

Grade of fibrosis	Amount of fibrosis
1. Loose reticulin, no collagen	Very few nodules
2. Compact reticulin with or without collagen	Few nodules
3. Somewhat cellular but made up mostly of collagen	Moderate number of nodules
4. Wholly composed of collagen fibres and virtually acellular	Many silicotic nodules
5. Acellular, collagenous, confluent	Large areas involved

RESULTS

Macroscopic Appearances

Macroscopic examination of the lungs of the animals in the asbestos and quartz-asbestos groups showed no outstanding differences over the first 100 days. The dust distribution between the two lungs tended to be irregular, and more dust apparently entered the left lung than the right lung. Foci of dust were seen on the surface of the lungs, but no fibrotic changes could be observed.

After 100 days the lungs of the quartz-asbestos animals became firmer and also larger in size compared to the lungs of the asbestos group. Areas of fibrosis, particularly on the dorsal aspects of the left lungs, were seen while in the asbestos group the lungs remained soft with only a few minute lesions visible on the pleural surfaces.

Microscopic Appearances

The grade of fibrosis and the amount of fibrosis produced by asbestos and an asbestos-quartz admixture in the lungs of rats over a period of 220 days are given in Table III.

TABLE III. GRADE AND AMOUNT OF FIBROSIS PRODUCED BY ASBESTOS AND AN ASBESTOS-QUARTZ ADMIXTURE IN THE LUNGS OF RATS

Days of survival	Asbestos			Asbestos and Quartz		
	Grade of fibrosis	Amount of fibrosis	Total fibrosis	Grade of fibrosis	Amount of fibrosis	Total fibrosis
20	1	2	2*	1	3	3
40	1	2	2*	1	3	3
60	1	3	3*	1	4	4
80	2	4	8*	1	3	3
100	1	3	3	1	2	2
120	1	3	3	2	3	6
140	1	3	3*	2	3	6
160	2	1	2*	2	4	8
180	1	3	3*	3	3	9
200	2	2	4*	3	3	9
220	1	3	3	3	3	9*

*Indicates cases with infection.

The pathological changes caused by these two dust samples followed more or less the same pattern over the first 100 days after the intratracheal administration of the dusts. Some differences were observed concerning the cell types involved, the rate of phagocytosis of the dusts, and the sites of tissue reaction, as well as the incidence of infection. On the introduction of both dusts a typical foreign-body reaction was found. The reaction in the quartz-asbestos group was more severe and numerous mononuclear cells and leukocytes were mobilized, much more so than in the lungs of the asbestos group, where most of the asbestos particles were phagocytosed within 80 days and relatively limited cell destruction occurred compared to the asbestos-quartz group. In the latter group some asbestos and quartz particles were found lying free in the alveoli up to 100 days.

Asbestos dust alone was readily ingested by the macrophages and transported to the vicinity of the small bronchioli, where big aggregates of dust eventually accumu-

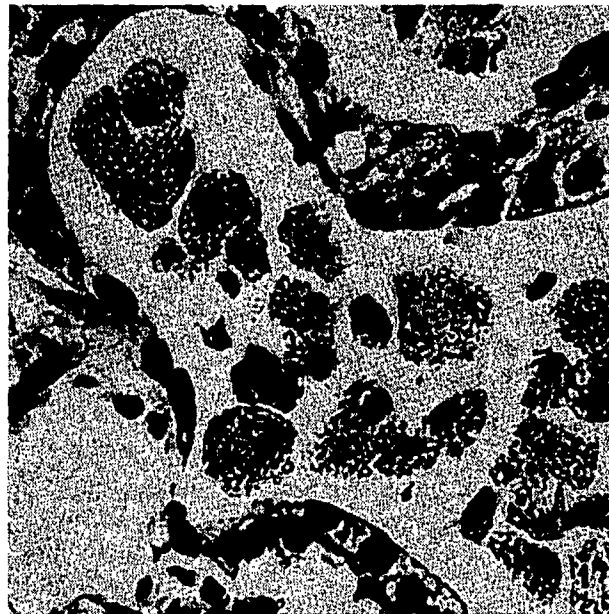


Fig. 1. Lung section showing numerous macrophages loaded with asbestos particles in the vicinity of a bronchiole, with some alveolar wall thickening, 60 days after the intratracheal injection of 50 mg. of pure asbestos dust. (H. & E. $\times 450$.)

lated. The dust lesions in the asbestos lungs were therefore primarily encountered around the bronchioli and to a lesser extent in lung areas with a relatively high concentration of dust. These lung areas were well marked by alveolar wall thickening and the accumulation of numerous macrophages and giant cells, loaded with asbestos particles (Fig. 1). The quartz-asbestos mixture, on the other hand, provoked a general and widespread tissue reaction in which the bronchioli, blood vessels and alveolar walls were involved. It appeared as if the presence of a small concentration of quartz interfered with the phagocytosis of the dust to such an extent that a diffuse fibrosis resulted.

Hyperplasia of the lymph nodes of the lung was uncommon in the asbestos group except in cases with infection. In the quartz-asbestos lungs the nodes appeared to be hyperplastic and infiltrated with fibrous tissue.

The incidence of lung infection in animals injected with pure asbestos tended to be higher than in those which received the asbestos-quartz mixture. From the histological sections it was observed that the bronchioli of several lungs injected with asbestos dust were completely blocked with mucus and infiltrated by leukocytes, macrophages, and mononuclear cells. Dust lesions in these lung areas, isolated from the respiratory tree, showed a marked increase in collagen content and progressed to grade-2 fibrosis (Fig. 2). In animals without infection the progression of the lesions was relatively slow and they reached only grade-1 fibrosis after 220 days (Fig. 3).

In the quartz-asbestos group an acute infection was