Driving forces behind the elimination of silicosis in Sweden

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Early Swedish observations relating to silicosis

In 1734 the Swedish scientist Carl von Linné wrote that workers preparing grindstones made of sandstone "rarely became older than 40 years". He also observed a marked excess of widows in a place called Orsa, in Dalecarlia, central Sweden, where sandstone production was localised. He named the problem "the Orsa-disease"(ref. 1). Linné noted that production primarily took place in the wintertime, in small cowsheds with no ventilation other than the chimney. Some of the workers died in their twenties or thirties according to Linné.

In 1830 an association was noted between chest disease and pottery production in Sweden. A study of workers in a quartz quarry from 1900-1930 resulted in the inclusion of silicosis in the list of occupational diseases eligible for compensation in 1931.The Johannesburg meeting in 1930 strongly influenced this decision.

Silicosis becomes a major OSH concern in Sweden

The first large scale investigation of silica exposed workers was conducted from 1934 -1938 (Torsten Bruce, 1942 (ref. 2). 1800 out of 2500 active workers exposed to silica had chest X-rays and it was found that 600 of them had silicosis. The study resulted in a statute (1938) requiring regular X-ray investigation of heavily exposed workers. The problem of silicosis was recognised in the late nineteen thirties and it was known that there was a high prevalence and severity of the disease. Local trade unions were actively involved in preventive action, particularly those trade union branches with members exposed to silica dust. Unemployment was the dominant concern at the central trade union level while employers appeared to focus on instructing workers to be careful and to avoid dangerous exposures, e.g. through the use of respiratory protection devices. Workers who were affected, in spite of "care and avoidance", were removed from areas with high exposures (ref. 3).

Labour shortage after World War II stimulated efforts to reduce emission of silica dust

The worst affected industries were potteries, steel foundries, underground iron and quartz mines and quartz related industries. In the nineteen forties, local management and union representatives began to institute radical preventive measures in many affected enterprises, with the notable exception of small enterprises. After World War II there was a general labour shortage and employers in heavy industries experienced recruiting difficulties, particularly where there were concerns about the risk of contracting silicosis. These circumstances were important driving forces for employers and local trade unions to collaborate to reduce exposure to silica dust. However, few measures were taken to reduce exposure to silica dust in some industries such as iron foundries or stone cutting, because there

was little recognition of the silicosis risk in these industries (ref. 3).

A 1960 register study showed a trend towards increase in the prevalence of silicosis

In 1960 Axel Ahlmark updated the 1942 study by Bruce on all diagnosed cases of silicosis (ref. 4). The report demonstrated a continued problem and pointed out new problem areas including iron foundries, granite work and mining. In spite of preventive measures there was also a rising prevalence from 1940, with an average incidence in the order of 110 new cases/year. The study drew from the registers of various insurance companies which were later merged into a central registry in 1953. This report prompted extensive work to measure, record and reduce exposures (described below).

In 1970 the prevalence of silicosis was 2100 cases including 900 with grade 2 or 3 silicosis. The death rate from silicosis was about 70 cases per year.

The silica problem became an issue for the radical movements of 1968

In 1968-69 radical movements influenced the political situation in the western world. In Sweden the movement was sparked by a wildcat strike by miner's that induced a widespread and radical discussion about the occupational health risks faced by industrial workers, including the risk of silicosis. One outcome of this movement was increased attention and resources for occupational safety and health (OSH) as well as legislation to promote OSH and the influence of workers in the workplace. Prevention and risk elimination became the focus rather than detection and cure of ill health (ref. 3).

In 1980 Peter Westerholm published an update of the registry studies from 1931 to 1975 (ref. 5). This study showed a trend towards reduced incidence of silicosis in the seventies while at the same time there was a prolongation of the period between first exposure and onset of X-ray changes and, consequently, an increasing age of the workers when X-ray changes were first detected. The X-ray changes initially detected tended to be milder than in earlier studies. Out of a total of about 4600 workers diagnosed with silicosis, 2000 cases were working in mining, quarrying and tunnelling, 1700 in steel or iron manufacturing, 400 in the ceramic industry with the remaining cases coming from a variety of other occupations. This study also demonstrated, in quantitative terms, the now well-known association between tuberculosis and silicosis, (in this study in the order of 10 times increased risk), and the increased mortality measured as time of life shortened in workers with silicotuberculosis.

Subsequently the incidence of new cases of silicosis has further decreased and is now close to zero; see Figure 1. From 2000-2004 a total of 5 new cases of silicosis have been reported.

The incidence of silicosis in the years before 1940 was underestimated, since chest X-ray investigations were not performed on a regular basis but only if symptoms prompted a medical investigation. Between 1940 and 1960 the numbers of persons exposed to silica had probably increased due to increased production, but preventive measures may at least have reduced the excessive exposures that may have occurred in the past. There are multiple causes of the decrease in incidence since 1970. Possible causes are discussed below and one of them is clearly a reduction in exposures.

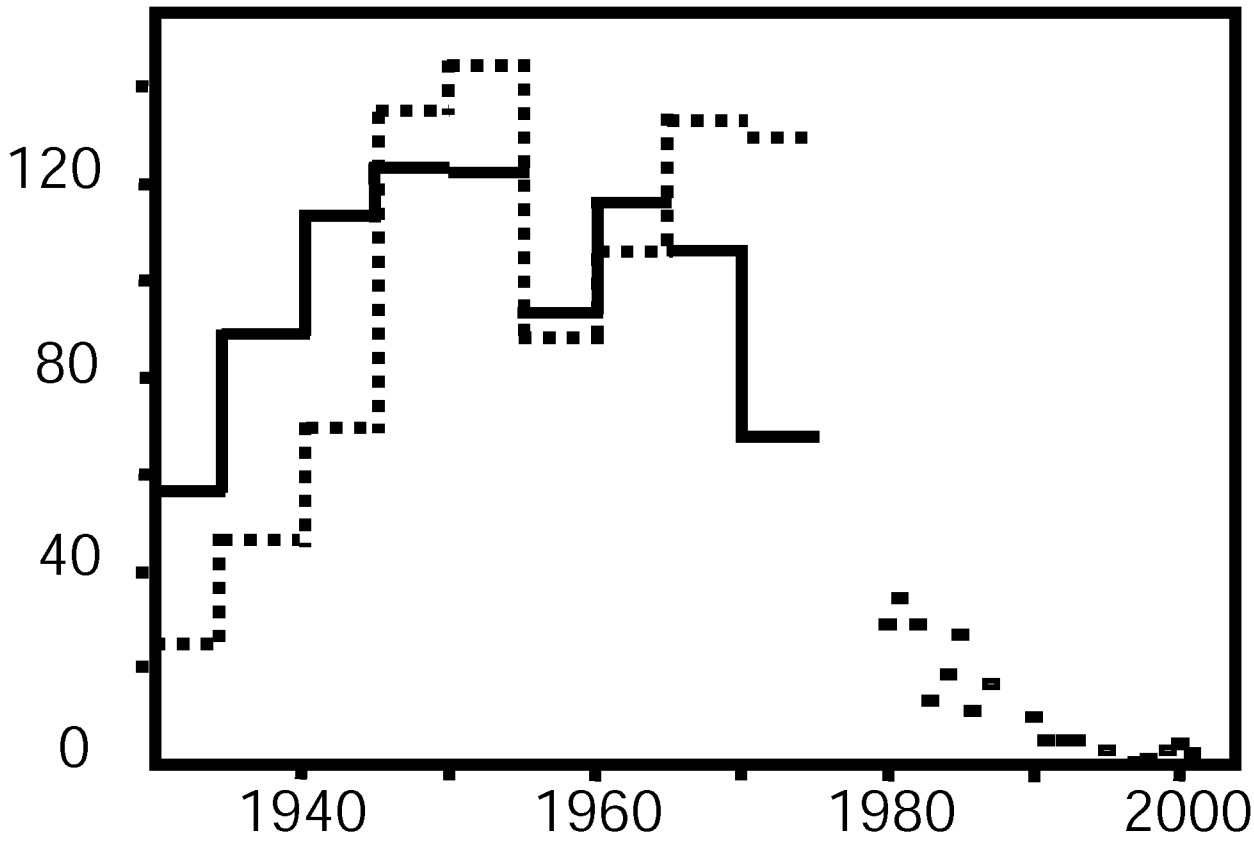

Figure 1. Incidence of silicosis in Sweden (new cases detected each year). Broken line represents cases notified before 1975, solid lines show the year of manifestation of silicosis estimated by evaluation of earlier chest X-rays. Before 1975 figures are available in five-year intervals, after 1975 the number of cases of silicosis notified to the registry each year are shown.

Extensive industrial hygiene measures in the sixties and seventies

A study of exposure levels in 170 workplaces was performed in 1963. A major investigation was started in 1968, partly prompted by joblessness among engineers. Unemployed engineers underwent training to become safety engineers. Forty trainees visited all 1700 workplaces with known exposure to silica dust, measured exposure and gave advice on dust reduction measures (ref. 6).

The study demonstrated that more than half the relevant work force was exposed to levels exceeding the exposure limit of the time (then 0,2 mg respirable dust/m^3 of air, today 0,1 mg respirable dust/m^3 of air). This prompted further extensive efforts to reduce exposures. These measures were largely effective, as evidenced in follow-up measurements of silica exposure performed between 1974 and 1980, but there were some exceptions.

The cost of reducing exposure

The calculated costs of reducing exposure to safe levels were considerable. For example, it was estimated that the measures taken to reduce the exposure to silica dust when building a new plant for granite crushing, amounted to 25% of the total building costs. The costs for preventive

measures were much higher when an existing plant was modified, compared with the cost of measures required to keep exposure at safe levels in new facilities (10-20% compared with existing plants). In difficult environments such as in granite crushing, the costs for OSH may amount to 15-25% of the total production costs (ref. 6).

Uncertainties about the exact relationship between exposure levels and the incidence of silicosis

Figure 1 shows a clear, (but perhaps misleading), time relationship between the reduction in exposure in the seventies and the incidence of silicosis. Measures taken between 1940 and 1970, to reduce exposure may thus have been more effective than would appear from the graph, since there is a long time lag between exposure and onset of silicosis. This is partly illustrated in a study of workers in a pottery. Extensive measures were taken in 1940 to reduce exposure but, in spite of this, a total of 47 workers contracted silicosis in the years between 1942 and 1972, including 15 after 1960. This may be due to ineffective prevention after 1940, but it is interesting to note that all of those who developed silicosis were exposed to high concentrations of silica dust at this pottery before 1940. The time between first exposure and the first appearance of X-ray changes is in the order of 20-30 years if exposure levels are moderate. The disease may still progress even if exposure is completely removed.

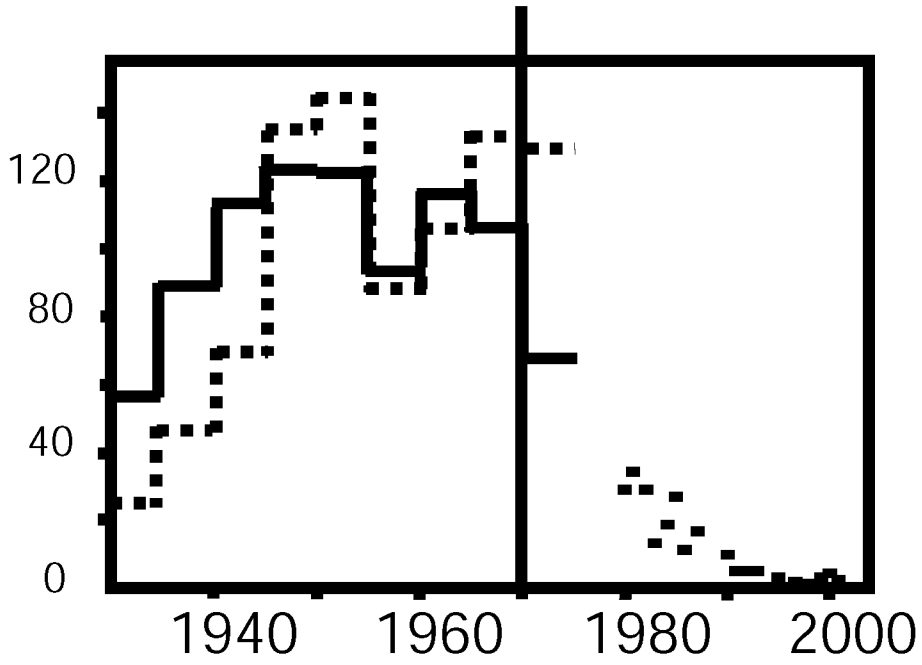

Figure 2. See legend to figure 1. A vertical line has been inserted at the year 1970.

In Figure 2 a vertical line is drawn at the year 1970. The investigators of that time could of course only see the historical data up to 1970 and they were alarmed about the apparently poor result from all the preventive work performed up until then. It is, however, possible that the preventive measures taken before 1970 may partly explain the subsequent dramatic drop in incidence. In other words, the measures taken to reduce silica exposure after 1970 were certainly helpful, but it is difficult to say if a lesser effort (and cost) could have

been sufficient to dramatically reduce the incidence of silicosis.

Another factor which explains the current low, (or indeed almost zero), incidence of silicosis in Sweden is that the exposed population is vastly decreased because of changes in production and increased productivity. For example, pottery work is much reduced, granite cutting is rarely practiced today (see Figure 3), and fewer workers are needed to maintain high production in mining and steel production because of increased mechanization.

Figure 3.
Granite cutters (about 1925). The subsequent introduction of power tools and enclosures to reduce the effects of bad weather, led to large increase in the number of cases of silicosis and silico-tuberculosis among granite cutters. Today the trade is virtually extinct.

Driving forces in the elimination of silicosis

The medical profession, specifically a few individual physicians, were very important in the early phase of detecting the problem of silicosis and in describing the magnitude and consequences of exposure to silica dust. The X-ray was the dominant means of detecting disease and the Johannesburg conference in 1930 provided an important standard for the interpretation of X-rays. They were strongly supported by local trade unions and by the branches of trade unions whose members were particularly affected by exposure to silica.

After the medical problem was identified, industrial hygiene professionals provided important help in measuring and reducing with the unit of industrial hygiene at Harvard, started in 1928. Industrial hygiene research in Sweden was originally located at the National institute of Public Health, (with economic support from the Rockefeller Institute), and was later moved to a forerunner of the National Institute of Occupational Health, now merged into the National Institute for Working Life.
Over time the trade unions became increasingly concerned about the silicosis problem. In Sweden there has been a tradition of tripartite cooperation in occupational health matters since 1938, so it was largely a tripartite proposition that influenced government to finance the 1968 "silicosis projects" described earlier. The fact that union membership has been stable

at about 80% for many decades adds weight to propositions from the trade unions.

The general public also became sensitised to the silicosis problem, (and the asbestos problem), through the radical movements of 1968-1969. This awareness provided fertile ground for strengthened legislation on occupational safety and health, on workers participation in OSH work and on the workers "right to know".

While the story of how silicosis has been virtually eliminated in Sweden relates specifically to the time period and social conditions in the country, it also demonstrates that silicosis is not an inevitable consequence of working in mines or steel foundries. Elimination of silicosis requires effort on many levels, both in society and in the individual businesses involved. In Sweden it was possible to gain wide acceptance for the required measures but it is important to recognise that a very significant driving force for this acceptance was a shortage of labour - when workers have a choice, they avoid employment that is unhealthy.

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Reference no 1 is available at the Royal Library in Stockholm, the remaining references can be obtained at the library of the National Institute for Working Life: www.arbetslivsinstitutet.se

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