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Commentary

Analysis for Asbestos in Environmental Samples

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As we get into more and more analysis of environmental material, it is becoming increasingly apparent—in large part because of man's effect—that it is critical to take a look at composition as a function of size distribution of these small particles. The Duluth situation is one well known to this group, and I think it is an excellent example. It is one in which we have natural contributions of material from along the lake shore and sediments in the lake subject to the possibility of resuspension as well as various industrial and even municipal discharges into the lake. Now if you look at the size distribution as presented by Nicholson *(1)* and at the parameters other than amphiboles, you find that in the kind of material you would see at 1000 ×, whether using electron microscopy or light microscopy, you get a tremendous amount of biological material. It is clear, as pointed out by Speil *(2)*, that size fractions of materials that we are dealing with—here in terms of asbestos but also a broader range of minerals that are affected by industrial processes — are going to be very extensively skewed.

Because of the problems we are facing at the moment, and our interest as researchers, the focus has been in terms of specific minerals or specific components. This has been clear throughout the whole history of pollution research. As we begin to take a look at the environmental concentrations of materials and get a better feeling for the kinds and variety of different compositions of inorganic and organic materials, we have to do a system study. I think that was very well pointed out by Speil's comments *(2)*. The extent of Transite pipe used in the United States is such that we have a great deal of chrysotile available in water systems, both in supply and systems of waste discharge, that is clearly going to affect particle analyses in water and must be analyzed in our studies of natural water bodies.

The geologist has often considered material found in water bodies as being from natural sources aside from obvious things like beer cans and great chunks of pollutants. He has considered these to be dominantly of natural origin, but I think as we work more on environmental samples of concern to man, we are going to have to take man's variety of discharges much more closely into consideration. We will have to consider how much material we can get out of air loading in various sites as opposed to sources of water-borne material.

Along with the size distribution, then, it is clear that magnification is a very significant item. The time and the money involved in this analysis is going to be very long. At the present time, the analytical facilities available are quite limited. Most of the facilities presently engaged in analyzing material of the size that we are considering are represented at this conference. There are few people working in very fine particle materials who are not present. This is a field, then, which will be growing very rapidly. The experience factor is one that increases rapidly. We have found a variety of different people with different backgrounds doing microscopy — chemists, biologists, geologists. It

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is very apparent that in each one of those fields they have a given advantage for certain material and a tremendous disadvantage for working with material of an environmental nature. The chemist has great difficulty with biologic and mineralogic materials; frequently the mineralogist has had trouble identifying biologic materials and so it goes. There is a tremendous learning-curve problem here in the initiation of any analysis. As a consequence I think that it is becoming quite critical that there be established, on a regular basis, interlaboratory exchanges of materials so that we can compare materials.

A variety of techniques are in use. The techniques that are presently using energy input such as rubout techniques, ultrasonification, and things of that sort we believe are increasing the number of particles and fibrils. This is going to depend upon, in part, the previous stress history of the materials that you are looking at. The degree of stress may be introduced by industrial processing for instance, where material is extremely finely ground. There is a tremendous energy input in that process alone. Presumptively, material so treated will undergo fragmentation more easily with lower natural energy input.

We have a problem that will increase as we look at the combination not only of particle morphology but of the chemistry of these particles. That is the question of the significance of stoichiometry of mineral groups. This is an issue then that is going to become even more significant with small particles than with large particles, because we have significant numbers of edge effects. Bound ions of a variety of elements may begin to interfere with the intensity and the adequacy of the energy-dispersive analytical techniques that are available.

In summation then, we are really very much in the infancy of what is clearly a difficult analytical problem and it is going to take us a good deal of time to deal with it. I am personally not persuaded that we are going to gain a great deal of value from mass concentration work, for instance, if the medical significance is focussing largely on size of particle. Mass concentration by various techniques of routine analysis on size distribution of material can be reached by bulk calculation.

We do have a number of analytical problems, I think, which really require — at the outset at least — that we seek to put as much information in a quantitative form in size distribution, in chemical composition, in mineralogical composition, as possible until we get some more common agreement than we have at the moment as to what constitutes a fiber. The 3/1 aspect ratio is not accepted everywhere, clearly not by the workers with whom we have worked. Some people use 5/1, some 10/1, etc. Description of 10 million fibers to one worker means something totally different than 10 million fibers to another worker. I think that the reduction of this material to a clear quantitative form in terms of chemistry, mineralogy, and size morphology is going to be the key to a mutual understanding of exactly what the environmental concentrations and sources of these pollutants are.

REFERENCES

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2. Speil, S. Chrysotile in water. Environ. Health Perspect. **9:** 161 (1974).