

Editorial

Mesotheliomas, minerals, and man-made mineral fibres

In spite of much research and frequent international meetings no clear advice can yet be given on the prevention of mesotheliomas. After the original observations of Wagner *et al*,¹ the evidence from South Africa has been consistent with the view that only crocidolite causes mesothelioma. Although conditions in the African chrysotile and amosite mines and mills have been sufficiently dusty to produce the other asbestos-related diseases, mesotheliomas have been almost exclusively confined to the crocidolite mines and mills and their environs.² Anthophyllite, commercially the least important form of asbestos, was mined in Finland with a lot of environmental dust pollution and although a high proportion of the population developed pleural plaques no mesotheliomas have occurred.³ The main source of chrysotile (other than Russia) is Canada and a few more mesotheliomas have been reported in the mining area than would be expected for the low background level of the disease.⁴ However, during the 1939-45 war South African crocidolite was processed at some of these mines and also some of the Canadian chrysotile is contaminated with tremolite. Similar contamination occurs in Cyprus where the tremolite is used for stucco and whitewash. Mesotheliomas have occurred in Cyprus but strife has prevented a full epidemiological investigation.

However, in the Western consumer countries the situation is confused. Dust-induced mesotheliomas have an average latent interval of about 40 years, so that the cases recognised since 1960 result from industrial conditions before and during the 1939-45 war. Records are scanty and memories are short, so reliable information as to dust levels or even the type of fibre used is hard to obtain. One of the most serious examples of mesothelioma induction is among gas mask workers in Britain and Canada. The civilian masks were made with filters containing chrysotile and the military respirators with crocidolite (probably from South Africa although the specification was for Australian). Although many more civilian gas masks were made, all but one

of the 100 or more cases have arisen among those who made the military gas masks. The one "civilian" case has not been fully investigated. A similar high incidence of mesothelioma has been reported by Selikoff and his colleagues arising from a dusty factory where amosite insulation material was made during the war.⁵ No chrysotile exposures with an exceptionally high risk of mesothelioma have been reported so far.

Although more information will be forthcoming from epidemiological studies, doubt will remain as to the safety of chrysotile. We may have to rely on information about exposure obtained by analysis of the residual dust in the lung after death. Optical microscope counts of asbestos bodies are relatively easy but asbestos bodies form frequently on the longer amphibole fibres and seldom on chrysotile fibres. Uncoated amphiboles (crocidolite, amosite, and anthophyllite) are thought to remain in the tissue unchanged for life. But magnesium leaches out of chrysotile and the fibres probably break up and dissolve completely. The rate at which this happens in humans is not known. Allowing for this and for the fact that some damage occurs when the fibres are extracted from the tissue by digestion, an estimate can be made of the fibre load by optical counting. This method detects the thicker fibres at the upper end of the respirable range. Electron microscopy with probe analysis is needed for the accurate identification and measurement of all mineral fibres in the lung tissue. It is slow, tedious, and expensive work and so far only relatively small numbers of lungs have been analysed fully. The results support the view that crocidolite is the most important cause of mesothelioma in Britain⁶ but that amosite may be the most frequent fibre in the USA.⁷ More important evidence may come from the examination of lungs where there was no history of exposure and where there are no more fibres seen by optical microscopy than we expect to find in a non-exposed individual. These have up to now been regarded as background or idiopathic cases.

Although careful control of the use of chryso-

Address for reprint requests: Dr PC Elmes, MRC Pneumoconiosis Research Unit, Llandough Hospital, Penarth, S Glamorgan.

tile and the cessation of commercial mining and use of amphibole asbestos will produce a very marked fall in the incidence of occupational mesothelioma, it may not be completely or permanently effective. Experiments designed to study the mechanism by which asbestos causes mesothelioma have been carried out by injecting samples of asbestos, man-made, and other mineral fibres, carefully ground to certain sizes. These dusts, of respirable size, have been injected into the pleura or peritoneum of rodents and found to be potent causes of mesothelioma. The potency seems to be related to fibre size and shape and unrelated to whether the fibres are natural or synthetic, asbestos or non-asbestos, crystalline or glassy, so long as they persist in the tissue. One of the most potent was prepared from a special fine grade of short chrysotile fibre of a type not previously handled commercially. Although these dusts did not represent the dust to which workers were exposed, the results of the experiments were interpreted as a warning that in future fibres other than crocidolite, including non-asbestos fibres, might prove a hazard.⁷ Studies of workers in the rock, wool and glass fibre industry have not so far confirmed these fears, even though the industry has been in existence for sufficiently long for a risk to be detected. Nevertheless, recent technical developments in the synthetic fibre industry have tended to produce fibres closer in size to those shown to be dangerous experimentally than those produced heretofore, and vigilance requires to be maintained.

Meanwhile mesotheliomas have been reported from certain villages in rural Anatolia where there seems to have been no significant exposure to asbestos.^{9,10} Further study of these two villages indicates that the most likely cause is the presence of erionite, a fibrous zeolite, in the local rock and soil. In this issue, Yazicioglu and colleagues describe another area of Turkey where a high incidence of both lung cancer and mesothelioma has been related to the use of tremolite for stucco and whitewash.¹¹ Other localised areas where such pleural and pulmonary disease occur are known in Central Turkey and in that part of Eastern Europe inland from the west coast of the Black Sea. The pattern of disease seems to vary from area to area. Until these situations have been fully investigated it is hard to predict the relevance of the endemic diseases to future hazards in industry. It is unfortunate that the relevant fibres may be predominantly in the submicroscopic size range and may require sophisticated, expensive equipment

for their investigation.

The results raise two groups of problems, those related to the populations in the endemic areas and those related to modern methods of mineral exploitation. The first problem is what can be done to protect the local population? Is it feasible to seal off the fibres and apply dust suppression techniques or to move the whole population to another area? As the fibrous minerals are distributed irregularly how are you to be sure the new area is safe? The second problem is to take account of the fact that fibres of various mineral origins but of potentially hazardous size and shape contaminate many minerals which are being exploited by dusty open-cast mining techniques. Are these operations safe, and are the minerals a danger to the user?

Mesothelioma has a mean latent interval from first exposure of about 40 years. As most of the natural and synthetic fibres which appear to be in the hazardous size range have not been exploited commercially until recently, human epidemiology is not likely to be a useful guide to the human hazard in the short term. Reliance will have to be placed on the results of in vivo tests in animals and in vitro tests using cell cultures to determine which fibres should be excluded from the air we breathe.

P C ELMES
MRC Pneumoconiosis Research Unit,
Llandough Hospital,
Penarth,
S Wales

References

- 1 Wagner JC, Sleggs CA, Marchand P. Diffuse mesotheliomas and asbestos exposure in the North Western Cape Province. *Br J Ind Med* 1960; 17:260-71.
- 2 Webster I. Malignancy in relation to crocidolite and amosite. In: Bogovski P (ed). *Biological effects of asbestos*. Lyon: WHO/IARC; 1973: 195-8.
- 3 Meurman LO, Kiviluoto R, Hakama M. Mortality and morbidity of employees of anthophyllite asbestos mines in Finland. In: Bogovski P (ed). *Biological effects of asbestos*. Lyon: WHO/IARC; 1973: 199-202.
- 4 McDonald AD. Malignant mesothelioma in Canada. In: *Biological effects of mineral fibres*. Lyon: WHO/IARC; 1980: in press.
- 5 Seidman S, Selikoff IJ, Hammond EC. Short-term asbestos work-exposure and long-term observation. *Ann N Y Acad Sci* 1979; 330:61-89.
- 6 Jones JSP, Pooley FD, Clark NJ *et al*. Pathology and mineral content of lungs of cases of mesothelioma in the United Kingdom in 1976. In:

- Biological effects of mineral fibres.* Lyon: WHO/IARC; 1980: in press.
- 7 McDonald AD. Mineral fibre content of the lung in mesothelial tumours. In: *Biological Effects of Mineral Fibres.* Lyon: WHO/IARC; 1980: in press.
 - 8 International Agency for Research on Cancer Monograph on the Evaluation of the Carcinogenic Risk of Chemicals to Man no 14. *Asbestos.* Lyon: TARC 1977.
 - 9 Baris YI, Sahin AA, Ozesmi M *et al.* An outbreak of pleural mesothelioma and chronic fibrosing pleurisy in the village of Karain/Ürgüp in Anatolia. *Thorax* 1978; **33**:181–92.
 - 10 Artvinli M, Baris YI. Malignant mesotheliomas in a small village in the Anatolian region of Turkey: an epidemiological study. *J Natl Cancer Inst* 1979; **63**:17–22.
 - 11 Yazicioglu S, Ilcayto R, Balci K, Sayli BS. Pleural calcification, pleural mesotheliomas and bronchial cancers caused by tremolite dust. *Thorax* 1980; **35**:564–9.