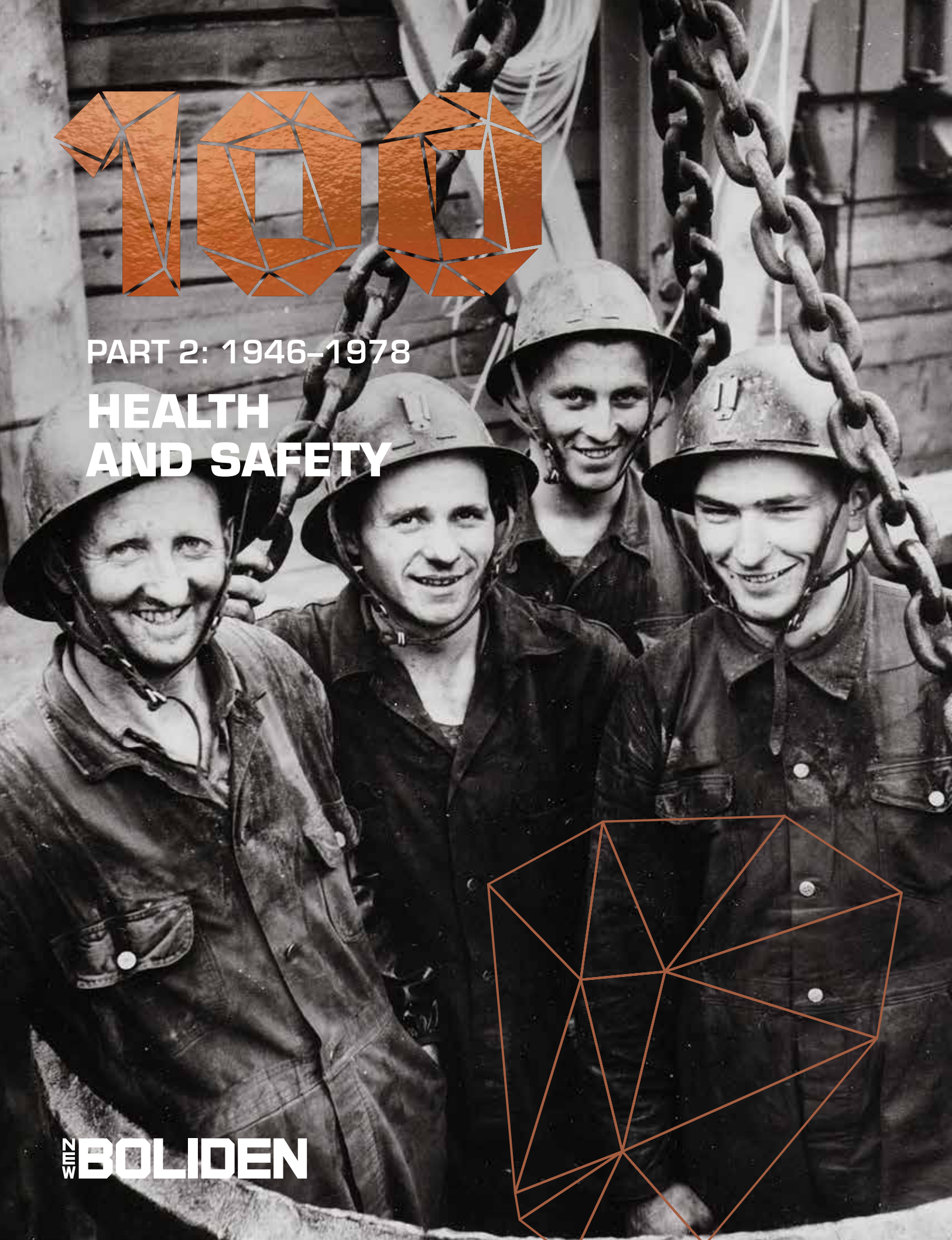
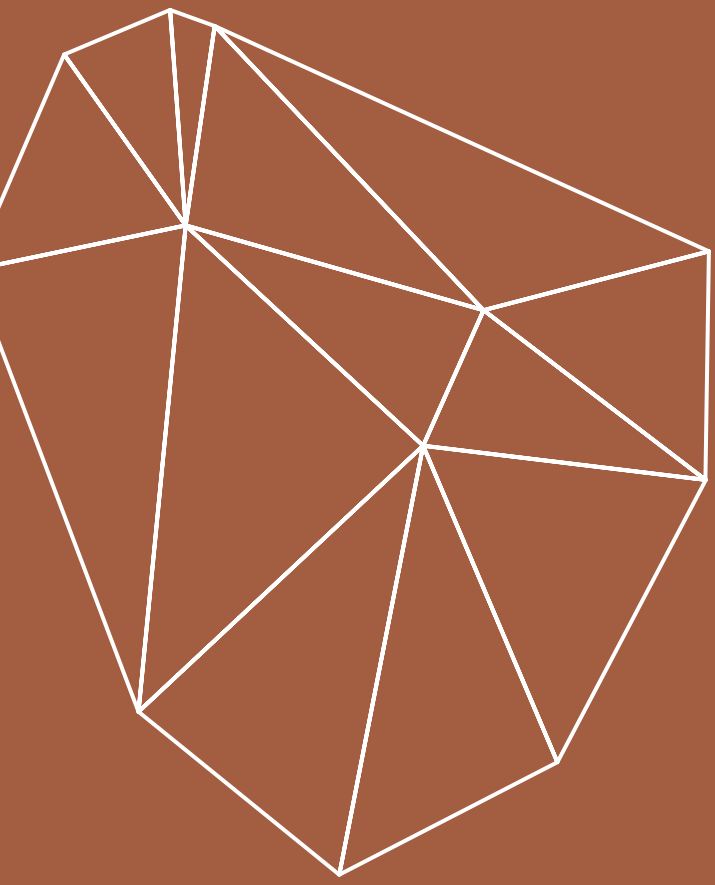


PART 2: 1946–1978

HEALTH AND SAFETY

BOLIDEN



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BOLIDEN 1924–2024

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A development we recognize

When peace returned to Europe after World War II it also meant the beginning of the large-scale generation and consumption of electricity. In the space of 20 years, Sweden went from generating around 10 TWh to around 50, and it was the rivers that provided us with energy. Electricity prices in Finland fell so low that Harjavalta turned the entire industry upside down by inventing flash smelting. It was an epoch in which copper enjoyed a unique position among base metals. Technical developments in the mining industry advanced rapidly, and Aitik soon loomed large in northern Sweden.

In parallel with large-scale solutions and technical breakthroughs, another astounding development took place during this period in respect of occupational health and safety. Seen through the lens of the present day we would probably still think that conditions were distressing, but the fact remains that despite increasing operations, the number of deaths in Boliden halved between the 1960s and 1970s. It was no longer just the mining of gold and copper that was important, people and their needs began rightly to assume a bigger place. The future looked bright, but we were not quite there yet.

I wasn't there in person during this period other than as a little kid on the southern shore of Lake Vättern, but I see many parallels with present times. Once again we see a need for new technology that can help us be better in many areas. Once again we see that copper is creating the foundations for the societal development we want. Will we get everything we want and succeed with everything we do moving forward? Probably not. However, we've learned a lot during the passage of time. We will go on trying, continue adapting and, most important of all, continue focusing on taking care of ourselves and each other.

Photo: Jeanette Hägglund

Stefan Romedahl
President Boliden Mines

As far as possible, employees must be spared work that is dirty, dangerous and dull.

Dag Berg, project manager
(Read more on page 26).

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Photo: Päivi Kanjalainen

“Everything developed in many ways over time, and when the zinc plant started up, the processes were in an entirely different class.

Read more about Jaakko Salminen on page 54.

MINING INDUSTRY Historical background

AN INCREASING ENERGY REQUIREMENT

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

Boliden's predecessor, Centralgruppens Emissionsbolag, began its operations in a time when demand for the type of metals that could be found in sulfide ores was very high; it was a time when mining such metals had the potential to be extremely profitable. However, economic conditions for the mining industry were changing rapidly. The financial crisis during the interwar years has been described as the deepest depression experienced by the West in modern times. The industries that were hit hardest were those that had benefited from World War I, including the iron and steel industry and therefore even parts of the mining industry. However, from the middle of the 1930s the business cycle was trending upward again, which also benefited the mining industry. In Sweden, Vattenfall

The community of Laver seen from the shaft tower roof, 1944.

expanded hydroelectric power and the electrification of industry, transportation and society began in earnest, with a rising demand for copper. Germany was rearming, and required both steel and export ore. The outbreak of World War II resulted in a rapid increase in demand for Swedish iron ore. Exports to Germany were part of a trade arrangement that went on during the war years until 1944, when Sweden unilaterally ceased the export of iron ore.

Rapid growth …

Following the end of World War II, the demand for minerals declined temporarily with the result that for a short while the mining industry cut back on its labor force. The falling price of copper also contributed to the closure of Boliden's copper mine and its mining community in Laver, at that time one of the company's most northerly mines. However, demand soon trended up again and the Swedish mining industry could once more benefit from a period of rapid growth in the global economy. In the wake of the war and the immense reconstruction requirements that came with it, the demand for base metals such as iron and copper rose. The reconstruction of cities, factories and infrastructure required enormous quantities of steel. At the same time, the automotive, shipbuilding and oil industries grew and demanded large volumes of steel. In Sweden, this period of strong sustained growth is usually referred to as the record years. In the northern orefields, LKAB expanded its mining operations in Kiruna and Malmberget, began mining in Svappavaara and launched spectacular city transitions and new constructions. In the Skellefte orefields, Boliden expanded operations in the existing mines and also started new ones.

Technological advances and the major demand for copper led Boliden to begin mining in Aitik in Gällivare municipality, which the company has since expanded to become one of Europe's biggest mining undertakings and Sweden's biggest industrial area by far. During the postwar years, even the mining industry in the Bergslag area was working at capacity. During the 1950s, there were around 60 iron ore mines in operation there, and an additional number of mines for other metals. Many of these mines were relatively small compared to

Photo: Harry Dittmer/Tekniska museet

The shipbuilding industry was one of the sectors that required large quantities of steel.

The United States took the initiative to a number of exploration projects during the 1950s.

those in the north, but there were also relatively large scale iron ore mines such as Grängesberg and Stråssa. The mining industry in the Bergslag area and in the system of copper mines, smelters and steel mills they formed part of benefited from the great demand during the record years.

The mining and metal industries in Sweden's neighboring countries also expanded during the postwar years. In Finland, mines were established for the extraction of copper, zinc, gold and iron ore. Companies in the industry grew large, and in time also internationally. The mining giant Outokumpu is a typical example. The mining sector in Norway also grew during these decades, with the extraction of iron ore, coal and copper as well as the processing of e.g. aluminum, cobalt, nickel and zinc.

… turned into a crisis

The United States took the initiative to a number of exploration projects during the 1950s, and they brought a wave of discoveries, especially iron ore deposits in Canada, South America, Africa and Australia. The company Grängesbergsbolaget from Sweden was active and opened iron ore mines in Liberia in the middle of the 1950s. International steel groups began extracting ore from the new deposits and exporting ore concentrate. At the same time, ocean freight prices fell in concert with the introduction of ever bigger vessels capable of intercontinental ore haulage at low prices. However, internationally, there was already overcapacity in production, and a crisis was in the offing.

Yet in the beginning of the 1970s, the industry still had great faith in the future and it was not prepared for the course of events that triggered the great crisis, namely a decision by the organization of oil-producing countries (OPEC) to raise oil prices. The decision was a hard blow to energy-intensive operations such as the steel and other metal industries, and by extension the companies that provided them with ore – mining. The number of residents in the mining communities shrank as the company reduced its labor force. An extensive demolition of workman's dwellings was planned, together with strategies for diversifying the economy in the municipalities that were dependent solely on mining. Large-scale industrial mining projects in the world's most northerly mining areas were hit hard during the period.

Photo: NARA/Wikimedia Commons (42716519B3)

The 1973 oil crisis not only hit industry hard, but also private individuals.

1946–1978

NEW DISCOVERIES AND BUSINESS FROM RESIDUAL PRODUCTS

During the decades after the end of World War II, Sweden would experience extremely rapid economic development. The demand for iron and other metals increased at record speed.

Text: Karin Jansson Myhr

Geophysical surveys in Näsliden, 1960.

Rebuilding a war-ravaged Europe took a lot of steel, copper and lead. Between 1948 and 1949, a remarkable increase in lead production took place on Rönnskär. Copper production was not affected as quickly, but the long-term increase came to be much greater. In 1948, just over 22,000 metric tons of copper were produced. On the other hand, the demand for nickel fell. Due to the lower prices, nickel production on Rönnskär, and the Lainejaur nickel mine closed down. Also, Boliden made a number of new discoveries that would be developed into mines. And it invested in new areas such as chemicals production.

The Renström mine, 1966.

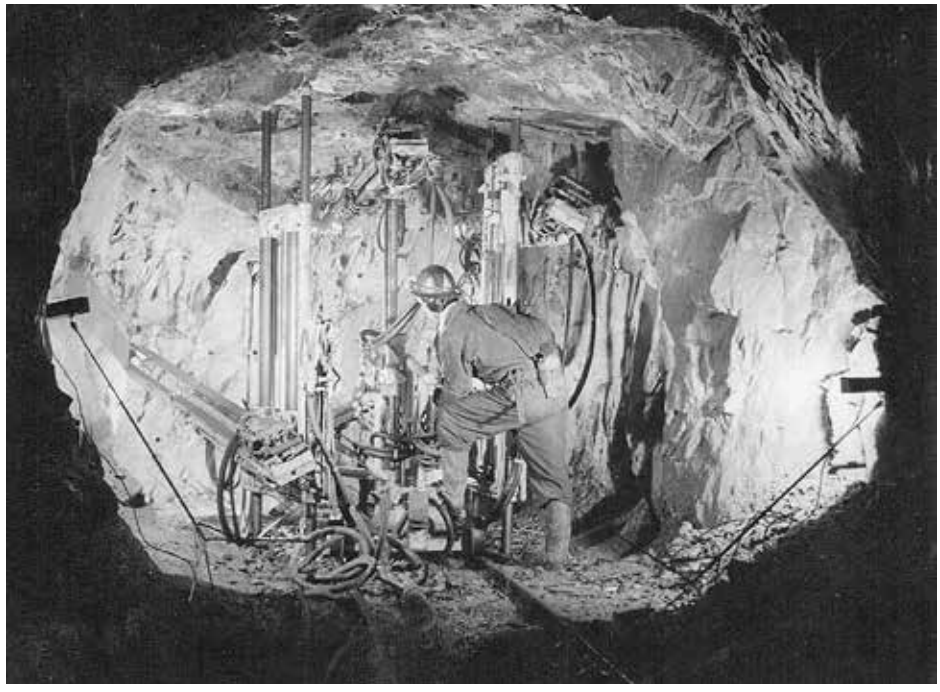
The enormous copper deposit in Aitik was one of the most important discoveries for Boliden's future.

Exploration and acquisition

The Skellefte orefield (in Västerbotten County) is the area that was surveyed most. From the 1920s until the beginning of the 70s, exploration was constantly in progress. The beginning of the 1950s saw the discovery of two orebodies, the Udden deposit, and the biggest, richest part of the Näsliden deposit. In the 1960s, a comprehensive geological effort was made that resulted in a new geological map covering major parts of the orefield.

In the middle and the end of the 1980s, a couple of major, important discoveries were made in the Skellefte orefield. The two orebodies Petiknäs South and Petiknäs North contained gold, silver, copper and lead. There was enough ore for 10 years' mining. These were two much-needed contributions in the economic crisis that Boliden would suffer. Thanks to the discovery in Petiknäs, Boliden made a new attempt in Renström, where the company had previously mined ore. This time the company found even more, and it's still being mined today. Today, the mine is Sweden's deepest, and in February 2019 it surpassed a depth of 1,500 meters below ground.

The enormous copper deposit in Aitik was one of the most important discoveries for Boliden's future. This was the place where the famous Blue Boulder, incredibly rich in copper but of hitherto unknown origin, was found in the 1930s. Today, the boulder is on show at the office in Aitik.



▲▲ Drifting in the Renström mine, 1966.

▲ Smoke divers in Långsele, 1962.

The Renström mine's mining engineer Lindfors and foreman Karlsson, 1955.

Loading in the Aitik open pit in 1973.

Priming a dynamite charge in Renström, 1955.

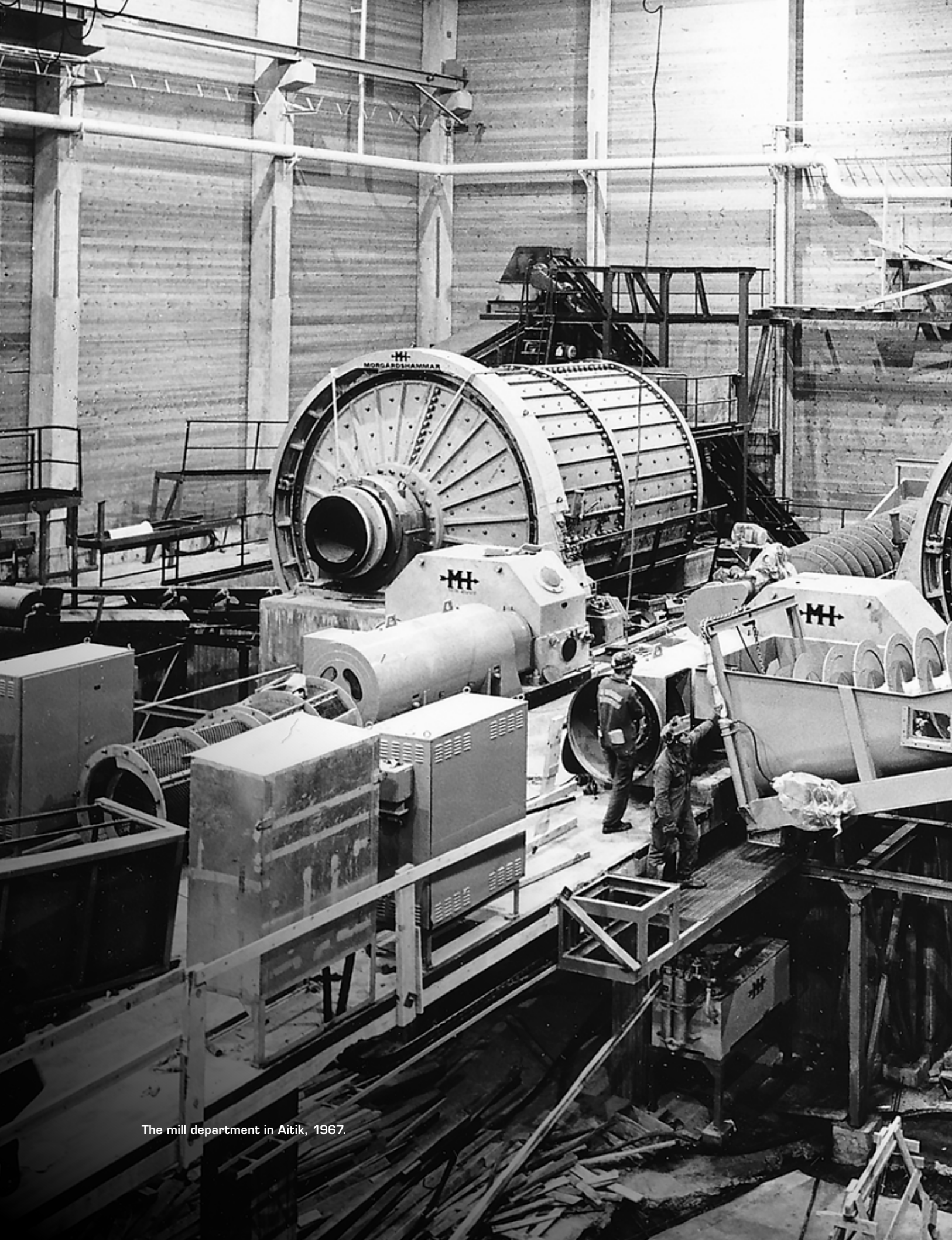
Assembly work in the flotation hall in Aitik, 1967.

The Aitik mine went into operation in 1968, but was initially no great success. Copper prices were low and forward planning short. During a period in the beginning of the 1990s, Boliden even calculated what it would cost to close the operation. But the mine remained, and in the beginning of the 2000s metal prices rose. Boliden chose to invest heavily in the operation, and thanks to technological developments in the mining of mineralizations with low metal grades, Aitik has grown to become one of Europe's biggest copper mines over the years.

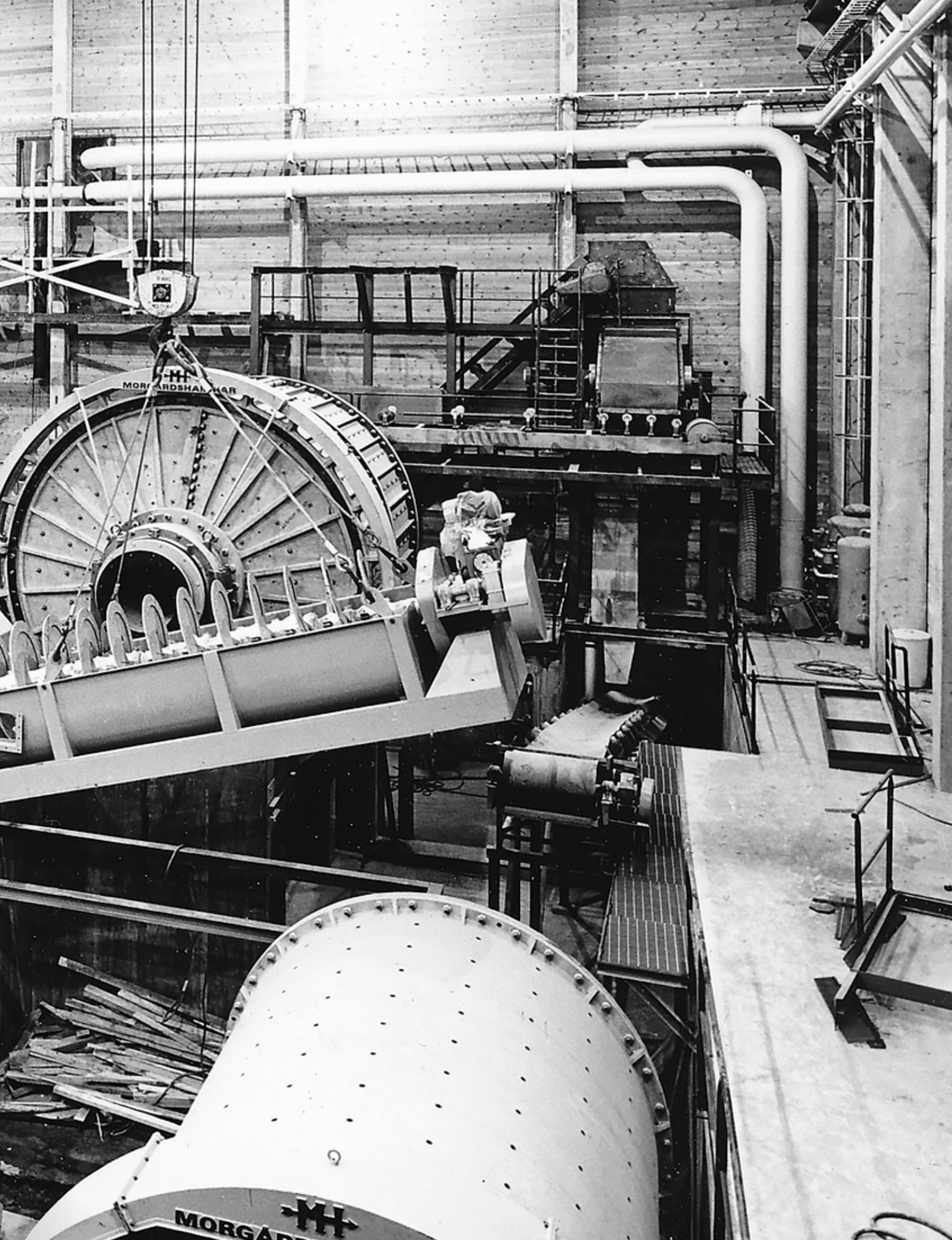
A fortunate acquisition came to characterize the 1950s for Boliden. When Boliden acquired Zinkgruvor AB in 1957, it became the owner of several mines in Bergslagen, including Garpenberg and Saxberget. Garpenberg is one of the world's oldest mines still in operation. Mining took place there as early as 375 BC, and has done so continuously since A.D. 400. After the acquisition, Boliden established an exploration office in Garpenberg, and in 1966 the Garpenberg North deposit was discovered.

Significant chemicals production

Many residual products arose from Boliden's ore processing, some of which



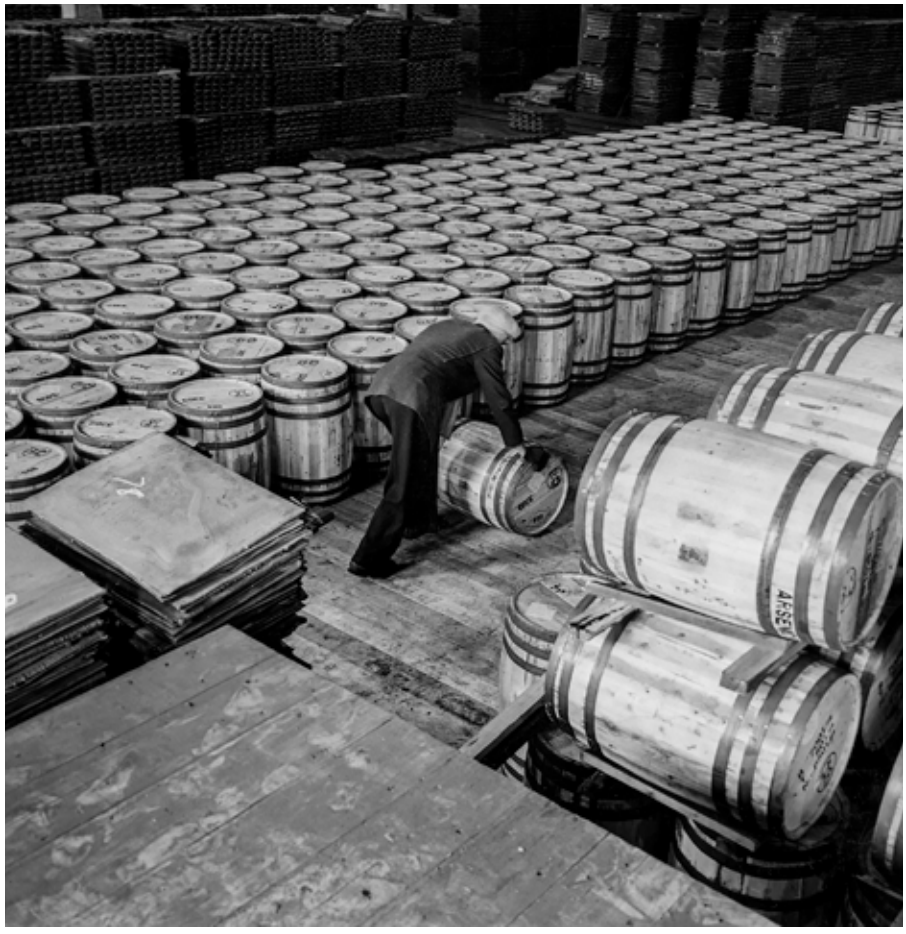
The mill department in Aitik, 1967.



could be hazardous. The reason behind the company's 1952 construction of a sulphuric acid plant on Rönnskär was to take care of flue gases bearing sulphur dioxide.

Just over 10 years later, Boliden acquired the industrial company Reymersholm in Helsingborg. Pyrite from the mines and some of Rönnskär's sulphuric acid was shipped there. Reymersholm was also a shareholder in the company Förenade Superfosfat, which later became Supra, with operations in e.g. Landskrona, Köping, Norrköping and Oskarshamn, and also in Tunisia. The main product was artificial fertilizer. In 1970 Supra accounted for 97 percent of the Swedish market, but it also manufactured other chemicals. Supra remained under Boliden's ownership until 1981, when the company was sold to Norsk Hydro.

During the 1970s, the chemical operations constituted their own division within Boliden, where the principal operation was the production of heavy inorganic chemicals. The most important products were sulphuric acid, phosphoric acid and hydrochloric acid. The acids were used to produce various solid chemicals, principally phosphates and sulfates. One best-selling chemical product was the drain cleaner, Boliden AVR. Almost everyone in Sweden who lived in an



Arsenic packed in wooden barrels, 1950.

During the 1940s, Boliden developed a new field of application for arsenic: lumber impregnation.

Work in Boliden's laboratory, 1948.

urban area, drank water that had been purified with chemicals from Boliden.

Other products were sodium sulfate and calcium sulfate. Among other things, Boliden's calcium phosphate was used in mineral compound feed, and calcium chloride for binding road dust. In the case of sodium sulfate and aluminum sulfate, the cellulose and paper industries were the biggest customers. Other specialty chemicals were used for such things as the production of washing powder. A residual product from the manufacture of phosphoric acid was gypsum, which Boliden sold to the cement industry.

As of the beginning of 1977, Boliden AB was restructured and two new companies formed: Boliden Metall AB and Boliden Kemi AB. The chemical operation then accounted for around 17 percent of Boliden's annual sales. This would rise at first, but fall later.

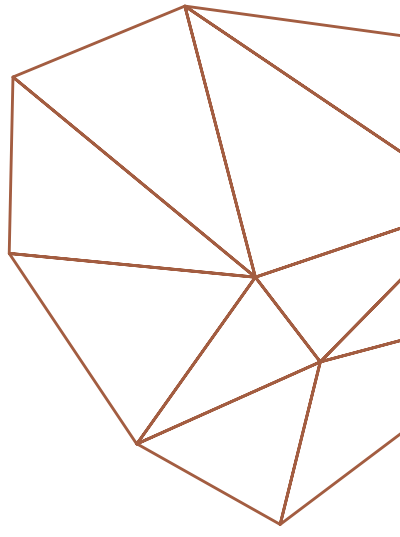
Profitable arsenic

Arsenic was another residual product from metal extraction. It was initially a major headache for Boliden, but later became a cash cow.

An arsenic refinery was built on Rönnskär, which began exporting refined arsenic in 1933, chiefly to South Africa. Arsenic was used there to produce a locust pesticide. Arsenic was also exported to countries such as the USA, UK, Germany, Argentina and others where it was also used in the manufacture of insecticides.

During the 1940s, Boliden developed a new field of application for arsenic: lumber impregnation. This was a very successful investment, in which Boliden created a proprietary patented and more effective method using what was known as Boliden salt. In 1941, 90 percent of all wood impregnation in Sweden used the method developed by Boliden. The method was baptized K 33, which became a global term in the field of wood protection. The abbreviation K 33 stands for 'Kungliga Tekniska högskolan 1933' [Royal Institute of Technology 1933], the year when Bo Häger, the inventor of the method, received his degree.

In the beginning of the 1980s, metal prices were so low that Boliden earned hardly any money from metals. So the manufacture of arsenic and chemicals became very important. But the thing Boliden earned most money from was forward trading in metals, which accounted for more than half of profits.



In focus: Aitik

Just south of Gällivare is Sweden's largest open-pit copper mine. It's probably also the cleanest, and best equal-opportunities workplace.

Text: Sara Johansson

With just over 900 employees, Boliden Aitik is the largest private employer in Gällivare municipality. Most of the employees live nearby, or at least in Norrbotten County. There are also many contractors, as there are almost always major projects underway in the mine. Almost 40 percent of the machine operators here are women, as are more than half of the truck drivers. This is extremely unusual in international terms.

Smart solutions

Nothing in Aitik turned out precisely the way people thought. Boliden had localized a deposit in the area as early as the 1930s. While the orebody was large, the copper content was low. It was not profitable to mine the ore using the technology of the times, but 30 years later it was a different story. Since then, things have happened fast. At the beginning of 1968, the company thought mining would take place at a depth of max 50 meters. Today, they're mining ore at a depth of 550 meters. In the intervening years, the company has also been able to increase the production volume from a couple of millions of tons per year to 45 million tons.

In open pits, it's often necessary to first remove large volumes of barren rock, waste rock, before reaching the ore. Despite this, Aitik is considered fortunate as

Construction of the foundation for a shaft tower and ore bin, 1966.

AITIK IN BRIEF

Commissioned: 1968

Operation: open pit

Minerals mined: copper, gold and silver

Number of employees: 814 (2023)

Photo: Lars de Wall

◀ The mill in the concentrator at Aitik.

◀◀ Mostly copper is mined in Aitik.

◀ Some of the world's biggest trucks are used here.

in almost all open pits, much more waste rock has to be removed to reach the ore.

Between 2006 and 2010 Aitik 36 was implemented, which was a major effort even measured in Aitik's terms. Production volume increased from 18 million metric tons to 36 million. An important component was a new concentrator that was more efficient than before and could extract copper from low grade ore. The plant uses gravity flow, which means the buildings have a decline, a slope, that forms part of the actual concentration process, obviating the need to pump water. The design was achieved with the aid of employees from the old plant. Another example of a smart solution developed by, or together with, Aitik personnel is control systems via smartphones. If someone has a good idea, they're encouraged to try it. Also, new products are often tested in the area by other companies as the climate is so extreme.

Big machines

The work in Aitik is carried out with some of the world's biggest machines. They include rock dumpers with a laden weight of 570 metric tons and whose wheels measure four meters across. And excavators that hold up to 45 cubic meters of rocks in their buckets. The trucks Aitik purchases are modified to precisely suit the operation. For example, now there are so many women drivers, the mine often replaces drivers' seats to fit people with a somewhat lighter frame. Retractable ladders are fitted instead of steps.

Development work is constantly in progress. A pilot project took place in 2018 and 2019 in which four of Boliden Aitik's trucks were modified with pantographs for electric operation along a 700 m test stretch, not unlike the way trains and trams work. The trolley project was such a success that a further 2.3 kilometers of overhead wiring would be

built. In 2023, training and trials began using autonomous trucks.

Effective occupational health and safety

The Aitik mine has been relatively free from serious accidents involving people. Only one fatal accident has ever occurred in the mine's history. It happened in the beginning of the 1980s when a truck rolled over. As is the case with new technology, safety work has also developed positively. It's work that is constantly in progress, both on the part of management and the shop floor. Safety representatives do a lot to drive day-to-day health and safety work, but the familiar atmosphere is another success factor. Employees testify to there being less hierarchy and more open doors than in many other places. And what's more, everyone removes their shoes in office environments. Perhaps this is partly the reason for the general cleanliness noted in the area, where even the concentrator is as clean as a new penny.

But accidents big and small can still happen. In September 2000, an accident of the bigger variety came incredibly close to becoming a catastrophe for both people and the environment. A dam failed and water with a high copper content flowed rapidly out. Fortunately, manager Stig Wennström discovered the leak, and also, a dam located downstream of the one that had failed managed to hold back the major volumes of water and tailings. Thus the outflow of polluted water was limited and a catastrophe averted. However, it led to comprehensive reinforcement work on the dam for the future.

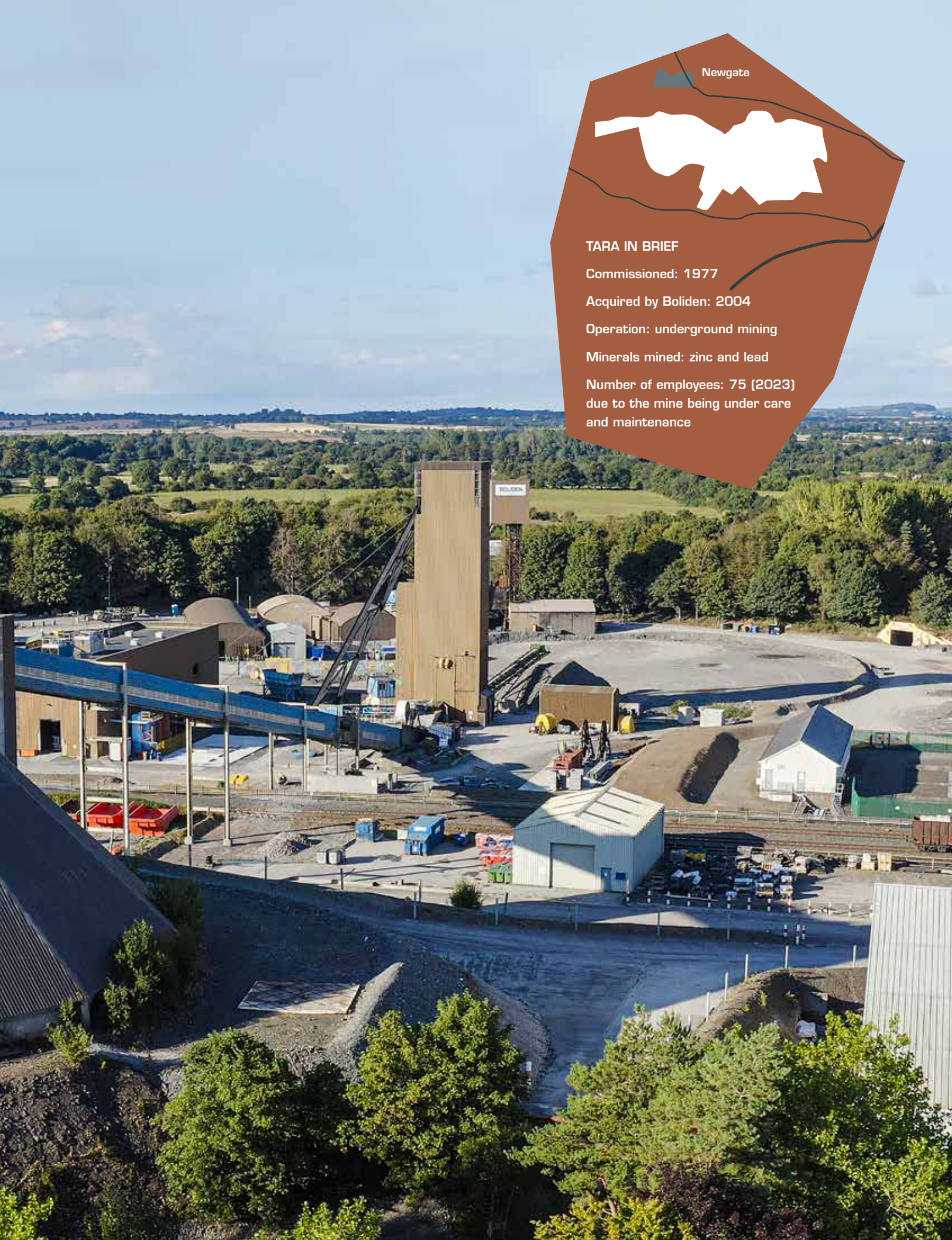
After the mine

Even though the mine is a popular employer, it's a good idea to have a direct link to seats of learning in an area where the competition for labor is so tough. Lappland's Gymnasium (high school) in Gällivare is home to the Boliden Model, the origin of many new recruits to the company. Also, at such a big workplace in an area with a small population, it's common to come across family connections among the employees.

Aitik is expected to remain in operation for a long time to come. When the mine is exhausted, there are plans for comprehensive reclamation work to make the area a natural part of the landscape once again. But until that time, mining must continue.

Even though the mine is a popular employer, it's a good idea to have a direct link to seats of learning in an area where the competition for labor is so tough.

When the mine is exhausted, the area will be reclaimed to become a natural part of the landscape once again.



TARA IN BRIEF

Commissioned: 1977

Acquired by Boliden: 2004

Operation: underground mining

Minerals mined: zinc and lead

Number of employees: 75 (2023) due to the mine being under care and maintenance

In focus: Tara

Tara in County Meath, Ireland is Europe's biggest zinc mine and also one of the largest globally. Since mining began in 1977, more than 85 million metric tons of ore have been extracted.

Text: Sara Johansson

Immediately outside Navan, 50 kilometers northwest of Dublin, is the mine with the fascinating name of Tara. The mine takes its name from the nearby mountain, which is said to be the place where Ireland's medieval kings were crowned, and which also plays a part in Irish and Celtic mythology. However, the history of the mine itself is not quite as long.

It began with a rock at the side of the road

A number of Irish mining entrepreneurs who had emigrated to Canada earlier, founded the Tara Exploration and Discovering Company, and began explorations in Ireland back in the beginning of the 1960s. When geologist Brian Byrne discovered an interesting rock at the side of the road in 1970 in an area outside of Navan, everything changed. Analyses showed the rock to have a high zinc content. An additional survey showed that the area contained ore that was unusually rich in zinc and lead. Construction work on the mine began in 1973, and production could begin in June 1977.

The reason behind its having taken so long between the discovery of ore and the start of operations was to do with

When production began in 1977, the company believed the ore would last for 20 years, but it turned out to be much longer.

Photo: Bengt Höglund

◀ Henry Paul gathering information from drill cores, 2012.

◣ The lifespan of the mine has been extended several times.

▼ Tara Mines Ltd began the work with constructing the mine in 1973 and four years later operations could begin in earnest.

the deposit's location so close to town. Reams of permits were required to begin mining there, and it probably would not be possible today. Most people in the immediate vicinity were farmers, and many were naturally worried about what was taking place. It has been said that people had nightmares about the entire area being dotted with deep, open holes down to bedrock. The mining company countered concerns by e.g. planting a tree for every inhabitant in the mining area to demonstrate that it was possible to combine the mine with green surroundings. Still today, one has the impression of driving through a park rather than to a mine when approaching Tara.

The art of extending the life of a mine

But a mine it is. Europe's biggest zinc mine, no less. Around two million metric tons of ore are mined annually for the production of zinc and lead concentrates. When production began in 1977, the company believed the ore would last for 20 years, but it turned out to be much longer. And if anyone can practice the art of extending the life of mine, it's the geologists at Tara. First of all, a group led by John Ashton discovered an offshoot from the initial orebody. This meant the mine's permit could be extended. In 2014, a new deposit at a considerably greater depth was discovered, Tara Deep, 1,000 meters deep in the bedrock.

However, there were many crises both before and after Boliden took over in 2004. In 1986, Finnish Outokumpu became the owner of the mine when it pur-

When production began in 1977, the company believed the ore would last for 20 years, but it turned out to be much longer.

chased it from the Canadian company, Noranda. This entailed major changes and more than a few rationalizations. Ten years later, it was time for more cutbacks, and at the end of 2001 the mine was closed completely for 11 months due to low demand and low prices.

The mine was flooded in November 2021 due to water leaking into an exploration shaft, threatening the entire operation, but a catastrophe was averted. Work to improve safety is in constant progress at Tara. An internal organization, Mine Rescue, consists of people who, in addition to their regular work, act as responders in the case of accidents.

Social cohesion

The mine is important, not just as an employer but also for social cohesion. Many families have worked in the mine for several generations. Tara has several social clubs where like-minded people gather to enjoy e.g. fishing or golf. And the open-house days when families and friends get to visit are very popular.

The proximity to Navan and Dublin makes it easy to recruit as people can combine city life with mining. Over the years, the mine has had a very positive impact on the region. A lot worked poorly in the 1970s, and so the coming of the mine and the beginning of production in 1977 was a big break.

Exploration and acquisitions have enabled a constant increase in mineral reserves and mineral resources. In recent years, Tara has focused on productivity-enhancing investments and cost reductions. But this is not always enough. In June 2023, a decision was taken to mothball the mine once again, this time as a result of e.g. low zinc prices and high energy prices. The ambition is to reopen the mine so that explorations toward Tara Deep can continue, but at the present time, no one can say when this will take place.

The proximity to Navan and Dublin makes it easy to recruit as people can combine city life with work.

TOPIC: HEALTH AND SAFETY

SAFETY CONSCIOUSNESS HAS TAKEN OVER THE INDUSTRY

Not everything was better in the old days. In fact most things were worse, and there's no doubt when it comes to fatalities and other accidents in the mining world. The statistics speak for themselves. But the trends have turned, and the reasons can be found in improved technology and increased awareness.

Text: Olle Lundqvist

The people who experienced Boliden's first decades are no longer with us, and their way of thinking is a far cry from ours. But mine work was a bit macho, no doubt about it. The mine was a man's world where men earned more money than in most other jobs, but at the price of danger to life and limb. Employees were aware of the risks and many became inured to such thoughts. Ever since 1927, when drifter Ernst Gottfrid Thornberg drilled into undetonated explosive and was hit by blasted rock, accidents resulting in deaths were unfortunately a tragic element in 20th century mining operations.

In many families, mining was a family tradition, but not in all. In some families the opposite was true, and the children of miners did not choose the same career precisely because of the accident risk. The 1960s were difficult with 27 fatalities in Boliden's Swedish mines. It's gotten better since then, or at least not as bad, and statistics have halved every decade. To be more precise: in 13 in the 1970s, 7 in the 1980s, 4 in the 1990s and not a single death since the start of the millennium.

Better technology and safer methods in several critical operations are just some of the factors behind the improved statistics.

Since the company purchased Tara, Odda, Kokkola and Harjavalta in 2003, two fatalities have occurred in the Irish mine, and none in the other locations. During the past 14 years, the company as a whole has been utterly free from fatal accidents in workplaces under Boliden's control.

All fatalities are tragedies, especially for their relatives, but also for the entire company. Bo Johan Nilsson, subsequently head of Boliden's Swedish mines, remembers how he and a doctor had to inform a woman that her husband had died in a rock fall in the Kristineberg mine.

"We rang her doorbell and a little young lad opened, and from the TV we heard the signature tune from Hill Street Blues. I've not been able to listen to that tune since without feeling bad."

Everything gets better

Out in the big wide mining world things have certainly gotten worse and go on doing so. Thousands of miners die in accidents every year, especially in coal mines. The causes of accidents include fires, rock falls and flooding and explosions or poisoning by gas. But this is a poor argument for not continuing to make work safer in Boliden's operations.

Better technology and safer methods in several critical operations are just

Handheld drills in the open pit in Kristineberg, 1952.

some of the factors behind the improved statistics. The use of rock bolts is one example. The walls are strengthened by drilling holes 270 centimeters deep and filling them, first with a quick-drying plastic solution and then with reinforcement rods. They are then sprayed with a fiber concrete solution to provide an even more stable surface. "The introduction of the wheel loaders meant working in a more protected position. Other machines, such as drilling units, also began to be controlled from an operator's cabin with a protective roof.

One safety-enhancing method is followed by the next, eliminating yet another hazard. The same goes for our approach and attitudes. Resistance has been a certain challenge.

Why wear a helmet and respiratory protection when we never did before and no one ever got injured or sick? Especially if it makes you sweaty and claustrophobic. And sure, there are veterans who've never used ear protection, and who turn out to have the best hearing of all at a hearing test. But this does not mean ear protection is unnecessary, only that some ears are tougher than others. It's the test results at the group level that count, and they provide an unequivocal message; ear protection saves hearing.

A former safety engineer tells us that It wasn't until the late 1980s that safety awareness had sunk in at every level of the company. Then it began to show at the basic level. And as we know, a steady drip hollows a stone. We can compare it to the safety belt law. When the law was introduced on January 1, 1975, everyone can remember the difficulty in adapting: "I'm only going to the gas station…" But today, safety belt use is second nature.

Creeping ill health

For the uninitiated, rock falls may seem to be the biggest, maybe the only, hazard in mine work. Or that it must be the

Another risk concerns a slow but steady creeping increase in ill health.

The occurrence of miners' disease, silicosis, in mine workers was discovered at the end of the 1940s.

world's most dangerous job. Neither one nor the other is true. There are more industrial accidents in agriculture and the construction industry, and in mines today, accidents with vehicles and mobile machinery are more usual than rock falls. Most fatal accidents happen in open pits, as automation underground has made it unnecessary for miners to be at the mine face. But the risk of rock falls remains, and one way of eliminating or at least reducing it, is rock reinforcement. Not only in areas we know are prone to rock falls, but more comprehensively and systematically.

Another risk concerns a slow but steady creeping increase in ill health. Silicosis, also known as miners' disease, occurred in employees in most of Boliden's mines, but especially in the mine in Laisvall, where the first 10 cases were discovered in 1949 and where more than 50 employees were confirmed as suffering from the disease over the next five years. Initially this seemed inexplicable. Work in Laisvall took place in precisely the same way as in Boliden's other mines. But then things became clear. More than in any other region, galena in the mountain range was embedded in sandstone with a high percentage of quartz, the dust from which turned out to be the culprit. What's more, because mining took place at a depth of only 100 meters, it was so cold that wet spraying was rejected as the water would freeze, and so dry drilling was used. Once the connection was established, work was adapted accordingly. The fresh air intake was increased, and strict rules about wet spraying were introduced. After 1954, only a few cases of silicosis were recorded each year, and those that were confirmed after 1980 related to people who were exposed much earlier or at other workplaces.

While silicosis no longer occurs in Boliden's mines, it remains a threat. There will always be quartz present in rock, and we have to deal with it. Respiratory protection is not enough. In addition to protective equipment and dust extraction, the solution is to enclose the workplace and use other ways to make sure that people do not come into contact with the dust.

Safety workers in Laisvall in 1963, in front of the notice boards that count accident-free days in the various departments.

Planning and prevention

Most people understand that work in underground mines has its risks, many to the extent that they could not imagine ever entering a mine. Concentrators and smelters have other potential risks for serious accidents. Here it's a matter of e.g. hot materials, chemicals and working at heights. Because automation in our plant has not come as far as it has in the case of work underground, there is also great potential here to intensify efforts to reduce human presence in especially hazardous areas.

Safety endeavors are not just about

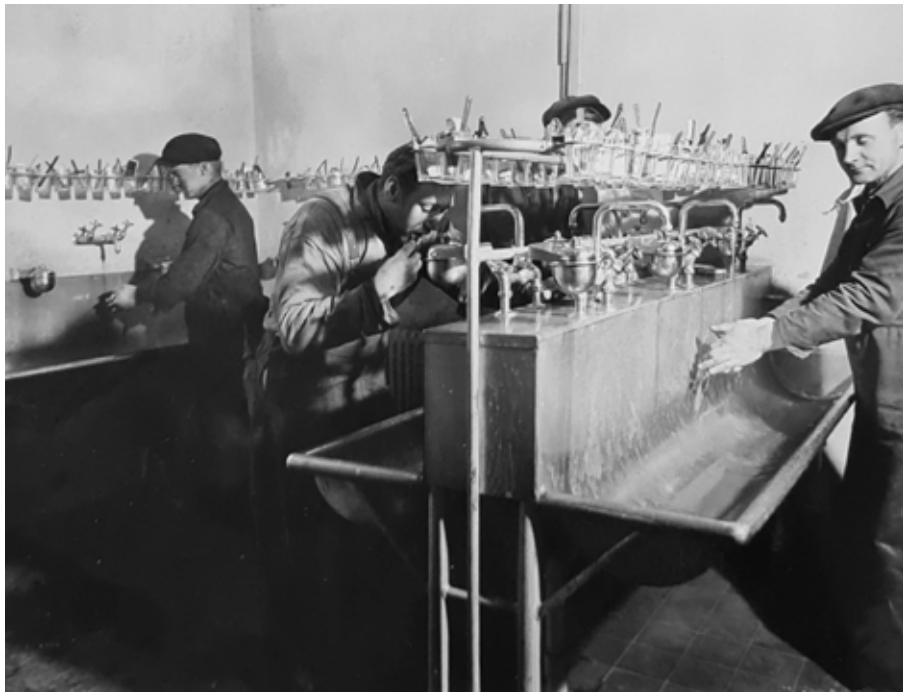
preventing fatalities but about preventing all kinds of accidents. For a first-time visitor, all of the signs and their exhortations including those demanding that we take care on the stairs may appear a little exaggerated, and the safety consciousness as borderline manic. However, they're there for a reason. Maybe you won't kill yourself if you trip on the stairs, but you are at risk of injury.

Because the smelters also have a dismal past, especially during the early 20th century. Between 1940 and 1959, 19 fatalities, i.e. an average of one a year, occurred on Rönnskär alone. During the same period, 2,569 accidents were noted, an average of 128 per year. Compare this with the years 1992–2011 with one fatality and 500 accidents (25 per year on average). Or compare it with 2012–2016 with no fatalities and 67 accidents (13 per year on average).

Harjavalta bears witness to the major change that has taken place in attitudes over the past 30–40 years in respect of safety. During the 1980s, they did not even count the number of accidents, but they added up to hundreds every year, usually burn injuries. These days, work is planned all the more thoroughly, and permits are required for all personnel to perform various operations. The changes were implemented quite easily, but it's necessary to explain and justify why things should be done in a certain way.

Technology, the environment and safety often go hand-in-hand, and changes can have multiple purposes. A good example of this is the extension of Odda, the biggest investment in Boliden's history. It's not only about creating the world's most modern and efficient smelter, but also the work environment and work content.

– DDD – Dirty, dangerous, dull. As far as possible, employees must be spared work that is dirty, dangerous and dull," says project initiator, Dag Berg.



“These days, work is planned all the more thoroughly, and permits are required for all personnel to perform various operations.

▶ Hazardous work in Kristineberg, 1943.

◀ In Bergsöe, where people work with lead, they always brush their teeth before lunch in order not to swallow lead particles.

Under our Be Safe motto, personnel are encouraged to report risks and suggest improvements.

Photo: Stefan Berg

Safety pioneer

Just because things were worse in the past does not mean they lacked early safety pioneers. Paul Bergsøe (1872–1963) is a good example. The Danish founder of today's Boliden Bergsöe was not just an innovator who saw the potential in removing tin from worn-out tin-plate products. He became aware of the risks involved in handling metals as early as the first decades in the 20th century. When workers who took care of re-smelting showed their manager their gold rings, which had suddenly turned white, he halted their work. Mercury vapor was confirmed to be present in the premises, and with this, Bergsøe became aware of occupational health. He is said to have been almost hysterically indignant if he saw any employee smoke in the plant, and his company was one of the first in Denmark to employ a company doctor.

Paul Bergsøe would have been overjoyed had he seen how things are done at the Landskrona smelter today. Lead levels in the blood of employees is constantly monitored. If it's above 2.0 µmol per liter, warning bells ring, and if anyone is confirmed above 1.8 three times, the employee concerned is removed from production until the values have dropped to a lower level. The matter concerns almost only men, as no women, with the exception of one process engineer who is present in the exposed environments for short periods, may work in Bergsöe's production as women have a lower tolerance for lead.

But it's not just about personal protective equipment. Safety risks are also excluded through the installation of treatment plants and filters that clean the immediate environs and process gases. These days, batteries are only seen briefly in the area before they are loaded into

▲▲ The first person in the world to trial a driverless rock dumper was Janne Nordlund in Ruttjebäcken's mine in Boliden, 1971.

▲ In 1983 in Saxberget they celebrated no fewer than 35 accident-free years.

▲ Boliden's safety engineer with the safety representative in the Långsele mine, 1960.

Photo: Stefan Berg

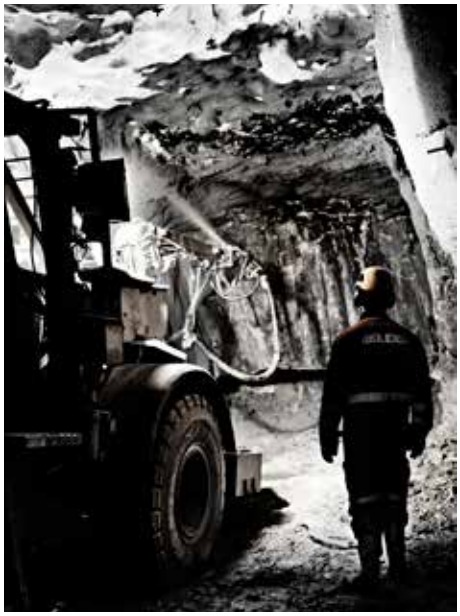


Photo: Stefan Berg

Photo: Stefan Berg

▲▲ Today, much of the work in smelters takes place from the control room, as seen here on Rönnskär in 2012.

▲ Spraying concrete to reinforce a rock cavity, 2012.

▲ In smelters, the risks concern e.g. hot materials and chemicals. Here we see an employee in Kokkola in full protective equipment.

storage halls, and the shaft furnace has been renovated several times, mainly with a view to improve the work environment. A new lead refinery that is safer for employees was built in 2006. Measurable effects have been confirmed, not only in the area of the smelter and among employees, but also in Boliden Bergsöe's surroundings. Lead values in Landskrona are today no higher than in Trelleborg, where there are no industries that handle lead.

A proactive safety culture

Just because things have improved, it does not mean safety work is complete. Today, part of the work involves increasing automation, especially in trucks. Autonomous driving is already a reality in our huge dump trucks, and this will mean changing assignments for truck drivers, who among other things will operate and supervise activities via monitors. Thus the risk of serious accidents will be reduced. But the risk of minor incidents, such as tripping over the last step on the staircase, is difficult to avoid.

Proactive is the word. Not reactive. It's about taking measures before the thing that must not happen occurs, and we must all be on the same page, not just the person whose job is safety. Under our Be Safe motto, personnel are encouraged to report risks, big or small, and suggest improvements.

Everyone who discovers a risk must be assured that it's okay to speak up and that they will be listened to.

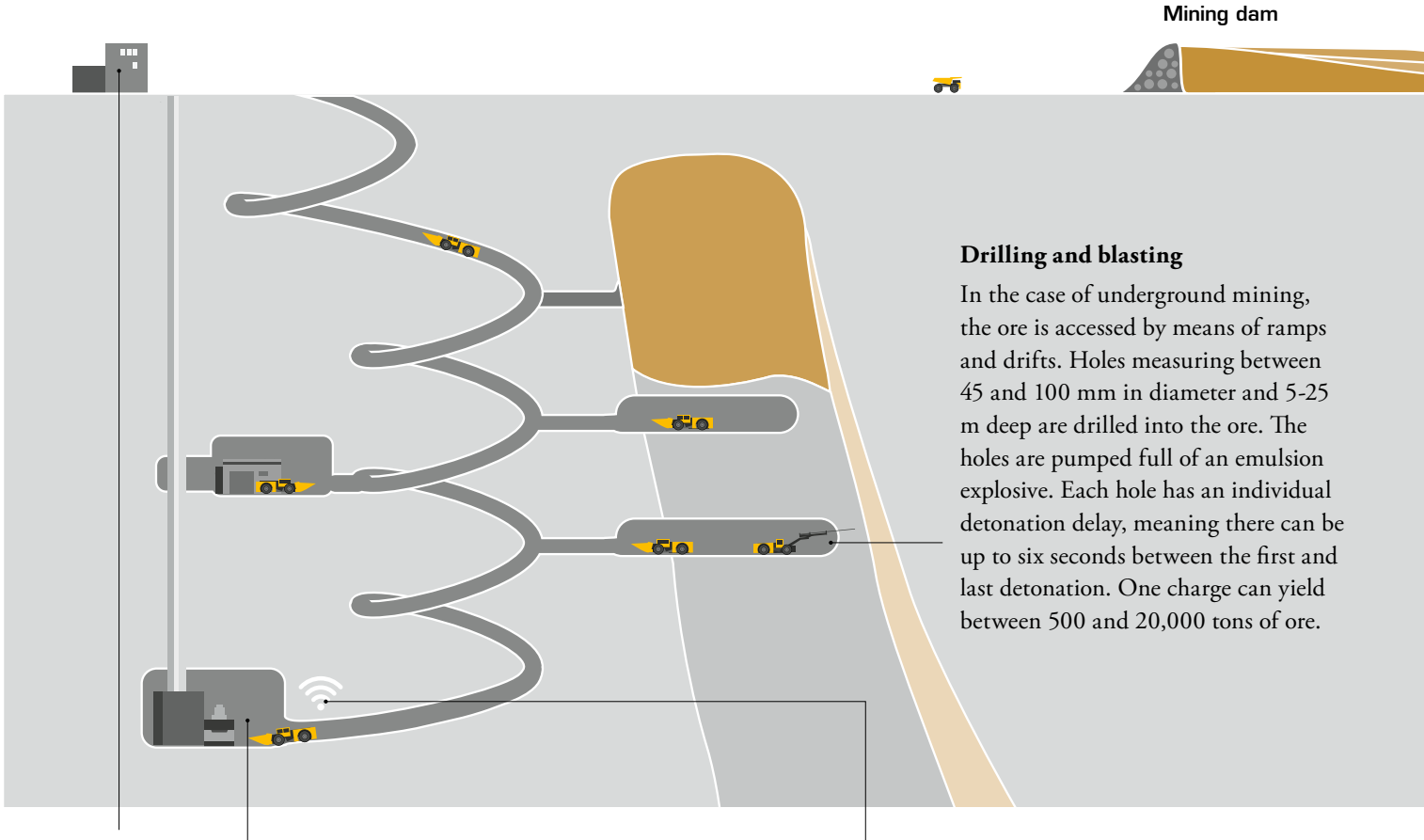
As of 2015, all Boliden employees are encouraged to take part in Be Safe days to discuss how the work environment can be improved at their own workplace. Every year, more than 50 such days are held, which has helped create workplaces that are both safer and more agreeable.

HOW IT WORKS
MINING

2

Boliden owns both open-pit mines and underground mines. As always, it's the location of the orebody and its geometry that determine how mining should best proceed.

UNDERGROUND



Drilling and blasting

In the case of underground mining, the ore is accessed by means of ramps and drifts. Holes measuring between 45 and 100 mm in diameter and 5-25 m deep are drilled into the ore. The holes are pumped full of an emulsion explosive. Each hole has an individual detonation delay, meaning there can be up to six seconds between the first and last detonation. One charge can yield between 500 and 20,000 tons of ore.

Remote control

Traveling time to working areas in mines, which can be many hundreds of meters below the surface , can take up to an hour. Increasingly, operators can control loaders and drilling machines from control rooms. These days, some loaders drive autonomously to shaft pits where the ore is tipped for onward haulage to the concentrator on the surface.

Crushing

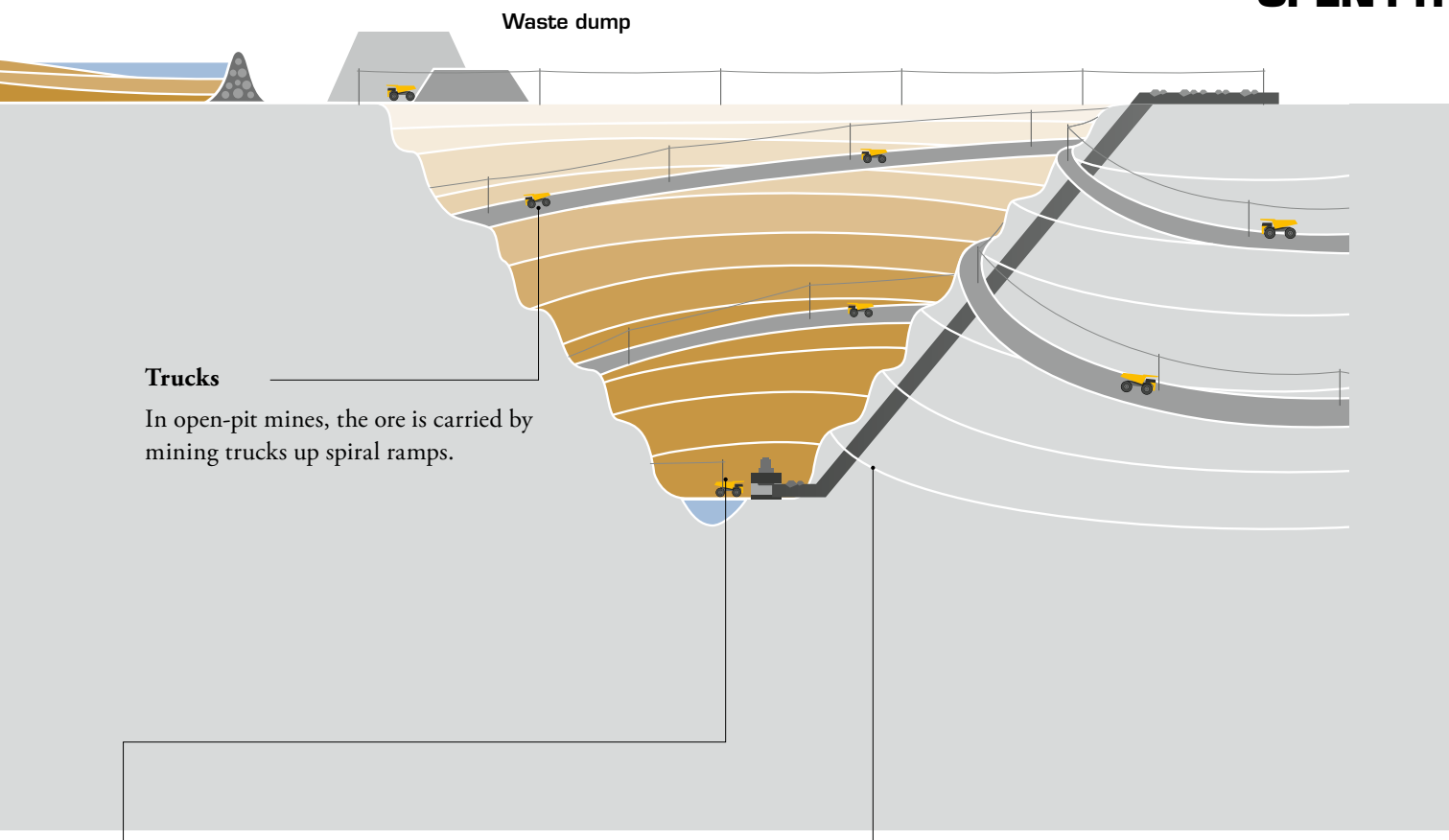
The mined ore is crushed into smaller pieces at the crushing plant before being transported first to an intermediate storage facility and then to the concentrator. In underground mines, the crushed ore is carried up through shafts to the surface using rock hoists.

Positioning

All of the mines are equipped with a positioning system that allows individuals and vehicles to determine their positions in real time. The technology works underground in a similar way to GPS to provide visual flows in production. This provides a safer work environment and greater productivity.

Mining technologies and methods are constantly developed. Today, we often use remotely controlled machines whose operators maneuver them from a safe distance from the mine face.

OPEN PIT



Trucks

In open-pit mines, the ore is carried by mining trucks up spiral ramps.

Optimal mine design

In open-pit mines, the ore is loaded onto mining trucks by excavators. The ore is then hauled to a crushing plant, which may be above or below ground. Crushing stations located down in the mine means short driving distances and fewer trucks. After crushing, the ore is hauled to the concentrator via conveyor belts.

Drilling and blasting

At the Aitik open-pit mine, the holes are 16-17 meters deep, and a normal round produces around 700,000 metric tons of extracted rock.

HOW IT WORKS
CONCENTRATION

3

It's the composition of the ore that determines how concentration will proceed. Fundamentally, the process functions in the same way today as in the past, but the methods are much more efficient, allowing them to extract more.

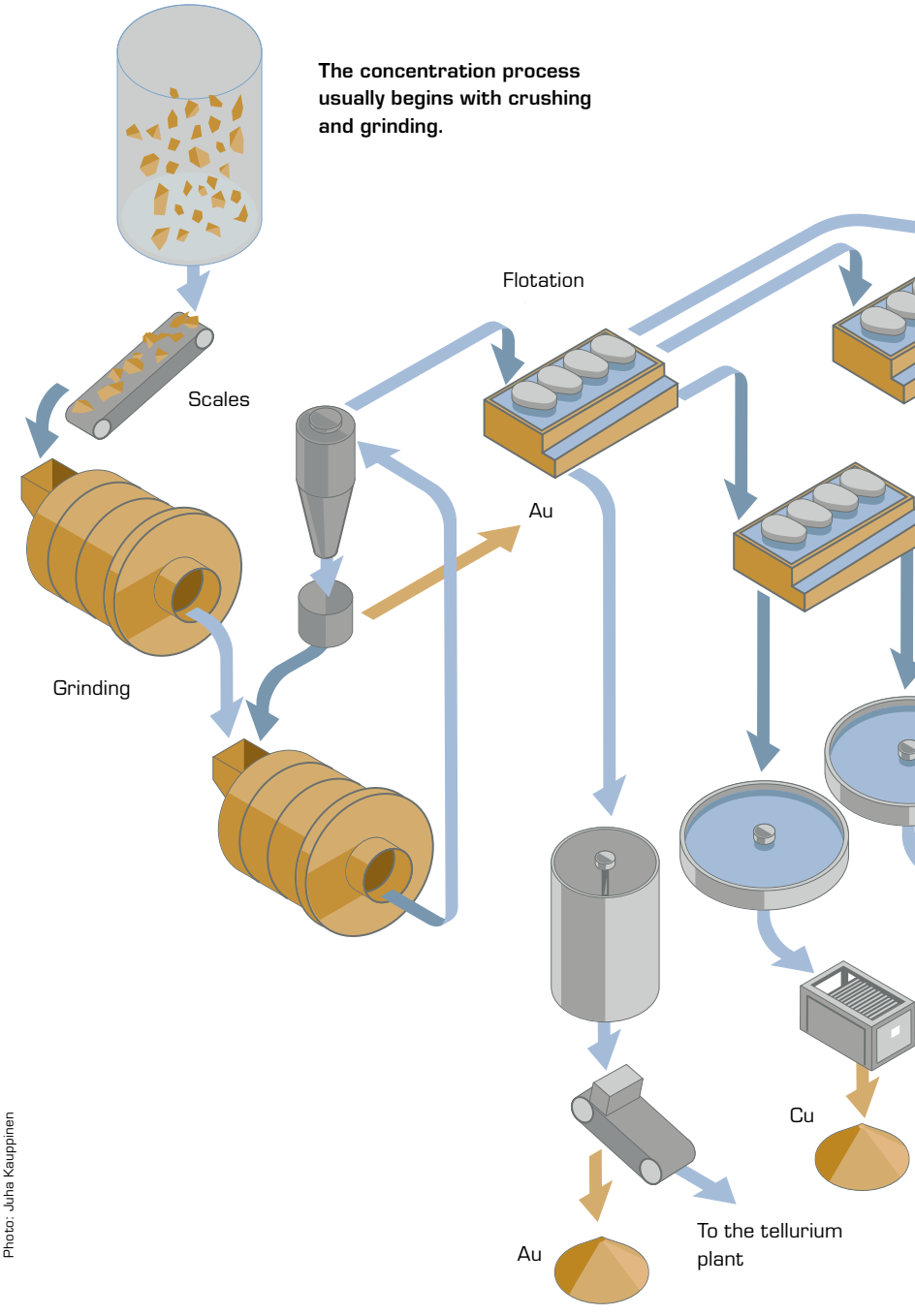
Grinding

The first stage in this process involves adding water and grinding the ore in large grinders. A popular method is autogenous grinding, which means the ore grinds itself without the addition of external grinding media. The end result is a slurry of water and finely ground ore.

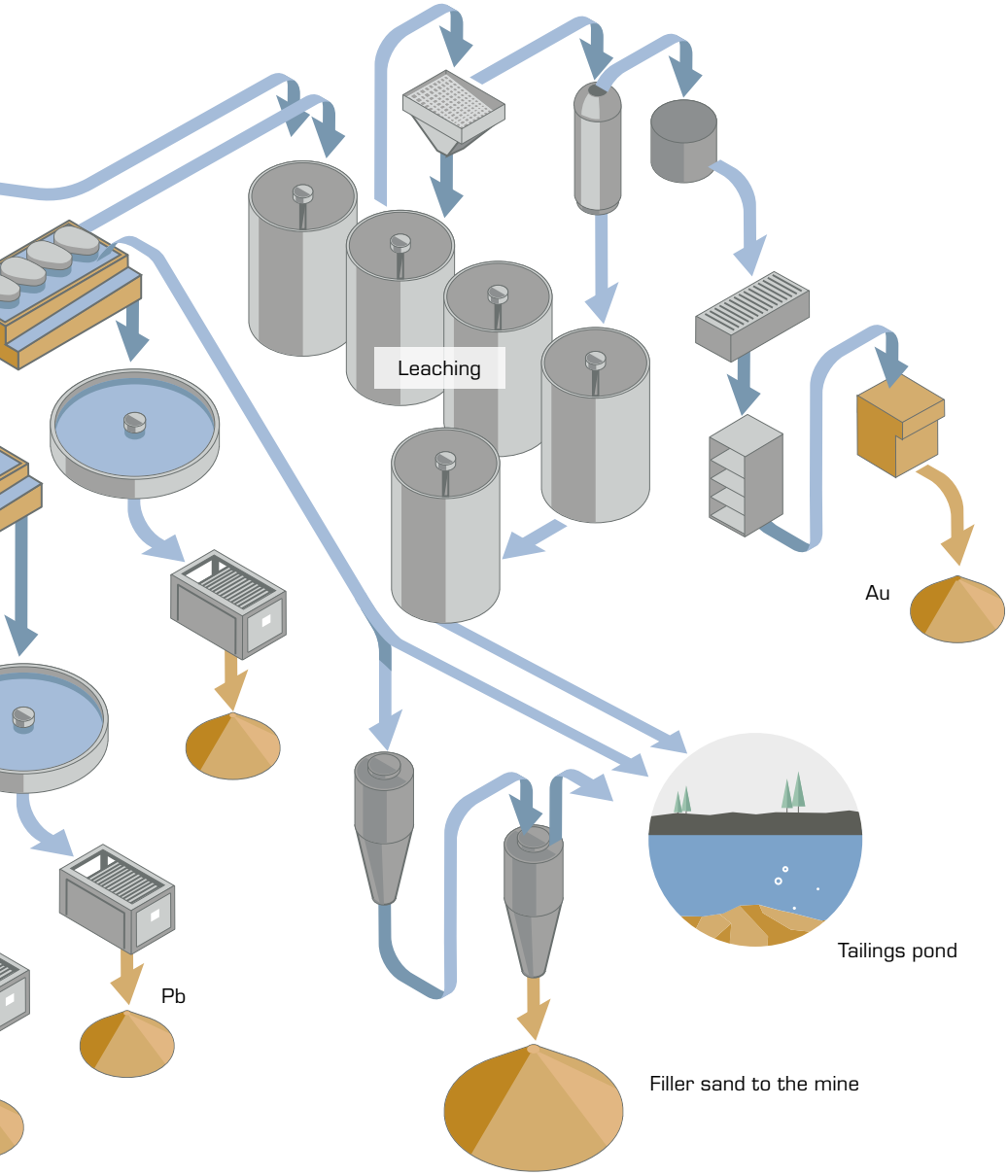
Boliden's concentrators primarily use a technology known as autogenous grinding where the ore is ground without the addition of a grinding agent. The technology provides lower costs but requires more advanced control than conventional technology. Autogenous grinding also means less wear and lower maintenance costs.

Photo: Juha Kauppinen

The concentration process usually begins with crushing and grinding.



These days, concentrator control rooms are often linked to mobile units so that operators have access to process data in real time. This in turn allows faster intervention when processes need adjusting, and it enhances the ability to delegate.



Flotation

The flotation process is a surface-chemical process, where small amounts of chemicals are used to affect the surface characteristics of valuable minerals, causing them to become hydrophobic. When air is blown into the slurry, the hydrophobic mineral particles adhere to the air bubbles and are carried up to the surface, where they can be removed in the form of a foam. The process is monitored by operators who, by adjusting a number of parameters, maximize the amount of extracted metal.

Leaching

The target mineral is separated using reactive chemicals. The leaching plant delivers a precious metal concentrate.

Dewatering and concentrate

The mineral is drained and filtered, producing a fine-grained concentrate, which is the mines' end product. Boliden's mines produce mainly zinc, copper and lead concentrates, which are refined by various processes at smelting plants to produce pure metals. Precious metals are bound in these concentrates and then extracted in the smelters.

JUST WHAT ARE WE LOOKING FOR?

Metals are important building blocks in the modern community, and in fact the standard of living we take for granted today is based on our ability to use of various metals.

Minerals are the building blocks of the Earth and other planets. They are what build the types of rocks, and in turn, the types of rocks build the planets. Minerals are comprised of one or usually more different elements and they have a specific chemical composition and crystal structure. In turn, the types of rock comprise mixtures of one or more minerals. Metals are elements that occur naturally in bedrock, soil and water. Of the more than 100 known elements, 80 are metals and a further six are known as half metals. Everywhere on earth, there are metals bound up in minerals. Many metals, such as iron, zinc, copper and chromium perform essential functions in all living organisms and are therefore vital in small or moderate amounts.

A metal is usually defined as being an element with metallic properties. A metal may appear e.g. very shiny, be highly electrically or thermally conductive and be very ductile. This makes metals suitable for use in very many areas.

Today, Boliden's operations focus primarily on the following six metals or elements:

Photo: Shutterstock

Photo: Shutterstock

Copper ore can appear in a number of nuances.

Metal	Designation	Mined in	Smelted in
Zinc	Zn	Boliden Area, Garpenberg and Tara	Rönnskär, Kokkola, Odda
Copper	Cu	Boliden Area, Garpenberg, Aitik and Kevitsa	Rönnskär, Harjavalta
Nickel	Ni	Kevitsa	Harjavalta
Lead	Pb	Boliden Area, Garpenberg, Tara and Kevitsa	Rönnskär and Bergsöe*
Gold	Au	Boliden Area, Garpenberg and Kevitsa	Rönnskär, Harjavalta
Silver	Ag	Boliden Area, Garpenberg, Aitik and Tara	Rönnskär, Harjavalta

In addition to these, a number of bi-metals such as various platinum metals.

**Secondary smelter only for recycling*

Photo: Esa Melametsä

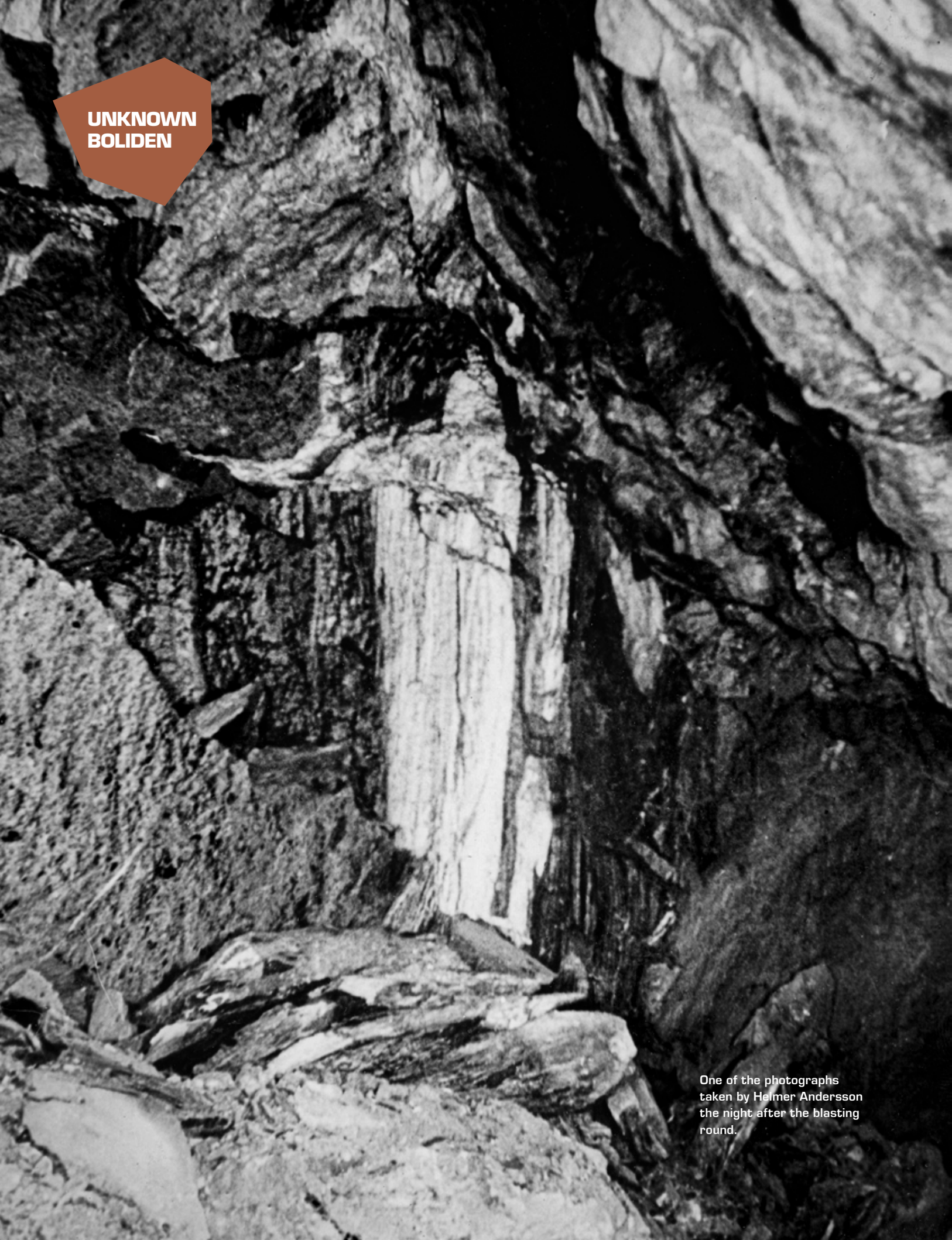
▲▲ Large zinc ingots produced at the smelter in Kokkola.

Photo: Shutterstock

▲ Rock meteorites can contain high levels of nickel.

▲ Gold bars and silver granules are two of our end products.

UNKNOWN BOLIDEN



One of the photographs taken by Helmer Andersson the night after the blasting round.

One last blasting round and the image of Christ emerged

The image was not to last. Regardless of how much attention and wonder it awakened when it was discovered, it was gone completely two months later. Yet the memory of the figure of Christ in the Kristineberg mine lives on.

Text: Olle Lundqvist

It's difficult not to be enchanted by the story, the one about what seems to have occurred on the night of November 28 and 29 in 1946. About how machine driller Johan Olofsson, who works with machine loading from stope 6 A in the A-ore at a depth of 107 meters, finished his shift just before midnight by completing one final blasting round.

"There was nothing unusual to see, so I went home as normal," he reportedly said.

Five hours later, his colleague Albert Jönsson began his shift, continuing where Olofsson left off, and was greeted by an amazing sight. In the spotlight on the rock wall's shimmering silver-white sericite quartzite, framed by darker chlorite quartz, he could see a figure of Christ just over two meters high dressed in an ankle-length cloak.

Blurred images

Jönsson informed his workmates, who entered the stope to witness the remarkable sight. On the other hand, Erik Eriksson was entirely unaware when he entered stope 6 on his regular inspection rounds during the mine workers' breakfast break. But he too discovered the figure of Christ, and the news quickly spread. When cartographer and photographer Helmer Andersson photographed the figure using the mine's Rolleiflex camera, he found the figure could only be discerned from the left and only if he stood a few meters away from the mine wall. It would be wrong to say the camera worked overtime. When the spotlights were aimed at the rock wall, only two negatives were taken, under two-second exposures.

During the following night, more pictures were taken, this time with a 6 × 9

In the spotlight on the rock wall's shimmering silver-white sericite quartzite, framed by darker chlorite quartz, could be seen a figure of Christ just over two meters high dressed in an ankle-length cloak.

folding camera. The film was developed immediately, but most of the pictures were underexposed and blurred. Even so, one of them was sent to the newspaper Norra Västerbotten, which published it on December 3, together with a short caption.

Meanwhile, Johan Olofsson had returned to work, and upon hearing that he 'had a picture on the wall' saw what he had not seen the previous night and was "struck dumb by the image of Christ."

Pilgrimage and a scientific explanation

The newspaper Västerbottens Folkblad had yet to publish an image, but only reported that "the image of Christ appears in the layers of schist." But the limited mass media attention was enough to attract many people to visit the mine, take the elevator down to the 120-meter level and then climb 13 meters up a ladder. During the first week after the discovery, 100 or more people are thought to have visited the stope, all the while work continued as usual.

The general manager of the Kristineberg mine, mining engineer Bertil Israelsson, was at the Swedish Mine Association's congress in Stockholm, but left as soon as he saw the image of the figure of Christ in the newspaper Norra Västerbotten. He is said to have been 'filled with a sense of the spirit' when he saw the image in reality, but nevertheless saw fit to provide Västerbottens Folkblad with a scientific explanation for the phenomenon. The gist of it was that the types of rock in the region's mountain ranges were often exposed to unilateral pressure, causing them to fold and compress, and that the quartzite schists that surround the Kristineberg ores, because of their varying chemical composition, assume a paler or darker tone, are soft and malleable and that the demarcation lines between the heterochromatic layers of rock types can form any kind of shape following a blasting round.

Most people were probably satisfied by that explanation. But not everyone. While work continued and the stope was filled with gravel at such a rate that after two months the image of Christ could no longer be seen, Boliden transferred the power of sale for the copies of Helmer Andersson's images to Holger Hedberg, a former miner who was reduced to running the kiosk in Kristineberg due to polio. He was able to sell around 20,000 of the postcards and enlargements that

During the first week after the discovery, 100 or more people are thought to have visited the stope, all the while work continued as usual.

The special composition of the rock in Kristineberg means that the surface can assume a paler or darker tone, something which may form patterns or figures after blasting.

In today's mine chapel there is a reproduction of the image of Christ discovered in 1946.

Photo: Curt Dahlberg

photography store owner Åke Burvall in Malå had made and printed by Almqvist and Kösters printers in Helsingborg. The images, which were especially popular during the Pentecostal movement's Lapland week, were linked to what was known as the Kristineberg prophecy which stated that Christ would one day reveal Himself in the rock. On closer examination, the prophecy proved to originate from a story that a woman in Vilhelmina is said to have heard from her grandmother, but which according to Professor of Religious Psychology Owe Wikström in the annual Kyrkohistorisk Årsskrift 1980, first began to spread in 1949, i.e. three years after the image of Christ appeared in the Kristineberg mine.

Impressive chapel

But the attention was still huge and the interpretations many. Christ in Kristineberg has become a concept, and it led to the creation of St. Anna's Chapel in 1990 (St. Anna is the patron saint of miners), located 90 meters below ground in the Kristineberg mine, in the area where the figure of Christ manifested itself.

These days you reach it by vehicle, but not your own, guided by employees of the cooperative society that runs activities in a church that was created with the support of the mining company. People can still see the figure of Christ there, but only in the form of a reproduction on the wall. It does not claim to be an exact copy of the original, but serves more as a reminder. But it's not the image that astonishes first-time visitors most, but rather it's the actual chapel, which was previously a workshop, that impresses. The space, the rock walls, the silence and the lack of windows and daylight, all interact to provide a sense of total seclusion from life above ground, promoting devotions and contemplation.

During the almost 80 years since the image of Christ appeared, it has been the object of many interpretations, some advanced and with a religious bias, but it has also given rise to Kristineberg's most popular sight, attracting between 1,000 and 1,200 visitors every year. Services are held there, as are weddings and baptisms, but the chapel is also a destination for both regular tourists and the faithful who come here through there religious beliefs.

UNKNOWN BOLIDEN

Bergsöe
in the shadow of the war

Boliden Bergsöe was formed when the Danish company Paul Bergsøe & Son chose to establish a recycling industry in Landskrona, in the middle of a raging war.

Text: Sara Johansson

"The construction of the Landskrona plant welded Danish and Swedish interests together. It was a time of war and crisis in Europe, at the time when the fellowship between brother peoples and an investment in a common future felt more meaningful and urgent than ever."

So says Svend Bergsøe, the son of founder Paul Bergsøe, describing the start-up in Sweden in 1942 in his book *Jag älskar dig Sverige!* (I love you Sweden!).

During the initial industrial build-up period, Svend Bergsøe commuted between Denmark and Sweden, but after indications that the German occupying power did not look kindly on the weekly trips, it was deemed safest for Bergsøe to move to Sweden, at least temporarily. He decided to put all his effort into the new operation in Landskrona and to do what he could for his occupied homeland from a distance.

In Sweden, he split his time between Landskrona and Stockholm and he often received great quantities of mail from the parent company in Glostrup, Denmark. He had also gained permission to remain

◀◀ Svend Bergsøe was the person who built up the business in Sweden.

◀ Aerial view of the Paul Bergsøe & Son industrial site in Glostrup, Denmark.


HALLBERG-SÖDERFORS A.B.

Photo: National Museum, Denmark

When Denmark was occupied by the Germans during World War II, many Jews were forced to flee.

in daily telephone contact with the company. The Danish liberty movement (resistance) saw an opportunity here. They asked him to help by allowing illegal messages to accompany the business correspondence and product catalogs and also to allow the telephone connection to become a channel for the resistance movement's contacts across Öresund.

Developed a system of codes

The leader for the Danish-Swedish aid for refugees was journalist Leif B Hendil who at the time lived in Malmö. He was an old friend of Bergsøe's, and together they developed a system of codes that was used during the last two years of the war. The system was relatively simple per se. In the middle of a telephone call between Svend Bergsøe and a counterpart in the company in Denmark, where they often referred to technology and metallurgical substances, they would insert a predetermined sentence such as " Now let's come to the point" or "Now listen up". In the next words spoken, the noun corresponded to numbers in the predetermined code. The numbers in turn corresponded to the place where the refugee boats should be contacted. In his book, Svend Bergsøe describes how stressful this work was, especially for his Danish colleagues. After all, he was himself safely ensconced in Sweden.

The Danish-Swedish aid to refugees succeeded in ferrying around 2,200 people from Denmark to Sweden. The organization and the system of codes they worked out is today described in the Frihedsmuseet in Copenhagen.

Postlude

After the war, both the company and Svend Bergsøe had to defend themselves against accusations of business transactions beneficial to the occupier as the company imported metal goods from Germany. He describes it as having been persecuted and threatened for two years while he tried to prove that they had worked on the basis of the conditions and regulations in force, and that he had all the time done everything he could to help the liberty movement. On the Swedish side he encountered greater understanding. On the front page of the Landskrona Posten of May 18, 1945 was the headline: *Landskrona company's goods catalog cipher – Bergsøe pulled the wool over Germany's eyes.*

After the war, he earned the praise of e.g. the newspaper Landskrona Posten.

Landskrona Posten

Landskronaföretags varukatalog chiffer

Bergsöe förde tyskarna bakom ljuset

Flera flyktingar till staden

DANSK TACKGÅVA till Landskrona

Stort Fredsnummer

Landskronaborna firade värdigt 17 maj

The company physician who was before his time

Text: Mona Stenberg

The Rönnskär plant's physician, Dr. Ivar Holmqvist was both well known and appreciated during his time. His great interest in occupational health improved the lives of many smelter employees.

Ivar Holmqvist was born in Ullervad in Skaraborg County, and from an early age he knew what he wanted to be – a physician. After his high school finals in 1929, he studied at the Karolinska Institute. He later worked as a hospital physician in Katrineholm, at the Carlanderska Hospital in Gothenburg, and in a surgical department in Eskilstuna. He came to Skelleftehamn in 1946 as the company physician and remained there until his retirement in 1974.

Tuttan Renholm worked with Ivar as a laboratory assistant. She analyzed the blood of smelter employees and recalls her kind and considerate boss:

"He always wore a navy blue suit and a clean white shirt every morning. I remember he smelled of Acqua Vera, and that he smoked a lot. His fingers were stained yellow where he held his cigarettes," she tells us.

During the forenoons he worked in the general reception on Örjansberg in Skelleftehamn. Then he traveled to the

> **He always wore a navy blue suit and a clean white shirt every morning.**

Sisters Valborg Nordin x-rays master painter Eriksson's hand, October 11, 1951.

Ivar Holmkvist was popular as a company physician. Seen here examining Stig Berglund, 1951.

doctor's office at the Rönnskär plant and worked there during the afternoons. His working day could begin early when it was time for e.g. an operation. It could also happen that Ivar was called out in the evenings and nights. He was known for always responding with a smile and a twinkle in his eye, and he was the epitome of calm.

It was his great interest in people and how the work environment affects them that led him to be so thorough in his measurements and assessments. Among other things, this resulted in a dissertation on skin lesions from arsenic. Another field of research concerned lead in the blood, which took him all over the world to hold lectures in the subject.

Great interest in sports

Ivar was active in an international physicians association, sickness fund expert in the Swedish Medical Association, a city counselor, a member of the public health committee, chairman of Skellefteå's Red Cross Corps and the chairman of the Skellefteå Musical Association. He and his wife Lola also took a great interest in sports, especially ice hockey. They had five children, and one of their sons came to play ice hockey in Rönnskärs IF, which then played in the top league. Ivar was the A-team match physician and went with them on their trips around Sweden whenever there was a match.

At that time, the ice hockey team trainer, Nisse Edholm, worked on Rönnskär. He has a very vivid memory of Ivar from an evening at Rönnskär's sports office. Ivar arrived there right after finding out that his son had died in an airplane accident. Probably the most difficult news a parent can ever get.

"I shall never forget that afternoon.

Ivar came in and said: 'I have to stay here, I cannot be at home'."

Nisse remembers it being a long evening at the office.

Thought along new lines

Ivar Holmqvist was not just a man with great commitment. He was also ingenious and thought along new lines. When another hockey player on Rönnskär, Roger Nilsson, was to play in the national team and had problems with an eye that had to be protected, Ivar said: "Let's make a visor like the foundrymen at the furnaces out on Rönnskär use." The hockey visor that Ivar och Mats-Ove Lindberg, who worked at the laboratory, created together can be seen today at the museum on Rönnskär. The inventor considered taking out a patent for it, but as it would have cost SEK 25,000, it never happened.

As a company physician, he was before his time in many regards. For example, he was the first to investigate lead in the blood of people who worked at the smelter. He realized early on the importance of moving people who'd been harmed by their work environment to other jobs outside the industrial area. It could mean a job as a doorman at Boliden House on Örjansberg, where the directors and engineers lived. It could also be a job in the workshop in Sävenäs where they made gloves and clogs for the workers out at the Rönnskär plants. He also devised a faucet for his doctor's office that he could close by pushing it to one side with his elbow without having to use his hands. All for the sake of good hygiene. Something that can be found in every single hospital and health center.

He realized early on the importance of moving people who'd been harmed by their work environment to other jobs outside the industrial area.

◣Rönnskär's company physician was before his time. He introduced new examinations and methods to improve the work environment.

▼The visor created by Ivar Holmqvist and Mats-Ove Lindberg is preserved in the museum at Rönnskär.

Secretary to ten smelting plant managers

Text: Olle Lundqvist

Managers come and go. On the other hand, Maija Casén stayed at her post, as long as she could play in a league of her very own.

> **Essentially, I've only stayed at home in connection with childbirth.**

When she retired in 2010, she had served all 10 of the general managers the smelter in Kokkola (aka Karleby in Swedish), had had until then. For that to be possible, you have to be really young at the start, as indeed Maija Casén was.

"I was 21 and had recently left business college when I was hired by Outokumpu in Kokkola in 1966."

During the first two years she worked in various office jobs, but in 1968 she was offered the position of secretary for Heikki Tanner, who was then general manager for three plants that Outokumpu had built up in the industrial area outside Kokkola; the sulphur and cobalt works and the power station. Tanner was then in his 50s and a strict man who made a point of addressing his younger colleagues formally. And Maija Casén responded accordingly

But the 1960s were the decade of change. The 'Du reform' (the use of 'Thou') had made a real impact in Sweden and was soon creating waves, even across the Gulf of Bothnia. And the second general manager, Erik Nyholm, was never in any doubt. He began using the informal pronoun from the very first day, and so did Maija.

Of the 10 general managers, Erik Nyholm was the only one with Swedish as his mother tongue. The others had been Finnish speakers, and essentially, Maija Casén was too.

"I grew up 70 kilometers outside Karleby in a community where only Finnish was spoken. But we learned Swedish at school, and Swedish was my husband's mother tongue."

Photo: Päivi Karjalainen

Adapted

Kokkola's general managers were known as managing directors in the 90s. The first to use that title was Ville Sipilä, and he was also the most long-standing thus far with 10 years in the position. Two general managers were only there for one year, while the others remained on average four or five years. This was not the case with Maija Casén, although that was never her ambition.

"I never intended to be part of the furniture, but for some reason everyone wanted me to stay."

All of the managers had had a background in Outokumpu, but they were by no means copies of each other, not concerning their education or their personalities. But Maija always adapted.

"Eight of them had a technical education, one was an economist and one a lawyer. The lawyer busied himself mostly with issues that had more to do with the organization, personnel and administration than production."

Maija Casén in front of the portraits of the first nine general managers she worked with. To her right is Jarmo Herronen, her tenth and last.

During Maija's 40 years at the smelter, her work changed quite a lot.

"Initially we worked a lot with typewriters and the telefax, and because there were no mobile telephones it could be difficult to get hold of managers for urgent matters."

In the 1980s, the technical advances came rapidly. Maija Casén noted that several of the managers were not exactly phenomenal computer users, which forced her to double down on adopting digitalization.

Her interest in her work never waned

Even though her job was formally the same, her tasks and position changed significantly due to her increasing experience, further education and organizational changes.

"In the beginning, I was the person who made sure the manager signed the paperwork. I finished up as secretary for Boliden Kokkola's management group, but without a vote."

The feeling of being able to develop at work was fabulous, she emphasizes. Maija Casén never felt the need to change jobs or companies. Every new manager brought change, new approaches and new contacts.

"My interest in my work never waned. There was never a single day when I didn't want to go to work!"

Perhaps this is why she only ever had a few days' sick leave during all her years.

"Essentially, I've only stayed at home in connection with childbirth. On the first occasion, maternity leave was only two months, the second time it had been extended to eight months."

'Outokumpu girls'

Maija Casén leads an active life as a pensioner, but perhaps a tad slower. For the first time, she and her husband Bobi, who is a dedicated competition sailor, are without a sailboat, and a troublesome knee has put an end to downhill skiing. But she takes exercise, plays golf, reads, goes to concerts and belongs to clubs and associations. But best of all she likes being with her grandchildren in Nådendal, two girls aged four and two.

She no longer has any contact with the smelter, but she does with a bunch of former colleagues who all had a long past at the smelter before it became Boliden Kokkola.

"In fact, we still call ourselves the Outokumpu girls," says Maija Casén.

BOLIDEN PEOPLE

Kept electrical equipment shipshape at Kokkola

Text: Marjukka Puolakka

Photo: Päivi Karjalainen

If you like your workplace, why change? Jaakko Salminen has lived according to those words for 42 years, making sure electrical equipment at the Kokkola smelter worked faultlessly.

Jaakko Salminen's 42-year career in the smelter at Kokkola (Karleby in Swedish) began back in 1963, when they needed electricians at the sulphur plant founded one year earlier.

"A fellow student on my electrical installer's course called and urged me to apply for a job at the plant, which then went by the name of Outokumpu. I called the manager, Tumminki, who summoned me to a meeting at the plant. So I went. After a short discussion, Tumminki asked me to come and begin work the following day."

The 22-year-old Salminen could not begin quite as soon as the next day, but two weeks later after he had taken care of his obligations to his previous employer, he began working at the plant in Karleby.

"I stayed aboard until I retired. The plant in Karleby was an excellent workplace, and going to work always felt meaningful. The work with on-call electrical maintenance provided variety, and every workday was different."

Electrical maintenance foreman

During his first years, Salminen worked on call, and after that as electrical maintenance foreman on the sulphur production line. Zinc production at Boliden Kokkola began in 1969 under the auspices of Outokumpu. As foreman for electrical maintenance in the zinc plant , Salminen had to make sure the electrical equipment was in good condition, and that they reacted quickly if a fault occurred.

"I received work orders and repair assignments. In the mornings I allocated the work among employees in the electrical team, and I tried to do this fairly, but I naturally did so based on everyone's knowledge and skills. I also did electrical work myself based on what I had time for alongside my job as foreman."

Zinc production is based on electrolysis, so it's essential for production that the electrical supply equipment is in impeccable condition and works safely.

"I made daily rounds to check and make sure that the rectifiers were working as they should. The power sources had to be used every week and this was principally my job."

During his long career, Salminen saw

significant development both in terms of electrical equipment at the zinc plant and in the entire installation's operating processes.

"When I began as an electrician at the sulphur plant, the equipment often went wrong and I responded to lots of different alarms. Everything developed in many ways over time, and when the zinc plant started up, the processes were in an entirely different class. They also invested constantly in updating personnel skills.

During his long career, Jaakko Salminen has seen many changes at the smelter.

A soon as we got new equipment we had to take a course."

Karleby is a great home town

Just as the zinc plant has changed as a workplace over the years, so has the town around the plant. The number of residents in Karleby has more than tripled since the beginning of the 1960s.

"When I came from Halso to Karleby for an electrical course in 1960, it was still a little village. Since then, the plans have meant jobs for thousands of people, and have led to an increase in the number of residents and greater prosperity in the town. Karleby is still my hometown, and I love it here.

> **"The work with on-call electrical maintenance provided variety, and every workday was different."**

BOLIDEN PEOPLE

He took Boliden to new depths

Text: Olle Lundqvist

Lennart Malmqvist initiated a project that made it possible to discover ore deposits deeper in the bedrock. But actually, he was trying to get out of a reservist's refresher exercise.

He was not his family's first Boliden notability. Four decades earlier, Lennart's uncle David Malmqvist left a huge impression in the mining company as the creator of the Boliden gravimeter, a geophysical instrument by which it was possible to find ore close to the surface (at a depth of 30-40 meters) by identifying those parts of the rock that weighed more than others.

Lennart himself had begun to study regular physics in Lund, but soon cast jealous eyes on his friends on the geology course.

"Not only did the subject seem interesting, they also got to be outdoors. Eventually I got permission to sit in on the lectures and tag along on their field trips without having to sit exams," Lennart Malmqvist tells us.

After 1970, the earth sciences became his main interest, but he stuck to physics, took a doctorate and was awarded an associate professorship in nuclear physics. Around about then he saw an ad: Boliden needed a qualified employee.

"I can't even remember what the job was about, only that at that time I should be on a reservist's refresher exercise. So I called my uncle David, who encouraged me to apply."

Lennart was called to an interview toward the end of the refresher exercise, so that settled the matter.

"The refresher was held in Skåne, but if you were applying for a job, you got time off, and I calculated that a trip to Boliden and back would take so long I could escape the entire final exercise."

Lennart Malmqvist peering out of a technology shed, 1970.

Borehole EM

He got the job. But he had no specific knowledge of geophysics. Today, he regards this as an advantage since he came without any preconceptions. He learned on the job and after a few years became head geophysicist. As such, he pushed through the development of the borehole EM, Boliden's most successful innovation thus far. In the middle of the 1970s, he and Nils-Erik Marinder were already running a deep drilling project. But it was Robert Pantze who, a few years later and together with Sven

Stig Strömbergsson and Robert Pantze out in the field in the 1980s.

Albin, hatched the idea for a method that involves lowering a probe into a borehole to sense where there was electrical conductivity, which is also an indication of ore. This makes it possible to find ore further down in the bedrock. Pantze has described Lennart Malmqvist as extremely engaged and positive to new ideas and instruments.

The project was a great success for Boliden. Lennart's wife Kerstin also comes into the picture; she was a mathematician and calculated conditions for finding ore at significantly greater depths than the 200-300 meters Boliden had so far reached. Suddenly they were working at 1,000 meters and deeper still, so the hypothesis worked. And when 75,000 meters drilled proved sufficient to reach the first deep ore (Petiknäs) instead of the usual 100,000, it was a miscalculation nobody complained about.

"It's all about finding ore"

After a few years, the deep drilling project was taken over by the geologists in line with developments taking place at that time. But despite the fact that Lennart held the banner high for geophysics, he did not take up arms when geology took over the geophysics role as the governing method for the choice of survey areas in deep exploration.

"We shouldn't cling to old procedures and organizations. It's not about geologists, geophysicists or geochemists. It's all about finding ore," declares Lennart Malmqvist.

In the middle of the 1980s, he was appointed technical director and head of Boliden's entire technical operation and was located in Stockholm, where he joined Group management. However, in conjunction with Trelleborg's take over, he left Boliden and came to be active in a number of positions far from the mining industry. Today he is enjoying a peaceful retirement a little way north of Kristianstad.

> **It's not about geologists, geophysicists or geochemists. It's all about finding ore.**

BOLIDEN PEOPLE

30 years behind the wheel

Text: Maria Ekman

In 1977, 34-year-old Anne-Maj Åkemalm climbed into her new workplace in Boliden Aitik. Having worked in catering and as a home help, the contrast was stark. But when her initial dismay had receded, she got on really well and stayed for the rest of her working life.

Anne-Maj Åkemalm grew up in Nilivaara outside Gällivare in a big family; she was the eldest of 15 children. She and her partner moved to Malmberget, and five years later to Dokkas, where she still lives today.

She had worked as a home help, a child minder and in catering, when her sister-in-law told her they were looking for truck drivers at Aitik.

"I took a chance, applied and got a job. We would get six weeks' acclimatization, as they called it. I thought to myself, 'I can handle six weeks, but not more,' the trucks were huge! But then I stayed for 30 years. It was a great workplace and I really liked it there," she tells us.

> We were friends with everyone, and it was almost like a family.

A chock on the gas pedal

After her acclimatization Anne-Maj Åkemalm, had second thoughts. Everything around the trucks was all so huge, so it didn't really make a difference. And it was easier than driving a car.

"It's all so different to the chores we do at home I thought that was good, better than working as e.g. a home help, which is very much like working at home."

The work was not physically demanding, but the trucks were not adapted for her height of only 153 cm.

In the beginning, she had to sit on the edge of the seat to reach the pedals. A makeshift solution with a chock made it easier to put the pedal to the metal.

"The trucks got better over time, and later it was possible to slide the seats forward," she says.

She had to find creative solutions. She would put her helmet on the ground and stand on it to reach the oil dipstick. But there was a suggestion box, and she submitted a proposal for hanging steps. They installed the steps and they worked well.

There were already four women at Aitik, and more were hired at the same time as Anne-Maj Åkemalm. According to Anne-Maj, being a woman in a man's world was not a problem.

"We were accepted despite being women, but in the beginning there were wolf whistles… We were friends with everyone, and it was almost like a family. And we had a great time during the breaks, we all took our breaks at the same time back then," she says.

Rolled the truck

She spent many years at Aitik, and she remembers one dramatic event especially well:

"I rolled my truck over; everything flew around the cab and I clung desperately to the wheel. They hoisted a young man up in an excavator bucket to help me. We were both taken to hospital and he had a fractured rib. Every one of my muscles ached as I had held on so hard."

In the circumstances, everything went well and there were many more years as a truck driver before retirement.

"For a while, both my son and grandson worked at Aitik at the same time as me. I thought that it was probably time for grandma to throw in the towel now."

Photo: Mikael Martinsson

DID YOU KNOW THAT ...

In the 1940s, underground workers at Boliden got to 'get a tan' in the solarium to combat illness through a lack of vitamins. During World War II, when there were no oranges or other classic sources of vitamins, solariums were set up next to the locker rooms for underground mine workers. This was not just in Boliden, but also in the Laver mining community. This consideration was not limited to mine workers, even school children in the area got to regularly enjoy the light from the solarium lamps.

Photo: Shutterstock

Internally, many mines and various parts of them have been given rather fanciful names over the years. In Tara, the zinc mine in Ireland, you can find your way to areas such as Katie's gold, German trench and Bondi Beach.

When a mine is exhausted, reclamation work restores the area so that it becomes a natural part of the landscape again. The restoration of a mining area is already determined at the mine planning stage.

BOLIDEN 100 YEARS PART 2: 1946–1978

In the decades after World War II, Boliden made a number of discoveries that would be developed into mines. It also invested in new business areas, such as the production of chemicals. While this, our second centenary year magazine, describes how operations in the mines work, it mainly talks about how our efforts in both the mines and smelters have improved safety over the years.