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Report on

THE PULMONARY RESPONSE TO BRAKE-DRUM DUST: A PRELIMINARY INVESTIGATION

for

JOHNS-MANVILLE CORPORATION

by

Paul Gross, M. D.
Director of Research Laboratory
Industrial Hygiene Foundation

Robert T. P. deTreville, M. D.
President

1968

Three of the hamsters were killed 7 1/2 months after the injection and lung washings were obtained from these animals using a modified LaBelle and Brieger technique. The sediments from these washings were smeared upon slides which were allowed to dry and were examined microscopically unstained.

All remaining hamsters and rats were killed 12 months after the intratracheal dosage.

All lungs were distended with formalin under a pressure of 10 to 12 cm of water. Paraffin sections were cut and stained with hematoxylin and eosin. Pertinent fields on these slides were photographed after which the slides were decolorized and impregnated with silver using Gordon and Sweets technique. The same fields were then rephotographed. The coverslips were then removed and the slides subjected to microincineration for one hour at 600° C. After treatment with concentrated hydrochloric acid and washing with water, the same fields were photographed for a third time, but now under dark-field illumination. By printing through a composite negative, made by superimposing the dark-field negative upon either light-field negative, a picture is obtained that relates the mineral dust to the tissues and cells.

Longer-term Reaction

A. Seven and one-half months (hamsters)

The lungs of hamsters killed at this time are nearly normal except for widely scattered foci in which a few alveoli contain clusters of macrophages and the lining cells of their septa are excessively numerous and swollen. An occasional giant cell is also found in the air spaces.

Smears of the sediment from the lung washings show scattered asbestos bodies, many of which are segmented (Fig. 3).

B. Twelve months (rats and hamsters)

The only significant lesions found in the lungs of these animals are accumulations of dust-filled macrophages within widely scattered clusters of alveoli, associated with slightly increased arborescence of alveolar argyrophilic fibers (Figs. 4-6). In some instances, the affected alveoli can be identified as ones that were evaginating off alveolar ducts or respiratory bronchioles. No collagenization of alveolar walls or obliteration of alveolar lumens is demonstrable. Also noteworthy is the fact that in rats in spite of a six-fold greater dosage, the amount of alveolar involvement at one year is not greater than that seen at four days with only one dose of 3.5 mg of dust. A similar discrepancy is found in the lungs of hamsters, which also show a degree of pulmonary involvement at one year with a total dosage of 10.5 mg not greater than that of hamsters four days after a single injection of 3.5 mg.

dust could be ascribed to inadequate dosage. This may be true. However, from a practical point of view, it is not likely that a city dweller is apt to inhale more than an extremely small dose during a 24-hour exposure; and, as seen in these animals, there is no tendency for the lungs to accumulate, compact, and sequester the dust as is seen with certain other dusts.[14] Consequently, removal of the inhaled brake-drum dust from the lungs may be expected to be good.

Nevertheless, it is advisable to repeat this study with a larger number of animals, using also larger dosages and allowing the animals to live out their lives.

Conclusions

Brake-drum dust has evoked a pulmonary response in rats and hamsters which suggests that this dust is biologically "inert."

Brake-drum dust is capable of producing ferruginous bodies in the lungs of hamsters that are indistinguishable from asbestos bodies.

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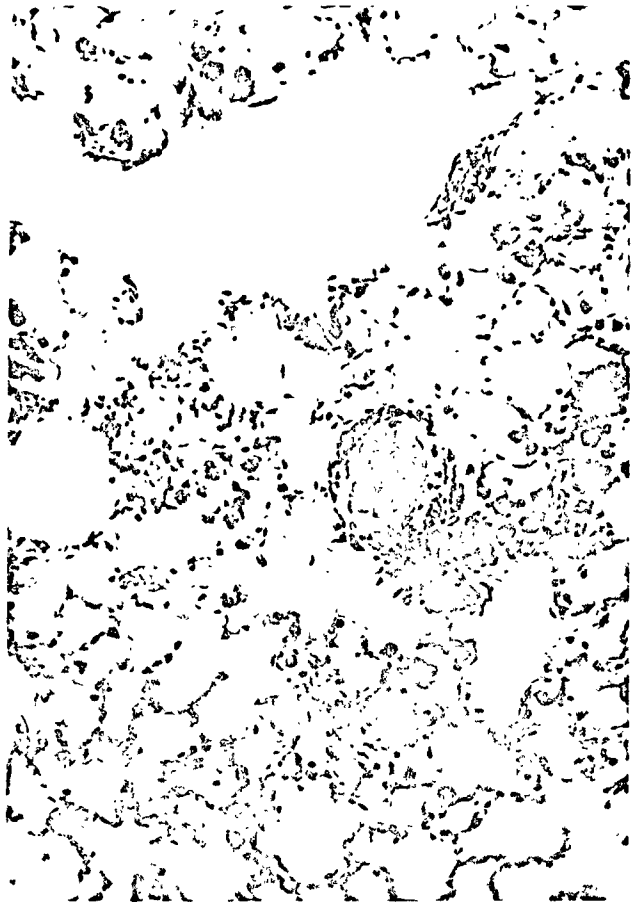


Fig. 3 Region of an alveolar duct one year after intratracheal injections of brake-drum dust. The tissue reaction at this time is not significantly different from that of Fig. 1 and still consists only of clustered macrophages. Hematoxylin and eosin. x 150



Fig. 4 The same field as in Fig. 3 but after silver impregnation, showing minimal arborescence of mural argyrophilic fibers. Gordon and Sweets. x 150



Fig. 5 Composite picture of the same field as in Fig. 3 showing that the macrophages still contain abundant mineral dust. x 150



Fig. 6 Smear of lung washings from a hamster injected intratracheally with brake-drum dust seven months previously, showing a typical segmented asbestos body. Eosin only. x1150