fibrosis, usually not disabling, but there may be marked disability when emphysema is advanced and fibrosis is massive and progressive.

7. Beryllium (beryllium oxide): Generalized granulomatosis. Marked disability when largely pulmonary because of interalveolar edema and fibrosis. Probably a sensitivity response and not a true pneumoconiosis. Berylliosis.

Other dusts, which are not of interest here because of not being retained in the lungs, are those that may cause chemical irritation of the upper respiratory mucous membrane, such as acids, alkalies, fluorides, chromates, cadmium, nickel carbonyl, and so forth. Many dusts inhaled into the lungs (lead, manganese, and so forth) are completely absorbed by the blood and may cause systemic poisoning. Many dusts, principally those that are organic, are purely allergens and may cause asthma and hay fever. Others, such as zinc oxide and cotton, may cause transitory chills and fever.

III. Anatomical Factors of Importance in Injury by Dust

The fate of inhaled dust in the body can be understood only by knowing something of the anatomical structures and physiological reactions involved in respiration.

The air passageway consists of the nose, pharynx, trachea, bronchi, bronchioles, and alveoli. The relationship of these various structures is shown in Figure 1.

1. Nose. The portions of the nasal cavities just within the external nares are lined with skin containing hairs. The remaining parts of the nasal cavities are lined with mucous membrane, composed on its surface of ciliated and mucus-secreting cells. This tissue is highly vascular and contains freely anastomosing venous channels. The nasal passages are connected directly with the air sinuses in the skull.

The hairs in the entrance of the nose and the mucous material secreted by the lining membrane collect many of the larger inhaled particles. The cilia of the entire respiratory tract tend to move material toward the mouth, those of the nose tending to force the mucous and particles in it toward the pharynx. The importance of the nose as a protective mechanism has been indicated by G. Lehmann.[6] This investigator studied 426 miners, of whom 241 had silicosis and 181 were normal, and found the median efficiency of nasal filtering in the silicotics to be 27.5 per cent and in the normals 45 per cent. He concluded from this that persons who develop silicosis do so, in part at least, because of a faulty filtering mechanism in the nose.

2. Pharynx. The pharynx is a common pathway for food and air, connecting the nasal passage with the oral pathway and with the trachea. Its nasal portion is lined with ciliated epithelium.

3. Larynx and trachea. The larynx lies between the pharynx and trachea. It

[6] L. E. Hamlin, *Rocky Mt. Med. J.*, **41**, 391 (June, 1944).
[6] G. Lehmann, *Arbeitsphysiol.*, **7**, 147 (1933); see also *J. Ind. Hyg.*, **17**, 37 (1935).

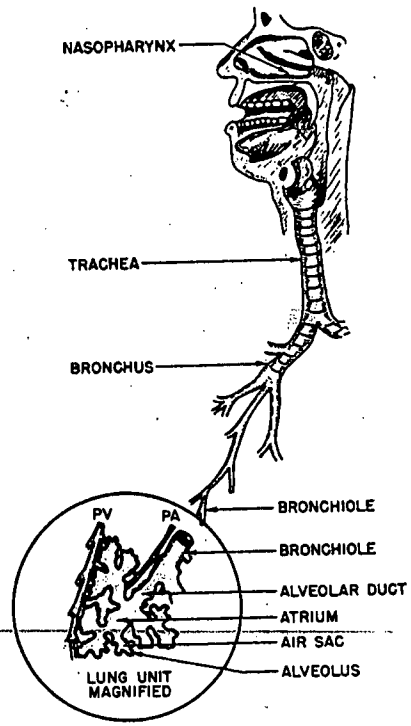

Figure 1. Diagrammatic representation of the respiratory tract.

is strengthened by strong cartilages, contains the vocal mechanism, and has at the opening to the oral passage a valvelike structure—the epiglottis—which closes the tracheal opening during swallowing to prevent food from entering the respiratory pathway. The trachea is a tube 1 to 2 cm. in diameter, strengthened by cartilage rings and, like the nasal pharynx, lined with ciliated and mucus-producing cells. The relationship of the trachea and bronchi to the lungs as a whole is shown in Figure 2.[7]

4. Bronchioles and alveoli. Macklin[8] divides the bronchial tree into two parts that may be compared to the trunk and branches of a tree. The first part, which extends from the trachea to the *terminal bronchioles* inclusive, serves simply as an air conduit, and, like the branches and twigs of a tree, has no respiratory function.

[7] J. Sabotta and J. P. McMurrich, *Atlas of Human Anatomy*, Vol. II. Stechert, New York, 1933.
[8] C. C. Macklin, *Am. Rev. Tuberc.*, **25**, 363 (1932).