PROGRESS IN PREVENTION: EARLY DIAGNOSIS AND MEDICAL CONTROL OF OCCUPATIONAL LUNG DISEASE

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I would like to touch the old—nevertheless very interesting—history of dust-related lung diseases very briefly. I will concentrate more on later results and on data available for further research and strategies for dust-exposed persons, especially miners.

PARACELSUS already mentioned the miners' disease, and he called it consumption of miners ("Bergsucht"). In this term, the relationship to tuberculosis is obvious. At this time and till the early fifties of this century, silico-tuberculosis was one of the main problems of complications of miners' dust-related lung disease. This is more or less history but not in all parts of the world.

RAMAZZINI of Padua (1780) described bakers' asthma for the first time which was caused by the organic flour dust as an asthma-like disease.

The term "pneumoconiosis" was introduced by ZENKER (1867) for the first time, and at this time pathologists showed us all the changes of the structures in the lungs caused by dust, mainly by quartz and coal mine dust. In Germany, mostly the term "silicosis" was used for "coal workers' pneumoconiosis" as it is called in English speaking countries. At present, coal workers' pneumoconiosis is still the most important dust-related disease from the sociomedical point of view. Many of us may remember the tremendous basic contribution given by pathologists and some may remember that for physicians' better understanding of this disease radiology was the key to a new era. These different pictures led to different X-ray classifications. The first internationally used classification was that of Johannesburg (1928) followed by the classification of the International Labour Office (ILO 1980/81). With one set of standard films edited by ILO we have an instrument world-wide available to control the development of pneumoconiosis by the X-rays and for comparative studies.

We leave history now and we move on to the present time.

The development during the last 30 years has shown tremendous progress not only on behalf of our knowledge. Our improved understanding of this disease "coal workers' pneumoconiosis" and very similarly of pneumoconiosis caused by organic dusts like bakers' asthma have had important progress for the expectation of life as well as for the quality of life of dust-exposed and disabled persons due to exposure to harmful dust.

The development of new methods in basic research work was followed by much better insights in the etiology and pathogenesis of these diseases. At the same time, new drugs, very efficient drugs, were developed which could not prevent these diseases till now, but could control the complications responsible for disablement and early death. Both early disablement and early death were terrible facts connected with most of the pneumoconiotic disorders and with the complications related to the different forms of pneumoconiosis.

To remember some of these steps, it may be useful to understand our plans and projects for the future.

There is no doubt that the improvement of dust control at all levels is a very important step for the control of dust-related diseases, but besides the improved dust control tremendous medical progress took place. All the coal workers who really develop problems in relation to coal workers' pneumoconiosis have obstructive airway diseases. This kind of airway obstruction starts on the basis of chronic bronchitis and is followed by obstructive bronchitis. In case of less strong X-ray changes, the obstructive airway disease is not more frequent than in non-dust-exposed men (REICHEL et al., 1969).

In categories B and C of the ILO classification this means large massive fibrotic lesions the incidence of which is twice as high as in non-dust-exposed men (the smoking habits of miners agree with the control group of non-dust-exposed men) (Figure 1).

Like patients with idiopathic obstructive bronchitis, the obstructive bronchitis of coal miners dictates the clinical situation of these patients. Fortunately, the obstructive bronchitis of coal workers with coal workers' pneumoconiosis can be treated in the same way with the same success as the idiopathic form of chronic obstructive bronchitis (Figure 2).

We control our coal workers with coal workers' pneumoconiosis very carefully. This means, coal workers with coal workers' related obstructive bronchitis stay under a controlled regime of treatment. Under the long-term treatment the expectation of like of our miners with large opacities and fibrotic lesions on the X-ray is now at least as long as that of the general population (Figure 3).

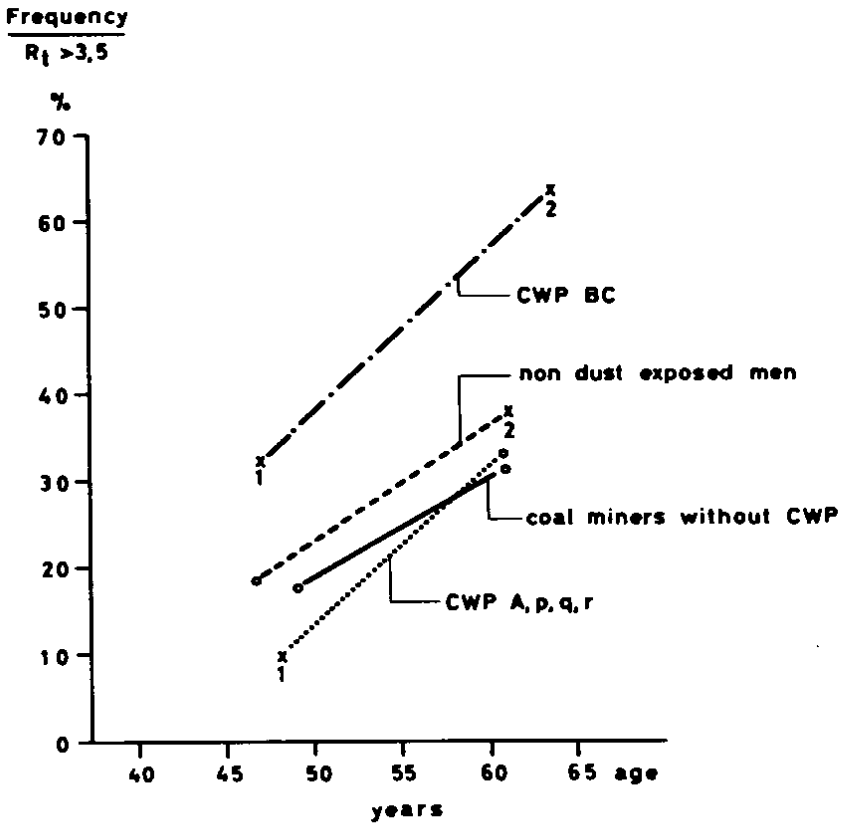

Figure 1. Age dependency of patients with obstructive airway diseases at different stages of coal workers' pneumoconiosis and of non-dust-exposed men (obstructive airway disease = R_{aw} >3.5).

At first glance, the situation may give satisfaction, but we have to realize that the age at which the coal workers develop obstructive bronchitis is nearly the same as 20 years ago. The mean age of the manifestation of obstructive bronchitis is 57 years. In the fifties the expectation of life after airway obstruction was 3.5 years on the average, and now the expectation of life is 16 years on the average. But during this time, coal workers with coal workers' pneumoconiosis and obstructive bronchitis are disabled and have more or less dyspnea, and some even develop cor pulmonale.

Therefore, for the future we have to avoid the development of coal workers' pneumoconiosis and we have to learn to avoid manifestations of chronic obstructive airway diseases.

First the development of coal workers' pneumoconiosis on the X-ray: The correlation between the ILO 12 step classification (from −/0 to 3/+) is relatively linear. Figure 4 shows the results of one mine in W.-Germany as mean value and also the progression of the worst and the best case (Figure 4).

From these curves we can calculate the ILO classification step time: it is the time in years necessary to get from one classification step to the next one (e.g., 0/1–1/0). In the example in Figure 4, the ILO classification step time is 8 years on the average. These curves allow an extrapolation at a relatively early time. From such curves we may learn more about the causes of the different ILO classification step times for different individuals as well as for different mines.

There are clear differences between different mines as Figure 5 shows (Figure 5).

We proposed that:

a) the X-ray development of coal workers' pneumoconiosis should be documented for each coal worker on ILO classification step times/exposure times curves;
b) an interval of 4 years for X-ray examination of coal miners is adequate and without any risk for coal miners at present exposure levels.

In order to prevent the pneumoconiosis due to obstructive airway disease the prevention of airway obstruction is the most important factor as already mentioned above. Today, we dispose of sensitive methods to detect early signs of lung function changes related to airway obstruction. In W.-Germany, we examined in 4 mines the miners by careful lung

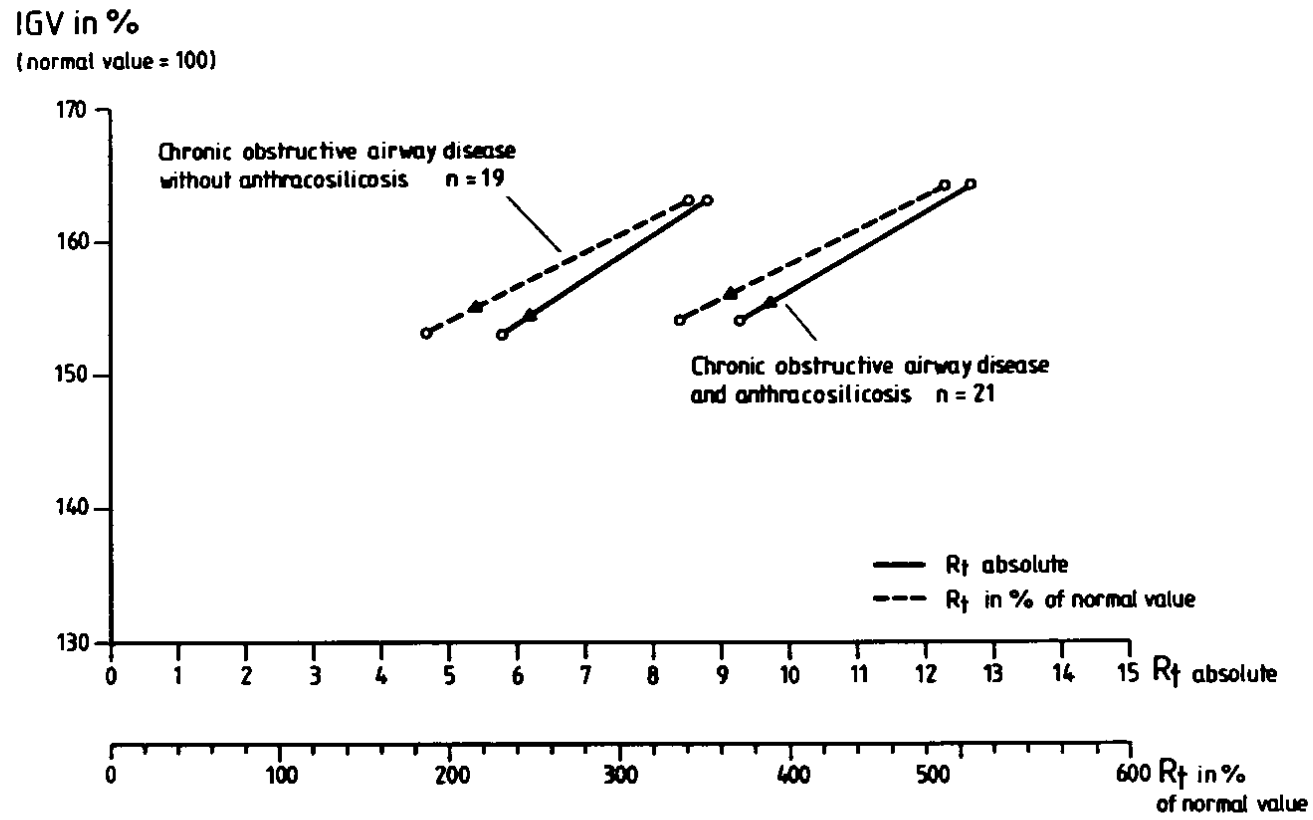

Figure 2. Decrease of airway resistance (R_t) and of intrathoracid gas volume (IGV) under typical treatment with bronchodilators and glucocorticoids in patients with pneumoconiosis-related obstructive bronchitis (n = 21) and of patients with idiopathic obstructive bronchitis (n = 19).

function tests. Among the miners is a relatively high percentage still at work who has obstructive airway disease, and there is quite a number of miners with oversensitivity (hyperreagibility) of the airways.

It is very important to detect persons with signs of obstructive airway disease as early as possible to control the development of the lung function of these persons:

1. to start with an adequate treatment at adequate time and
2. to avoid progression of this disease. It is very likely that an early treatment can control this disease and can avoid progression.

We have to control the lung function of dust-exposed persons with adequate methods. Time intervals for re-examination could be 4 years but not longer.

Dust concentration decreases in the inhaled air are most important for prevention. The very effective dust masks are normally worn for short times only. The acceptance of normal light masks depends on the isolation, and therefore on the development of sweat under the mask. The loss of the possibility of communication is also important and problems of increased airflow resistance may be a factor, too.

The light masks (Figure 6) comparable to those masks worn in hospitals, have in this respect many advantages, although they decrease the dust concentration only for about 70%.

1. They allow communication with other persons without effort;
2. They soak up the sweat around the mask;
3. The decrease of dust concentration in the inhaled air is about 70%, and therefore the ILO classification step time increases so that during the life time coal workers' pneumoconiosis responsible for dust-related obstructive airway disease will not develop (Figure 7).

CONCLUSION

In addition to the best available dust suppression we should emphasize that the light (one-way) masks will be used continuously. With this strategy, coal workers' pneumoconiosis could be controlled so that dust related obstructive airway diseases never will occur.

These results shown mostly for coal miners and coal workers' pneumoconiosis can be transferred more or less to other types of pneumoconiosis.

Our knowledge about the development of pneumoconiosis increased tremendously. During the last decades we could dispose of strategies which are able to slow down the development of coal workers' pneumoconiosis suddenly and which can avoid the coal workers' pneumoconiosis-related obstructive airway diseases. Furthermore, we can improve the health situation of the miners we are responsible for.

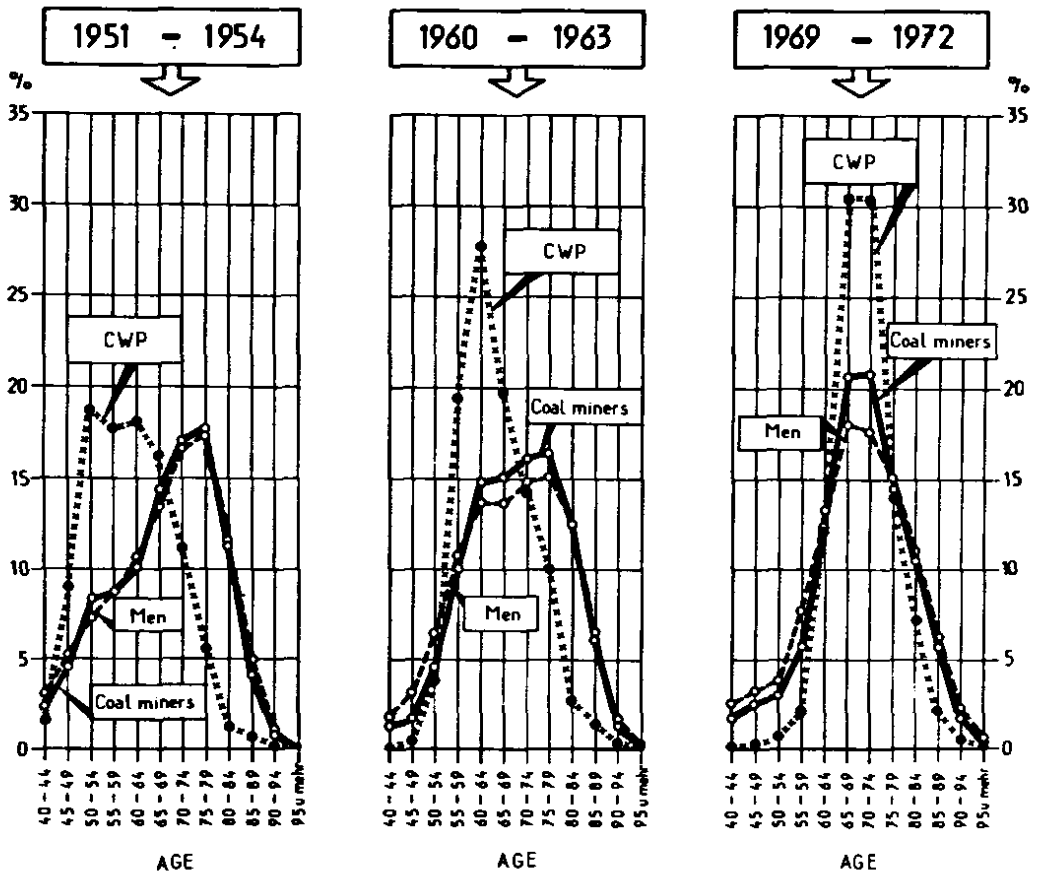

Figure 3. Expectation of life of coal workers with obstructive bronchitis and of miners without coal workers' pneumoconiosis and of non-dust-exposed men in the years 1951–1954, 1960–1965, 1969–1972.

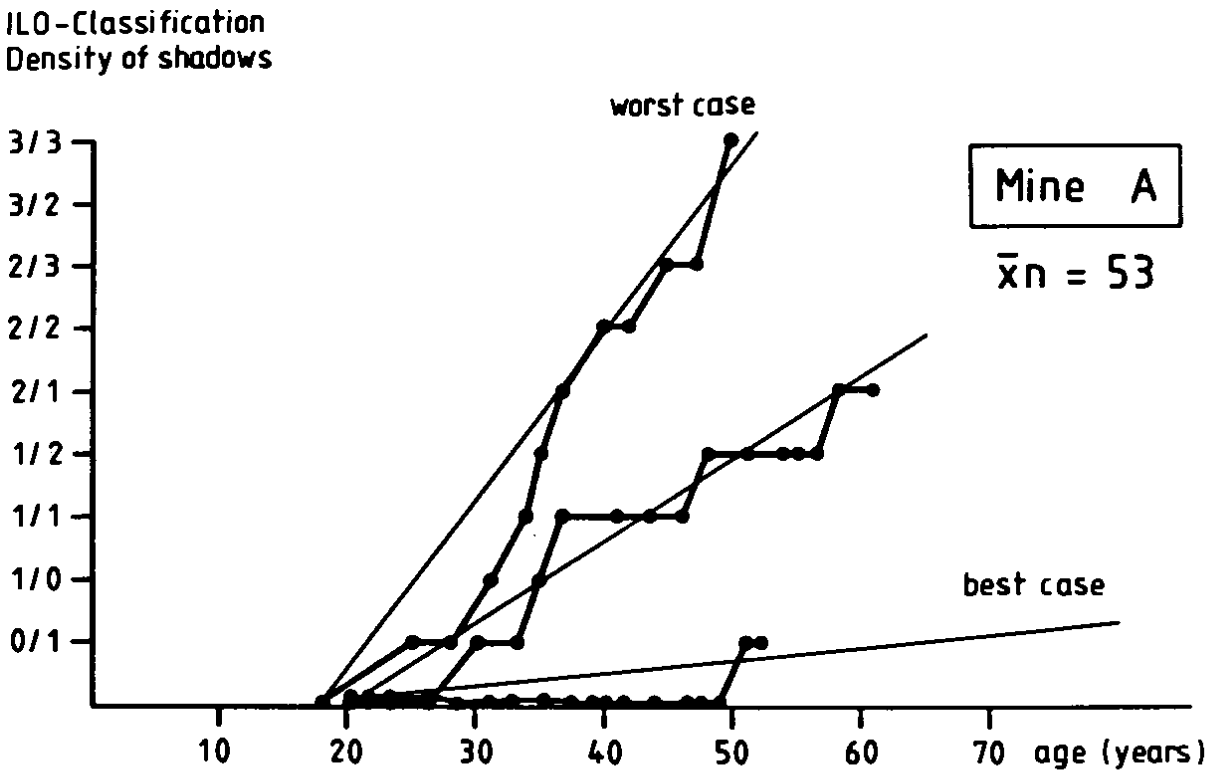

Figure 4. Correlation between ILO classification and exposure time (mean values of 53 miners and the best as well as the worst individual case).

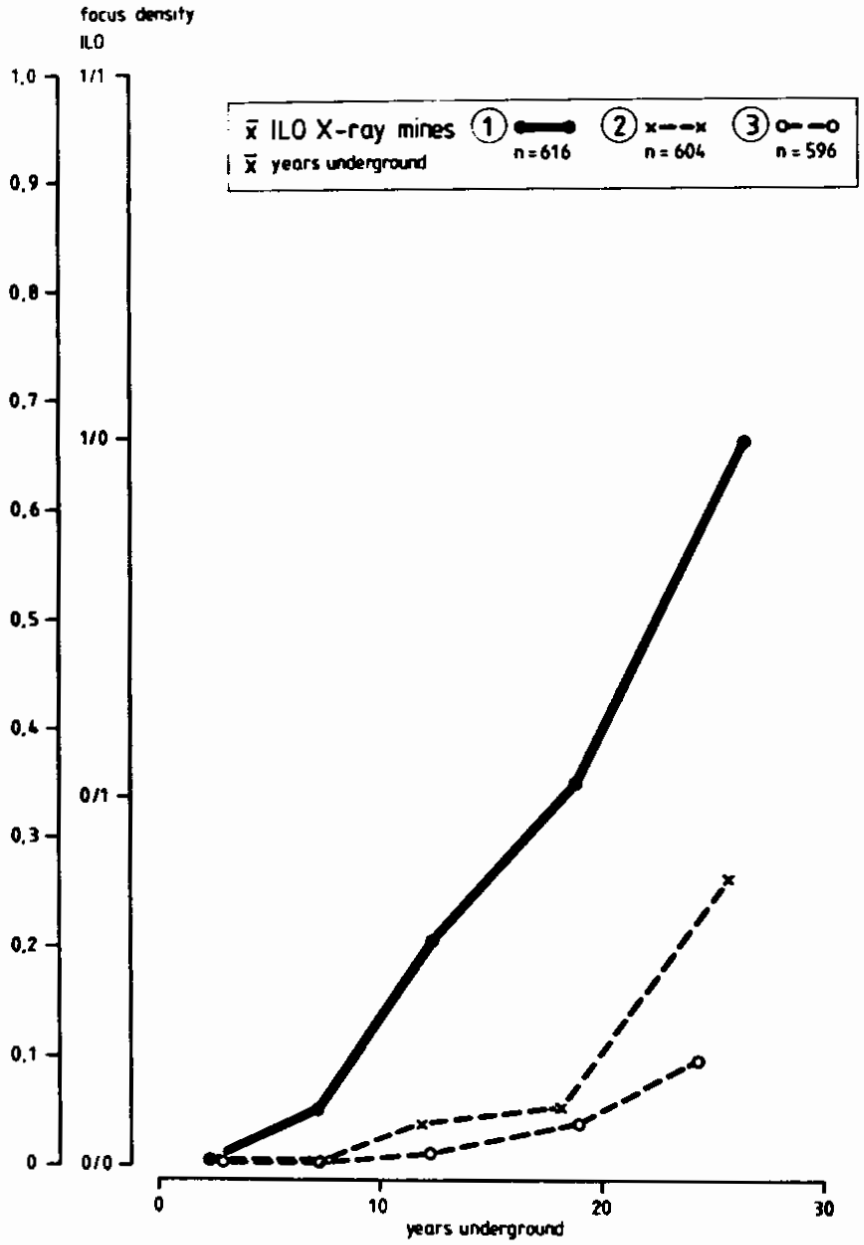

Figure 5. Correlation between ILO classification steps and exposure time on 3 different mines in W.-Germany (mine 1 n = 616, mine 2 n = 604, mine 3 n = 596).

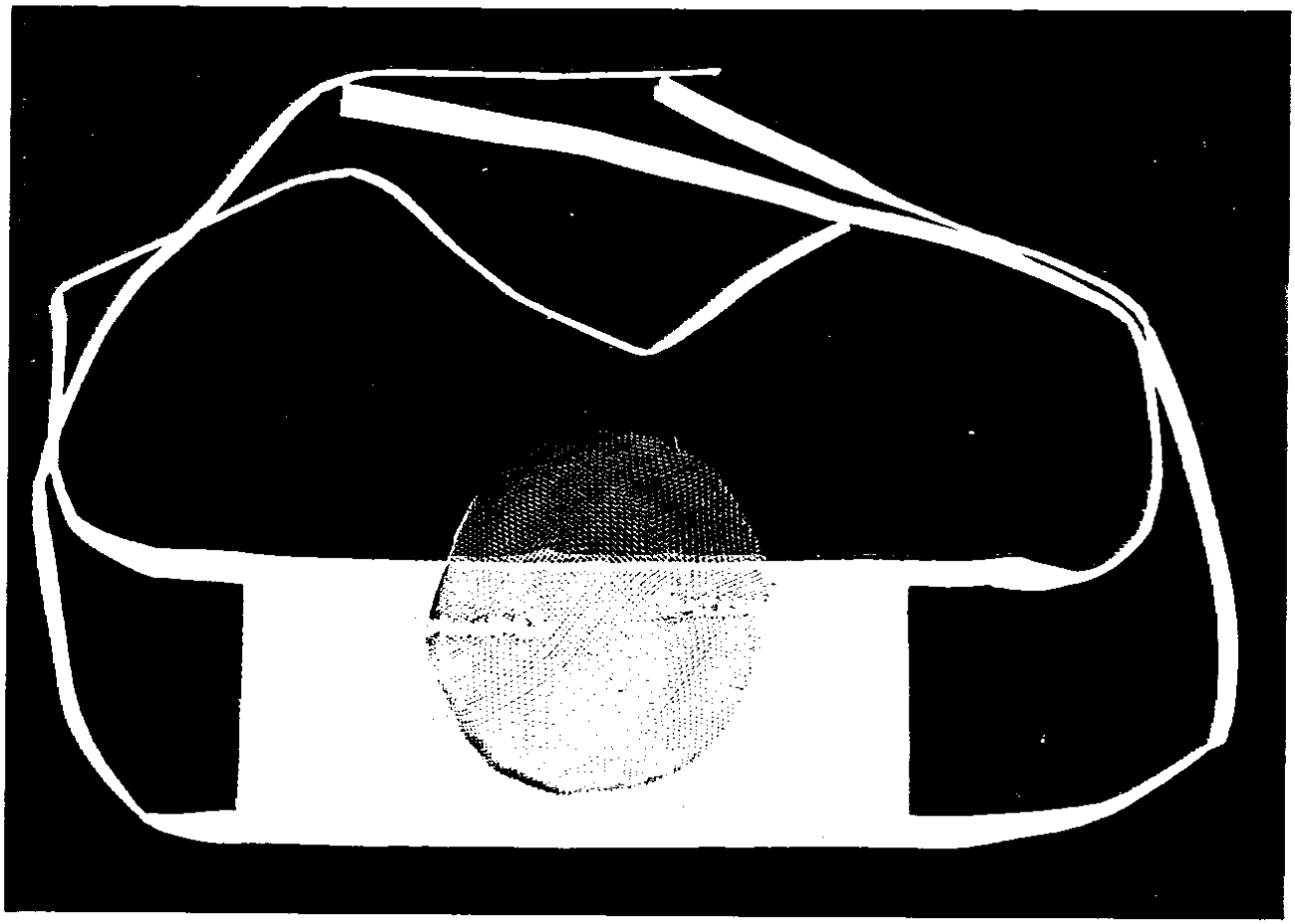

Figure 6. Light mask with very good acceptance and many advantages protecting against the development of coal workers' pneumoconiosis (decrease of dust concentration in the inhaled air ~70%).

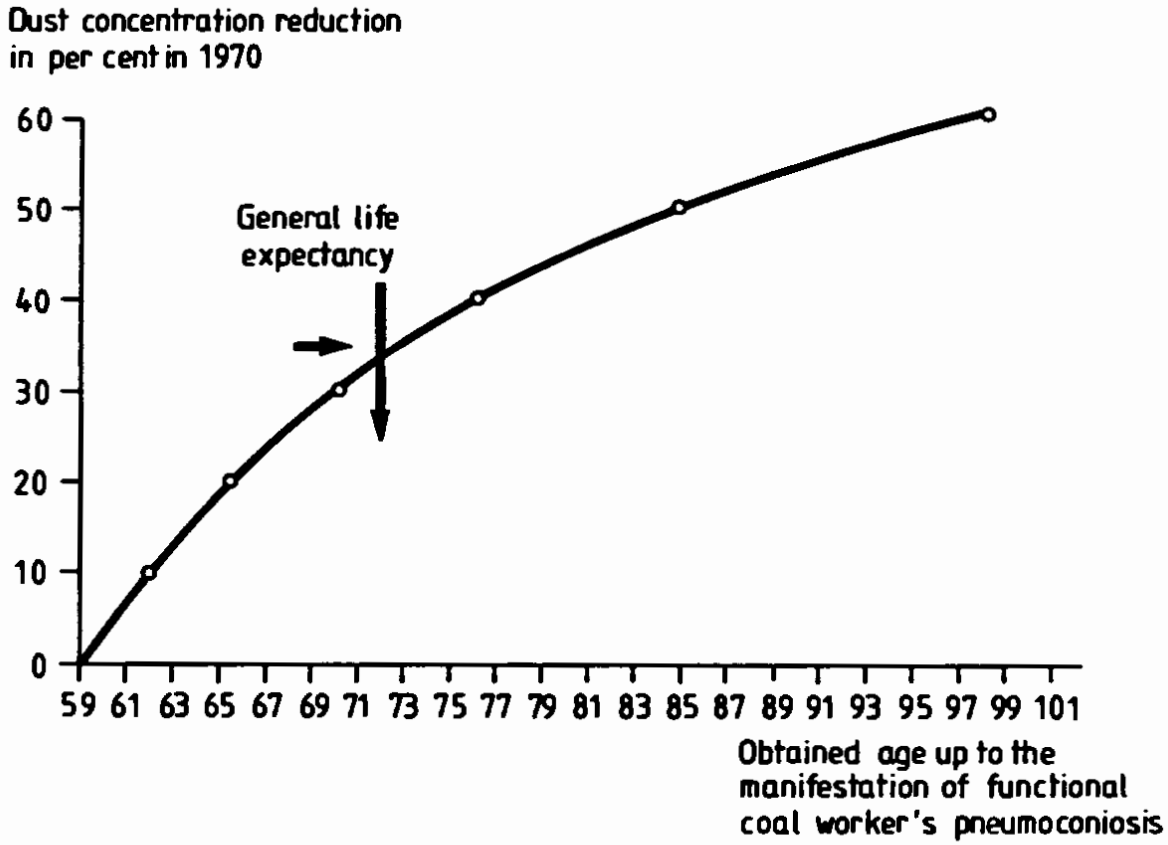

Figure 7. Relationship between decrease of dust concentration in percent of the values from 1970 and the age at which X-ray changes take place which could be responsible for coal workers-related obstructive airway diseases (a decrease of about 35% would be enough to prolong the manifestation time to the values of the normal expectation of life).

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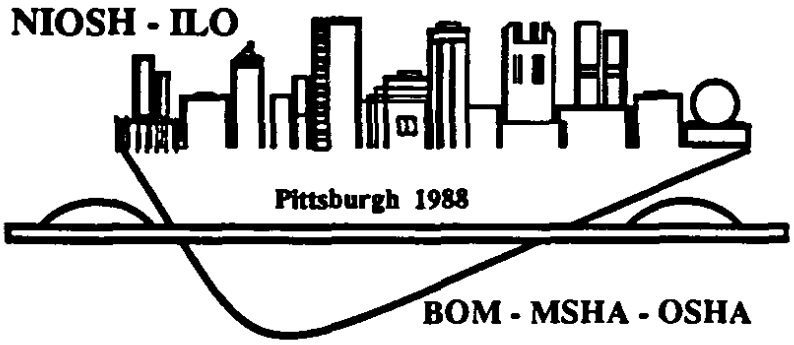

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