Governmental Responsibilities in Environmental Health

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AS I was having lunch in a hospital a couple of weeks ago, my eyes began to water and burn. The presumptive diagnosis was smog. I was in Los Angeles, a city of 6 million people and 3 million automobiles.

In this instance, I was being exposed to an environmental health hazard which produced an immediate, subjective symptom. For the many other environmental pollutants and conditions to which I was exposed on the same day, and to which all of us are exposed on every day of our lives, no such convenient, though uncomfortable, indicators exist. These, of course, include other chemicals present in air and in our water supplies, the additives in our food, the tensions, strains, noise, and vibrations characteristic of our urbanized and industrialized Nation, and the ionizing radiations which bombard us from both manmade and natural sources.

As we prepare to meet these new challenges, we in the health professions find ourselves entering into many new alliances. We discuss ionizing radiations with nuclear physicists, air pollution with meteorologists, and water pollution with chemical engineers and aquatic biologists. These things seem far removed from the medical curriculums which many of us studied 20 or 30 years ago. Yet they are fundamental to the health of the American people in the coming years.

Dr. Burney, Surgeon General of the Public Health Service from 1956 to 1961, delivered this address at the annual meeting of the American Institute of Chemical Engineers held in Washington, D.C., December 7, 1960.

Accompanying this diversification of the health sciences has been a progressive complication of economic, social, and political patterns within which we carry on our work. Thus, while we are exploring new sciences on the one hand, we are also seeking to develop new modes of cooperation and interaction in the administrative and governmental fields.

Clearly, all levels of government must be deeply involved if we are to create and maintain a safe and healthful environment. Because both the causes and the effects of the new health challenges are nationwide in scope, the Federal Government has a vitally important role. There are equally cogent reasons for acceptance of responsibilities by State governments, by metropolitan agencies, and by strictly local units. Related responsibilities should logically be borne by nongovernmental organizations.

Generally speaking, prior to World War II, environmental health was viewed in terms of microbiological problems. The public health concern with water pollution related to biological contaminants. Community air pollution was localized, and control, for the most part, was smoke abatement and soot removal.

However, the war-spawned upsurge in scientific advancement and the postwar pattern of accelerating technology and population behavior have broadened considerably the public health base of environmental health. Biological contaminants in the environment are still a major factor. But now the complex chemical contaminants, their behavioral patterns in air and water and their composite and synergistic effects, need special attention. The

unprecedented speed with which we are developing and using new substances and new materials has outdistanced our ability to determine and control their composite impacts on public health and well-being.

We need to keep in mind the predicted metropolitan-industrial growth factors. Currently 100 million people, 150 percent more than in 1940, depend on surface streams for drinking water. By 1980 this figure will be 165 million. In 1970, three out of four people in the United States will be breathing the air over only 10 percent of the total land area.

Obvious questions are: At what point on this fantastic growth curve will we be in serious trouble? And just what will be the nature and extent of that trouble?

In seeking answers to these questions, the Public Health Service and other agencies have established programs designed to explore the medical and biological impact of various contaminants and to monitor public exposure to these hazards. The following discussion on chemical contaminants in water and air is a report of the Public Health Service's national monitoring networks on water and air.

Challenge of Chemical Contaminants

Our drinking water nowadays contains an assortment of organic chemicals, many of them of industrial origin. The kinds and amounts of chemicals added to food are usually known, and suitable controls to protect health can be established. Yet water contains additives of unknown composition and in unknown concentrations. None of these additives improve the water, many of them damage its quality, and some may harm the consumer.

Concentrations of synthetic organics in water are low, usually ranging from 20 to 500 micrograms per liter. Nevertheless, even 1 microgram per liter of some chemicals causes difficulty. Chlorophenol causes taste in water, and endrin, a chlorinated insecticide, kills fish at this level.

One chloroform extract recently recovered from a river, and from the drinking water of a city using the river as a supply, has shown the presence of naphthalene, diphenyl ether, styrene, acetonitrile, ethylbenzene, tetralin, and chloroethyl ether. In another instance a toxic type of chemical was found in the Mississippi River from St. Louis to New Orleans, a distance of 1,000 miles.

Water consumers in some locations receive these mixed chemicals in amounts from a few micrograms to 1 or 2 milligrams per day. Whether a constant dosage of mixed organic chemicals occurring in drinking water can be harmful to humans is not known; the types of chemicals which have been recovered make it evident that we should find out.

Turning to the air pollution field, chemicals from chemical and metallurgical industrial sources contribute a large variety and tonnage of pollutants to the atmosphere as well as to water. However, the combustion of fuels contributes still greater variety and tonnage. Flames in furnaces and open fires and explosions in internal combustion engine cylinders synthesize many larger and more complex molecules than in the parent fuels, and fix atmospheric nitrogen. These reactions continue in the open atmosphere. These larger molecules result in the eye-irritating, plant-damaging, visibility-reducing smog of cities. A forecast of future energy usage shows large increases in consumption of coal, gas, and petroleum during the next 20 years, despite the advent of nuclear power.

The National Air Sampling Network monitors these airborne chemicals in 250 cities and nonurban sites, analyzing samples for 30 specific inorganic substances, and producing several organic fractions (aromatic, aliphatic, oxygenated-neutral) from which a number of organic substances have been isolated. These organic fractions are being tested in experimental animal colonies at the National Cancer Institute and at the University of Southern California for tumor production. To date about 20,000 samples have been obtained and more than 100,000 chemical analyses made.

One of the more than 30 substances found in community air, which the Public Health Service is analyzing, is benzo(a)pyrene, also known as 3-4 benzpyrene, a representative of a larger class of polynuclear hydrocarbons which are presumed to have significance in the causation of cancer. According to our surveys, a person breathing nonurban air would inhale

approximately 1 microgram of benzo(a)pyrene per year. The smoke from one pack of cigarettes per day would contribute about 60 micrograms per year. But a person inhaling the air in some cities would take in from 110 to 150 micrograms of benzo(a)pyrene per year.

The chemical findings reported here offer a supreme challenge to the public health physician. Our problem is one of chronic exposure—lifelong, 24 hours a day. Lead, for example, is present in our food, air, water, and tobacco, coming from such sources as agricultural sprays and automobile exhausts. The source of such a cumulative poison is less important than total exposure. Does our increasing use of tetraethyl lead in gasoline present a hazard, upsetting a delicate balance presently assumed to have a margin of safety? Or, examine sulfur dioxide, perhaps the commonest air pollutant. Apparently not cumulative, as is lead, its action appears to be one of repeated insult and irritation which may increase susceptibility and enhance the action of toxic agents. Do detergents in water act in toxic fashion, or do they increase cell permeability to aid the introduction of more injurious substances?

What about carcinogens in water and air? The urban-rural and the national distribution of excessive lung cancer mortality statistics suggest similarities to those of benzpyrene in air, although there are outstanding exceptions. Are there other agents in the cities, in rivers, in the air? Are there other factors such as crowding, culture, food, and background radiation? These questions pose problems for public health practice, for control action and prevention.

Implications of Ionizing Radiation

No discussion of our new environment as it affects our health would be complete without consideration of the health implications of ionizing radiation, dramatized by the upsurge of nuclear energy and its byproduct, radioactive isotopes, with manifold uses in medicine, industry, and research. To this must be added the X-ray, which not only has brought enormous benefits as a medical tool but which, improperly used, adds appreciably to the health problems of the nuclear age.

A hint at the vast scale of health implications of the rapidly developing nuclear age is given in a report of the National Advisory Committee on Radiation:

- Between 1925 and 1955, the estimated annual whole-body X-ray doses received by the average individual in this country increased 900 percent, from 15 millirems in 1925 to 135 millirems in 1955.
- Between 1952 and 1958, the number of medical users of radioisotopes in the United States increased more than 400 percent, from 445 to 1,935.
- The predicted growth of U.S. nuclear power capacity from 1956 through 1995 will result in an increase in the accumulated volume of high- and intermediate-level wastes from 1,500,000 gallons to approximately 2 billion gallons.

Understanding the impact of radiation on living organisms is a particularly formidable challenge because it differs radically from phenomena with which we are more familiar. In radiation we are dealing with subatomic particles and forces. Since these exert their effects physically by means of high energies, they cause profound changes in living cells and tissues.

A tremendous amount of research has been done and a great deal is known about the health effects of ionizing radiations in relatively heavy dosages. It is well established, for example, that exposure to high but sublethal levels of radiation has three different kinds of deleterious effects on groups of laboratory animals: a general shortening of the lifespan, increased frequency of genetic mutations, and increased incidence of cancer.

Whether or not threshold levels for these effects exist, and if so what they are, comprises one of the most important of our research problems. Meanwhile we are compelled to assume, first, that any radiation is harmful at the cell or tissue level; second, that damage done is irreversible; and third, that radiation damage is, therefore, cumulative throughout a person's lifetime.

These, then, are among the health challenges of the contemporary environment. It is tempting to try to deal with them separately, in neatly packaged compartments labeled water pollution, air pollution, radiation, and so on. In

fact, however, they are so interwoven, and so mutually reinforcing, that they can be dealt with most effectively if they are considered as parts of an interrelated whole, the total environment of modern man. Just as health itself is indivisible, so the environment is indivisible in its impact on human beings.

This environmental health problem differs from traditional health concerns in several important ways, some of which I have already suggested.

The first of these is the nature of the biological assault. The health professions and the public are accustomed to the communicable disease pattern, in which the timespan between exposure and onset is relatively short. Cause and effect relationships are relatively easy to establish, leading directly to preventive measures upon which much of public health and individual medical practice have been developed.

However, the health effects of chemicals and ionizing radiation often are far off in the future of the individual or even, in the case of radiation, of the species. Predicting those effects and relating them to cause is extremely difficult. The hazard to the individual is related to the cumulative total of minute quantities of radiation or chemical toxicants received continuously or intermittently throughout his life, regardless of their source. The genetic hazard to the species from low-level radiation, and possibly from chemicals, must be extrapolated far into the future and thus is even more difficult to assess.

Apportionment of Responsibility

A second fundamental difference between the new environmental problems and the more traditional health problems has to do with governmental and administrative patterns. Perhaps the greatest challenge that we face lies in the complexity of the political, social, and economic structure within which solutions must be found and applied.

It has been a long-standing principle in public health, as in many other fields, that the fundamental responsibility rests with the local community. And, having uttered the magic phrase "community responsibility," we seem to assume that clearly defined, firmly established communities exist which claim the unswerving loyalty of a certain specific group of people, generally referred to as "citizens," who have complete control of their collective destiny.

To the best of my knowledge, few such communities exist in our metropolitanized, industrialized Nation. Certainly they do not represent the dominant mode of existence in contemporary America. Instead, most of us live in a set of interlocking and overlapping communities which function, or fail to function, on a number of levels. We live in a subcommunity which gets its name from a housing development or shopping center. This is part of a suburb, which, in turn, is one of a number of satellites of a central city. This metropolitan complex almost undoubtedly occupies more than one county, and it may sprawl across two or three State lines.

Meanwhile, too often, this complex is being served by an administrative and political structure erected in horse-and-buggy days, when county seats were spaced a day's journey apart. The metropolis is the fact; the jurisdictions are, in the present context, fiction. "Local responsibility," in terms of modern environmental health problems, covers a multitude of localities sharing a common air supply, a common water supply, a common background of natural and manmade radiations, but usually lacking common administrative machinery.

Superimposed on this governmental tangle is the problem of economic responsibility in private enterprise. Some of the modern environmental pollutants are byproduct wastes of industrial production. Others, automotive exhaust is the most obvious, result not from the manufacturing process but rather from the use of the product. Still others, for example the use of radiation in medicine, result from the supplying of direct services to individuals.

In dealing with a microbiological threat to health, we can go all out for total eradication. But the microchemical and microphysical hazards are undesirable effects of highly desirable processes. We must seek not eradication but containment. We need to evolve relationships and apportion responsibilities which permit full utilization of modern technology at minimum hazard.

Plainly, there are three broad avenues of ap-

proach which must be followed simultaneously and at accelerating speed if we are to strike this kind of balance:

First, research programs which provide knowledge as to the health effects of specific environmental pollutants, singly and in combination, cumulatively over periods of years.

Second, comprehensive environmental monitoring programs to maintain a continuous check on the nature and degree of population exposure to these pollutants.

Third, the development and application of control procedures to eliminate unnecessary exposure wherever it may occur.

The key word here is "simultaneously." The need for more knowledge cannot justify needless delay in the application of controls. We are confronted by health problems which develop over periods of years or even generations. To wait until the final proof is in before taking steps to reduce pollution would be indefensible at best and suicidal at worst.

This is the nature of the road ahead. The governmental problem in environmental health is: Who shall be responsible for what? It demands hard, cold, realistic answers.

In the Public Health Service we are in process of regrouping and strengthening our forces to deal effectively with what we conceive to be our areas of special responsibility.

Administratively, our programs in water pollution control, air pollution, radiological health, and occupational health have all been raised to the status of operating divisions within the past 3 years. Congress has under consideration combining these and related programs into a new Bureau of Environmental Health, parallel organizationally to the three existing bureaus.

This new bureau will provide for the integration of the medical and engineering components of our environmental programs, and make optimal use of the many research and other methods which are applicable across the board in environmental health. It will combine a strong intramural research program with an extensive extramural, grant-supported program making use of laboratories of universities, industrial organizations, and other agencies.

Meanwhile, our research effort has already been greatly augmented, especially in air pollution and radiation. We are conducting and supporting studies of the biomedical effects of specific pollutants and controlled radiation doses on laboratory animals. We are carrying out broad-scale epidemiological studies designed to detect relationships which may exist between specific disease conditions and environmental exposures. We are, as I have already noted, widening the coverage of our monitoring networks in water, air, and radiation.

In addition to its function in research and investigation, the Public Health Service is assisting State and local health agencies to develop vigorous and effective environmental health programs. To date, their interest and willingness to undertake such activities has run far ahead of the supply of available personnel; for this reason, a very sizable portion of our environmental health funds is being devoted to technical training. The Sanitary Engineering Center at Cincinnati, long overburdened, has been supplemented by three regional radiological health laboratories at Montgomery, Ala., Las Vegas, Nev., and Rockville, Md., designed to serve the States in their respective regions. Numerous State and local agencies are already supplying invaluable baseline data and making other important contributions to environmental health protection. We look forward confidently to more of the same.

This upsurge of interest at all levels of governmental health administration is most heartening. It represents a basic change of attitude by the public health profession, and a broadening definition of public health.