The Work Environment in the Swedish Iron and Steel Industry during the 20th Century

Maths Isacson

Throughout the ages, iron and steel has been produced under unhealthy conditions. Despite better equipment, new production processes and active safety measures, today's iron and steelworkers are still exposed to considerable health and accident risks. This assertion is supported both by available statistics and by the report of the 1988 Work Environment Commission.[1] The Commission's survey concluded that iron workers are one of the "most endangered groups" with a clearly above average risk of serious accident, stress injuries and premature death.[2]

A full century before this Commission examined Sweden's 400,000 most dangerous jobs, the Workman's Insurance Committee (*Arbetarförsäkringskommitten*) studied sanitary conditions in the country's factories by order of the national government. The dark sides of industrialisation were then becoming increasingly apparent. Liberal MPs pushed through the study, which led to the Occupational Hazards Act of 1889. The Committee found that sanitary conditions were worst in the urban industries. Included here were Stockholm's cigar factories, metal casting plants, cotton-wool factories, painting shops and snuff and bone meal grinding establishments. All these were housed in close quarters that totally or partially lacked ventilation. In these industries, injuries took time to develop. Work accidents, on the other hand, were usually less serious here than in the many rural work places. Mining suffered the most fatalities, followed by construction and tanning. The iron industry also had a very high accident rate, even if the injuries were usually not as serious as in mining. Still, the risk of injury was substantial. The blast furnace gasses were explosive and reaped their victims. Workers had their fingers crushed in the forges. In the rolling mills, which were then replacing the older hammers, pinching and crushing accidents were common. The smiths inhaled pernicious coal dust and the ore crushers breathed in ore dust. In the rolling mills and casting plants, stomach and lung catarrhs were common. Drafts were a major problem, as was excessive heat and cold. The dark and

[1] A state commission that was appointed to investigate work related illness before a modification of the work environment law.

[2] Kartläggningsgruppens rapport till arbetsmiljökommissionen, p 59. For risk profiles, see p 42.

dirty rest huts where the smiths and blast furnace workers spent their break time were unsanitary. Time spent there reduced the worker's resistance to disease.[3]

The intention in this article is both to paint a picture of the ever-changing working conditions and health risks faced by those who worked in the iron and steel industry over the past century and to suggest some plausible explanations for these conditions and changes. I have carried out this investigation with the help of available statistics, reports and life histories.

The Industry[4]

The Swedish iron and steel industry goes back to the Middle Ages. By the end of the 12th century, mine working peasants had erected furnaces where they co-operatively smelted the ore they took from their small mines. Starting in the 13th century, the original primitive furnaces, the so-called blister ovens, in which the peasants smelted their limited amounts of lake and marsh ore, were successively replaced by larger and more costly installations. The area in Central Sweden where this occurred has long been known as *Bergslagen* ("the Mining District"). These furnaces produced pig iron, which initially was further refined into osmund iron. This was then primarily exported to ports on the south coast of the Baltic. Somewhat later, probably during the first half of the 15th century, the peasants known as *bergsmän*, in co-operatives erected hammers where the iron was refined, its carbon content being reduced and converted into bar iron. The quality was improved and larger quantities could be produced.

During the 16th century, the Swedish state took a more active role in the industry, but production did not increase significantly until the 1630s. Swedish participation in the European wars required iron. Encouraged by the state, foreign merchants and Swedish nobles now entered the business. A rapid expansion followed, with first Holland and then, starting in the 1670s, England being the principal exports markets. At the end of the century, there were 320 bar iron works in Sweden. In addition, Finland, at this time part of the Swedish kingdom, had approximately ten more. There were also an additional 110 facilities owned and operated by *bergsmän*. Owing to opposition from the state and the new iron masters who had emerged since the 1630s, the peasants had been driven out of the final stage of production. The division of labour favoured by the state called for the peasants primarily to mine the ore and convert it to pig iron. The last, and most profitable, stage was to be reserved for the iron masters.

Swedish iron had its heyday during the first decades of the 18th century, before English iron masters and metallurgists had yet developed methods for producing

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[3] Gårdlund (1942) pp 336 ff.

[4] Hildebrand (1992), Attman (1986), Fritz (1997). See also Ruist et al (1989), Isacson (1992) and Industriförbundet (1992).

iron with mineral coal (puddle iron). Sweden had iron ore of good quality and vast forests that could produce the fuel required by blast furnaces and forges. Indeed these consumed huge quantities of charcoal that were produced in the forest and delivered by peasants. At least four peasants or cotters were required to produce and transport the charcoal required by a single smithy worker.

A few decades into the 18th century, Sweden accounted for approximately one third of world bar iron production. Starting in the 1720s, however, Russian iron began to take a much larger share of the rapidly growing English market. Sweden elected to restrict production, partly in order to maintain prices, but also to avoid the problem of rising charcoal and transport costs. Fifty thousand tons per year had by the early 19th century risen to 60,000, of which 85-90 per cent was exported. Now, the industry was struggling with major problems. True, other markets such as North America, Germany and France had partly replaced England. Still, modernisation was essential if Sweden was to survive as an iron producer. During the 1840s this necessary adaptation gained speed, first with the Lancashire method and then, starting in the 1870s, with ingot steel.

The old hammering technology (i e German and Walloonian forging) that required great skill was, during the last decades of the 19th century, replaced by ingot steel (i e the Bessemer, Martin and Thomas processes). Fuel consumption was drastically reduced, and larger capacity plants, employing a growing force of unskilled workers, were erected. Together, ingot steel, the railroads and the new joint stock organization quickly altered circumstances, and ferrous metal production was industrialised. Between 1862 and 1914, the number of bar iron works decreased from 440 to 140, while average production per plant increased ten fold. A growing share of iron production was going to domestic customers, especially the engineering industry, shipbuilding and construction. Despite this major expansion, however, Sweden's share of world production shrank. Around 1890, it was down to approximately two percent.

A second wave of consolidation occurred during the 1920s, when a number of large concerns were formed in the aftermath of the post World War I downturn. The period between the late 1930s and the mid-1970s, however, was generally a period of non-stop expansion. This was especially rapid during the 1950s and 1960s, when the production of raw steel increased by nearly 7 per cent per year (from 1.5 million to 4.5 million tons). At the same time, a clear division emerged between commercial (*handelsstålverk*) and speciality steel plants. The former produced simple, standardised products in great quantities, while the latter's output consisted of specialised products (especially wire, tubes, laminated steel, tool steel and cold rolled plate). Technology developed step wise. The electric steel process had its breakthrough in the early 1930s, while Bessemer and acid Martin steel diminished. In the mid-1950s, the oxygen process appeared. Starting in the mid-1970s, it and electric steel totally replaced the older methods. Following the economic crisis of that time, Martin facilities were rapidly scrapped. At the same

time, the production of pig iron was concentrated in two locations (Luleå and Oxelösund). Under state leadership, the production of commercial steel was restructured and rationalised. A similar process occurred in speciality steel on the initiative of the private owners. By the mid-1980s, the Swedish steel industry had passed through a severe and, for many communities, painful restructuring process that left it in a stronger international competitive position. Still, when the new decade of the 1990s dawned, Sweden accounted for only one-half per cent of world production.

In 1890, approximately 23,000 persons worked in the industry (17 per cent of all industrial employees). By 1935, despite a drop following World War I, the number had risen to circa 30,000. There then followed a period of rapid growth. Despite major rationalisation during the entire post World War II period, employment increased almost continually. At its peak in the 1960s, the iron and steel works employed circa 55,000 persons (7 per cent). Starting in the mid-1970s, there then ensued a very rapid decrease in employment. In the course of ten years, 43 per cent of the labour force disappeared. This was slightly more than what occurred in the EC, but much less than in Great Britain. Right after the mid-1990s, the industry employed just over 20,000 persons (2 per cent of all industrial employees). New technology, rising quality requirements and new products, together with changes in work organisation, have also combined in recent decades to increase the share of white collar workers in the remaining firms. These, incidentally, now have a growing element of foreign ownership.

Historical Research on the Work Environment

In Sweden, historical studies of the work environment are a new and not as yet well-developed area of research.[5] Existing studies are either very general or directed at areas other than iron and steel.[6] The exception is the research on working conditions at the iron works in Österbybruk by historian Annette Thörnquist. Even this study, however, is directed at a limited, albeit very important, health problem, namely silicosis.[7] More recently, Karl Fredrick Lindstrand, previously the plant administrator at the Halmstad ironworks, has presented a survey of the work environment problems specific to the iron and steel industry.[8] Previously,

[5] For surveys of this research, see Edgren & Olsson (1991), Thörnquist (1994) and Karlsson (1998).

[6] For general studies, see Sund & Åmark (1990), Sund (1993), Lundh & Gunnarsson (1987), Ekström & Hall (1990), Isacson & Söderlund (1995), de Kazinczy (1996). For industry studies, see Olsson (1986) (graphic industry), Berggren & Olsson (1988), Isacson (1990) (engineering industry), Bjerregard (1993) (shipyards), Persson (1993) (forestry), Eriksson (1991) (mining industry)

[7] Thörnquist (1993).

[8] Lindstrand (1995).

Sigvard Montelius and Barbro Bursell have briefly described working conditions in the pre-industrial iron industry.[9]

The present article does not consider all aspects of the work environment within the industry. I limit myself, first of all, to the *workers* in the iron and steel industry; that is, to those directly affected by the industry's production processes. Secondly, I concentrate on the physical aspects of accidents and work induced illnesses. Psychosocial health risks, such as psychological stress, harassment, isolation, inconvenient working hours and inadequate or excessive responsibility, are given less attention.[10] Thirdly, I concentrate on conditions inside the production facilities and, to some extent, on outdoor work. The external environment, that is the industry's pollution of air, water, soil and populated areas, is barely considered. Indeed, this latter problem is generally seen as being outside the area of research on the work environment

The Concept of Work Environment

Since the 1960s, the term "work environment" has been a standard part of the Swedish language. The concept gained wide spread currency during the 1970s, when work life was closely scrutinised and new safety legislation was enacted in several stages. Previously the standard term had been occupational safety, which referred principally to equipment intended to prevent accidents and, to some extent, work related illness. The term work environment, however, actually existed long before the late 1960s. An article in *Teknisk Tidskrift* (Technical Review) from as early as 1943 uses the term in a remarkably modern way: "A new work environment thus is much more than the office or the plant. It is a totality with many features".[11]

As noted, however, this broad perspective only became generally accepted during the 1970s. Starting in the last decade of the 1880s, when health problems in industry first attracted attention, until the end of the 1960s, the state and the parties on the labour market concentrated on reducing work accidents and on providing victims or survivors with reasonable economic compensation. The basic causes of health problems, technology and work organisation, were seldom addressed. A realisation that the rising trend in accidents had to be broken, as well as the need to consider psychosocial conditions, only emerged slowly. The possibilities for correction were limited by economic constraints, as well as by a lack of knowledge concerning ergonomics and the effects on people of dust, drafts,

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[9] Montelius (1959), Montelius (1966), Bursell (1974).

[10] For a survey of the psychosocial factors, see Järvholm (1995). For the iron and steel industry in particular, see SOU 1975:83.

[11] Isacson & Söderlund (1995) p 51. *Nationalencyklopedins ordbok* (1995) states that the term "work environment" goes back to 1956.

gasses, poisonous substances and stress. Generally speaking, working conditions were subordinated to productivity and profitability goals.[12]

One hypothesis in this connection is that working conditions in the iron and steel industry improved substantially mostly during two periods, during the end of the 19th century and during the 1970s and 1980s. Between these two periods, there was limited improvement and even deterioration. The history of work environments is by no means one of continuous advancement. The last century displays several retreats.

The introduction of ingot steel technology and rolling mills, together with the resulting concentration of production that occurred at the end of the 19th century, probably increased the number of accidents and work related illnesses. The small German and Walloonian forges, as well as the charcoal blast furnaces, were closed, and production was concentrated in fewer and larger facilities.[13] The production of Bessemer, Martin and Thomas blooms that were then processed in rolling mills noticeably altered the work and the work environment. It is reasonable to expect that the new workers did not know how to protect themselves from the dangers of the strange environment. In these facilities, the workers generally had less responsibility and influence on work organization than had been the case in the old German, Walloonian and Lancashire forges. The recruiting of new workers, many of whom lacked experience of iron and steel production, can be expected to have led to more accidents and work related illnesses.[14]

I locate the second turning point in the late 1970s and early 1980s. Now working conditions improved. The closing of old facilities as a result of the international steel crisis, the consequent concentration of production and investments in new technology (including robotics), as well as increased awareness of the problem that resulted in stricter legislation and inspection, all contributed to this outcome.[15]

Starting in the 1960s, the Iron Works Association (*Järnbruksförbundet)*, the organisation representing the employers, devoted resources to improving personal safety equipment. This program was expanded during the 1970s. Efforts were shifted from improving the individual's protective gear to improving the entire work environment. In 1972, the Metal Workers' Union, the Iron Works Associa-

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[12] Isacson & Söderlund (1995).

[13] Attman (1986) pp 95 ff.

[14] Unfortunately there is a lack of reliable statistics from the 19th century. Furthermore, when statistics increasingly were collected during the early 20th century, they still had serious shortcomings. The hypothesis in the text is supported by the qualitative pronouncements of district physicians, contemporary writers, life histories and government studies. The latter include the Worker Insurance Committee of 1884 and the Occupational Hazards Committee of 1905. On the history of the statistics, see Andersson (1990).

[15] See Berglund (1987), chapters 1 and 2 for a review of the development and pages 104-112 for a description of problems and actions taken concerning the work environment. See also SOU 1975:83 p 15.

tion and the Work Environment Laboratory initiated a joint project concerning the work environment of the steel mills. This survey was followed up by additional projects.[16] During the next two decades, work places have been retrofitted, hazardous work assignments and environments have been eliminated, protective gear has been improved and inspection has been made more effective. However, as is clear from the previously mentioned Work Environment Commission report, risks have not been totally eliminated. The problems of smoke, noise, dust, heat and cold remain in part. Transport, the handling of red-hot iron and steel, repairs in tight spaces and so on occasionally result in accidents and illnesses. In addition, new health risks have appeared and increased. These include psychological stress and shift work related heart attacks, repetitive motion injuries and the boredom and isolation associated with automation.[17]

The Work Environment as a Power and Awareness Question

Industrialisation brought new, previously unknown, health problems. The large-scale recruitment and rapid turnover of labour undermined the old system of successive instruction in an occupation, which included learning how to handle dangers. Industrialisation also increased the risk of accidents through its higher work pace and reliance on piece wages.[18]

Accidents, and growing health problems in general, resulted in successively stricter occupational safety acts (1912, 1931, 1938 and 1949), as well as in a general insurance system. Within the framework of the Saltsjöbaden settlement,[19] the Swedish Trade Union Confederation (LO) and the Swedish Employers' Confederation (SAF) reached an agreement in 1942 concerning occupational health and safety. This led to a major acceleration of efforts to prevent work-related injuries in Sweden. Joint safety committees worked successfully in many enterprises. Initially, however, the emphasis was on simple measures, together with an awareness campaign with the slogan "safety first".[20] Still, even these efforts gave measurable results. In the early 1950s, the rise in the number of accidents in

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[16] Berglund (1987) pp 104-105. Among these projects were studies of the climate in electric steel mills, hot work environments and the problem of dust. See SOU 1975:83 p 10.

[17] Kartläggningsgruppens rapport till arbetsmiljökommissionen (1989) pp 42 and 99. See also SOU 1975:83 p 45 and passim.

[18] See for example Berglund (1982). See also other studies of work life from the late 1800s, including Ekdahl (1983), Johansson (1988), Berggren (1991) and Gårdlund (1942) pp 303 ff.

[19] The Saltsjöbaden settlement refers to the general agreement reached in December 1938 between the principal parties on the Swedish labor market, the Swedish Trade Union Confederation (LO) and the Swedish Employers' Confederation (SAF). This agreement was reached after the national government threatened to intervene with legislation limiting labor market conflicts. The parties themselves preferred to reach an agreement designed to reduce such conflicts. See Magnusson (2000) pp 232-34.

[20] See, among others, Isacson (1990) pp 142 ff, Thörnquist (1993) pp 67 ff, de Kazinzcy (1996) pp 265 ff and Sund (1993).

Swedish industry was halted.[21] The expanded occupational safety organization at individual work places, including safety representatives and committees, together with the visits and suggestions of occupational safety inspectors, resulted in fewer work injuries. New technology and the closing of old facilities also helped reduce accidents. At the same time, however, new, previously unknown risks gradually appeared in the work place. Before these new risks were understood and counter measures taken, the workers were once again exposed to accidents and illnesses. The more intense work pace and the recruitment of new workers also had negative effects.

During the last century, measures to improve occupational safety have had their ups and downs. Knowledge and effort has been directed towards those problems that, at a critical point in time, have attracted the attention and interest of the actors. Once such problems have been identified and measures against them taken, it has been tempting for firms and unions to relax. They neglect to follow up on the consequences of the introduction of new technology, processes and substances. Only when human beings have once again been injured, medical costs risen, protests grown in strength and convincing data on injuries and their causes become available, is a new series of measures taken.[22] From the end of the 19th century until the 1970s, the basic approach was to use existing technology and work organization to cure the worst problems, but only after they had arisen.[23]

Over a long time period, people's comprehension of risk, and what is acceptable and what is unacceptable, has changed. The work environment and health risks are an awareness and power question, encapsulated in a cultural context. As long as work largely was done by hand, and people toiled in mines and factories, on roads and at sea, in the forests and on walk ways, in cattle sheds and in fields, attention was primarily directed at reducing serious accidents. Working class and peasant men and women were both less aware of, and less concerned with, protecting themselves from other, less apparent, health risks, such as smoke from furnaces, moulds and dust. While it is difficult to say for sure how those living in the early industrial society felt and thought on this question, it is reasonable to assume there then was a greater acceptance among workers of hard physical work and minor injuries than is the case today. Hand injuries, worn out backs and knees and lung disease were part of life and something that artisans, peasants and workers pretty much had to accept. This was especially the case in the masculine working class culture. These were no place for coddling. Old timers recall how

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[21] See Johansson (1990) pp 99-94.

[22] This reasoning can be found in the final chapter of Isacson & Söderlund (1995) pp 47-50 and Isacson (1997).

[23] This said without denigrating the instructions of the Occupational Safety Authority (from 1949), the work of the occupational safety inspectors or the proactive efforts undertaken at individual work places.

difficult it was to get workers in noisy work places to start using ear guards, helmets and other protective gear, and not just because these were unwieldy and troublesome. Using such equipment was seen as a sign of weakness.[24] Furthermore, those working on piece rates felt pressured to take risks and to ignore protective equipment, especially as long as they were young and vigorous. The low level of sick pay, together with the difficulty in getting firms, doctors and insurance companies to accept injury claims, made it easier to ignore mild injuries.

Unhealthy Work Environments as Steelworkers Remember Them

Like their compatriots in the German, Walloonian and Lancashire forges, the workers in the charcoal blast furnaces had physically demanding and exhausting jobs. The same applied to all those who loaded and transported raw materials, intermediate goods and finished products in the old iron industry. The work required both strength and endurance. Old industry films that have been preserved, such as one concerning the Korså mill and the Ågs blast furnace in Dalarna from the 1920s, reveal the physical nature of the work and raise questions concerning earlier work environments.[25] How accident prone were these facilities? Thus, for example, ingots were dropped under reloading, tram cars derailed and turned over, horses bolted and kicked, red hot iron caused burns and workers fell from ladders and fell on slippery surfaces.

Oscar J. Kypengren, a foreman at one of Domnarvet's steel plant intermediate rolling mills, has described the working conditions at start of the 20th century in a, for the time, large and modern steel plant. He emphasises the intense heat near the furnaces, the work intensity and the filth:

> In the wire mill, there was a hectic pace to the work, especially during the actual rolling. The heating furnaces, where the materials were heated, were so close together that those workers had to endure terrible frontal heat from their furnace and radiating heat on their backs from the next furnace. The initial rolling workers had to bear the heat from the furnaces and from the material. The rest of workers had to be continually alert and to use their tongs to grab the speeding wire. It then had to be quickly reinserted in to the next pair of rollers. This was repeated until the wire had been reduced to the proper dimension, usually circa 5 millimetres. Water had to spray on the taps and on some of the rollers. During the winters, the workers were often soaked, and since there was no temperature control, their clothes often

[24] See, for example, Isacson (1990) chapter 5.

[25] The Korså/Åg film is preserved in the Stora Corporation's museum in Falun. Since it is very illustrative and educational it is often shown. The iron and steel industry, however, has many other preserved films, although they have not usually been transferred to videotape. See Molander et al (1996).

> froze, especially while the rollers were being reset. During the summer, the air was full of small iron particles, scraped off during the work, and glowing embers, all mixed with sweat, soot and oil. When the workers left the plant at the end of their shift, they looked like Negroes.[26]

Work in the large halls was in many ways different from outdoor work in switching yards, depots and loading areas. To a much greater extent than the indoor workers, the outdoor workers were, and still are, dependent on the weather. Often the weather was less favourable than in the Korså/Åg film from the 1920s. The gradual bringing of work tasks in under roofs and into heated buildings improved conditions during the 1920s.[27]

During the 1950s and 1960s, things were further improved by the abandonment of charcoal ovens and Lancashire forges.[28] The heat, noise, drafts and heavy physical work, especially in connection with transport, did not disappear, however, with these old plants. The Bessemer, Martin and Thomas processes continued to demand heavy physical labour. In addition, for a long time rolling continued, at least partially, to be done with the help of manual work and simple tools.[29] Even today, some transport and reloading work is done outdoors.

Gradually the work environment in iron and steel improved. Many health risks, however, remained for a long time – and new ones arose. In the middle of the 20th century, work in the steel industry was still physically demanding, and the work environment was dusty, smoky and noisy. Cold and drafts from open gates alternated with intense heat from furnaces and materials. Conditions, however, varied between, and even within, plants for the industry's roughly 38,500 year round workers (of which 1,075 were women).[30]

The Work Environment at Domnarvet Steel Mill in the 1950s

The Thomas process (basic Bessemer steel) was already an established refining method at Domnarvet at the start of the 20th century, when Oscar J. Kypengren

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[26] Rehnberg (1952) pp 224-25.

[27] Outdoor work under sometimes harsh weather conditions did not disappear all at once. See, for example, Thörnquist (1993) pp 139 ff concerning the working conditions for cleaning cast products at the iron works in Österbybruk during the 1950s, 1960s and 1970s.

[28] The Lancashire forge at Ramnäs was the last in Sweden. It was closed in 1964. The last charcoal blast furnace was in Bredsjö. It ceased operations in 1966. Molander et al (1996) and Industriförbundet (1967) pp 151 ff.

[29] The country's last Bessemer furnace closed as late as 1961. The last Thomas converter (in Luleå) ceased operations in 1972, while the last Martin furnace was abandoned during the early 1980s. See Ruist et al (1989) p 37.

[30] The survey of technical developments can be found in, for example, various annual editions of the Industrial Association's (Industriförbundets) publication *Sveriges Industri* (1925, 1936, 1948, 1961, 1967, 1985 and 1992). For the number of year round employees, see the 1967 edition, p 161. Compare to SOS *Bergshantering* (yearly), Ruist et al (1989) p 43 and Fritz (1997).

began to work at the intermediate rolling mill. Starting in 1910, the company was totally dedicated to basic steel production. The Thomas process replaced the production of acid Bessemer and Martin steel. At that time, production amounted to approximately 100,000 tons annually, making Domnarvet the largest steel mill in the country.[31]

Following World War II, Domnarvet was quickly modernised and expanded. The owner, Stora Kopparbergs Bergslag, had grand plans. Production was to be increased from 200,000 to 400,000 tons annually. The facility's work area was virtually doubled during the first six post war years. All aspects of production were modernised; among other things, new large intermediate and final rolling mills were built. Despite difficult conditions, production was maintained during the expansion period. The turnover of workers was at some points as high as 45 per cent annually. Still, the number of employees rose from 2,000 to 3,000. Since the early 1940s, even some women had worked on the factory floor.[32] Most of the new workers, however, were men who came from the Swedish countryside or foreign countries, including Finland.

Leo Pantsu began working in Domnarvet's Thomas works just before Christmas of 1951. Together with a younger brother, he had just fled unemployment and poverty in Finish Karelia. The rest of the family was still in Finland, but they were soon to follow. The brothers immediately found work in the Thomas works at Domnarvet. Leo became a puddler (*skänkskötare*).[33]

As a puddler, Leo did shift work as part of a team that had a rolling schedule. Four mornings, followed by 48 hours rest, four afternoons, followed by another 48-hour rest period, four nights yet again followed by 48 hours rest and then the same schedule all over again. The facility operated continuously, even during major holidays. It halted only for a few weeks during the summer. Leo had his workstation near one of the furnaces in the great hall. A small diesel locomotive pulled the ladles full of red hot metal, on specially designed cars, some distance from the red-hot furnaces. The workers poured the metal (5-6 tons) into the hearth. They cleaned the ladle before the furnace was once again tapped. Their assignment also included inserting a new plug in the tap hole. Any scrap metal in the ladle also had to be removed before the next tapping. When the brick lining of the hearth was worn out and had to be replaced, a special work team was called in.

Leo Pantsu recalls that in the Thomas works it was hot in the summer and cold in the winter (except by the furnaces). The gates were open, and it was draughty, dusty, noisy and tiring. "There was a terrible roar when the oxygen was blown

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[31] See Rydberg (1992) p 85. For comparative production figures, see Attman (1986) p 111.

[32] *Domnarvet 100 år* (1978) pp 47-48 and 53-54. See also Rydberg (1992) p 178 for a description of the post war modernization. For the entrance of women in the iron and steel industry, see Rylander (2000).

[33] Interviews with Leo Pantsu (born 1926) 1996 and 2000.

through the iron." The smoke and dust, as well as the heat, were a problem. "During the summer, the work shirt could stand by itself. We sweated, ate salt tablets and drank enormous quantities of water. It was easy to burn oneself. The iron was 1,600 degrees (centigrade). If we took too long before emptying the metal, and the brickwork was worn, the metal could burn through the bottom of the ladle. We were supposed to test the heat with our hands on the outside of the ladle." The safety equipment consisted of gloves and overalls. The company provided the former. The overalls the workers bought themselves from some store. Only in the late 1950s were protective goggles, helmets and ear protectors introduced.

As for Leo Pantsu, he successfully avoided work accidents. On the day after Easter in 1953, however, a very severe accident occurred in another division. Five furnace workers were killed by poisonous gas that leaked out because of a faulty water seal. Only two weeks earlier, in a similar accident, blast furnace gasses had extinguished a human life at the Fagersta mill, another large iron works in the area. Overall, gasses have reaped many lives in furnaces, iron works and steel mills.[34]

Steel production also left its mark on the environment surrounding the furnaces and mills. The smoke and the drifts of ashes were extremely troublesome for both people and buildings. Ultimately, electric filters and ash separators were required to reduce these emissions.[35] At Domnarvet, the Thomas works was closed in the early 1960s. The blowing of pure oxygen through melted pig iron was introduced at Domnarvet in 1956. The success of this method caused the company leadership to substitute it for the old production methods over the course of the next decade.[36] Both the inner and the outer environment benefited from this change in technique. The awareness of work environment problems also increased at this time. Both management and labour began to understand the drawbacks of environments such as that at Domnarvet's old Thomas works. It was not until the 1970s, however, that work on identifying and solving problems took off.[37]

The Work Environment at Storfors Tube Mill

In 1954, Leo Pantsu moved to the tube rolling mill at Storfors. There he worked for two years as a hand roller of seamless tubes. The work team consisted of three men who exchanged assignments every hour. One step involved using a grasping tong to move the end of the preheated, red-hot sections of metal into each new hole along the roller. Large sections weighed 80 kilos. The tube of metal was moved back and forth through the mill, until it had been stretched to the desired

[34] Stråby (1984) pp 145 ff.
[35] See Lindstrand (1995) p 37.
[36] Rydberg (1992) pp 180 ff. *Domnarvet 100 år* (1978) p 67.
[37] Berglund (1987) pp 104 ff and SOU 1975:83.

dimensions. Smaller sizes required replacing the grasping tong with a device attached to the metal. During the milling process, a reaming rod bored the appropriate inner size.

Even though the tube rolling mill was also hot, dirty and noisy, conditions were not as bad as in the Thomas works in Borlänge. No protective wear, not even gloves, was used here either. The graphite dust was especially troublesome. The reamer rod that drilled the hole in the tubes was dipped in a graphite mixture. As a result, the air was constantly full of graphite dust. Things were even worse in the sliding bench workshop, the "spaghetti works". Many women were employed there. One worker in ten was a woman, which was an unusually high number at that time. One of them was Elvi Pantsu, Leo's wife. Together they had two young daughters (6 and 4 years old). On many occasions, when their parents' shifts coincided, the little girls had to fend for themselves.

Elvi Pantsu worked as a regulator and in an elevated location. Right below her, a pair of men brushed the tubes with graphite. She recalls that she was jet black after her shift. There was no protection against the dust. The environment was unhealthy, especially for pregnant women. Elvi herself had an early stage miscarriage and had to quit the tube mill after barely a year. "The doctors said the foetus was totally deformed".[38]

Back to Domnarvet

From Storfors, the Pantsu family moved to Nora, where the parents worked at Nobel's explosives factory. This was also an extremely unhealthy environment. In 1960, they returned to Borlänge where Leo got back his job as a puddler in the Thomas works. As he remembers, the environment had not improved during the intervening six years. From other sources we however know that the managers were aware of the problem with silicosis. During the 1950s they tried to diminish the risk, using for example olivine instead of quartz in the sand for the cast.[39] According to Leo the environment in the Thomas works had not changed much, but at least the firm now provided dark goggles, helmets and ear protectors (ear muffs or plugs). "At first no one wanted the helmets. They were heavy and clumsy. I resisted at first, but you got used to them."

The calcium that formed the basic lining of the converter gave Leo dermatitis, "…itching and red blotches all over my body. The doctor told me to get away from there". Leo then switched to the new and large thin plate works. Following

[38] Interviews with Elvi Pantsu (born 1929) 1996 and 2000. The new, modern tube mill in Storfors was profiled in *Dagens Nyheter* in the May 31, 1955 edition. Special emphasis was put on the large number of women workers, most of them with a foreign background. Among the 850 workers at Storfors, ten different nationalities were represented.

[39] See Annette Thörnquist's article in this book.

a period in packaging, he went to the coating works (*betverket*). There he remained until 1987, when he took early retirement because of back problems.

The plate that was to be coated came from the broad band works. After having been temporarily stored outdoors, the rolls of plate were taken to the coating works and opened. The ends were cut off and evened, and the plate was then put on a reel. The next step was to machine-weld the plates together into a long band. The metal was then freed of dross and other surface particles in a bath of chemicals. After the bath, the plate was rolled up and cut into suitable sections. From the coating works, the plate was taken to the cog mill for final processing.

During Leo Pantsu's first years in the division, the plate was coated with sulphuric acid. This quickly burned holes in clothing. If anyone got acid on his hands, it had to be washed off immediately. The acid was automatically pumped in and out of the vat. If a weld broke during the coating process, the work was immediately halted. The vat was emptied, and a worker climbed in and hand welded the joint. Then the vat was refilled with acid.

Around 1980, the facility was modernised and converted to hydrochloric acid, which is less harmful to the skin. Still, caution continued to be important. Hydrochloric acid is dangerous to breathe. Those who worked close to the vat, or who repaired a broken weld, had to wear facemasks. By this time, the firm provided the safety equipment, including acid resistant shoes.

Compared to the Thomas facility, the work environment in the coating works was better. It was also gradually being improved. Initially, putting the rolls of metal on, and then taking them off, the reel was done from a modest hut. The supervision and welding was done next to the vat. In the new coating facility, the workers moved into a comfortable control room. From there, the process was supervised and controlled with the help of computers. The machines were adjusted according to tables. Naturally, the workers still occasionally had to go out to control the reeling, the edge smoothing and the coating or to redo faulty welds. In the control hut, they had a good view of things, and they escaped the noise, dust and smoke. There they could brew coffee and keep and heat their food. In the Thomas works, Leo and his comrades had eaten their sandwiches right next to their work place. No screened off eating area existed in the early 1950s, or ten years later for that matter. In the late 1960s, the coating works had a hut where the workers could eat the food they had brought.

The work environment at Domnarvet improved markedly starting in the early 1970s. In addition, more and more women were employed in the plant, as in the industry in general.[40] In the Thomas facility, however, there were no women. In several other workshops, however, women had been working since the 1940s. Labour turnover was high, and employment rose during the 1950s and 1960s.

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[40] The number of women increased from 1,660 out of 34,170 annual workers in 1960 to 3,480 out of 36,060 ten years later. SOS *Bergshantering*.

This was a period of high labour demand throughout the economy. If they could, many workers refused to work in poor environments, especially at a time when these were a subject of discussion and increasing concern. The companies simply had no choice but to improve matters. As noted, this was often done in conjunction with new investments.

At Domnarvet, many physically demanding, noisy, dirty, draughty and dangerous work places were closed after the mid-1960s. These included the blast furnaces, the Thomas facility and the electric steel facility. Fork lifts and new, more flexible overhead travelling cranes facilitated the handling of tools, materials and finished products. The buildings were equipped with heating and ventilation systems. Control rooms eliminated the worst noise. At the same time, however, the pace of work increased. In the old coating works, for example, 180 meters of plate were processed per minute. The new facility could soon handle 500 meters per minute, and the pace kept increasing. Work operations were done more and more quickly, and supervision was tightened all along the line.[41]

The work organization at Domnarvet was changed in the early 1980s. Responsibility was shifted from the foremen to the workers. The latter were given more responsibility for the daily work, and the supervisors began to listen to their opinions. At the same time, the labour force was reduced. Six thousand employees in the late 1960s had, by the mid-1990s, shrunk to 2,500 (of which 1,800 were unionised). It was expected that the workers would take greater responsibility and actively contribute to increased production. Two hundred thousand tons in the mid-1940s had risen to 400,000 tons ten years later. The million ton mark was passed in the early 1970s.[42] By the late 1990s, the thin plate facility of SSAB in Borlänge was producing 2.1 million tons annually. A much smaller number of persons were thus producing a much greater quantity of plate, with the help of ever more technically advanced and expensive equipment. Even in this environment, however, extremely serious work accidents occurred on occasion. Thus, in early September 1996, a 35-year-old was crushed to death under a freight car in SSAB thin plate's switching yard. Today, freight trains are radio controlled. Instead of three men, two are responsible for switching and coupling the cars. The dead worker simultaneously had to use a control box attached to his belt, handle radio communications through a microphone on his chest and manually couple cars.[43]

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[41] Leo Pantsu 16/7 1996.

[42] Rydberg (1992) pp 177-78 and 184.

[43] *Södra Dalarnes Tidning* 17/9 1996. The occupational safety representative is highly critical of the work conditions at the modernized switching yard. "The company wanted to save on personnel, and thus sacrificed safety", he maintains. He adds: "It was too much to keep track of at one time. These dangerous jobs must have routines that are as simple as possible."

Accidents

The description of the work environment in the iron and steel industry makes it clear that work place accidents were not unusual. Personally, Leo Pantsu escaped serious work accidents. On the other hand, both he and his wife suffered illnesses that can be related to the work environment. A serious back problem resulted in Leo being retired early, barely sixty years old. Elvi changed jobs. She found employment in a store.

What then do the available statistics have to say about the character and change over time of accidents within the iron- and steel industry? I primarily want to discuss three questions: how have accident rates changed over time, how does the industry compare with other industries in terms of the frequency and severity of accidents and, finally, what are the principal causes of accidents in the iron and steel industry?

Industrial Accident Rates in Sweden over Time

The official statistics on the number of accidents have serious shortcomings and give far from an accurate picture of developments. For a long time, reporting, especially by small firms, was disturbingly poor. The reporting rules were also changed on several occasions. Particularly the changes contained in the 1955 law complicate long-term analysis.[44] Since no better source exists, however, reliance must be placed on the official occupational injury statistics.[45]

The number of reported work place accidents in Sweden increased continuously from the beginning of the 20th century until the end of the 1940s.[46] Especially starting in the mid-1920s, following a deep economic crisis, both the number of accidents and the rate of accidents per worker increased rapidly. This development has several possible explanations. For one thing, injury insurance was improved, making it worthwhile to report even minor injuries. In addition, industrial rationalisation increased the pace of work and the propensity to take risks.[47] Yet another possible explanation is the large migration of young men and women from agriculture to industry during the 1920s and 1930s. Most of them lacked any industrial experience and did not know how to protect themselves. The rate of accidents per 100 annually employed workers doubled during the 1920s. The Depression of the early 1930s, when many workers were excluded from the fac-

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[44] Starting in 1906, occupational injuries have been reported in the annual Swedish government statistics: SOA, later SOS, SCB (Statistics Sweden) and reports from Arbetarskyddsstyrelsen (The National Board for Occupational Safety and Health). The reporting was changed in 1917, 1929, 1955 and 1977. See Andersson (1990).

[45] Sund & Åmark (1990) p 43 and de Kazinczy (1996) pp 421 ff.

[46] See SOS *Olycksfall i arbete*.

[47] Berggren & Olsson (1988) pp 64 ff and Isacson (1990) pp 16 ff. The rationalization movement in Sweden is treated by De Geer (1978).

tories, resulted in a temporary decrease in the accident rate. When the wheels once again began to turn, however, rationalisation and new investment also accelerated. The result was an increased number of work place accidents. Occupational safety became one aspect of the discussions concerning labour market peace and productivity growth. Accidents were expensive, both for the firms and for society. As noted, occupational safety became a central part of the new Swedish policy of labour market co-operation that developed during the late 1930s.[48] Starting then, local, organised safety efforts became widespread.[49]

The over all accident rate in Swedish industry, however, did not immediately decline. In fact, it continued to rise until the last years of the 1940s. The annual rate of reported accidents per 100 yearly workers then peaked at 15, as compared with 6 in the mid-1920s and 10 in the mid 1930s.[50]

At the start of the 1950s, the rate declined, but it soon stabilised at a slightly lower level. The mid-1960s saw a modest increase, followed by a new downturn in the 1970s. The really great decrease, however, did not come until the 1990s, together with the deep economic crisis. Many old, non-modern facilities were abandoned and many people, both old and young, lost their jobs. The organisation of work changed, and firms invested in new technology. In addition, the introduction of waiting periods before health insurance could be claimed and reduced compensation levels helped tidy up the numbers.

The number of work place fatalities, however, decreased continuously starting in the early 1950s, indicating an improvement in the work environment. By the early 1990s, approximately 80 persons died annually in Sweden as a result of work place accidents. Adding those who died in work related travel accidents and illnesses, the number rises to approximately 170. In the early 1950s, a normal number would have been over 550.[51]

While the number of accidents has decreased during recent decades, the number of reported work related illnesses have increased sharply. It is also the case that the accident rate per 100 yearly workers did not fall, but rather increased, during the 1980s and the early1990s; that is, until the economic crisis and the radical changes in the insurance system.[52]

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[48] Johansson (1989) pp 149 ff.
[49] See, for example, Isacson (1990) pp 137 ff.
[50] SOS *Olycksfall i arbete*.
[51] Isacson & Söderlund (1995) p 71 and Andersson (1990) pp 164 ff.
[52] See SCB *Statistisk Årsbok för Sverige* , SCB/Abetarskyddsstyrelsen (1993) table 1.2.4. Also de Kazinczy (1996) pp 426 ff and Isacson & Söderlund (1995) pp 70-71.

Work Place Accidents in Iron and Steel[53]

How does iron and steel compare to the overall Swedish accident picture? The industry follows the general pattern, but clearly at a higher level. For a long time, iron and steel was one of the most accident-prone industries in Sweden. The rate of accidents per 100 yearly workers was sky high compared to the over all average. During the 1910s and early 1920s, only the mining industry, especially coal mining, had a higher accident rate. From 1924 through 1937, the iron and steel industry generally was worst. The high, or low, point was reached in 1935, with almost 29 accidents per 100 annual workers (compared with barely 10 for the whole economy). Starting in the late 1930s, the industry improved its positions and gradually made its way down the ranking list. In 1944 it had reached sixth place and in 1954 a creditable eleventh place. Other industries quickly passed it, especially mining, metal processing (fast growth and new workers), navigation (especially during the war), transport (traffic accidents), construction (rapid expansion starting in the mid-1930s) agriculture and forestry (mechanisation) and the wood industry (including construction related carpentry).[54]

During the 1950s and early 1960s, the iron, steel and metal works industry places just below the top group of most accident-prone industries. Starting in the late 1960s, however, the industry began to move back up the list. The accident rate increased. Starting in 1955, the number of accidents, measured per one million work hours, increased from a low of 32 in 1963 to 53 in the early 1970s. By then, the industry had assumed second place in the rankings.[55]

It was in this situation that the industry's leadership commenced a co-operative effort intended to reverse the negative trend. At the same time, the national government appointed an investigative commission.[56] This commitment by the industry, the unions and the government to improve the work environment succeeded over time in reducing the accident rate. Since accident rates in other industries also declined, however, the iron and steel industry retained its high position on the list, for women as well as for men. Looking only at women, the industry was number one in the accident rankings in 1993. In that year, the men were in third place, trailing only metallic mining and fire and rescue services on this far from desirable list.[57]

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[53] The official statistics do not consistently separate out the iron and steel industry, but instead include a small number of firms that process other types of ore. Firms dedicated to iron and steel, however, dominate throughout the period. The "Ore Processing Industry" was the term long used in the official statistics. It was later replaced by "Iron, Steel and Metal works". See SOS *Olycksfall i arbete,* SOS *Yrkesskador* and later injury statistics published by Riksförsäkringsanstalten (The National Swedish Insurance Bureau), SCB, etc.

[54] SOS *Olycksfall i arbete*. See also Berggren & Olsson (1988) p 65.

[55] SCB *Miljöstatistisk årsbok 1978*.

[56] SOU 1975:83.

[57] SCB and Arbetarskyddsstyrelsen.

Despite major efforts in the area of occupational safety, in the early 1990s the iron and steel industry once again was among the leaders in accidents per worker. The explanation can be found in a number of inter-related factors. First of all, the share of white-collar workers has been, and remains, lower than in most other industries (thus raising relative rates). In addition, it is difficult to eliminate all risks in this type of production, where people work in the vicinity of red hot metal, large rolling mills, overhead cranes and forklifts. The control panels, on the other hand, mean watching display screens and can result in long periods of inactivity. When problems occur in complex processes, there is great danger of injury, both to line workers and to the repair personnel. This is especially the case when the stakes are high and speed is essential.

Accident Severity

By itself, the relative accident rate by no means tells the whole story concerning worker peril. The official statistics also indicate that average accident severity was generally *lower* in iron and steel than in many other industries. When, during the first half of the 1920s, the industry led the rankings for the reported number of accidents per 100 yearly workers, it did not make the top ten for the number of work days lost to accidents per yearly worker (severity index).[58] Starting in the late 1920s, however, there was a deterioration. Until the mid-1940s, the industry fluctuated between fourth and sixth place on this list. In the late 1940s, improvement once again set in. The severity index declined, and the industry fell a few places on the list. Mining continuously topped this tragic list.

Starting in the early 1960s, the severity index for the Swedish economy as a whole slowly declined, from 1.5 lost work days per 1,000 work hours in 1960 to 1.3 in 1970 and 0.98 in 1975.[59] The iron and steel industry continued to find itself a few notches down on the list (5^{th}-8^{th} place). The industry also had a lower severity index during the 1960s and 1970s than in the mid-1950s. After a drop in the late 1950s, however, the index remained well above 2 lost workdays per 1,000 work hours for the following decades, with some year to year variations. Mining continued to lead, followed by quarries, forestry, the wood industry, transport and construction.

The situation improved, with the severity index declining, towards the end of the 1970s. By 1993, for all sectors combined, it was 0.4 for men and 0.2 for women. It was considerably higher in iron and steel, but still well below the industry's performance two or three decades earlier. Construction now led the list for

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[58] The severity index is the number of lost workdays per yearly worker calculated according to a special formula. See SOS *Olycksfall i arbete,* for exampel 1954, p 22.

[59] SOS *Yrkesskador*.

men and food processing that for women. Ore refining was still among the most dangerous industries, particularly in terms of the severity index for women.[60]

Causes of Accidents

To what types of accidents have iron and steelworkers been most prone, and has the industry's accident profile changed significantly since the 1920s? Does the industry display an accident profile similar to, or very different from, the Swedish economy as a whole?

Generally speaking, the iron and steel industry fits the general pattern. In the pre-1950 period, industrial machinery caused many serious accidents everywhere. "Lifting, carrying and handling objects" also led to serious injuries. The industry was different mainly because of frequent accidents caused by "flammable and hot materials" and "intensive light and radiant heat". Accidents involving rail bound vehicles and lifting mechanisms were also relatively common and severe. Slipping and falling, on the other hand, were less common in iron and steel than in the economy in general.[61]

Over the period 1920-1954, the tendency, both in the economy as a whole and in the iron and steel industry, was for accidents caused by lifting, carrying and handling objects to become relatively more common.

Even after the mid-1950s, machinery continued to be the most important cause of accidents. Lifting and carrying, on the other hand, caused fewer and fewer serious accidents, both in the industry and in the whole economy. The explanation lies in the post-war rapid increase in the use of electric overhead lifts, cranes, forklifts, rail bound vehicles and trucks. On the other hand, serious accidents involving vehicles, elevators or cranes became increasingly common. During the 1960s, there were three pre-eminent causes of accidents in the Swedish economy: vehicles, machines and falls. These were followed by hand tools and elevators and cranes.

Each industry had its special problems. Mining and forestry, the most accident-prone industries, were also different in that falling objects resulted in many serious accidents. In the iron and steel industry, accidents were primarily caused by machinery, followed by elevators and cranes, falls, vehicles and hand tools. Over time, heat and physical stress also became increasingly common causes of injury.

The investigation of the steel industry's work environment that was done at the government's behest during the first half of the 1970s confirms and deepens the picture. A questionnaire was sent to a sample of the industry's workers. The answers revealed that the risk of injury was perceived to be greatest in steel mills,

[60] SCB/Arbetarskyddsstyrelsen (1993).
[61] SOS *Yrkesskador*.

followed by rolling mills and wire works. The workers put the risk of burns first, followed by crushing and being hit by objects on overhead lifts.[62]

Work Related Illnesses

For a long time, the insurance system was primarily directed at work accidents. It was, and still is, much more difficult to demonstrate that an illness is work related. The examples of asbestos (asbestosis), quarry and casting plant dust (silicosis) and vinyl chloride (cancer) confirm this.[63] Resistance from physicians, firms and insurance companies resulted in workers reporting few of the illnesses that they thought were work related. The official statistics contain only 1,400 reported cases of work related illness in the mid-1950s, compared to 120,800 workplace accidents and 13,500 work-related travel accidents. Thereafter, the reports increased only slowly, until the late 1960s when they more than doubled in just a few years. In 1972, 7,100 work related illnesses were reported. The really great increase, which was partly the result of changed insurance compensation rules, however, occurred after the late 1980s. Furthermore, repetitive motion injuries and allergies now emerged as a major problem.[64] As noted, it was in 1988 that the government appointed the Work Environment Commission.

Here we shall discuss the illness profile for the iron and steel industry since the mid-1950s. At that time, women in industry were particularly subject to occupational illnesses, especially in the chemical and wood industries. The iron and steel industry consistently had lower figures. Even here, however, women, such as Elvi Pantsu, were disproportionately the victims.

The government study of the steel industry's work environment from the early 1970s also dealt with the risk of occupational illness. The workers consulted placed hygienic problems first, ahead of accident risks and ergonomic stress. Three environmental factors were emphasised: noise, air pollution and indoor climate. The workers in the Martin facility, the electric steel facility and the rolling mill were especially tormented by the noise. As for air pollution, dust and smoke were particularly troublesome in the steel works, the blast furnaces and the sinter and sponge iron works. The climate problem concerned drafts and temperature changes, which were most troublesome in steel mills and at blast furnaces.[65]

The changeover to working at control panels, together with an increased work pace, made the problem of repetitive motion injuries more serious. The report of the fact-finding group for the 1988 Work Environment Commission notes, among

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[62] SOU 1975:83 pp 11 and 36. In the spring of 1973, a questionnaire was sent to 1,242 selected workers at eight different companies. 1,021 (83 per cent) replied. Ibid, chapter 3.

[63] Sund & Åmark (1990) chapter 3, Thörnquist (1993), Isacson & Söderlund (1995) pp 60 ff.

[64] SCB/Arbetarskyddsstyrelsen (1993) table 1.2.4. See also Sund & Åmark (1990) chapter 4, Ekström (1990) and Isacson & Söderlund (1995) pp 60 ff.

[65] SOU 1975:83 pp 11, 29 and 93.

other things, that women in the iron and steel had an "increased frequency of stress injuries". Male furnace and metal oven workers were observed to have an increased risk of developing stress injuries, lung disease and heart attacks. Male hot and cold roller mill workers, like the smiths, also suffered a large number of stress injuries. The smiths also suffered an elevated risk of hearing loss. The foundry workers too were badly affected by hearing injuries, as well as joint problems. In addition, their risk of developing lung cancer was above normal.[66]

A study of the relationship between working life and heath, published in the mid-1990s, complements this picture. According to the mortality registers, male furnace and metal oven workers, like all iron and metal plant workers, display an elevated risk of experiencing a heart attack.[67] Asthma is also common among furnace and metal oven workers. Female steel, metal, smithy and casting workers suffer an increased incidence of stress injuries. With regard to skin disease and psychic disorders, however, the situation of iron steelworkers in the early 1990s is more favourable.[68] Still, statistics from the 1980s and 1990s clearly show that steel and metal works rank high in reported work related illnesses per 1,000 workers.[69] The numbers are especially high for women workers, who suffer in particular from stress injuries in the neck, shoulder, back and arms. The men also have a high ranking. They are afflicted with stress injuries, in addition to hearing loss, dermatitis and allergies.[70] Leo Pantsu is not alone in having suffered injury from his work in the post World War II Swedish steel industry.

Conclusion

Today's iron and steel industry has come a long way from its obviously unhealthy work environment at the turn of the 20th century and even in the 1950s. Even so, the industry's workers are often afflicted with accidents, musculo-skeletal disorders and hearing injuries, as well as lung disease. Work place accidents are common, although on average not quite as serious as in many other industries. Despite a major effort since the 1970s, it has not been possible to eliminate all risks. New technology and new processes continually bring with them new, unanticipated dangers. The combination of a higher pace of work, greater demands for efficiency and profitability and greater worker responsibility leads to increased psychological stress and, it is reasonable to assume, greater risk taking.

Reports, official statistics, films, photographs and narratives concerning the earlier work environment in the iron and steel industry still support the conclu-

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[66] Kartläggningsgruppens rapport till arbetsmiljökommissionen (1989) pp 42 and 99.
[67] Järvholm (1995) p 53.
[68] Järvholm (1995) pp 68 and 95 and chapters 9 and 12.
[69] SOS/SCB and Arbetarskyddsstyrelsen (1985), *Arbetssjukdomar 1985*, table 6B and the reference in note 64.
[70] SCB/Arbetarskyddsstyrelsen (1993) table 11.

sion that working conditions have improved decisively, especially since the early 1970s. The short run risk of suffering serious work injury is probably less today than at any time during the last hundred years. Nonetheless, experience indicates that it is dangerous to become complacent, assuming that the problem is largely solved. In a time of rapid change in technology and work organization, there is always a risk that new, previously unknown dangers will creep in. The work environment and human health can also easily be overshadowed by efficiency and profitability goals. The tendency towards replacing permanent employees with outside contractors at peak times and for special tasks also leads to a reduced interest in observing and improving the work environment. Still, it is important to continually improve equipment and conditions so as to minimise risk and limit work injuries and illnesses. Indeed, this is more likely to enhance, rather than lower, efficiency and profitability. Occupational illnesses and injuries not only cause unnecessary human suffering, they also lower productivity and impose great costs on firms and society.

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Interviews

Elvi and Leo Pantsu, Borlänge, 16 July 1996 and 13 August 2000.

Efforts to solve the silicosis problem in the foundries could in turn create new hazardous working sites – outdoors. Photographer: Nils Hjort, Österbybruk.