

occupational and general importance. The further pursuit of studies of this type may result in the evolution of general concepts applicable to the identification of susceptible individuals and protection of such individuals. The immuno-chemistry of gaseous agents should also be more extensively studied.

Our present ability to detect changes in man may not be adequately sensitive. Either the methodology is too insensitive, the experimental design is not good, or the wrong responses are being investigated. New responses, and/or more sensitive detection methodology, appear to be promising avenues. Improved methods of odor detection and discrimination, of measuring eye irritation response, visual acuity definition, and central nervous system response hopefully will provide new estimates of threshold values for human criteria.

An increasingly important need in the realm of health effects is more adequate evaluation of the contribution of air pollution to accidents. For example, reduced visibility, eye irritation, increased carboxyhemoglobin (with attendant impairment of operating performance), and contribution to stress status, are readily itemized as potential dangers to air and ground traffic.

More thorough evaluation of the potential effects of pollutants upon the eye and upper respiratory tract, both alone and in the presence of infectious agents, is desirable. Considerable losses in manpower due to absenteeism have been correlated to air pollution exposures, but the specific contribution of air pollution has not been clarified.

As this partial list of some of our needs for research into the health effects of air pollution indicates, Mr. Chairman, our knowledge is far from perfect. And since our knowledge is imperfect, there has been some reluctance on the part of the scientific community to develop air quality standards. It seems to me, Mr. Chairman, that we should get on with the job. Our knowledge of the effects of air pollution will in all likelihood never be perfect, and for that matter air quality standards will in all likelihood never be established purely on the basis of scientific knowledge. The health threshold for human exposure to radioactive substances is zero. Yet few of us would take the purist view that the use of X-rays for medical purposes should be banned and that atomic energy plants should not be built. To eliminate traffic fatalities completely we would need to eliminate motor vehicles completely. Yet few of us would see the automobile destroyed. If we are to apply the rational approach to air pollution control, we must achieve a consensus on what "clean air" should be, and we will achieve that consensus only by considering the relevant factors of environment—social, political, and economic, as well as scientific.

As you know, Mr. Chairman, in the Clean Air Act the Congress recognized the need for yardsticks of air quality, calling upon the Secretary to publish criteria reflecting the latest scientific knowledge of the predictable effects of various pollutants in the atmosphere. This Department has prepared in preliminary form criteria for two principal classes of pollutants, the sulfur oxides and the photochemical oxidants, and is working on criteria for two other classes, the nitrogen oxides and carbon monoxide. It is hoped that these criteria will assist the States and local governments in establishing air quality standards.

The second problem we must solve if we are to apply the rational approach to air pollution control is technical. We do not have today fully developed methods of bridging the gap between air quality standards and source emission standards. Our methods are particularly deficient for that very situation in which air pollution is most critical—the multiple source of urban situation. For suspended particulate matter we can approximate the transition using emission inventory techniques. The particulate matter omitted from each source in an area can be estimated, and from a comparison between the overall estimate and the air quality standard a percentage reduction can be calculated. For some gases and fine particles computer programs have been written to accommodate a large number of sources of different categories, to take into account varying times of maximum emissions, and to take into account varying meteorological conditions. However, these programs require a wealth of data, and they have not been developed to the point where they will accommodate reactions between pollutants after they leave the source, such as the reactions which result in photochemical smog, and they will not accommodate particulate matter that falls out, or nuisances, such as odors, which usually emanate from a single source.

Mr. Chairman, this concludes my review of the adequacy of the present technology for controlling air pollution. I would like finally to briefly describe for you some of the forms and the extent of Federal Government efforts to advance that technology.