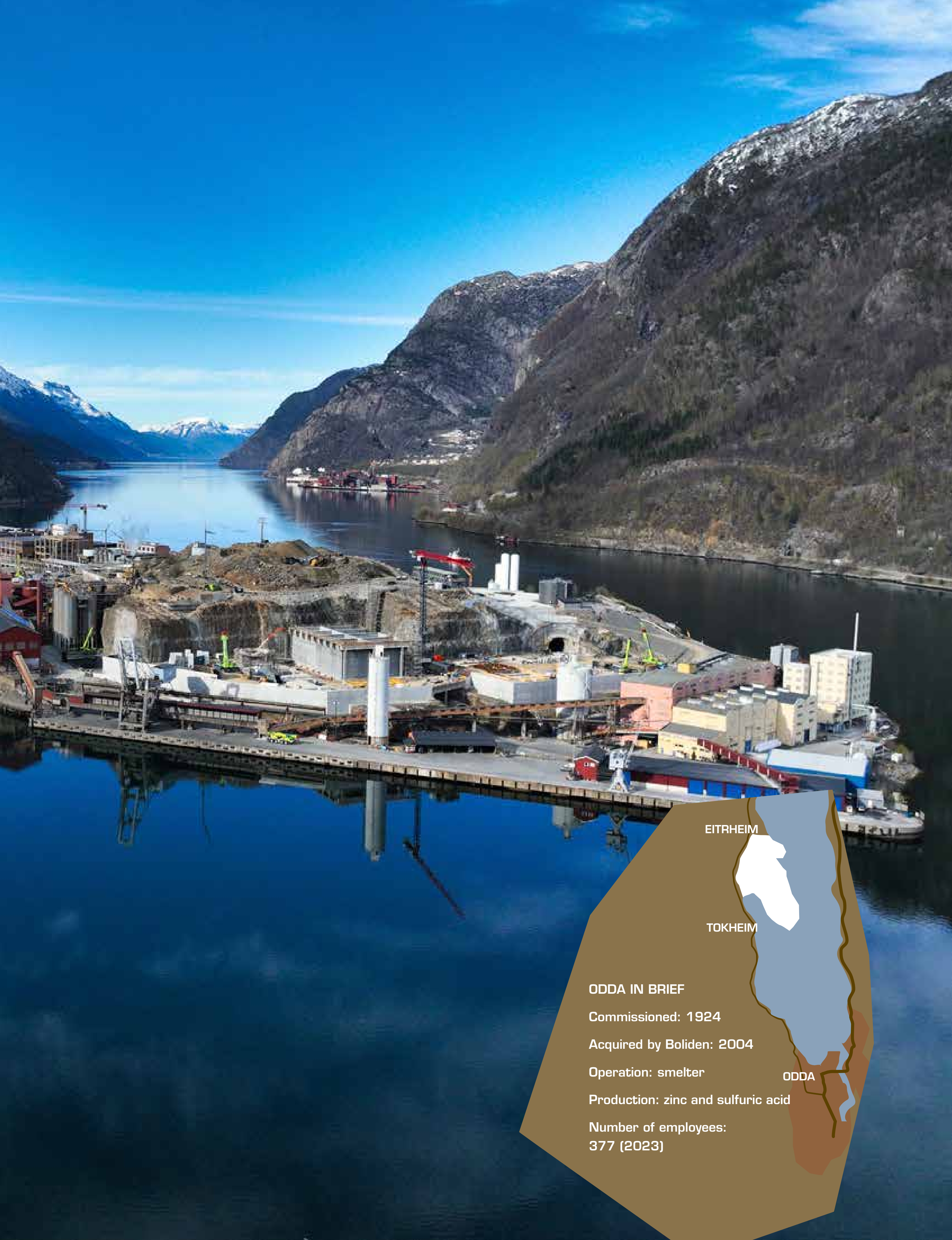
The construction of a power station at the beginning of the last century was the basis for everything. When electricity made its debut in the little town furthest inland in Norway's Sørfjorden, it did so in spades. The power station had capacity far in excess of what was actually needed, and because the transformer had yet to be invented, they were compelled to use the energy generated as locally as possible. This led to a rapid expansion of industry in the area. Norway's Det Norske Zinkkompaniet was founded in Odda in 1924. Actually, it was European interests acting through the Franco-Belgian Compagnie Royale Asturienne des Mines who were behind it. The company needed a smelter that could handle zinc, and although Odda was a long way north, it had the electricity they needed.

The smelter, known as the Zinc works, was not the only one in Odda. There had also long been a smelter for carbide and cyanamide in town, and an aluminum smelter was established a few kilometers away in the neighboring town of Tyssedal. There was enough energy for everyone. The zinc smelter was located at Sørfjorden's mouth, which was practical for shipping freight to and from the smelter. Natural conditions and an ice-free sea made seaborne shipping possible.

Many different owners

Because of its importance for the local community, it enjoys great support today.

◀ A rapid expansion of the industrial area allowed the establishment of Det Norske Zinkkompaniet in Odda in 1924.



ODDA IN BRIEF

Commissioned: 1924

Acquired by Boliden: 2004

Operation: smelter

Production: zinc and sulfuric acid

Number of employees:
377 (2023)

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Constant technical development and streamlining has made the smelter in Odda the success it is today.

Two thirds of the employees live in Odda or its surrounding area. However, this was not always the case. Initially, a certain hostility arose between the workers and the local farmers. But because people who had previously earned a living in agriculture began to commute to and from Odda to work at the smelter, it became a lifeline for many a smallholding in the area. They could continue farming with the aid of the income they earned at the smelter.

In 1965, Boliden acquired 50 percent of the shares in the Norwegian smelter. The other half was initially owned by Compagnie Royale Asturienne des Mines, then British Petroleum Minerals and finally Anglo-Australian Rio Tinto. In 2001, Finnish Outokumpu became a temporary owner, but Boliden has been the sole owner since 2004. The time following Boliden's takeover was tough in financial terms, but the outcome was good. Many testify that there is peace of mind in having a single owner, and Boliden has historically stood for stability in the operation.

Rock caverns saved the fjord

Constant technological development and streamlining has made the smelter in Odda the success it is today. It has been possible to test new solutions, and the personnel have been sent on study visits to other countries in order to absorb new knowledge and hopefully bring lessons learned home with them. For example, up until the 1960s only 60 percent of the zinc could be extracted. When a new method known as the jarosite method was introduced, they succeeded in extracting much more – up to 95 percent.

The rock caverns in Odda are part of a comprehensive environmental initiative.

The zinc produced by the smelter is exported, mainly to the UK and the rest of Europe.

The smelter's end product, zinc ingots, is shipped chiefly to the UK and the rest of Europe. While the construction and infrastructure industries are the biggest users, the automotive, haulage and electrical consumer goods industries are also important for zinc. Whether zinc is used in construction materials or coatings for other materials, it's highly recyclable.

The construction of a new electrolysis installation in 1986 was the biggest expansion until then. That same year, the first rock chamber repository for jarosite was commissioned in Odda. Known as rock caverns, they formed part of extensive, systematic environmental management. In 2014, the rock repository at Odda was extended with an additional two rock cavities. Today, mercury and sulfurous waste is also stored here along with copper mattes from the lead smelter in Bergsöe. The permit to dispose of waste in the rock caverns proved to be incredibly important for animals and people alike. Sørfjorden was previously known as one of the world most polluted fjords, whose waters sometimes became utterly red. Today everything is clean, the water is clear and the fish have found their way back.

Historically large investment

And once again, the place finds itself in the middle of major change. Bigger than ever before. The current renovation, scheduled for completion in 2024, involves employing 1,000 more people in the area. Meanwhile, production in the smelter continues as usual.

The project is one of the biggest investments in Boliden's history and involves the construction of several new installations including a new calcination furnace and a new sulfuric acid plant. It also concerns the expansion and modernization of the leaching and cleaning installation, a new electrolysis hall and the expansion of the foundry and dockside infrastructure. The project also means that the level of digitization and automation in the operation will increase, which will help improve productivity. Today, annual zinc production is 200 metric kilotons. This will now increase to 350 metric kilotons.

An extensive smelter upgrade is in progress that will involve a major increase in production capacity.

A STORY ABOUT TECHNICAL ADVANCES, BIG AND SMALL

100 years ago people chipped away at rocks looking for ore. We still do. The difference today is that we do so much more, and sometimes use other methods. Since 1924, both our know-how and the arsenal of implements has grown, and in fact almost everything in our toolbox was created by Boliden in-house. Technological developments in every area have been essential for the company's future well-being as a going concern.

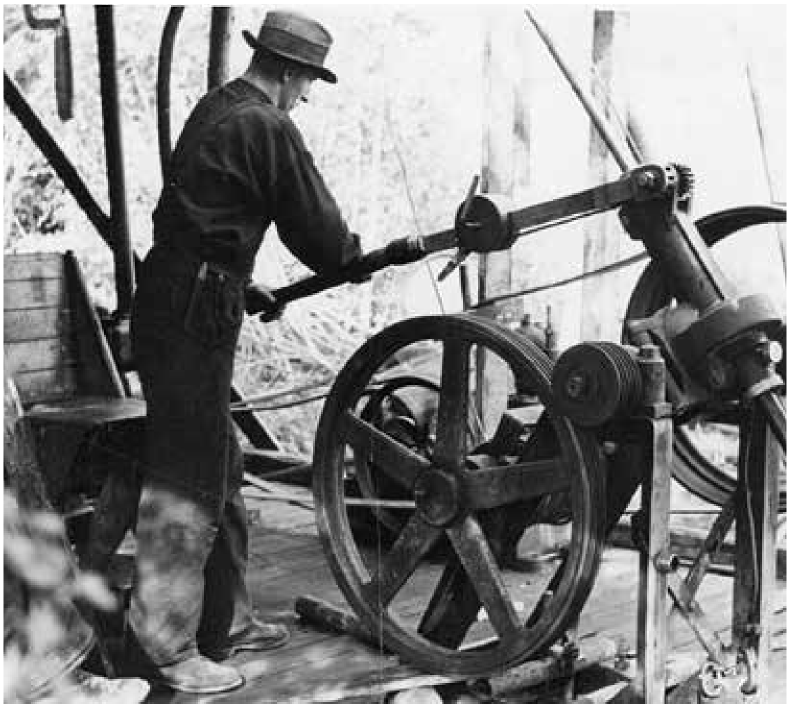
Text: Olle Lundqvist

It all begins with exploration. And Boliden's exploration history begins with the Holmtjärn ore in 1924, a small deposit with an astoundingly high gold content. It was here that Fritz Kautsky, Boliden's exploration legend, discovered a depression in a rocky outcrop filled with a white powder that proved to be a mineralization rich in arsenic. With the help of electrical measurements, they discovered a deposit which despite its small size (it lay beneath an area of only eight square meters) and its rapid extraction, created the financial conditions that allowed the discovery of the Boliden ore in Fågelmyran on December 10, 1924.

The precise localization was determined using the equipotential line method developed by engineers Nathorst and Lundberg from the company AB Bergsbyrån. The equipotential measurement was the run-up to the constant development of geological and geophysical methods and instruments, virtually all of which were proprietary items.

New measuring methods

Because density is one parameter that



differs for compact sulfide ores and high conductive shale, Boliden began to develop an instrument in 1935 to measure local variations in the Earth's gravitational fields. In 1939, the Boliden gravimeter began being used in regular measurements.

Toward the end of the 1930s, Boliden also began using two electromagnetic exploration methods developed by AB Elektrisk Malmletning (ABEM), but the methods were rather finicky and required the use of kilometer-long cables that had to be coiled up. Instead, the slingram method came along in 1945, developed by Geological Survey of Sweden (SGU). The slingram was an electromagnetic prospecting instrument with a movable transmitter and receiver, and the initial intention was primarily to make prospecting for ore simpler and cheaper. And the results proved to be better than those of older methods. However, the slingram method was labor-intensive. To the rear was a person with a small transmitter in a backpack and carrying a horizontal transmitter coil with a diameter of 1.5 meters, known as a slingram. Ahead went another person with a somewhat smaller horizontal coil, the receiver coil, and between them were an additional two people, one with receiver electronics in a backpack and another who took the readings.

In 1946, Boliden began developing an electromagnetic method with great depth sensitivity, the deep sling technology, which was used until the end of the 1960s. At this time, Boliden's interest in discovering large, low-grade copper ores that could be mined in open pits increased, mainly inspired by the expansion of the Aitik mine. The search for such low-grade ores required more sensitive geophysical instruments. Thus in the beginning of the 1970s, the company developed its own VLF system (VLF = Very Low Frequency).

The development of borehole radar began in 1973, and in 1981 a fully functioning system was completed. The borehole radar made it possible to e.g. survey fracture zones. Electromagnetic borehole measurements have been widely used by

◤ Hilding Nyberg conducting measurements in the field.

▲ Operating a drilling machine in the Renström mine in 1937.

“ The search for such low-grade ores required more sensitive geophysical instruments.

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The borehole EM was conceived during a coffee break in the Saxberg mine, 545 meters below the surface. EM as in electromagnetic.

Boliden, especially in explorations close to mines.

The innovation was conceived in a coffee break

And so it has continued, with new methods and instruments that have grown ever more efficient through constant technical development, usually in small incremental steps. But sometimes it involves giant strides, and the longest strides of all were taken by mining physicist Robert Pantze and his colleague Sven Albin in 1978.

The borehole magnetometer worked excellently on magnetic sulfide ores, but what about in areas where ores are not magnetic? The borehole EM was conceived during a coffee break in the Saxberg mine, 545 meters below the surface. EM as in electromagnetic. The method is based on transmitting alternating current in a square coil on the ground, enclosing one square kilometer. The primary field transmitted from the coil induces alternating current in electrically conductive mineralizations down in the bedrock. The alternating current creates a secondary field which in turn can be measured using a coil system in the probe.

The first prototype was ready on October 10, 1979, and the borehole EM proved to be an enormous success. As with almost all of the other Boliden innovations, the patented instrument has been produced for Boliden's own needs and is a major contributory factor in a number of extraordinary exploration successes. One example concerns Garpen-

▲▲Slingram measuring in progress, 1955.

▲Engineer Tennberg conducting electrical intensity measurements in Mensträsk, 1923.

▲Svante Holmqvist with an electrical prospecting instrument with a VLF receiver, 1973.

berg in 1999, when measurements in two holes resulted in the discovery of three new orebodies, and another concerns Kristineberg, where an orebody with a zinc grade of 16 percent was found at a depth of 1,100 meters with the aid of an EM 34 ground measurement variant of the borehole EM.

But developments have not only revolved around alternating current and magnetism. In Tara, Boliden's Irish mine, a decisive exploration success was achieved with the aid of seismology. An explosive charge was detonated on the ground, not for blasting purposes but to create a really loud bang. By studying how the sound waves it generated were reflected, they were able to localize a major zinc deposit described as very promising, at a depth of two kilometers.

Bigger, more efficient and safer

While the purpose of technical development may be greater efficiency, it may also mean greater safety and a better work environment. The three often go hand-in-hand, and what the original intention behind an innovation may have been is often difficult to know. Judging by the 20th century's miserable accident statistics in the mines one can guess that initially, cost savings weighed heavier than safety. Either way, technical development in the mines, as in exploration, took place gradually and in the open pits it was mostly about bigger machines, loaders and mining trucks alike. Also, tests have been conducted with electrified vehicles for several years in both Kevitsa and Aitik. These days, personnel who look after crushing and milling mainly have control rooms as their workplaces, where they supervise and remotely control processes with the aid of monitors. Most things have become bigger underground as well. This applies equally to tunnels, ramps and stopes. Today, and to an ever increasing extent, operators maneuver remotely controlled machines at a safe distance from the actual mine

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While the purpose of technical development may be greater efficiency, it may also mean increased safety and a better work environment.

Martin Burvall in Laisvall in 1967, with a micro-seismic instrument that registers the formation of fractures in rock and pillars.

face in order to avoid the risk of rock falls. In this case it mainly concerns safety, but the precise reason is not always clear. When planning to introduce more and more driverless machines (see separate article) we do so both to avoid exposing personnel to the risks that are still associated with mining, as well as to increase efficiency. Not only does this increase availability, it also enables one person to supervise more vehicles, which being without drivers, are able to work longer. But what is clear today is that miners are subject to entirely different requirements, whether they work above or below ground.

From ore sorting to flotation

Because the first ore found contained mineral grades that today would appear terrific, the requirement for concentration was lower. The process could begin by manually sorting the ore that had been brought up from the mines, initially into 16 different qualities.

But grinding and flotation already existed 100 years ago, and these techniques have of necessity been constantly refined in our concentrators in Boliden, Aitik, Garpenberg, Tara and Kevitsa. If the ores in the early 20th century were simple, i.e. contains few or one single mineral, then ores in recent times are both poorer and more complex with contents that cause problems for our smelters. This places greater demands on concentrators, where technical developments have taken place in increments both big and small. Ball grinding and rod mills were followed by autogenous grinding, where rocks grind each other apart in a technology in which Boliden has been a world leader.

Cyanide leaching, as with most new techniques, has made it possible to mine and make use of new ores by e.g. transforming tellurium from a troublesome ingredient to a marketable product.

Pressure air filters have replaced drying kilns, and drum filters have halved the maintenance requirement and so forth.

> **But grinding and flotation already existed 100 years ago, and these techniques have of necessity been constantly refined in our concentrators in Boliden, Aitik, Garpenberg, Tara and Kevitsa.**

▶ Plastic from batteries are recovered in the plastics separation plant in Bergsöe. This has also resulted in an improved work environment.

◀ When the flash furnace in Harjavalta was commissioned in 1949, it almost doubled production per hour compared to electrical furnaces. Two of the men behind this trailblazing innovation were Petri Bryk (left) and John Ryselin.

Photo: Bruno Ehrs

> **Kokkola has also taken giant strides thanks to technological advances.**

These days, much of the work is managed from control rooms, as seen here in Tara.

Boliden's concentrators are among the world's most efficient.

From welfare to the flash furnace

Boliden Bergsöe recovers 97 percent of all of Sweden's scrapped car batteries. But 40 percent of the batteries comprise more than just lead, especially plastic, and the solution was to create a plastics separation plant. To meet the differing requirements of customers, the company has developed methods to produce the correct alloys, where percentage differences are measured to four decimal places.

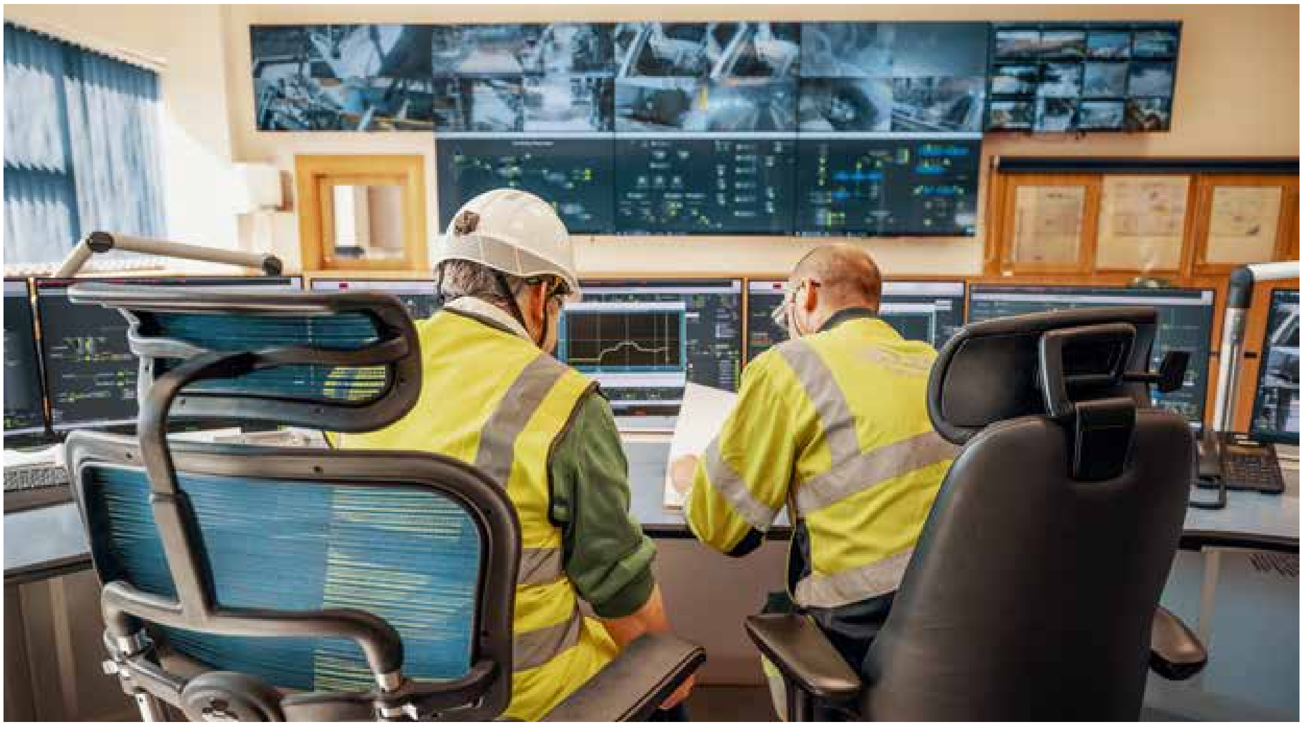
Boliden's other smelters also have a history of constant technical development, and Harjavalta is a true pioneer. Back in 1949, it developed a flash furnace that almost doubled production per hour compared to electrical furnaces. The technology was trailblazing and for decades, people from all over the world converged on the smelter in Finland.

Kokkola has also taken giant strides thanks to technological advances. In the 1980s it was all about automation, 10 years later it concerns direct leaching. The result has been constant production increases, from 90,000 metric tons of zinc in 1973, to 310,000 metric tons in 2018, despite a reduction in the number of employees from 700 to 540 over the same period. Production capacity today is even higher.

Electronics recycling

'Scrap' doesn't sound like it's worth much, but people at Rönnskär have a different opinion. As early as the 1940s, the smelter began to supplement its concentrate from Boliden's mines with other raw materials. Scrap metal was purchased, initially mainly in the form of high-value copper from roofs, gutters and cables. But in 1966, 13 metric tons of circuit boards arrived from America. Mounted on small plastic boards were electrical wiring and transistors with a copper, gold and silver content that would appear astounding today.

The recovery has continued. In 1972,



Rönnskär received a scrapped supercomputer that weighed more than seven metric tons with the gold content of 401.7 g per ton! The circuit boards alone weighed 861 kilos.

By 2012, they were fully committed. That was when the e-kaldo converter plant was completed, a station in the smelter's production flow that has made Rönnskär the world's most efficient electronics recycler.

Enormous investments

The e-kaldo converter plant on Rönnskär cost SEK 1.3 billion. A lot of money, but less than the most recent investments in Aitik and Garpenberg. And significantly less than the SEK 8.5 billion invested in the smelter in Odda, where the company, with the aid of the latest IT technology, is building the world's most modern zinc smelter. The 300 employees will grow to 350, but since Odda is already number two worldwide in terms of productivity per employee, they will now be in a league of their very own. Production will increase from today's 200,000 metric tons to 350,000 metric tons per year.

In conjunction with the upgrade, the roasting plant and sulfuric acid plant will be the biggest in the world, and the electrolysis hall among the biggest in the world with a production that will increase from 30,000 to 190,000 metric tons. Around one thousand people, many of them employed by e.g. Portuguese contractors, are involved in the upgrade, which will be the biggest in Boliden's history, and which is being completed while production continues at the normal levels.

Photo: Jeanette Hägglund

▲▲ **The new leaching plant on Rönnskär allows the extraction of more metal from residual materials while also reducing the amount that has to be deposited as waste.**

▲ **Surveying a mine and orebody using modern 3D technology.**

Little things make a big difference

Further advances can be expected. Artificial Intelligence, AI, is knocking on the door of the mining industry, and as in other industries, it has the potential to entail major changes. But if we look at our history, Boliden's successes cannot solely be attributed to a number of revolutionary innovations and significant investments. There is great strength in the day-to-day work where our employees often find ways to do things a little better today than yesterday. Ideas for smarter, more efficient solutions are constantly being hatched in all of Boliden's installations, and they will continue to do so.

First in Europe with self-driving mining trucks

They are huge and enormously heavy. The mere sight of a fully laden mining truck that weighs 532 metric tons is impressive. But just imagine the same truck rolling toward you without a driver. It might sound like a vision of the future, but it's already reality in the Aitik mine in Gällivare.

Text: Olle Lundqvist

In August 2023, seven of the mine's trucks were in self-driving operation in production. They not only lack a driver behind the wheel, they're not operated from any control room either. There will soon be an additional 10, i.e. half of Boliden's trucks in Aitik. The project is known as the Autonomous Hauling System, abbreviated as AHS, and is the first of its kind in the EU.

"The system was already in operation in South America and Australia 10 years ago. Conditions there are different. There, it's enough that a mine supervisor gives the okay, whereas here the EU's CE marking regulations, safety regulations and requirements for extensive documentation apply," Rikard Mäki tells us.

He's the project manager and in charge of the department running the transition. Twenty-four of Boliden's own employees are here along with experts from Australia and South America, and truck manufacturer Komatsu and its suppliers are also represented. In all, around 50 people work with AHS, in addition to the personnel who man, and will come to man, the new control room. But again, no one is driving the trucks. The control room operators only inform the vehicles where they should proceed, which they do along various pathways created with the aid of GPS technology linked to sensors on the trucks.

Expensive investment

The trucks resemble their driven equivalents. In most cases, it concerns the same type of vehicle. They undergo a three-week conversion in which they are equipped with antennae and cameras and checked according to a test program. This naturally costs quite a lot of money. The AHS project has a budget of SEK 218 million.

"We're on schedule and largely on budget, despite a number of cost increases caused by a weaker Swedish currency," says Rikard Mäki.

The project was launched in the fall of 2021, and 18 months later, in March 2023, the first self-driving trucks were on the move in the gigantic open pit. Things have moved really quickly, which usually means a lot of initial glitches.

"Actually, we haven't had any major problems. Sure, it happens that reindeer sneak into the mining area, but if they

Rikard Mäki is in charge of the transition to self-driving mining trucks.

Whether you're in a car or on foot inside or outside the mine, everyone must be trained in the safety thinking self-driving trucks demand.

▲▲ **Everyone who works in the area must be trained in issues concerning self-driving truck safety.**

▲ **Those who were previously drivers will be assigned new tasks, such as in the control room, and be trained on simulators.**

get in the way of a truck, the truck will stop." The same thing will happen if a boulder falls from another truck.

The truck will stop immediately. It's one of the system's safety features, and is usually something that can be attended to in a few minutes. This is where the control room personnel come into the picture. They will see if something unforeseen occurs, and immediately raise the alarm with someone to get the truck moving again. Help is seldom far away, as the self-driving trucks are supported by mine workers dedicated to the specific task in vehicles constantly on the move in the mine area – two pit patrollers per shift. But the trucks are the concern of significantly more people.

"Everyone who works in the mine is affected. We have 800 Boliden employees and almost as many contractors. Whether you're in a car or on foot inside or outside the mine, everyone must be trained in the safety thinking self-driving trucks demand."

Revolution

The transition is something of a revolution and is taking place for several reasons. The labor market in Norrbotten is so overheated that it's difficult to find truck drivers, but it's also a matter of safety and efficiency. Driverless trucks can stay busy round-the-clock. And we also avoid payroll costs for drivers. However, this does not mean anyone working today will lose their job.

"We foresee no risk of redundancy. The drivers will be assigned different tasks, such as in the control room or as pit patrollers," says Rikard Mäki.

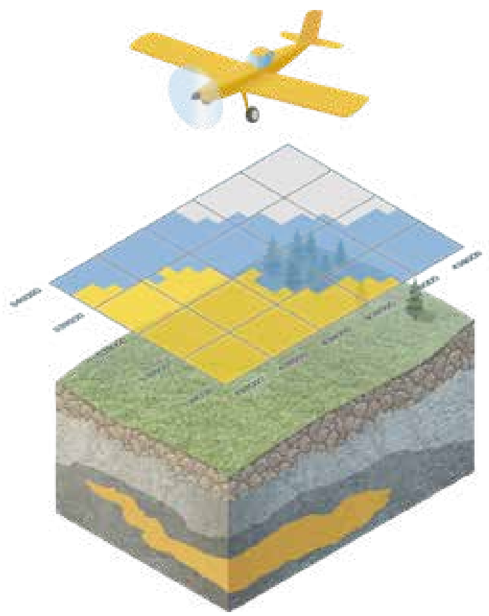
For them, the transition will involve 9 or 10 weeks' internal training, and for other mine employees, 2 or 3 weeks. The project is scheduled for completion in March, 2024. Then what?

"The trend in most workplaces is more automation. It seems quite likely that even more of our trucks will be self-driving in the future."

HOW IT WORKS
EXPLORATION

1

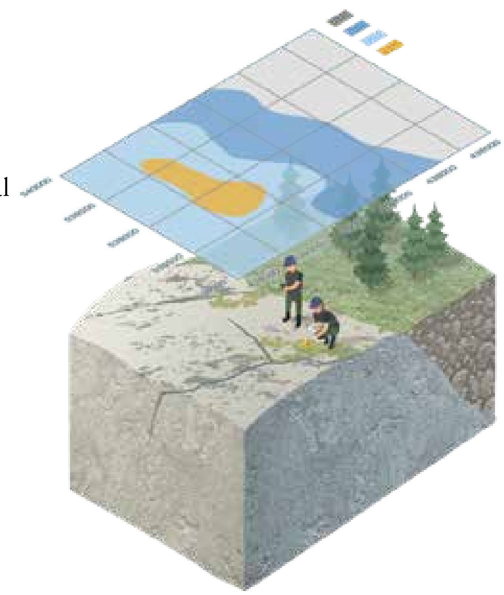
Admittedly, while methods have changed over the years, they remain the same in principle. The keys to successful exploration are geological knowledge, access to land areas with potential ore, the constant development of survey methods and long-term thinking.



◀ **1.**

Aerial geophysical surveys

Geophysical surveys are conducted from the air, at ground level and underground. Typically, aerial geophysical surveys are conducted to map regional geological structures and thereby identify areas of interest for metals exploration. Common aerial survey techniques include radiometry, and measuring magnetism, gravitation and electromagnetism.

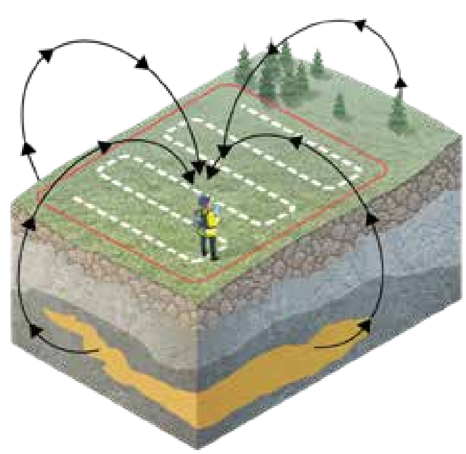


2. ▶

Terrestrial geophysical surveys

Terrestrial geophysical surveys are carried out when a geological area of interest has been identified and requires a more detailed investigation. Boliden carries out electromagnetic, electrical, magnetic and gravimetric terrestrial surveys.

Underground, corresponding surveys are conducted through boreholes in the existing mine infrastructure.



▲ **3.**

Bedrock mapping

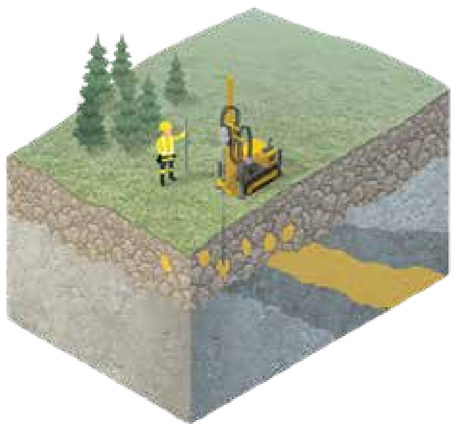
In places where it's visible above ground, bedrock is surveyed to gather geological information that provides clues about financially viable mineralizations. This often includes searches for geologically interesting boulders that have separated from the bedrock.

Exploration can be divided into four main phases: selecting an area, initial regional investigations, ongoing local investigations and test drilling. It often takes many years from the first geological survey until mining operations begin.

4. ▶

Geochemical sampling

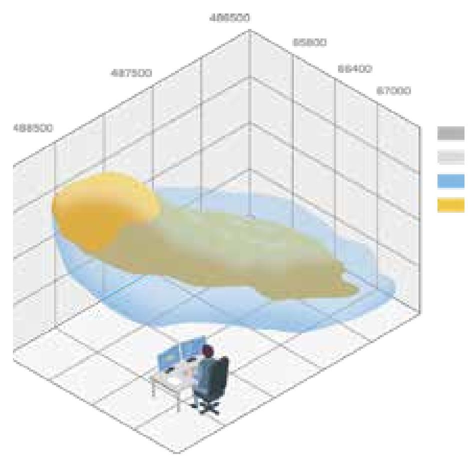
In places where the bedrock is covered by moraine, geochemical sampling of the overburden is carried out to study the area's chemical composition. Sampling can be carried out manually with a spade or with the aid of a small drilling rig.



▼6.

3D bedrock modeling

3D models depicting the geology, mineralization and financial parameters are created based on the data collected. These form the basis for the creation of mine plans and decision-making in mining operations.



◀5.

Diamond drilling

By extracting cores from boreholes that reach down as far as 2,000 meters underground, the bedrock's geology and possible mineralization can be surveyed in depth. This exploration method is not only used from the surface, but also in existing mines.

UNKNOWN
BOLIDEN

A very long cableway

The almost 96-kilometer cableway between Kristineberg and Boliden was built in 1942–43. It was to be the world's longest and was built during that century's most severe winters.

Text: Olle Lundqvist

In April 2023, geologists Rolf Jonsson and Monica Johansson had walked one-time-too-many past a nailed-shut wooden box in Boliden's archive. Their curiosity was bigger than both of them. Grasping a pry-bar, they brought to light what was the beginnings of a masterwork. The box contained nothing less than the drawings for the huge cableway construction project. Stowed away after the project's completion, but now recovered 80 years later.

"They should be seen as historic industrial treasure," says Rolf Jonsson.

The background was World War II. The world was crying out for metals, and there was a shortage of rubber and fuel in Sweden. This was a pressing need for Boliden, which had to come up with new ways to haul its ore. The last fifty kilometers from the concentrator in Boliden to the Rönnskär plant were no problem. There was already a railway. But to the west, the only alternative was by road, and once the war started, road haulage was no longer sustainable. Building a railroad would take too long and cost too much.

The solution was a cableway.

Many challenges

Not only would the cableway be the longest in the world, it also had to be built quickly. It had to be ready in 16 months. The planning, including negotiations with landowners and delimation, took place in 1941-1942, in weather that was equally bitter and miserable. In temperatures of -45 C, it was easy to confuse swamps with solid ground. More than one intended location for trestles had to be changed when the spring weather made the rock-hard ground soggy and wet and impossible to pour concrete on.

The staking out, ground surveys and clearance work alone (to prevent trees falling onto the cableway, a 40-meter-wide path was created through the forest) employed 170 men. A great many, but nothing compared with the actual construction.

In all, 1,500 people worked on building the cableway. Staff from Boliden looked after the road construction and haulage, while a contractor was responsible for pouring and Nordströms Linbanor took care of assembly. The pace was rapid, and the work not without accidents. When concrete was being poured for a trestle

In all, 1,500 people worked on the cableway's construction.

◀ The cableway in 1958.

in Fårberg, two people were seriously injured, one so seriously that he died on the way to hospital. Many people involved worked extremely hard, and not just those involved in the actual construction. This was also true of the catering staff, who on one occasion went on strike.

A total of 514 concrete trestles were required, of which 16 were located in watercourses. The shortest was 8 meters, the tallest 38 meters (they were made of solid concrete up to a height of 21 meters, but above that they were hollow). The distance between the trestles varied between 11 and 429 meters. The planned 900 baskets were increased to 1,400. They were gradually replaced with lighter versions, increasing the load capacity from 1,200 to 1,400 kilos per basket. And the baskets traveled in a straight line, well almost. The cableway had eight sections and ten stations: Kristineberg, Ytterberg, Strömfors, Rakkejaur, Mensträsk, Bjurfors, Åsen, Renström and Boliden and an extra station in Kusfors, where ore was transshipped for onward haulage along the northern trunk railroad. Practically all of the stations were close to Boliden mines, which happened to be in an almost straight line and virtually equidistant – just over 10 kilometers – from one another.

Record freight

24,000 metric tons of concrete, 1,100 tons of rebar, 400 km of cables and lines and construction costs that came in at around SEK 20 million. The construction can be described by many different numbers, but perhaps the most important are the 4,744 metric tons of ore that were hauled along the cableway in 1974. More than at any time before or since.

It took around 40 people to operate, and the keyword was synchronization. The baskets would leave the various stations, the motors of which were independent of one another, at the same time. You had to be on your toes, and maintain contact with the station in Örträsk, which was the connection hub." The baskets traveled at 11 kilometers per hour (three meters per second), and they had a stopping distance of two meters at each station. Sometimes there would be a really big bang, and now and then the cableway stopped completely and would not restart until the mechanic on duty had responded and fixed things.

But, on the whole, things worked as

"The baskets traveled at 11 kilometers per hour (three meters per second), and they had a stopping distance of two meters at each station.

The planned 900 baskets were increased to 1,400.

they should, at least well into the 1970s, when the installation began to show its age.

Even though the record year was noted during this period, operational disruptions were becoming more frequent. Operating costs tripled during that decade, and then doubled again during the early 1980s. In 1986, a trestle collapsed in Hornberget, haulage capacity fell by half and a decision was taken to close the facility, which it did on January 9, 1987. In the future, ore would be hauled by truck.

Tourism by the basket load

Two years later the cableway was resurrected along the 13 kilometers between Örträsk and Mensträsk when an association dedicated to the world's longest cableway began passenger traffic. Four-seat cabins modified for tourists who, with a lunch basket on the table, proceeded at a stately 10 km/h along a route that included 3 kilometers above water. It was a success from the beginning in terms of both passenger numbers and media attention. In the first 10 seasons, 100,000 tickets were sold, but after a while interest cooled and in 2016 the cableway was closed for good at the end of the 28th tourist season.

But the memory, and the drawings, of the magnificent construction live on.

◣In all, 1,500 people worked on the cableway's construction.

▼Workers and divers during construction of the cableway in Örträsk, 1942-1943.

▼▼Cableway tensioning station, 1943.

UNKNOWN BOLIDEN

The move to Harjavalta

Dismantling an entire smelter, moving it from one part of the country to another and then reassembling it sounds impossible. Doing it in six months is even more unreasonable. But that's what happened in Harjavalta.

Text: Olle Lundqvist

The new smelter in Harjavalta taking shape.

Almost one thousand people were involved in the move and the reconstruction.

The smelter's History 2.0 began in 1944 during World War II and the Continuation War of 1941 through 1944 that was fought between Finland and the Soviet Union, in which the latter took so much land that the border between the countries was drawn only two kilometers from the smelter in Imatra, then owned by Outokumpu. The Soviet Union behaved evermore aggressively yet with a certain restraint, possibly because it wanted to appropriate the smelter and therefore did not want to destroy it.

One thousand people

After the war, 90 percent of the copper produced by the smelter was sold to the Soviet Union as war reparations. Prior to this, anti-Russian sentiment had, for good reason, grown ever stronger. Staying put in Imatra felt too unsafe. The company decided to move the switchgear to the other side of Finland, and there were three reasons for the choice of Harjavalta:

1) It had a railroad.
2) It had sand with a high silica content. Silica binds iron in the slag; the higher the silica content, the less slag there is, which reduces metal losses.
3) It had a hydroelectric station. If Finland's biggest power station was in Imatra, its second biggest was in Harjavalta.

And so the smelter was moved there. To succeed in dismantling the converters was impressive, taking apart the electric furnace equally so, not to mention the construction of the new plant. But thanks to the efforts of almost one thousand people, they succeeded. At first, it seemed almost impossible to get hold of the necessary labor as so many men were at the front. The work continued, thanks in particular to the 200 or more Russian prisoners of war and around 30 mental patients who worked on the construction site.

Own police and 'social services'

They were able to connect power to the first smelter on Christmas day, 1944. Production got underway, but in many other areas Harjavalta was forced to assume greater responsibility for its employees.

Initially, they consisted largely of young and middle-aged men who had previously worked at the smelter in Imatra. Most of them had experienced war right up close. It was over now, but had left its mark. Many had seen far too much violence and were suffering from what is known today as post-traumatic stress. Just because they managed work did not mean they could handle leisure time. Harjavalta got more than its fair share of alcohol-fueled brawls, and pretty soon things were so unruly that the smelter was forced to employ its own police and actually create something that resembled social services. And because the troubled souls with wartime memories were not only the bachelors, but also family breadwinners, the smelter had to do more than just pay out wages. It also had to make sure enough money was set aside for rent or mortgage payments on the home loans that Outokumpu had also provided, and to be available for other family matters.

Initially, there were major class differences both at work and in the community. For example, there were four different sauna facilities. One for shop floor workers, one for office workers, one for engineers and one for managers.

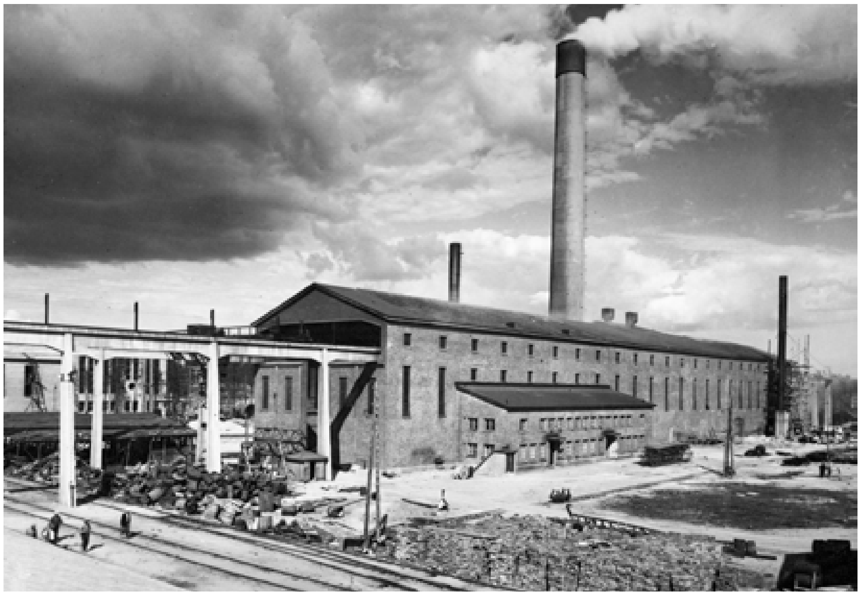
Outokumpu built homes, both apartments and houses, and loaned money to people who would rent or purchase them. It also took care of snow clearance, but not outside all buildings. While it was a class society, it did not mean that the people with higher status could dominate local politics. On the contrary. Most of the smelter's employees worked in production, and this was reflected in municipal elections, where there was a distinct bias toward the left.

Two-fold population increase

Pretty soon, Harjavalta's population doubled from 3,000 to 6,000 residents. This demanded bigger schools and other social services, and here too, the smelter had to step up to the plate. But not everyone was an experienced tradesman from the area close to the Russian border. Even residents from Harjavalta and its environs, e.g. those who had previously worked on the land, were attracted to the smelter, not least because of the comparatively high wages.

But this did not mean everyone was overjoyed. Nobody can deny that during its first decades, the smelter was a major polluter. Its environmental impact was especially noticeable on the surrounding spruce and pine forests, and Outokumpu had to pay substantial compensation to the region's forest owners. As with Boliden's other smelters, a great deal has happened on the environmental side, often going hand-in-hand with production increases. For example, the 1993–96 Harjavalta was carried out primarily for environmental reasons, even though it just happened to increase production.

The smelter no longer has its own police or any 'social services'. Eighty years later, these employees no longer create unrest in the community but have become established citizens in a Harjavalta whose population once rose to 8,000. It has fallen back to 7,000, e.g. because many youths are drawn to metropolises such as Tampere.



▲▲ **The copper smelter in 1946.**

▲ **Material and machinery from Imatra was loaded onto railroad cars and hauled west to the new industrial site.**

BOLIDEN PEOPLE

The prospector who gave Boliden a flying start

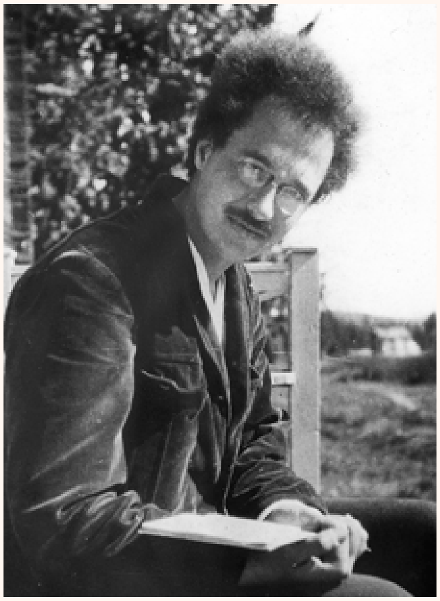
Text: Olle Lundqvist

Maybe someone else also would have found the ore. The Boliden ore – the ores in i Renström, Rakkejaur, Laisvall and many more. But the person who did turned out to be Fritz Kautsky, and thus his efforts are the underlying reason for Boliden's coming into being and its future successes.

Fritz Kautsky (1890–1963) was an Austrian who belonged to a family whose first notability was his uncle Karl Kautsky (1854–1938). He was an internationally renowned German social Democrat and economist with such independent opinions that Lenin described him as an apostate.

Fritz's father was an artist, and also the head of the Vienna Opera's decoration department, where his son would spend his evenings. He would do his homework there during performances, and could not avoid learning most things about opera music. But instead of living up to his father's dream of becoming an actor, Fritz Kautsky gained a broad geological education in Vienna and Berlin. He carried out field studies in the Alps and later became assistant to the geological Institute in Turku before he arrived in Boliden in 1921 for a short-term summer job. This was the start of a career in the company that would be his employer for the rest of his working life.

Fritz Kautsky, summer 1922.



A nose for indications

During his first years in Boliden, he returned every winter to Vienna and the University where he broadened his education with essays in subjects peripheral to ore geology. His great passion was actually paleontology in which he achieved renown as a specialist in tertiary mollusks, and he also became internationally known for having compiled a stratigraphy over tertiary sediments in the Vienna basin between the Alps and the Carpathians. This came to have fundamental significance for oil exploration in Europe.

Naturally, Fritz Kautsky was not alone in his work as an ore prospector. Even back then, exploration was teamwork. But Kautsky had an excellent nose for which indications could lead to something big – based of course on his sound knowledge. He didn't quit until the person who'd told him he'd found a strange, huge rock five or more kilometers away actually led him to it – the Svanfors boulder. He had the necessary stamina and stubbornness, and this would later result in the discovery of the Boliden ores. And it was Fritz Kautsky who developed boulder tracing. He put together a team of young men with local knowledge who grew to become passionate prospectors.

Simple and social

Kautsky was in his element during summer hikes through inland Västerbotten, but he despised the monotonous winter office work. He preferred a simple lifestyle. During his early period in Boliden, before he was reunited with his wife and their two sons, he accumulated no more possessions than would fit in a single rucksack. He was known for going bareheaded, regardless of the weather. Things went so far that he wanted to donate his head to scientists upon his death in order for them to find out what effects cooling had on it. But he also had a social temperament and found women more interesting than men, and during high-society dinners he had no problem regaling his female table partner with fascinating facts and anecdotes.

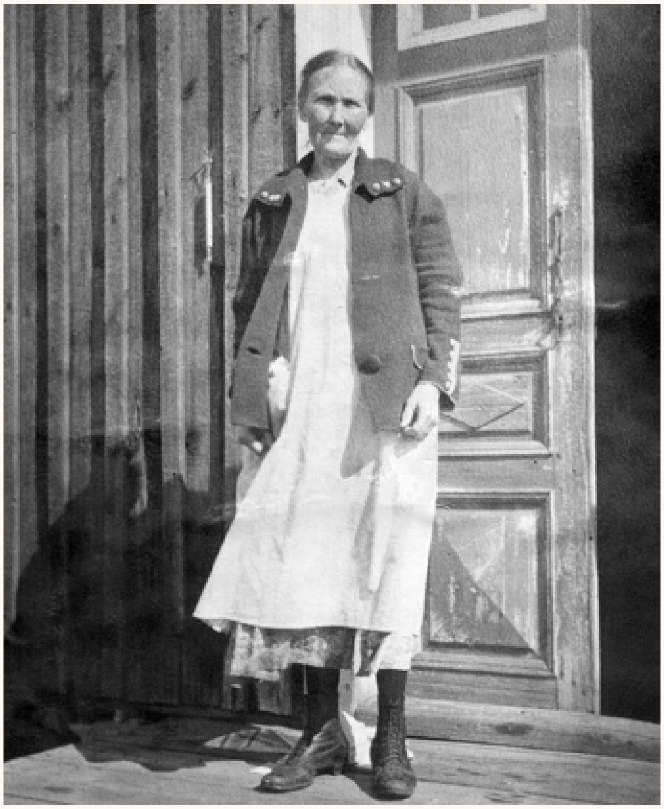
Without her land, there would have been no mine

Text: Sara Johansson

Impoverished widow Margareta Lundberg was suddenly much better off when a prospector struck gold on her land. But few people could guess the great significance this little plot of land would have for the entire region.

On December 10, 1924, test drilling on the Fågelmyran bog in Bjurliden in Västerbotten County had a lucky break. The ore deposit discovered proved to have a very interesting content, in fact an unexpectedly high gold grade.

The land was owned by Margareta Lundberg who was then 58 years of age and a twice-widowed, single mother of five. She and other landowners in the area had been offered SEK 12,000 each for the right to use the land and the right of ownership of any discoveries made on their land. The agreement concluded required Centralgruppens Emissionsaktiebolag to pay SEK 300 on July 1, 1925 and SEK 900 on December 31 that same year. The remaining amount would be paid at the rate of SEK 1 per metric ton of ore mined until the entire sum, SEK 12,000, was paid, after which the rights to the land and the ore would be transferred in full to the mining company. Because the discovery was made on Margareta's land, nobody but her received more than the down payment. She also sold a nearby forestry stand for the amount of SEK 8,000. In all, SEK 20,000 was paid out to her.



Margareta Lundberg outside her house in 1925.

A different kind of agreement

Many people thought that Margareta had sold the rights to the discovery far too cheaply, but she herself was satisfied. In an interview with the periodical Vecko-Journalen, she said: "I owned a gold mine for 25 years and derived no joy nor earned a single penny from it. Why then should I not be satisfied now that in my old age I'm better off thanks to the company, and can see how thousand of other people are also better off because I sold what was for me, and anyone else up here, worthless land?"

The sales agreement also included a provision that a number of villagers and Margareta's male children and grandchildren would be offered work in the mine, which was the case for those

Today, the house Margareta lived in is known as the Boliden Farmhouse.

who so desired. Margareta's grandchild Henry Lundberg, who would come to enjoy a long career with Boliden, is a good example. In 1973, he became CEO for the Rönnskär plant and in 1975 he became CEO for Boliden Metall, which consisted of Boliden's smelters and mines in Sweden.

And the formation of the mine brought with it another benefit: the villagers finally had a proper road. Previously there had only been a six-kilometer cart track to Svanström, where the post office and nearest store were located. Now a little country store could be opened in Bjurliden, which meant people no longer had to travel five or six kilometers to shop. Thanks to the arrival of the mine, Bjurliden gained a better power supply.

The name of the mine, Boliden, arose from a printing error on the 1902 ordnance survey map, on which Bjurliden was erroneously named as Boliden. Previously, a different deposit had been found in Bjurliden in the parish of Norsjö, so that name was already taken. And so the Fågelmyran deposit came to be known as Boliden.

Recognized after her death

Margareta did not have time to experience much of Boliden's beginnings as a community. She suffered a stroke and passed away on April 15, 1931. She was recognized long after her death when a street was named after her, and a park in Boliden was also named after her later. At the end of the 1950s, her cottage in Bjurliden was moved to little Lake Sidtjärn in Boliden. Today, the building is known as Boliden Farmhouse and is cared for by Boliden's local cultural society.

Mining continued until 1967, when the Boliden mine was closed. Maybe Margareta Lundberg did not have time to enjoy the money she was paid, but there can be no doubt that the gold deposit on her land meant a great deal for the local community and the country as a whole. There are many people still today who earn a living working for the company that arose thanks to the mineral deposit.

This article is based on information from Margareta's great great-grandchild, Anton Rosendahl.

"I owned a gold mine for 25 years and derived no joy nor earned a single penny from it.

BOLIDEN PEOPLE

Gold fever in the lab

Text: Mona Stenberg

It was chemist Thelma Berggren who analyzed the drill cores that proved to have a higher gold content than anyone could ever imagine. Thus it was her work that underlay the formation of Boliden.

She was born in Kalmar in 1891, and was given the unusual name of Thelma Ebba Armida Bengierd Berggren by her parents Hilma and Eberhard. Thelma moved to Stockholm, where she studied chemistry and did something as unusual as receive a BA in 1915. A few years later she began work as a chemist at Centralgruppen's lab in Ulvsunda outside Stockholm. There she analyzed drill cores from prospectors, who, after much toil, had extracted them from the ground in Västerbotten.

Could hardly believe her eyes

In August 1924, Thelma Berggren received a specimen labeled "arsenic ore clump from skeletal formation in Holmtjärn". When it was time to analyze the specimen, the gold analysis went wrong, and as she was to begin her vacation the following day she sent off the analysis certificate without determining the gold grade. Later, she is supposed to have said: "Had I known how huge a gold content the specimen contained, I would probably have postponed my vacation for a week." When Thelma returned, she got busy with the specimen again, and when she saw the results she could hardly believe her eyes. So she stayed late on Saturday evening and repeated the specimen analysis. When her boss, Doctor Axel Lindblad, received the analysis certificate on Monday morning he called her immediately and asked if it was some kind of joke. No, it was not. Lindblad hastely left for Ulvsunda to take a look at the gold. It was unusual for an analysis to show 1,165 g of gold per ton ore. However, not all of the deposit was fully as rich in gold as these first analyses showed. But there was sufficient to begin very profitable mining.

On December 10 that same year, drill cores were extracted from what was hoped to be a bigger deposit in the Fågelmyran area. The work was piling up for Thelma. Axel Lindblad told her that if she stayed behind every evening until the analyses were finished, she would get a week's leave afterwards. Thelma worked until midnight every evening, and then returned to the lab by streetcar at 5 o'clock every morning. In an interview, she had this to say about that time: "I never took the leave I was promised. How could I leave the laboratory when everything was so exciting?"

And it was well worth it. The analysis showed a high gold content there, too. In other words, it was Thelma's analyses that led to the formation of Skellefteå

Boliden's laboratory in Stockholm at the beginning of the 1930s. Thelma Berggren on the left.

Thelma Berggren at work in 1947. The following year the laboratory moved north to Skelleftehamn, but Thelma did not move with it.

Gruvaktiebolag, and what is now Boliden.

Generous to children

After a while, the laboratory was moved from Ulvsunda to Bryggargatan in Stockholm, and in 1948 it was moved north from Stockholm to Skelleftehamn. Thelma Berggren did not move with it, but instead began working for AB Atomenergi.

So who exactly was Thelma? Other than somebody who was good at her job.

She lived her entire life in an apartment on Östermalm together with her sister, Elsa. Both sisters had studied, and they had jobs that in those days were unusual for young women, Thelma as a chemist, and her sister Elsa worked as a government clerk at the then crown pensions agency. It has been said that they wore the same type of striped cotton dresses with zips at the front and a belt. And as often as not they had braided hair pinned up like buns, around their ears.

Neither of them had children, but they fostered a Finnish girl in their home. The siblings Bengt and Ulla-Britt, who were the grandchildren of the Berggrens' cousin, also came to play an important part in their lives. Ulla-Britt, today called Roos, recalls a tradition they shared. The day before Christmas Eve, the children got to visit their grand apartment to enjoy coffee and cakes, and in the drawing room was a chair covered with a quilt. Under the quilt was a pile of neatly wrapped packages.

"They showered us with presents. I remember I was always given a doll. Then there were always some books and a few joke novelties from Buttericks. My brother and I had great respect for the sisters.

Thelma Berggren died in 1977, 86 years old.

> **"I never took the leave I was promised. How could I leave the laboratory when everything was so exciting?**

BOLIDEN PEOPLE

His stubbornness saved Boliden

Text: Olle Lundqvist

There's short-term thinking, and there's long-term thinking, and in 1929 were at odds with each other. At stake was Boliden, and had majority owner Ivar Kreuger gotten his way, the mining company would have been short-lived. But Boliden's management put up a fight, and the person who did the fighting was Oscar Falkman.

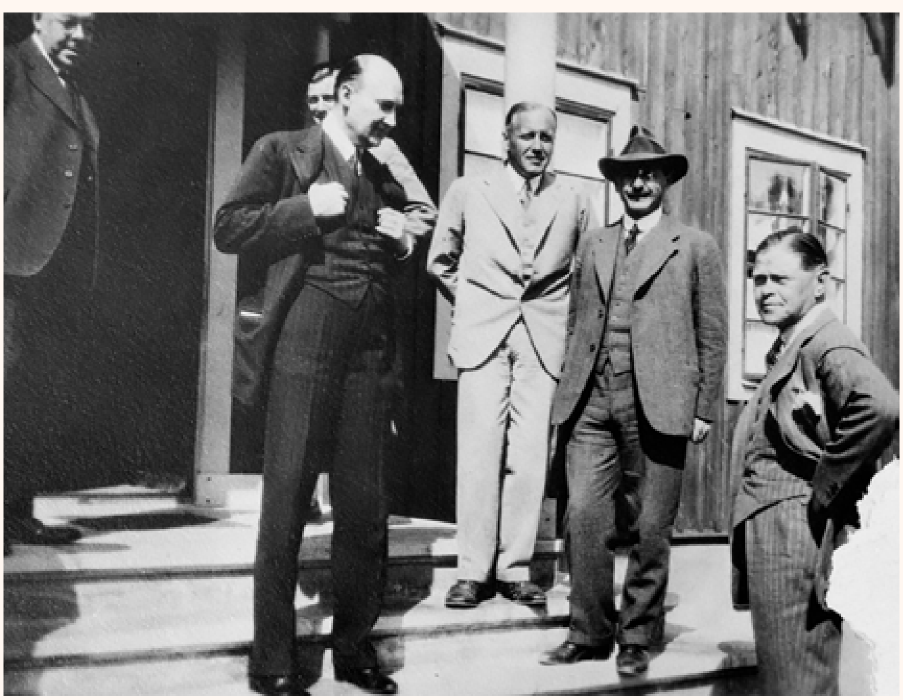
Oscar Falkman was Boliden's first CEO. Although he took up his position when Boliden was formed, he in fact already controlled the company in 1915 when he was appointed CEO of predecessor Centralgruppens Emissions AB.

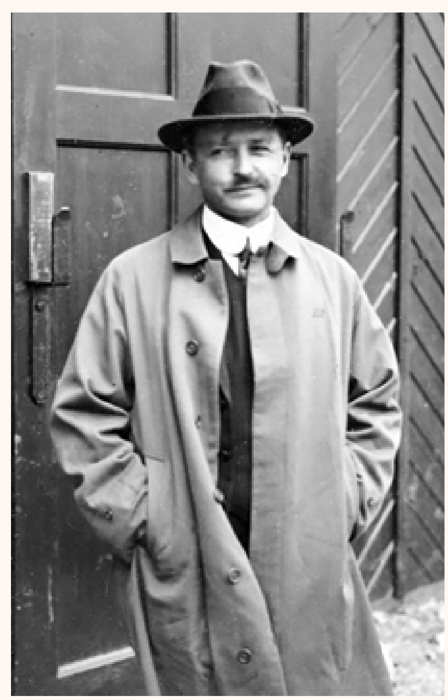
Ivar Kreuger was Sweden's big industrial hero who founded and controlled a business empire so big and prosperous that he could lend money to the national treasuries of both France and Germany. In 1929, he bought 90 percent of the nascent Boliden AB. That same year, the Wall Street crash occurred and Kreuger's creation began to falter. The stock that had been used as collateral for bank loans as big as half the Swedish currency reserve lost a great deal of its value. Suddenly, everything was going against Ivar Kreuger, and he had difficulty in obtaining the capital his businesses required.

The shares in Västerbottens Gruv AB and Skellefteå Gruv AB were secretly purchased for SEK 57 million via Skandinaviska Banken (with loans from the latter) whose CEO Oscar Rydbeck also became Chairman of the then Skellefteå Gruv AB's Board. The share purchase took place on December 16, 1929 and

▼ Dr. Axel Lindblad, mine manager Erik Wesslau, engineer Ivar Kreuger, head geologist Dr. Olof Baeckström, director Oscar Falkman and engineer Krister Littorin outside Boliden's company hotel in 1931.

◢ Oscar Falkman was also the CEO of Boliden's predecessor, Centralgruppens Emissions AB.





Twin frame Electromagnetic measurement in Mensträsk. Director Oscar Falkman on the right and engineer Karl Sundberg, center.

just over six months later on July 20, 1930, Ivar Kreuger still enjoyed the status of national hero.

Buy cheap, bleed it dry and sell dear

A fascination for mines and smelters was hardly Kreuger's great motivation. So what did he actually want Boliden for? To develop? No. To buy it cheap, bleed it dry and sell dear.

When the smelter in Rönnskär was planned, it was on the basis that mining would initially extract around 100,000 metric tons of ore per year, equivalent to the smelting of no more than 75,000 tons at Rönnskär, with a certain margin for a subsequent increase. But when Ivar Kreuger quickly insisted that the installations on Rönnskär should be planned such that mining in Boliden would increase to 800,000 or indeed 1,000,000 tons per year, CEO Oscar Falkman resisted. He asserted that extracting 600,000 tons of ore per year would mean that instead of a lifetime of 37 years (at an extraction rate of 200,000 tons per year), the mine would be exhausted after just 12.5 years. He insisted that this would not only be catastrophic for the company and its employees, but also for the entire community that had grown up around the mine and smelter. And as if that was not enough.

"The decision would involve an immediate sixfold increase in a currently incomplete and untested initial plant section whose designs were in many regards untested, with arsenic and fume injury hazards and newly employed personnel who were for the most part entirely unused to smelter operations," was how Falkman expressed it. An invitation to trouble, in other words. And risks.

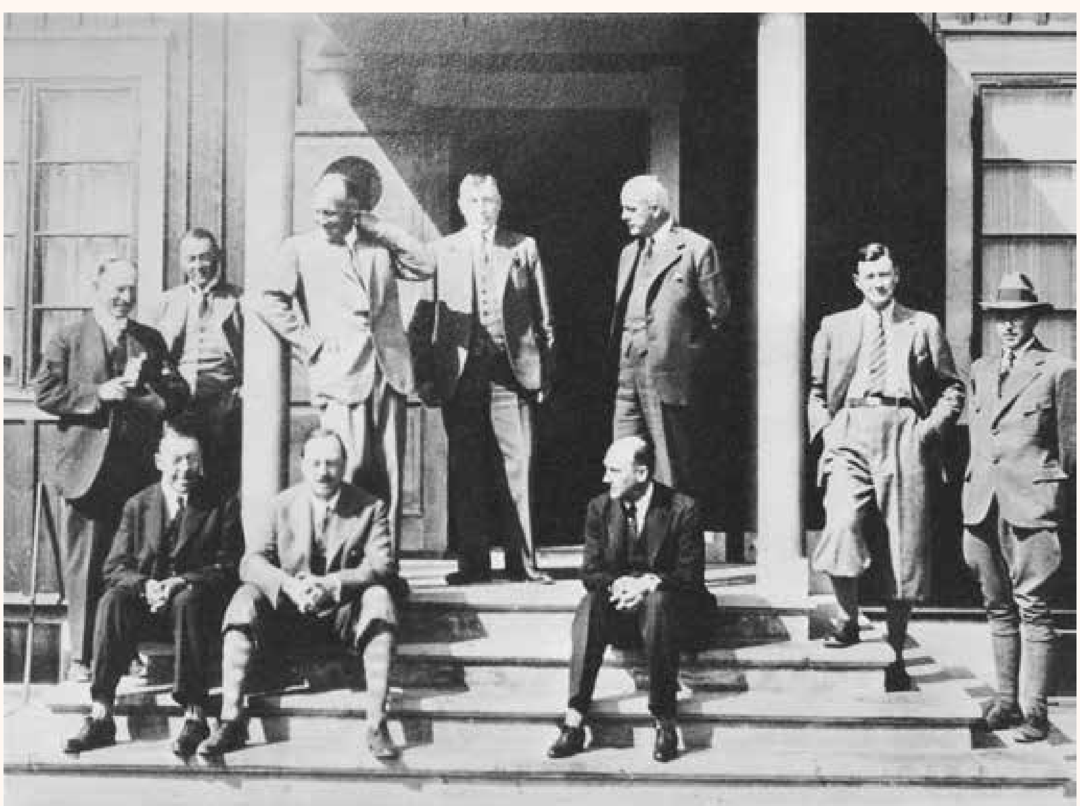
Oscar Falkman's pleas fell constantly on deaf ears, but he did not give up. He continued to protest. He traveled to the USA to study the smelter whose methods Ivar Kreuger insisted should be the model for Rönnskär. He remained unconvinced and argued persistently, and finally Kreuger gave in. There was no plundering of the Boliden ore, which would instead last until 1967. And the expansion of Rönnskär continued at a reasonable pace as originally planned.

"Unusual problems and outcomes"

Did this save Boliden? In contrast to many other companies in the Kreuger group, and despite the turbulence the dramatic expansion plans had caused, Boliden was still a stable company; but what would have happened if Kreuger had put his plans for the Boliden mine and Rönnskär into practice? Shortly before his demise he had said to have expressed plans to replace Boliden's management. Not surprising considering how Oscar Falkman and his colleagues had fought against a drastic expansion.

On May 12, 1932, Ivar Kreuger was found dead in his apartment in Paris. It was determined that he had committed suicide. Oscar Falkman continued to successfully manage Boliden until 1943, when he retired. Six years later and entirely on his own initiative, he wrote a book about his years in the mining company. Because he based a great deal of the book on the minutes from board meetings, he reports the company's development in great detail. The book begins with the sentence: "There cannot be many Swedish industrial companies that have had such unusual problems and outcomes as Bolidens Gruvaktiebolag."

"Oscar Falkman's pleas fell constantly on deaf ears, but he did not give up.



Ivar Kreuger (center) sitting on the steps of the company hotel in 1931, surrounded by Boliden's management.

DID YOU KNOW THAT …

Copper from Boliden is used in the particle accelerator in the CERN laboratory in Switzerland, which discovered the Higgs boson. The discovery, which was announced in 2012 and described as monumental, helped explain why even the very smallest of material's building blocks have mass.

Foto: Wikimedia Commons (16284713042)

The energy-saving flash smelting method for copper concentrates that was developed in Harjavalta back in 1949 is today the world's most used method for smelting copper concentrates.

Gold is not just good to look at. Today, gold is an important material used for the manufacture of components in the electronics, space and pharmaceuticals industries.

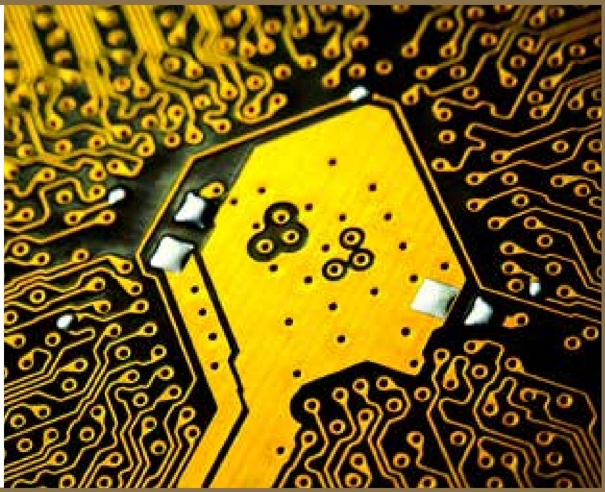


Photo: Shutterstock

BOLIDEN 100 YEARS PART 1: 1924–1945

On December 10, 1924, a discovery was made that would have a major impact for many years to come. The gold-bearing ore that was discovered in Fågelmyran in Västerbotten County laid the foundation for the company we know today as Boliden. This, our first centenary year magazine, takes a closer look at how exploration work proceeds. We will also discuss why technological advances are an important reason for our successes.