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Source and Identification of Respirable Fibers

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Fibrous bodies with an iron-containing coating have been found in the lungs of persons coming to autopsy in a number of urban hospitals, the number of fibrous bodies varying greatly with approximately 4 to 6% of the persons examined showing numerous bodies. Because these findings raise questions with regard to the possibility that asbestos is a factor in increased lung cancer, questions concerning the nature, source, and significance of these bodies are discussed in the light of research needed to find answers.

Introduction

INVESTIGATORS, during the past several years, have reported the occurrence of fibrous bodies in the lungs of persons coming to autopsy in urban hospitals. These bodies are characterized by an iron-containing structure coating the fibers and exhibit a golden yellow appearance. Although the techniques of the investigators varied somewhat, the data provide evidence that the occurrence of these bodies in the lungs of urban residents is not restricted to isolated localities and is not a chance observation.

Thomson *et al.*, 1963, reported finding fibrous bodies in the lungs in 26.4% of the autopsies in a series of examinations in Cape Town;[1] Thomson and Graves, 1965, reported 27.2% in Miami;[2] Cauna *et al.*, 1965, 41.0% in Pittsburgh;[3] Webster, 1965, 39.2% in Johannesburg;[4] Meurman, 1966, 57.6% in Finland;[5] Anjilvel and Thurlbeck, 1966, 48.0% in Montreal;[6] and Cooper and Tabershaw, 1966, 42.0% in San Francisco.[7] In these investigations the percentage of lungs having numerous fibrous bodies varied from around 4.0% to 6.0%. It is not known how many of this group may have been occupationally exposed to fibrous materials or may have lived in residences adjacent to manufacturing establishments processing fibrous materials.

In carrying out these studies, the investigators examined smears taken from lungs of persons coming to autopsy for the presence of fibrous bodies. All coated fibers that resembled the well-known golden-yellow fibrous bodies seen in the lungs of asbestos workers were termed "asbestos bodies" even though the nature of the fibers in the different studies was never identified.

A considerable difference of opinion exists concerning the identity, source, and meaning of pulmonary fibers and their associated fibrous bodies. On the premise that the fibrous bodies observed in the lungs of persons at autopsy are all "asbestos bodies" and that coated fibrous bodies are a specific reaction to asbestos fibers, some investigators have concluded that asbestos fibers are significant air contaminants and suggested that this may have an effect on community mortality patterns. Others believe that asbestos is only one of many types of fibers that produce similar fibrous bodies in the lungs.

The presence of golden-yellow fibrous bodies in the sputum and lungs of asbestos workers was first reported by Marchand, 1906,[8] and by Fahr and Feigel, 1914.[9] These bodies were studied in more detail and further described by Cooke, 1927.[10] He recommended that they be called "curious bodies" and speculated that

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TABLE I
Examples of Minerals with Fibrous-like Structure

Ortho- and Ring Silicates*
Epidote Group (epidote)
Sillimanite, Kyanite, Mullite
Chain Silicates
Pyroxene Group (diopside, hedenbergite, jadeite)
Wollastonite
Amphibole Group (anthophyllite, tremolite hornblende, riebeckite, amosite, grunerite, actinolite, crocidolite)
Sheet Silicates
Mica Group (Muscovite)
Pyrophyllite
Talc
Serpentine (chrysotile)
Clay Minerals (vermiculite)
Prehnite
Framework Silicates
Zeolite Group (natrolite scolecite thomsonite, stilbite, mordenite, ferrierite)
Non-silicates
Oxides (cassiterite, limonite, rutile)
Hydroxides (brucite)
Sulphates (gypsum, celestite, anhydrite morenosite, alums)
Carbonates (calcite, siderite, magnesite)
Phosphates (apatite, vivianite)

*Classification taken from—Deer, W. A., R. A. Howie and J. Zussman *An Introduction to the Rock Forming Minerals*. John Wiley and Sons, Inc., New York, N. Y. (1966).

FIGURE 1. Electronmicrograph showing submicron chrysotile fibers

FIGURE 2. Electronmicrographs of attapulgite particles

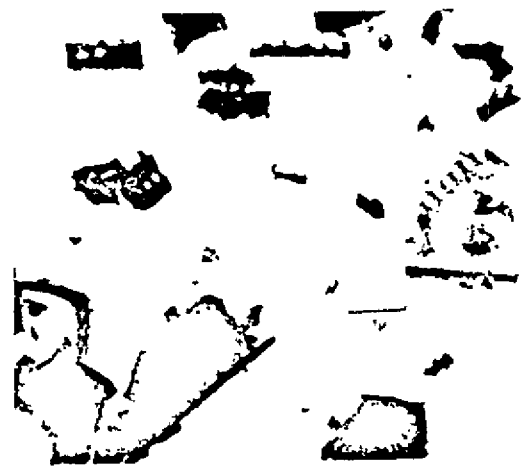

FIGURE 3. Electronmicrograph of diatomaceous earth.

FIGURE 4. Electronmicrograph of sillimanite.

any fine spicule of mineral could effect a similar response. Subsequently, coated fibrous bodies have been found in the lungs of workers in a number of non-asbestos industries.

Vorwald *et al.*, 1951,[3] and Gross *et al.*, 1966,[4] reported that fibrous minerals, other than asbestos, are capable of producing pseudo-asbestos bodies in animals. There is increasing evidence that the coating of inhaled fibers in the lungs with an iron-containing material is a general protective mechanism and, therefore, a non-specific response. The morphology of these pulmonary bodies in many instances may be very similar although different kinds are involved. Gross *et al.* recognized that such coated fibers be[illegible] asbestos bodies" [illegible] have not been specifically identi[illegible]