Thomson had assumed that all the bodies found in his cases were caused by asbestos, but anthracosis bodies have been known for a long time from the lungs of coal miners. Gloyne, in 1949,[12] reported bodies similar to asbestos bodies in the lungs of workers exposed to graphite. This indicated that the process of body formation was not limited to asbestos, although, since the coal and graphite bodies had dark central cores, it was thought that they could not be confused with genuine asbestos bodies. In 1968, however, Gross et al[13] reported that structures indistinguishable from asbestos bodies could be formed in experimental animals by the injection of such materials as aluminum silicate needles, silicon carbide whiskers, and fine glass fiber. Because all the bodies contained iron, it was suggested that they and asbestos bodies should be given the general name of "ferruginous bodies." Since minerals of similar size range to those used in these experiments are ubiquitous, it now seems very likely that many of the bodies seen in the lungs of the normal urban population result from minerals other than asbestos.

The deposition of a coating containing iron around a variety of different mineral fibers indicates that a very general process is involved, and it is of great importance, therefore, to elucidate the biochemical conditions required for body formation. As a first step, an electron microscope study of a variety of experimentally produced ferruginous bodies was undertaken to see if all these bodies have the same ultrastructure, and whether this is exactly the same as asbestos bodies. Asbestos bodies from guinea pigs and one human had previously been examined by Davis in 1965,[14,15] and it was reported that these structures were always formed intracellularly within macrophages or giant cells. The body coating consisted of small granules approximately 60 A in diameter and it was suggested that these might be ferritin. The body coating was sometimes deposited as a single layer but could consist of a number of layers of variable thickness and density. Sometimes the outermost layer consisted of radially arranged fine filaments about 60 A in diameter, and it was suggested that these represented some form of calcium deposit. It has now been shown that the fine structure of apatite crystals is very similar to these asbestos body filaments, and it now seems likely that the outer layer of some asbestos bodies is made up of this material.

In the experimental studies of ferruginous bodies, the following minerals were used: ceramic aluminum silicate, silicon carbide whiskers, and fine glass fiber. In addition to this, a commercial preparation of elastin was also tested to check on the structural similarity between elastosis bodies[10] and other ferruginous bodies.

Materials and Methods

In the first experiments, mineral samples were injected intratracheally into hamsters as reported by Gross et al[13] in 1968. It was found, however, that although the resulting ferruginous bodies were common enough to be easily found with the light microscope, they were too dispersed to be found with the electron microscope except on rare occasions. It was known, however (Davis, unpublished data), that the intrapleural injections of asbestos dust into guinea pigs resulted in the production of large granulomas which contained many asbestos bodies after as little as two weeks. For this reason it was decided to use the intrapleural technique with other minerals. For these experiments, 25 mg of test material was suspended in 1 ml of physiological saline and injected into the right lower thoracic cavity of guinea pigs. The animals were killed between two and six weeks after injection and the resulting granulomas were divided into two segments. One was fixed in formol saline for light microscope examination and the other was fixed in buffered osmium tetroxide for electron microscope study.

The light microscope sections were stained by Perl's method for iron. This stains the coating material of the ferruginous bodies a dense blue, making them easily visible against the background of a pale, neutral red counterstain. The material for electron microscopy was embedded in epoxy resin and stained with lead citrate.

The injected materials were as follows:

1. Glass fiber, a commercial sample with an average fiber diameter of 0.05μ to 0.99μ. Initially

8005 1449

PRODUCED BY FORD