THE HEALTH EFFECTS OF AIR POLLUTION AND THEIR IMPLICATIONS FOR CONTROL

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THE HEALTH EFFECTS OF AIR POLLUTION AND THEIR IMPLICATIONS FOR CONTROL*

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INTRODUCTION

Air pollution is particularly interesting, not only in and of itself, but because it is the prototype of problems to come.

It is the prototype because it is intimately linked with the texture, problems, and activity of modern urban life. Where previously we sought the health effects of air pollution by attempting to pin them to the effects of individual pollutants acting separately, we are coming to realize that in a problem of this sort there is no one villain that can be pinpointed, discovered, eliminated, and the problem solved.

We are no longer as much in search of one substance in the atmosphere to account for the health effects of air pollution as we are in search of an understanding of the complex chemistry occurring in our dynamic atmosphere and the results of that chemistry on our health. But simultaneously we have become aware that we are no longer seeking one disease for which air pollution is solely responsible. Rather, there are numerous diseases in part caused by infection, by allergy, by cigarette smoking, by hereditary predisposition, by aging, to which air pollution may be only an added insult in the final outcome—a chain of events initiated by our birth, furthered by our habits, and inexorably linked to the design of our industrial society. The luxury of previous public health research—looking for one cause, one disease—is finally lost to us. And, I believe, with that loss we are ready to progress further in understanding the unquestioned health effects of air pollution and how to control it.

The legal basis for the control of air pollution has progressed from nuisance law to the statutory regulation of specific substances as the sophistication of the sciences involved progressed. But if the multifactorial nature of the problem has stymied the previous research approach, it may stymie legislation based on that research; where simplistic research approaches have failed, so too may simplistic legal remedies. The statutory control of air pollution by pursuing air pollutants one by one as evidence accumulates seems clearly inadequate to a technology producing new pollutants or sources of pollution at an almost geometric rate. Progress in control may require a return to nuisance law, perhaps more broadly based and sophisticated than formerly but still effective in achieving needed abatement.

As a basis for understanding the health effects of air pollution, ensuing sections

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of this article deal with the nature of the research problem as well as the lines of evidence that have accumulated.

To maintain a manageable size I have confined myself primarily to air pollution as it occurs in the industrial atmospheres and is typified by the sulfur oxides. This is not to minimize the great importance of the other pollutants and the automobile, but I believe the conclusions that arise from a consideration of one type are applicable to the others.

I

NATURE OF THE PROBLEM

At the outset, let us review the nature of the biological research problem that is posed by air pollution. As John Goldsmith[1] clearly stated several years ago, this is a problem in toxicology, determining for man in his natural setting (now increasingly urban) the relationship between the dose of the noxious agent in the atmosphere and the biological response in man. Classically the toxicologist works in the laboratory and is able to present the dose of the pure toxic agent over such a wide range that he is assured of going from no effect to the most severe effects and can reliably assess the noxious capability of the substance in question. But in air pollution studies that occur in the natural setting, almost none of the ideals of the toxicology experiment are met; conversely, in laboratory studies of the effects of pollutants on man or animals, almost none of the realities of the urban setting are approximated.

What complicates these studies? For simplicity the examples that follow are based primarily on sulfur dioxide, but the problems are almost the same for all the common pollutants.

First, the dose, the sulfur dioxide, except under the most bizarre and rare circumstances, is present in the urban atmosphere in very low concentrations and over a very narrow range. The peaks are rarely ten times the daily averages. The peaks themselves are usually not above one part per million (ppm). One ppm is about the bottom of the range frequently used in the laboratory. The highest levels to which populations are exposed, therefore, are so low that they are seldom used in the laboratory. New York City levels average around 0.15 ppm.[2]

Second, sulfur dioxide does not exist alone in the atmosphere. When it is present, almost invariably, numerous other substances which may or may not have an effect on man are also present. Because of atmospheric conditions, concentrations of the other substances will be increased at the same time as the sulfur compounds are increased. It is difficult, therefore, for the scientist to know whether an effect he has observed was caused by the sulfur compounds, or by the other materials present—

[1] Personal communication from John Goldsmith, 1961.

[2] J.R. McCarroll & E.J. Cassell, unpublished data, Christodora Monitoring Station, New York City, 1962-65.