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Public Health Engineering

A TEXTBOOK OF THE PRINCIPLES OF ENVIRONMENTAL SANITATION

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VOLUME I

Part One The Air Contact

With a Chapter on Insects and Insect Control
by Harry D. Pratt, Scientist, U. S. Public Health Service

Part Two The Water Contact

In Collaboration with

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the sweat and consequent reduction of the osmotic pressure of the body fluids. This condition is remedied by the administration of salt.

Laundry workers are exposed to a hot moist air, a particularly unfavorable combination. Similar conditions prevail in the dye houses of textile mills. High humidity at ordinary temperature is frequently observed. This results in damp clothing and body chilling when the worker goes out into a cold air.

In cold-storage rooms, the aging rooms of breweries, and similar places, low temperatures are maintained. These conditions are more readily offset by suitable clothing, but workmen passing in and out are subject to the unfavorable effects of sudden changes. Physical labor in the saturated cold air of an icehouse causes profuse sweating, which saturates the clothing and largely reduces its insulating property.

Other characteristics of industrial conditions are the various air contaminants that are associated with many operations. These may be classified, according to their physical state and origins into dusts, fumes, smokes, mists and fogs, vapors and gases.

Dusts are particulate matter in a temporary state of suspension, due to their high degree of dispersion. Those particles capable of being inhaled range in size between 0.5 and 10 microns. As a group they cause mechanical irritation in the upper respiratory tract and may accumulate in the lungs. Soft-coal miners often show, on autopsy, completely blackened lungs.

Dusts may be chemically irritant, toxic, or abrasive. Organic dusts may excite allergic reactions; they may consist of bacteria, the spores of fungi, or other living material.*

Dusts containing silica (SiO_2), if breathed in quantity or over a period of years, produce a pathologic condition of the lungs known as *silicosis*. Silica dusts are associated with hard-rock mining, quarrying, tunneling, and stone working. They are found in the air of foundries, from the use of molding sand, and in wood-working establishments, resulting from the operation of *sanding*.

Asbestos, a magnesium silicate, is extensively mined and worked into fireproofing materials and fabrics. Its inhalation leads to another lung disease, *asbestosis*. Other silicate dusts appear to lack the peculiarly harmful effects of asbestos and of silica.

Fumes. As employed in industrial hygiene the term *fumes* refers, rather indefinitely, to metallic and metallic-oxide dusts, in an exceed-

* R. R. Sayers, *U. S. Pub. Health Service, Pub. Health Repts.*, 53, 217, 1938.

ingly fine state of suspension, as they arise from the molten metal. Fumes may also arise from other volatile substances. They are considered to be colloidal dispersions of solid materials.

MISTS AND FOGS. These differ from fumes in that they are condensed to a finely divided liquid form or have resulted from atomizing a liquid. The terms are familiar to us when water is the dispersed system.

VAPORS AND GASES. These terms have their usual connotation. We speak of the vapor of benzol, a volatile liquid at ordinary temperature, and of carbon monoxide gas, normally gaseous.

SMOKE is a colloidal system of the products of incomplete combustion. It is characterized by its optical density. It is usually accompanied by other products, irritating to the eyes, throat, and lungs; the highly toxic carbon monoxide is also likely to be found in the smoky products of incomplete combustion.

OTHER CLASSIFICATIONS. The various atmospheric impurities may be further classified, according to their effects, as irritants, or toxic, infectious, or allergic agents, or as associated with certain specific pathological effects. They are also distinguished as to the portal of entry. The three principal portals are the respiratory tract, through inhalation; the stomach, through swallowing; and the skin, through direct absorption.

PHYSIOLOGICAL STUDIES. Fortunately, for our present needs, it will be unnecessary to list either the many industrial processes involved or the specific air contaminants of each. Among the organic solvents alone, the number of different compounds employed is very large and is constantly growing. Each such material must be studied with reference to its physiological reactions when breathed or brought into contact with the skin.

This is the work of the physiologist, and a large amount of information has been gathered and tabulated concerning the specific effects and the limits of tolerance of many of the commoner substances. The better of these studies report tolerance as a time-of-exposure function; that is, a given concentration in the air may be tolerated for a stated period, in hours per day or per week, or perhaps, as in the case of silica dust in stone working, in total years of exposure.

It is unfortunate that the development of new industrial processes and the rapid introduction of new chemical substances has gone far ahead of this logical program of health protection. It too often