Health Implications of Air Pollution

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The origins of the problem of smoke pollution date back far beyond the modern industrial era. No one is better acquainted with this fact than the Smoke Prevention Association of America. Although the problem itself is an old one, the health implications have been the object of much scientific and lay concern throughout the country in the past year. Because of the concentrated attention that has been focused on the health aspect lately, I shall confine my remarks to this particular phase of the problem.

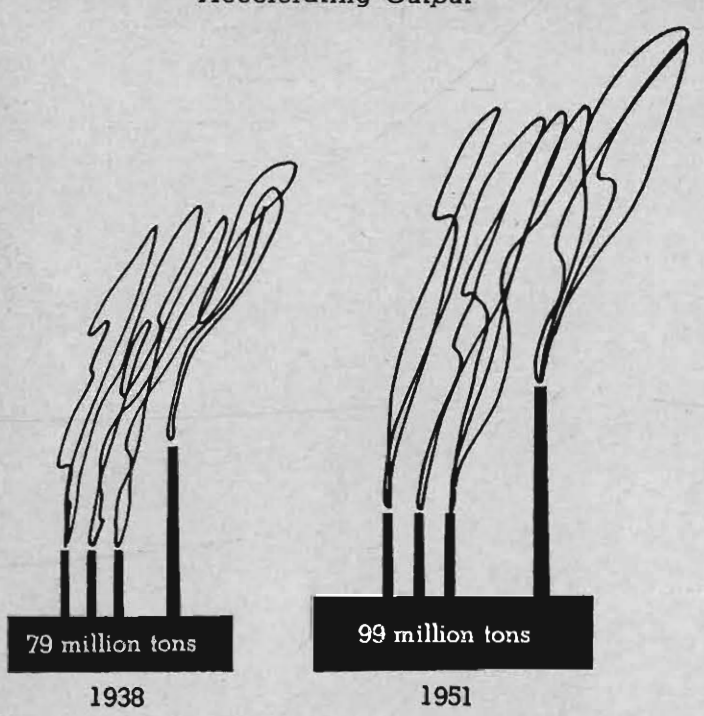
Despite early concern with air pollution, it is only recently that we have been forced to realize that there were health implications inherent in the problem. Even our understanding of the nature of air pollution has antedated this realization by less than a score of years. For it has been only within the last two decades that we were able to put the problem under a microscope, so to speak, and to analyze its component parts. Today we know that air pollution embodies more than the smoke aspect which was recognized first. We know that we must also consider the dusts, fumes, vapors, mists and other contaminants that are emitted from industrial plants. We have found that the latter, by far, make up the more complicated phase of the problem, because they do not lend themselves to a uniform solution.

The control of smoke is well understood. Smoke abatement measures are based generally on the use of only nonvolatile or low volatile fuels, or on the use of specially constructed furnaces which assure complete combustion. But they do not solve the whole pollution problem. To rid the atmosphere of the contaminants spewed into it by countless industrial operations calls for numerous and varied methods. The smelters of zinc plants alone emit such particulate matter as zinc, lead, cadmium, sulfur and chlorine, as well as gaseous substances like sulfur dioxide, carbon monoxide and carbon dioxide. When you consider the vast number of industries using raw materials and intermediate products which produce an ever greater number of contaminants, as well as the millions of homes and transportation vehicles which contribute to air pollution, you cannot escape realization of the magnitude of the problem.

Unless we take prompt action we may expect an intensification of this problem through our constantly-accelerating production. The steel industry, for instance, expects to produce in 1951 almost 99 million net tons of ingots, an increase of almost 20 million tons over 1938 production. To produce that much steel means that every minute an estimated 250 tons of iron ore and 203 tons of coal will be used.

As we undergo the tremendous growth in a variety of industrial activity in the next half century—as presaged by the increasing use of ionizing radiation, the development of plastics and a host of other synthetic products and processes, and the attempt to harness atomic energy for peaceful pursuits—it is imperative that we take proper precautions to control the resulting pollutants lest we become victims of our growth.

Even our expected increase in population presents a difficulty for people, as well as contaminants and certain meteorologic conditions, are factors of the air pollution problem. The congestion of population and concentration of industries are reflected in voluminous literature describing the economic and nuisance effects of air pollution. In addition to these considerations has come the awareness—and whether or not it is justified in every instance remains to be proven—that air pollution is affecting the people's sense of well-being; the realization that it transcends the nuisance stage and has more than economic and esthetic implications.



Extent of Present Knowledge

Much speculation has been voiced over the effects of air pollution on the course of tuberculosis, its deleterious effects in shutting out the germicidal rays of the sun, and other theories. You may remember that in his paper *Health Aspects of Air Pollution* presented at your 42nd annual conference, Dr. A. J. Lanza told of loose claims that atmospheric pollution has an effect upon the incidence of respiratory cancer. He pointed out that there is not enough evidence to substantiate these conclusions. Dr. Lanza, in the course of his talk, made a plea for a "considered and intelligent viewpoint in the matter of atmospheric pollution", and I want to try to achieve just that. Let us leave conjecture aside for the moment to review some hard, cold facts.

The first major piece of evidence of the health implications of air pollution came in 1930 when the Meuse Valley in Belgium was blanketed by a heavy smog and 60 persons lost their lives. Prolonged stable weather conditions had bottled up the contaminants in the valley for about four days and the chemical concentrations kept building up until they had reached fatal proportions.

We were to encounter similar meteorologic conditions 18 years later, in October 1948, in Donora Pennsylvania, where almost 6,000 persons were affected, 20 of them fatally. In both instances the affected communities, lying in bowl-shaped valleys where contaminants could be confined easily, experienced a meteorological phenomenon known as an inversion. At such times the temperature of the air at ground level is less than that of the air above it whereas normally the reverse is true. This stable condition minimizes the vertical mixing of the air that normally takes place and the absence of strong wind currents keeps horizontal dispersion at a minimum. In Donora these conditions lasted four and one-half days. Had they lasted only a few hours or a day or so the results, of course, would have been different, for short periods of smog are not uncommon and present no danger of wholesale sickness or death. It is the prolonged smog that may have a disastrous aftermath.

Although the term "smog" originally meant a combination of smoke and fog, its connotation now includes all kinds of fumes, gases and other emissions, in addition to particulate matter. The duration of a smog, as we have seen, is dependent on meteorological conditions. Ordinarily a wind or cleansing rain will come to sweep away the contaminants before they reach dangerous concentrations, but we have sufficient reason now to believe that the weather can be a bad actor and common sense dictates that we be ready for any such eventuality.

Aside from these dramatic acute episodes, we find in various areas periodically recurring smogs with disagreeable effects. In Los Angeles, for instance, about ten to twenty times a year smogs cause severe lachrymation as well as irritation of the nasal passages of the residents. The Los Angeles situation, by the way, affords one of the best examples of the distinction between smoke and industrial emissions in the etiology of air pollution. The City of Los Angeles burns oil and gas—there is no smoke problem as such—yet it has a terribly real air pollution problem.

More serious effects of contaminants on health may be illustrated by findings of investigations of the plant working environment, which can be more closely controlled than those of the general atmosphere. Lung disease has been shown to result among employees exposed to beryllium compounds. In some areas it has been alleged that even people living near beryllium plants have been affected. Investigations have also pointed up the occurrence of pneumonia in manganese plant areas.

To give you more details on the health implications of air pollution I'd like to be a little more specific about what we found in the Donora study. That was an investigation with which our whole division was intimately concerned for one year and I can speak on it from personal observation. I know that Dr. Helmuth Schrenk, who was in charge of the investigation, spoke at your last meeting about the methods and procedures used in this study. But I should like to tell you about some of the findings which were as yet unpublished when Dr. Schrenk spoke. The salient points in the biological data that I believe would be of most interest to you are the incidence and severity of illness during the smog, the main clinical manifestation and the significant relationships between the affection and other factors.

The illness graph showed that 43 % of the population were affected, ranging from slight to extremely severe, with 20 fatalities. The affection was essentially an irritation of the respiratory tract and other exposed mucous membranes. Particularly noteworthy was the direct relationship of both incidence and severity with increasing age. This observation has much meaning for us because of our increasing interest in geriatrics and our concern with any influences to which the elderly may be particularly susceptible. We were also searching for indications of pre-existing ailments; so we considered it highly significant that the fatalities had previous cardiorespiratory diseases.

Unanswered Questions

Although we are encouraged that these findings present a substantial body of data, we cannot but discern that they cast a long shadow of unanswered questions. The mass of data that we accumulated has succeeded in emphasizing just how few are the conclusions that can be drawn. We have now verified the acute health effects of air pollution, it is true, but no light has yet been shed on the long-range effects. We know the effects of acute exposure to concentrated contaminants under unusual meteorologic conditions but we must learn how the people's health is affected by continuous exposure to the usual concentrations under normal weather conditions, year in and year out.

In addition to determining the chronic effects on healthy people we must make a special study of the influence of air pollution on cardiacs, asthmatics and people with other respiratory diseases. As yet it is unknown whether air pollution only aggravates, or also causes the onset of respiratory diseases. Also, to what extent does damage to the respiratory system affect the cardiovascular system? We must get that answer, too. We must further ascertain the possible special effects of air pollution on children and on the elderly. Does the loss of sunlight lessen a child's resistance to disease? And, as I mentioned before, what about the aged? Science's conquest of the communicable diseases has enabled people to live to more advanced years. Now that their life span has been increased we must consider the effects of air pollution on this group and ensure that it is not a contributing factor to shortening their lives.

As one step toward answering all these questions, basic research is requisite to determine what concentrations of substances are necessary to produce either acute or chronic effects. We must also learn whether the air contaminants from industry—gases, fumes and particulate matter—always act singly on human beings, or act in combination, or act on each other to produce an agent which is more poisonous than any of the single substances or than the total acting in combination.

At present, values known as maximum allowable concentrations have been established for industrial environments where normal persons, excluding children and the aged, are exposed to in-plant contamination for eight hours a day. As yet we do not have comparable information for contaminants in the outside atmosphere affecting individuals of all ages and in all physiological and pathological conditions over a 24-hour-a-day period.

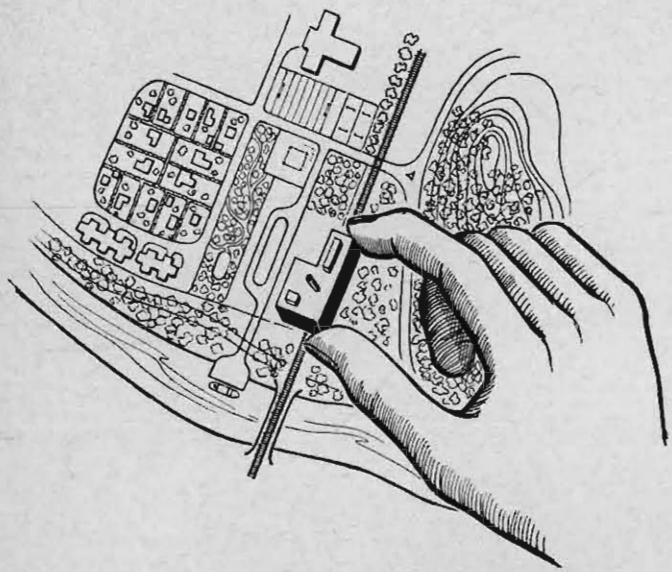
Knowing our present limitations we must, therefore, be wary in pushing for air pollution ordinances. The smoke abatement regulations in force in many cities are good as far as they go, but we should not develop legal standards for the control of other emissions until a more thorough study of the problem has been made.

As a result of the heightened interest in air pollution, numerous bills, ranging in scope and severity, have already been introduced in state legislatures throughout the country. Some states are feeling their way very carefully, first studying the problem. South Carolina, for instance, has authorized the creation of a committee to make a full and complete study of the needs and means for regulating and controlling smoke, soot, smog and other similar public nuisances in the state and to report back to the legislature on the results of the study, together with recommendations, within a specified period of time, On the other hand, some states are promoting full-scale air pollution prevention and abatement programs, some of which may be too rigorous. The bill proposed in New Jersey, for example, has so many restrictive provisions that industry has felt impelled to fight it. Such stringent measures are completely unrealistic in the face of the little actual knowledge available to date. Legislative concern is good, but we must move easily in the field of regulations.

However, that does not mean that industry has reason to delay in acting to correct the present situation. Even in the absence of clinical data, we can control the pollution to an effective degree by using proven industrial hygiene techniques. If we had waited all these years for clinical evidences of damage before instituting measures for the control of hazards in the working environment, industrial hygiene would still be in a primitive stage. Some occupational diseases have been known to run a course of as much as ten and more years before the worker recognizes, through subjective symptoms, that something is wrong and presents himself for diagnosis and treatment Fortunately we did not wait. We merely instituted the most practical engineering controls possible. Even though experience may later have proved that all these prophylactic actions were not clinically necessary, as long as they were feasible we went ahead with them.

Thus, the methods for the control of air pollution are already at hand. We are not in totally unexplored territory. Where the big challenge comes in, however, is to find *cheaper* methods of control. That is the challenging task confronting the engineer. Although workable in most instances, current methods of control

sometimes are either inadequate or too costly to perform the job of trapping contaminants. To illustrate the economic impracticality encountered at times, it is conceivable that a small plant with a capital investment of $50,000 would be required by a too-stringent law to spend more than its total assets to reduce atmospheric pollution with techniques in current use. Obviously, under such circumstances, a company would be forced to close its doors.



In the absence of suitable controls, plants may be required to move outside the city limits. This solution of course, leaves much to be desired for general application. It might be the answer in limited instances if there were stricter and better city planning and if industrial zones were established in areas where the factor of air pollution has been given serious consideration. Until we have rigid zoning, however, a company moving to an isolated location cannot assume that it has carte blanche to pollute the atmosphere and that it therefore need not install proper control measures. All too frequently it has been demonstrated that people move in and build around a plant. Then, regardless of the fact that the company was the first to move to that site, it is forced to take corrective steps by the pressure of public opinion. The wiser course of action by far would be to use the proverbial ounce of prevention and install proper safeguards at the outset. In a true exercise of foresight in selecting a site for new operations, industry should also give due consideration to the meteorologic conditions of a location as well as to transportation costs, availability of raw materials, personnel and other factors.

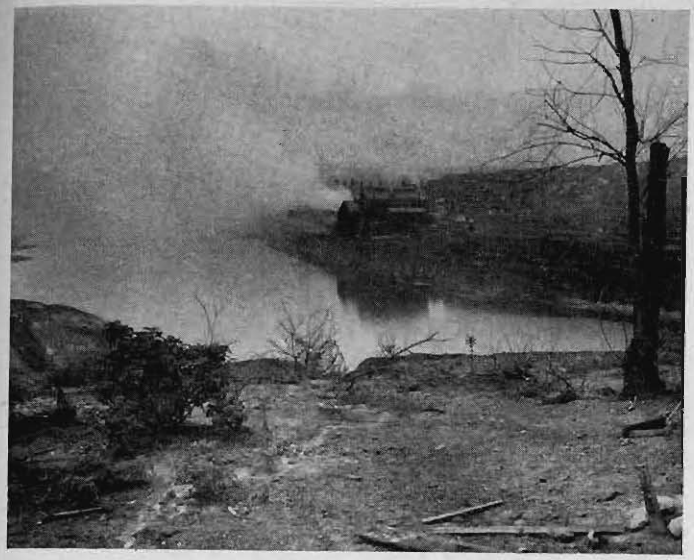
What CAN Be Done Now

By using available scientific techniques and apparatus, industry, the home and transportation and other sources of contamination can reduce their air pollution load despite the gaps in existing knowledge in this field. As you know from your own endeavors, progress is sometimes slow. Before the solution to a complex problem is seen in its entirety there is interim work on the phases that have been unravelled. So too with air pollution we can wrestle with the problem using the knowledge that we have at hand while at the same time we explore the unknown.

Let us see just what we have now in the way of tools to cope with this problem. Air contamination can be readily evaluated by a combination of air sampling with specifically designed scientific equipment and subsequent laboratory analyses. This procedure is followed on a quantitative scale, enabling determination as to the concentrations of contaminants that may be present. The Donora study employed these techniques and they will also be used in other surveys. As a result of the increasing interest in air pollution, new scientific methods and instruments are constantly being evolved. For instance, the Thomas recorder has been developed for the continuous determination of sulfur compounds in the atmosphere. The electron microscope has facilitated the identification and classification of particulate matter. In process of development are recording instruments to determine the halogens and the chlorinated hydrocarbons in the atmosphere. In the laboratory special equipment has been set up to indicate the reduction of ultra-violet rays and total sunlight when minute amounts of various contaminants are present in the atmosphere. Exposure chambers are now being employed to determine the effects on human beings of exposure to various concentrations of contaminants.

On the control side, I have already mentioned the smoke ordinances which are a sound basic step in the control of the smoke component of air pollution. Over and beyond these, as we have seen, emphasis must be placed on the need to control industrial emissions which do not lend themselves to that type of regulation. Here, too, various control techniques may be used effectively. The principle of dilution, using high stacks, some of which tower over 500 feet, may be employed. Or the answer may lie in conversion—as, for example, the complete combustion of gases to combat objectionable odors—or in collection. The latter technique utilizes a variety of principles and apparatus such as ultrasonics, electrostatic precipitators, steam precipitators, scrubbers, mechanical filters, centrifugal separators and gravity chambers. This variety of available measures ensures that, by and large, industrial emissions can be controlled although better tools may have to be developed in certain instances.

To elaborate on this point I should like to refer back to our Donora study. In complying with our recommendations the zinc plant, one of the chief contributors to the pollution load in the Donora area, has already gone forward in the control of the operations mainly responsible for contaminating the atmosphere. Furthermore, in order to be alerted to any impending adverse



weather conditions in time to take further precautions, the company has installed a teletype machine to receive daily U.S. Weather Bureau reports. All these actions will help to ensure that there is no repetition of the Donora crisis.

What Lies Ahead

The developments that I have traced for you thus far are also an intimation of what we may expect in the future. For, with the problem of air pollution, the present is not only prologue but also part and parcel of what lies ahead. The action which we are initiating or continuing now will be carried on in the future with what we hope will be increasing effectiveness. There is a compelling urgency for such activity for recent events have proven that air pollution is not a theory that can be shelved for a later, less busy day.

Since the intensive year-long investigation at Donora, the Public Health Service has been assisting the states on a consultative basis. We expect that additional funds will be made available to us so that we may move forward in air pollution studies which we are planning, as well as extend greater aid to the states with their problems. This activity, I should like to reiterate, will be in addition to, and of a different nature than, current smoke abatement efforts which must be continued.

Industrial hygienists in state and local official agencies are being informed of our work and in increasing numbers they are beginning to concern themselves with air pollution. These personnel are the best qualified to assume this responsibility because control of a'mospheric contaminants is only one step removed from their traditional function of controlling the working environment. By virtue of their position in health departments they are also able to bring all the state's health resources to bear on this problem.

While official agencies are engaged in these studies, industry must work on similar projects simultaneously. There is an obligat on upon all industry to conduct diligent research into the status of its own problem. Each industry should study thoroughly its particular operations to determine what processes emit pollutants into the air, as well as the nature and quantity of the contaminants. On this groundwork of data, industry can then base its research efforts to control the degree of pollution

I realize, of course, that many plants embarked on such projects years ago and they are to be highly commended. Others, however, are hiding behind the skirts of the excuse that air pollution is either too vague or too overwhelming a problem.

Just as we have been shocked out of our apathy by the sad pollution of our waterways when that reached such alarming proportions, so too we must realize that the time has come that we can no longer spew contaminants into the air as a catch-all dilutant. With increased industrialization we cannot afford to be careless. We have already had one tragic example of what may happen when the weather goes bad on us. Additional research may also well discover insidious effects of every-day exposure to contaminants which may exact a toll on our vitality and well-being. Although we do not yet know the extent of the problem we have been dealt a sufficient body blow to recognize the danger.

The responsibility for the control of air pollution rests in a large part with engineers and the public will lean heavily on their efforts. I can think of no other problem confronting the engineering profession that demands more ingenuity or the taxing of all its resources, or which is fraught with more responsibility than the health of our people.

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