More Scientists Now See a Threshold in the Effect of Asbestos

Development of cancer proceeds in several steps, from the entering of a carcinogen into the body to development of clinical disease. At each of these steps the organism possesses defence mechanisms able to destroy the developing cancer cells. Only when all of these mechanisms are overwhelmed does the clinical cancer result.

Experience suggests that it takes large doses of a carcinogen to overwhelm these defences, and that there is a certain *threshold* under which the natural defences prevail. Low levels of exposures to carcinogen appear to be tolerated without harm. Low level exposure to the sun for example (Diagram 1).

A Controversial Hypothesis

In contrast to this experience, another school of thinking suggests that there is a linear relation between the dose of carcinogen and the development of cancer. This means that with decreasing dose, the effect (e.g. number of cases of cancer) gradually decreases along a straight line all the way to zero, so that even very small doses have some effect, and the only safe level is a zero dose. Thus, there is no threshold, and the notion that *"one molecule of a carcinogen"* or *"one fibre can kill"* results. (Diagram 2)

The latter concept is hypothetical, derived from wide extrapolations from results of epidemiological studies of consequences of the past exposures or from animal experiments, both done with exposures sometimes several orders of magnitude higher. Nevertheless this is the concept used by some authorities as the basis for proposals to ban asbestos.

Many scientists do not accept the *"one fibre can kill"* concept. J. Kleinerman, formerly pathologist with I. Selikoff, writes :

Recent studies suggest that a threshold of cumulative exposure exists below which the risk of lung cancer is not raised. Estimates of this threshold are in the range of 25 - 100 fibres/cc/years, an amount equivalent to the threshold lung burden of asbestosis. This has led to the concept that an increased risk for lung cancer as a result of asbestos exposure is present primarily where asbestosis is seen." (1988)

Fibrosis of the Lung vs Lung Cancer

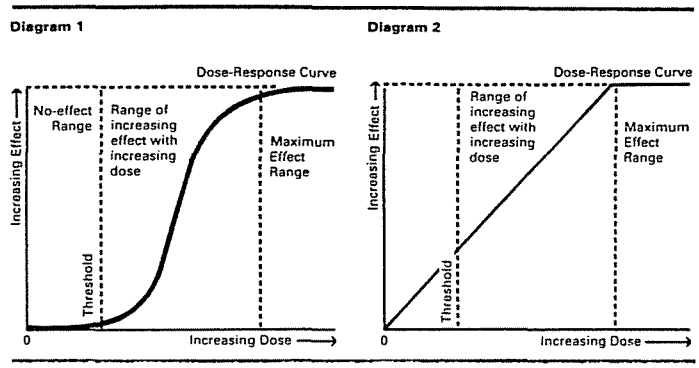
Indeed, fibrosis of the lung tissue such as asbestosis, has been suggested to be a necessary precondition of asbestos-linked cancer of the lung by epidemiology, and the evidence is supported by animal experiments and pathology. "It is our opinion, that carcinoma of the lung associated with asbestos exposure is a result of scarring within the lung. ...There is little convincing evidence for significant genotoxicity of asbestos..." writes Dr. Kuschner (1987). In 356 cases of lung cancer in Suzuki's and Selikoff's asbestos insulation workers, all but a single case showed mild to severe lung fibrosis.

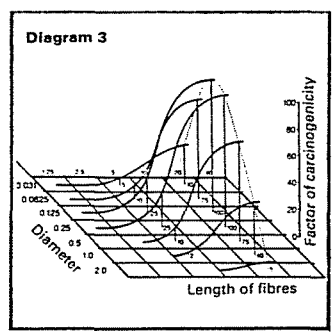
If pulmonary fibrosis (asbestosis) is a precondition without which a lung cancer is not attributable to asbestos, let us examine whether there is a threshold for asbestosis in epidemiological studies. At University of Boston, 1,632 asbestos workers exposed in shipyards and factories have been followed over a long period in a longitudinal investigation. Not one case of significant asbestosis was seen among those who started to work during the last 27 years (Gaensler, 1988). This is consistent with the everyday industrial experience that low exposures under modern control conditions have not led to any excess mortality from lung cancer and/or of mesothelioma (Browne, 1986).

It has been suggested that mesothelioma only develops on tissue changed by fibrosis of the pleura or peritoneum (Kuschner, 1987). This would suggest a threshold for mesothelioma.

Dr. Pott's Hypothesis

The effect of the dimensions of fibres on their carcinogenicity has been extensively studied. It has been established (Stanton) that the long and thin fibres are the biologically active ones while activity of very short fibres is questionable. Ten years ago, Dr. F. Pott proposed a hypothesis in which the activity of fibres only gradually decreased with decreasing length and with increasing diameter. No threshold of activity was considered. Along with





the view of *"one fibre can kill"* a new thesis *"very short fibres are also carcinogenic"* was developed and the Pott diagram was used for justification of this thesis. It is still occasionnally used by some authorities. (Diagram 3)

It is thus, of major interest that the author of this diagram, Dr. Friedrich Pott, a highly regarded experimental pathologist of Düsseldorf, surprised the scientific community by a recent article summarizing his recent research and proposing a new definition of a carcinogenic fibre (1987).

He proposed "to classify all natural and man-made mineral fibres with an aspect ratio of > 5:1 as carcinogenic when they are longer than 3 microns, thinner than 1 micron (or can split into such fine fibres) and when they can persist in the tissue for more than 3 years." For fibres which fail to persist in the tissue long enough, he introduced the term *durability threshold* value.

Pott's acceptance of critical dimensions for carcinogenicity of fibres, which negates the applicability of his earlier diagram, and the adding of a *durability threshold* concept, has important practical implications. According to the present Pott definition, there would be no cancer risk from asbestos in the environmental air, in buildings insulated with asbestos (if not disturbed), in the city air, in water, since practically all such fibres are under the threshold length of 3 microns. And chrysotile asbestos, in contrast with durable amphiboles, would probably come close to, or even under, the *threshold of durability*.