

counting obtained at different magnifications. At the low magnification shown in the upper right of Fig 4, the number of fibers and fibrils counted was only 45. However, when the magnification was increased photographically, the count increased to 59. Occasionally, even at the highest magnification, organic debris (partially digested tissue) obscures chrysotile from view.

Some fiber fields were counted by scanning and were then photographed; recounting of the fields photographed indicates that they were initially "undercounted" (Fig 5). The findings reported here are based upon scanning values, and are not corrected for photographic results; the fiber and fibril counts given, therefore, reflect minimum values.

There exists a close association of undigested tissue and chrysotile fibers and fibrils. Chrysotile fibrils occur not only next to, but in the midst of, partially digested tissue. Fibrils inside the undigested tissue tend to be thin-walled and relatively small. Clay minerals are present in the undigested tissue as well. Asbestos "counts" from photographs again demonstrated the presence of more chrysotile than could be counted directly on the screen.

Figure 6 demonstrates the close association of chrysotile with well-formed polygonal plates, morphologically similar to clay and talc minerals. This association is striking because chrysotile fibrils tend to be both "surface-" and "edge-sorbed." Sheet silicates tend to have a negative surface charge and a positive edge charge. This suggests that one of the following mechanisms is at work: (1) The chrysotile fibrils possess a range of surface properties. (2) Different sheet silicates are involved in the association. (3) Both 1 and 2. (4) The association is artifact. The morphology of the sheet silicates indicates that they may be kaolinite (Compare with kaolinite plates shown in Beutelspacher and van der Marel,⁸¹ Fig 19 to 32, pages 53 to 59; Fig 259 to 260, Page 271; Fig 238, A and B, page 252. Several of the sheet materials resemble bentonites, Fig 130, page 137, as well as labile chlorite, Fig 152 and 153, page 161). This association may be important in determining the origin of the chrysotile source. The nature of the pitted surface texture is likely artifact produced under the

electron beam (compare with naturally occurring clay minerals).

In the extracts examined, only three of 28 cases showed what appeared to be asbestos bodies on the EM level. In each of these three cases, asbestos bodies were observed with the light microscope. Figure 7 shows one of these bodies. The asbestos body is morphologically like asbestos bodies observed by Suzuki and Churg²⁵ and appears to be nucleated on chrysotile. It is a paradox that, although asbestos bodies were readily observed with the light microscope, very few were observed with the EM. The reasons may lie in the preparation technique: the water drop is drawn off the EM substrate by means of a wet filter paper; the moisture is quickly and strongly "sorbed" into the blotting material; nearly all of the larger particles are "pulled" along with the water, as evidenced by brown discoloration of the wetted filter paper. It is likely that only the smallest and most highly surface-charged particles remain attached to the substrate.

Diatom fragments, other fibrous materials including fibrous glass and amphibole asbestos types and sheet silicates were observed to be present in the lung dust residues. The occurrence of fibrous particles (other than chrysotile and currently unidentified) is relatively frequent. Diatom fragments, although occasionally observed, were rare.

Comment

Unaltered chrysotile is uncommonly found as the core fiber in asbestos bodies removed from lungs of people in the general population. In an electron microprobe study of 16 cases from which such asbestos bodies were recovered and analyzed,¹⁵ none were chemically equivalent to unchanged chrysotile. Fifteen of 16 analyses, however, were consistent with magnesium-leached chrysotile, and one was consistent with amphibole (amosite). We have similarly examined asbestos bodies from the lungs of a Canadian chrysotile miner and from hamsters injected with chrysotile, all of which gave results consistent with magnesium-leached fibers.

This could well have been predicted, in that biological environments would seem ideal for this. Indeed, with the rapid splitting of the fibers into their unit fibrils, the surface



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means of EM. lie of chrysotile material which in Suzuki and



men. Photographic stentily gave simple visual function of fast, particle gested debris. difference in