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Establishing Environmental Criteria

Medical Perspectives

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No reasonable person today would suggest that pollution of the environment is not a serious problem, one which demands the application of all the intelligent, scientific, and technical effort we can muster—and can afford. Physicians are aware of this. Industrialists, for the most part, are aware of it. Scientists from a number of disciplines are working diligently to define the problems and to find solutions. Unfortunately, the greatest deterrent to sound progress at present comes from those who engage in unscientific exaggerations while demanding instant results. All sorts of dire predictions are being made by all sorts of people, but those most frightening with respect to health are being made by persons who are *not* physicians.

In their importance to humanity, the possible effects of pollution on health far outweigh aspects of aesthetics or comfort. Health is the realm of physicians, and so it is important for physicians to know what substances in the environment are hazardous to health, or potentially so. A major problem is that zealots are calling some situations health hazards when they are in fact merely nuisances, because this makes the need seem more pressing and the consequences dire. Sometimes this is done out of ignorance of the significance of dose-response relationships. Beyond all others, physicians are aware of such relationships; they know that for every substance a certain dosage level is needed to produce an expected response.

Because health is the most important concern in community contamination, and because the doctor is best able to understand the physiological response to various levels of contaminants, the physician should play a more important role in public information about and community response to pollution control.

Contaminants emitted into the atmosphere arise from many sources. Some result from community operations, such as garbage disposal and incineration. Agricultural burning, fertilizing, and insect-control account for some, and still others have their origin in industrial processes or the operation of automobiles, trucks,

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buses, boats, and airplanes.

We call attention to the fact that we said "contaminants" and not "pollutants." The introduction of harmful, impure, or otherwise undesirable substances into something previously untainted constitutes *contamination*. The result may, for practical purposes, be negligible. It is only when these substances render the atmosphere or water foul or noxious to health or life that the word "pollution" is properly applicable.

This may seem to be only an exercise in semantics, but the point of emphasis is that many people have fallen into the sad practice of loose speech and fuzzy definitions in the whole area of environmental control. They cry havoc when what is really needed is merely nuisance abatement.

The fact is that the far-out claims about air pollution are, at best, frightening citizens, especially parents, and, at worst, are in a fair way to leading to panic, simply because of the lack of precise understanding of the actual health effects of contaminants in the air we breathe. In a few well-publicized acute episodes of near-disastrous magnitude, serious illness and death have resulted from polluted air. Therefore, pollution in high enough concentrations can be serious. On the other hand, it is perfectly apparent that even in the urban areas of our country the life-span and general state of health continue to improve, and so the concentrations commonly found in urban areas must be less than disastrous. Again we return to dose-response relationships. High enough concentrations can be harmful to health. Lower concentrations, even though they may offend us in terms of aesthetics or comfort, can be completely harmless to health.

Physicians know that the respiratory system is equipped with very efficient self-cleansing mechanisms, and can defend against and dispose of even abnormal amounts of foreign substances which are inhaled. One seldom hears or sees this fact referred to, however, in the talks or feature articles on air pollution. Physicians know that the body also has marvelous detoxifying mechanisms that can handle low doses of a wide variety of substances with no harmful effects, a fact the public press almost universally ignores.

It is well, too, to keep in mind that "pollution" of the air is an inherent part of the phenomena of nature. Volcanic ash has been an important pollutant, as has smoke from forest fires. Ozone in high concentrations is temporarily present in the air following lightning storms. Many others could be listed.

Man, blamed and maligned as the worst polluter, produces only about 0.5% of the total air contamination through his inventions and activities. It is true that this relatively small amount can cause serious problems because, in contrast to that from natural sources, those for which man is responsible are localized and may be concentrated.

Thus, a power-generating plant may emit several hundred tons of sulfur dioxide (SO_2) per day, and air movement across an urban area can increase the particulate loading by tenfold compared to the air of a nearby rural area.

The articles which follow will deal in greater depth with specific contaminants and their effects. We wish merely to touch on a few examples that, in our judgment, indicate the areas in which physicians have much to offer and in which the medical perspective is essential.

Of the millions of tons of material thrown into the atmosphere each year, carbon monoxide (CO), largely from transportation sources, is the major pollutant, constituting about 50% of the total loading by man. Its most serious effects, of course, are to be expected in persons with chronic heart and lung disease, but at low concentrations the effects may be manifested by visual impairment and slowed reaction time. To date, most studies of the effects of CO have employed short-term, high-concentration exposure. Future CO toxicology must be directed to physiological changes produced by low levels over long periods of time.

Other major contaminants are the oxides of nitrogen and sulfur, hydrocarbons, particulate matter, and vapors and gases. Sulfur dioxide has been depicted in the public press as the most damaging, corrosive, and irritating to humans. Actually, in high enough concentrations it can produce bronchoconstriction. We physicians would not be likely to term such effect on airway resistance as "corrosive." Careful research on humans has shown that more than 13,000μg of SO_2 per cubic meter of air is needed to produce any measurable bronchoconstriction. This can be compared with the governmental community air quality standard of 80μg of SO_2 per cubic meter of air. The physiological response to SO_2 may be enhanced in the presence of particulates, moisture, and oxidation, and is also influenced by individual susceptibility. But it is apparent that SO_2 levels in community air must reach relatively high concentrations to be deleterious to health.

Hydrocarbons constitute approximately 15% of the total contamination in the ambient atmosphere. The most important, from the standpoint of being potential photochemical pollutants, are the double-bond olefins, substituted aromatic hydrocarbons, and aldehydes and ketones.

Polycyclic aromatic hydrocarbons are universally present in the atmosphere, and much attention has been directed to some of them because of their carcinogenic potential. Thus far, experimental production of lung tumors in small animals has not been accomplished by inhalation, and the literature presents no clear-cut correlation between the effects of polynuclear aromatic hydrocarbon pollution and lung tumor production in man. Neither does present information indicate any direct health effects due to the gaseous hydrocarbons in ambient air, but "present information" is still inadequate to state unequivocally that there can be none, for instance, under extremely adverse meteorological conditions.

Of the seven oxides of nitrogen known to exist, only two of toxicological importance are present in ambient air—nitric oxide (NO) and nitrogen dioxide (NO_2). No data from either animal or human studies suggest that NO is a health hazard at

concentrations found in ambient air, but since it readily oxidizes to NO_2, it possesses potential toxicity. The toxicology of NO_2 is difficult to discuss because of the inadequacy of relevant data from human studies. An article that follows will describe the effects of NO_2 on schoolchildren in an urban area. The effects of oxides of nitrogen at levels of community air pollution at this time must be considered as potentially irritating and possibly related to chronic pulmonary fibrosis, but there is insufficient evidence of its qualitative relationship to them.

With regard to water pollution, the problems are vastly different today from those of a few decades ago when the major concern was waterborne bacteria responsible for cholera and typhoid fever. Development of effective filtration and chlorination techniques has virtually eliminated such epidemics. At present, the volume of industrial and metropolitan wastes is tremendous and includes an ever-increasing number of synthetic chemical contaminants which did not even exist a dozen years ago.

Most available data on the effects of chemicals in water supplies have come from experiences in industry. However, some information has been obtained from episodes of acute illnesses which result from the presence of some uncommon natural constituents in drinking water, or accidental contamination from spillage or seepage of some chemical.

More than 500 new chemicals are developed each year, and many of these find their way into our waterways. Such chemicals as nitrates and nitrites, arsenic and selenium, mercury, organic carcinogens, and trace-metal antagonists present real challenges to water pollution control.

Scientific data on the relative importance of heavy metal toxicity are scarce. The Food and Drug Administration admits to little knowledge regarding levels of toxicity for metals in foods. Many chemical processes, for instance, use mercury, which ultimately escapes into waste water and tends to settle in the sediment of lakes and rivers. Small organisms not only ingest the metal, they transform it into a more toxic form. Bottom-feeding fish eat the small organisms and are in turn eaten by larger game fish. Mercury becomes increasingly concentrated with each successive step. Although mercury probably has been present in high concentrations in fish for many years, and possibly has no effect on persons eating the fish, it is nevertheless a cumulative poison. It exists in food fishes as methyl mercury, which is a highly toxic substance that causes neurological damage, produces chromosomal aberrations, and has teratogenic effects. Stopping the discharge of mercury into our waterways is only one aspect of the problem; of greater concern is what to do with the mercury already lying on the river bottoms.

Recent studies raise the question as to whether drinking water which contains minute amounts of carcinogenic pollutants may, over many years, contribute directly or indirectly to cancer in man. Efforts to link organics in drinking water to cancer prevalence have so far been unsuccessful.

Of major consequence with regard to soil pollution are the pesticides. The dilemma of pesticides lies in the fact that while they do much good, they threaten a great deal of harm. They aid in increasing food and fiber production through protection from insects, rodents, and weeds, but by their poisonous nature they may also endanger human life by long-term, low-level effects.

Because of recent adverse publicity, the public seems to believe that pesticides have been spread with reckless abandon all over the landscape, contaminating all food and fiber crops and polluting the whole environment beyond reclamation. As a matter of fact, it is impossible to find anything in current popular literature that puts pesticides in a favorable light. If it can be shown that a pesticide has accumulated in animal tissue, there is no end to the allegations made against it.

For the last decade the dangers of DDT, its buildup in the environment as well as in human tissues, have been a public health issue in this country. It was almost completely banned from use in the United States by the Environmental Protection Agency (EPA) this year. However, after seven months of hearings by the EPA during which a stream of scientific witnesses testified, the hearing examiner found that there was no conclusive evidence against DDT. In fact, some of the evidence was clearly questionable. The World Health Organization has recently sought to persuade governments to recognize the fact that although DDT may have certain hazards, they should not be allowed to obscure its immense advantages. The World Health Organization feels that, in spite of the adverse publicity, there is no present justification for abandoning this valuable weapon in the fight against disease.

Physicians, especially those concerned with public health, *are* becoming more aware of the relationship of man's well-being to his environment. It is imperative that they maintain a scientific and professional approach, and calmly appraise all the facts relating to health, disease, and ecology. Scientific research is a slow, methodical process, and no amount of hysteria, government funding, or legislation will hasten resolution of the problems of physiological reactions.

This article has merely referred to some of the aspects of the various kinds of pollution, meanwhile urging physicians to become involved, albeit on a sound and professional basis. While we are all familiar with the acute episodes of serious pollution such as occurred in Donora, Pa, and the Meuse Valley—and the disaster at Minamata Bay, Japan, in which more than 100 died of mercury poisoning—we, as physicians must learn how to evaluate realistically the long-term effects of these pollutants at low levels. With this background, the medical profession can meet what we consider to be its obligation to help in development of proper criteria for environmental controls, and in maintaining the medical perspective.