sue and pleural membranes as well as cancers. Whereas identification of asbestos dust as a cause of fibrosing inflammation of lung tissue occurred as early as 1907,[2] it was not until 1930 that a more definitive study by Merewether and Price[3] resulted in the regulations which greatly improved hygienic conditions in asbestos factories in the United Kingdom. The development of lung cancer in asbestos workers, first reported by Wood and Gloyne[4] in the U.K. in 1934 and by Lynch and Smith[5] in the U.S. in 1935, was not firmly established until 1955 by the publication of Doll[6] of a study of workers in an English asbestos textile factory, and in the United States by the paper of Selikoff *et al*[7] in 1964 concerned with cancers in insulation workers. In 1960 the relationship between the inhalation of asbestos dust and mesothelioma was demonstrated by Wagner *et al*.[8]

Asbestosis is a diffuse but nonuniform fibrosis of the lungs that is generally most severe in the basilar portions. As a result of the fibrosis some of the airspaces (alveoli) are not perfused with blood and alveoli that are perfused with blood may not be adequately ventilated because of stiff, thickened alveolar walls. The fibrosis makes the lungs less compliant, thereby increasing the energy requirement of breathing. There is increasing impairment in diffusion of gases leading to increasing breathlessness.

It is not uncommon to find thickening of the visceral pleura, sometimes very severe, by extension of the parenchymal inflammation. This causes an additional increase in the effort of breathing.

The parietal pleura may show patches of severe thickening, particularly over the diaphragm and the lower portions of the chest wall — resulting in the so-called pleural hyaline plaques. These may become visible in X-ray films of the chest — particularly, if they become impregnated with calcium salts. Such pleural plaques may develop from asbestos exposure in the absence of asbestosis. They cause no symptoms.

A study of the members of an asbestos insulators union revealed that deaths from lung cancer in this population was much greater than expected.[7] A later investigation by Hammond and Selikoff of a much larger number of these workers (17,800) showed that nearly all cancers occurred in cigarette smokers.[9] The conclusion of these authors was as follows:

> *"It seems clear, then, that lung cancer is uncommon among asbestos insulation workers who have no history of cigarette smoking, and that if the risk is increased such an increase is not great."*

The total lung cancer rate in this cohort of workers was 4.8 times the expected. The asbestos insulators who had a history of cigarette smoking had a lung cancer rate 5.4 times the expected rate; but compared to the lung cancer rate of the nonsmoking workers, the smoking insulators' lung cancer rate was 14 times greater.

All types of asbestos are known to cause the inflammatory changes in the lungs and pleurae described above and lung cancer. However, there is experimental and epidemiologic evidence that there may be differences in the potential of the different asbestos types to produce disease. Thus, it has been suggested that crocidolite has the greatest potential to produce disease; chrysotile, the smallest; with amosite occupying an intermediate position.[10] In a study of 1348 retirees from the asbestos industry by Enterline and Henderson,[11] the respiratory cancer rate of men exposed only to chrysotile was 2.4 times the expected, whereas this rate was 5.3 times the expected for men who had been exposed to a combination of chrysotile and crocidolite. In the asbestos cement industry a similar difference was observed. Workers exposed only to chrysotile and cement (shingles and sheets) had a respiratory cancer rate of 1.4 times the expected, whereas workers exposed to both, chrysotile and crocidolite and cement (asbestos cement pipes), had a respiratory cancer rate 6.1 times the expected.

Mesotheliomas are rare, usually rapidly fatal cancers that originate from the surface lining the chest or abdominal cavity. From 1960 through 1975, 4539 mesotheliomas have been reported worldwide.[12] The vast majority of these cancers were in people exposed to crocidolite alone or in combination with other types of asbestos. McDonald and McDonald[12] tabulated those reports of mesothelioma where the type of asbestos exposure was known. Although the number of such cases is small, where the exposure was to crocidolite alone or in combination with other types of asbestos, death from mesothelioma constituted 6.1% of the deaths from all causes, with a range of 2.42% to 16.07%. In contrast, deaths from mesothelioma in workers exposed only to chrysotile constituted only 0.3% of the deaths from all causes, with a range of 0.24% to 0.87%. An even greater contrast is found in the Finnish statistics of workers exposed to anthophyllite. Meurman *et al*[13] investigated 216 deaths that occurred among approximately 900 miners and millers of anthophyllite during the 32-year period 1936-1967 and found not one case of mesothelioma.

Not all mesotheliomas result from asbestos exposure. There is a background of "naturally" occurring mesotheliomas that has been estimated to be about ten for males and four for females per million persons aged 45 years and older.[14] Furthermore, it is not uncommon in the various epidemiologic studies reported that 15% or more of the mesothelioma cases have no history of ever having been exposed to asbestos. Perhaps the most important indication that mesotheliomas may result from causes other than asbestos exposures; in this instance, also environmental, comes from a report by Baris *et al*[14] who described a mesothelioma incidence of 2.3% in 1974 in the village of Karain in Turkey (population, 604). This population has been exposed for many generations to dust from the soil that contains kaolin, mica, and vulcanic glass particles, but no asbestos.

A small excess of deaths from gastro-intestinal cancers have been noted in several epidemiologic studies of asbestos workers.[9,15] An association of laryngeal cancer with asbestos exposure has been claimed. Pancreatic cancers and lymphomas have also been mentioned in this connection. However, conversion of the association to a causal relationship rests, as yet, on an insecure basis.

Whether or not there is a dose-effect relationship associated with asbestos dust has been answered affirmatively by a number of epidemiological surveys.[15-19] Whereas this relationship is clear-cut with regard to asbestosis and lung cancer, it is less well-marked with regard to mesothelioma; but it is, nevertheless positive. McDonald[20] points to a case-control analysis based on seven cases of mesothelioma at Thetford Mines that includes no case with less than