Despite both administrative and technical difficulties, public health officials have many resources to draw upon as they move to limit damage to the Nation's health by nuclear radiations.

Administrative Aspects of Nuclear Energy

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THE PUBLIC HEALTH administrator looking at nuclear energy finds himself confronted with some unique problems. Some of these stem from the nature of radiation and its biological effects, and some from existing professional, administrative, and legal relationships, over which he has little control.

One unique aspect of radiation protection is that it presents an opportunity, if not a necessity, to develop special practical preventive measures beforehand, in anticipation of contamination, to prevent serious exposures of large populations. In the past, public health has been permitted to indulge in occasional lapses. The results of its failures have often inspired greater and stronger preventive measures. With respect to radiation, however, the penalty may be irrevocable and possibly final.

Nature of Radiation Hazards

There are both an abundance of data and a complete lack of assurance as to the nature and sources of the health hazards of radiation associated with nuclear energy, with the operation and products of nuclear reactors. While the precise biological effects of radiation are as yet uncertain, the current scientific consensus is that any dose of radiation is harmful to some degree. Therefore, any unnecessary exposure should be avoided. In other words, doses should be kept at a minimum, consistent with the benefit that will be gained from radiation.

A second general premise is that damage is irreversible and cumulative. Hence, all sources of exposure of individuals or populations must be considered, irrespective of their nature. Related to this aspect is the difference between two types of exposure: external, which results primarily from gamma and X-rays, and internal, from ingested or inhaled radioactive materials.

Also to be considered are two general types of effects: the short-term, acute effect that one normally associates with high dose rates resulting from an accident or a weapon; and the long-term, cumulative effect of low-level doses, usually associated with normal, civilian uses of nuclear energy but including even those slight but chronic doses associated with the widespread fallout from weapons testing.

Sources of Radiation

For complete perspective on nuclear energy, the administrator first needs to look at all the sources of radiation.

Everyone is and always has been exposed to natural background radiation. This radiation varies with geographic location, elevation, and other factors and includes both internal (natural radium, radioactive potassium, breathed radon and thoron, for example) and external

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exposures. While not practically controllable, it contributes substantially to an individual's total lifetime exposure. It has been used as a baseline from which to compute maximum permissible doses.

Medical and dental uses of X-ray; medical, industrial, and research uses of radium and radionuclides; and industrial uses of X-ray are well-known controllable sources of radiation exposure.

The major prospective source of radioactive material and potential radiation dose, however, is the nuclear reactor. Reactors are becoming increasingly common as research tools in medical, educational, and industrial institutions and establishments. Power reactors for vessel propulsion have been installed by the Navy and are being applied to merchant vessels. The commercial power reactor at Shippingport, Pa., is now in operation, and many more power reactors are under development. We may expect a wide variety of operating reactors in and near populated centers within the next decade.

All reactors produce certain radioactive wastes. Such liquid, gaseous, and solid radioactive materials are usually treated or segregated at the reactor site or diluted in discharge. Extremely radioactive spent fuel must be isolated or removed from the reactor site for treatment at central chemical processing plants, as there is no way to reduce the radioactivity or shorten its duration. The major source of radioactivity is the fuel, which builds up radionuclides as a result of nuclear fission until fission is no longer practical and the fuel is "spent." To segregate fission products and recover fissionable fuels, spent fuel elements are processed at special plants owned by the Atomic Energy Commission and located on Federal reservations. AEC has requested proposals from private industry for the construction and operation of additional plants for chemical processing of spent fuel. Under investigation also is the possibility of continuous treatment of liquid fuels at the reactor site.

Wherever treatment is carried on, it is necessary to deal with treatment and disposition of low-level wastes; transportation of either highly radioactive spent fuel or fission products segregated from the fuel; and ultimate disposition of millions of curies of fission products, now mostly stored in tanks underground.

To recapitulate, reactors present a special challenge to air pollution control, industrial hygiene, water pollution control, solid waste management, transportation of extremely hazardous materials, and, above all, high-level waste disposition.

In addition to the hazards related to normal reactor operation, an accident, or accidental discharge of radioactivity, could produce immediate, acute contamination of areas outside the reactor site. The accident hazard cannot be fully evaluated, for lack of experience. It is real enough, however, to be causing concern to industry, insurance companies, and Congress. The consensus seems to be that there is no danger that a reactor will produce a nuclear explosion, but that a chemical or steam explosion in a reactor plant could seriously contaminate several square miles.

The final significant health hazard associated with nuclear energy is that resulting from military testing of nuclear devices and weapons. Tests by the United States, the U.S.S.R., and the British Commonwealth all have added measurably to background radiation. Except in the area surrounding the Nevada Test Site, tests have not added detectably to the gamma background as measured on a G-M survey meter. They have, however, added to the airborne radioactivity and to radioactive fallout, rainout, and washout. Health authorities are therefore less concerned with fallout as a source of background radiation than with the possible assimilation and concentration of long-lived radionuclides in all living organisms, with the prospect of injury from their chronic presence in human tissue. The full significance of this fallout is not yet known.

Administration and Standards

Unlike other health hazards, many sources of radiation produced by nuclear energy are beyond the direct jurisdiction of the local or State government. The Federal Government is exercising an unusual influence on both the development and control of nuclear energy. There are, of course, many reasons for this, such as the participation of the AEC in weapons development, national security implications, and

restrictions on many activities and much of the information related to radiation. Whatever the reasons, AEC is issuing licenses to and establishing health and safety criteria for private industries and users falling within the scope of the Atomic Energy Act of 1954.

This situation gives rise to a number of questions. In this country, the States have as one of their constitutional powers the protection of the public health. The question has been raised as to whether the licensing activity of AEC has preempted from the States the right to exercise control over AEC licensees. This specific question may be answered by a court decision or by legislation. The Atomic Energy Commission is currently proposing an amendment to the Atomic Energy Act which would, with certain reservations, recognize the States' right to exercise their police powers over nuclear energy. In any event, at this moment the respective authority of the States and the Federal Government in the atomic energy field is not clearly defined.

At present, both Federal and State governments have an opportunity to reduce the potential hazard. From a health standpoint, it makes no difference whether ionizing radiation comes from an X-ray machine or radium under State jurisdiction or radioactive substances under the control of AEC or foreign governments. The public health agency must consider all of these sources of radiation exposure in administering a radiation control program, even though it cannot assert complete control over manmade sources of radiation. If a State has already proceeded to regulate sources of radiation within its jurisdiction, it is in a far better position to challenge other radiation sources. Meanwhile, the public must look to higher authorities also, and not only to AEC. The AEC cannot legally exercise control over sources other than special nuclear materials, byproduct materials, and utilization and production facilities. Others have responsibility related to transportation of radioactive materials, weapons tests, and naturally occurring and machine-made radiation and radionuclides.

Resources Available

The public health administrator will find that there are a number of resources available to guide and assist in developing and carrying out a radiation protection program.

While the basic rule in radiation protection is that all unnecessary exposure to radiation should be avoided and that each exposure must be justified on the basis of benefit gained, one must also have a guide as to levels of dose and concentrations of radioactivity which call for special consideration in the light of assumed benefits. The parent group for developing recommendations on maximum permissible doses and concentrations of radioactivity in the environment is the International Commission on Radiological Protection. This body, composed of professional and scientific members from many countries, establishes basic standards and criteria which are the foundation of recommended standards, laws, and regulations.

In the United States, basic radiation protection standards are drawn up by the National Committee on Radiation Protection and Measurement, composed of representatives from a broad range of professional and scientific organizations. The committee operates through 11 subcommittees whose recommendations are published by the National Bureau of Standards. The publications of broadest interest to the public health agency are Handbook 52, Maximum Permissible Amounts of Radioisotopes in the Human Body and Maximum Permissible Concentrations in Air and Water, and Handbook 59, Permissible Dose From External Sources of Ionizing Radiation. Others of the handbooks deal with more specific subjects.

The American Standards Association has created a Nuclear Standards Board, and has established under this board seven projects dealing with various phases of nuclear energy. Of particular interest to the health professions are projects N1, Glossary of Terms in Nuclear Science and Technology; N2, General and Administrative Standards for Nuclear Energy; N3, Nuclear Instruments; N6, Reactor Hazards; and N7, Radiation Protection. To date, the Nuclear Standards Board has approved, as an American standard, the Glossary of Terms in Nuclear Science and Technology, published in 1957 by the American Society of Mechanical Engineers. No other standards have been published as yet under this board but committees are active in their development.

The American Public Health Association has appointed a committee to work on radiation with the Association of State and Territorial Health Officers and the Conference of State Sanitary Engineers. This committee has prepared a policy statement, model legislation, and an orientation pamphlet, and is developing an administrative guide.

The Council of State Governments has also developed and recommended State legislation dealing with nuclear energy. This suggested legislation encompasses all aspects of the nuclear energy industry rather than health protection alone.

As mentioned before, the Atomic Energy Commission has established health and safety criteria applicable to licensees under the Atomic Energy Act of 1954. These have been published as Standards for Protection Against Radiation (10 CFR 20). While these apply only to establishments under the control of the AEC, they represent the only specific control in States that have adopted no laws or regulations to control radiation hazards. The regulations are based on but are not identical with recommendations of the National Committee on Radiation Protection and Measurement. Some States use these regulations as advisory guides in the absence of specific State regulations, while others use them as models in developing State regulations. The AEC regulations do not cover all sources of radiation, however, and are not entirely applicable to State control.

Role of the Federal Agencies

The Federal Government exercises a greater influence and plays a more direct role in radiation protection than in any other public health program.

The greatest part of the Federal resources is being devoted to military applications. In order to monitor the products of weapons tests, the Public Health Service, under agreement with the Atomic Energy Commission, operates a radiation surveillance network composed of 43 stations equipped to collect air and rain samples and take daily gamma readings. These stations, which also estimate the amount of radioactivity in particulate matter collected from air samples, are operated by State and local health department personnel. Samples are sent to a PHS laboratory in Washington, D. C., for final counting. Results of the surveillance estimates are immediately made available to the State health officers concerned, and weekly reports of the laboratory are sent to all State health officers.

A Medical Liasion Officer Network, composed of medical personnel from the Public Health Service and State and local health departments, also under agreement with AEC, is available to investigate reports of injury allegedly due to fallout.

With respect to civilian applications of nuclear energy, the AEC plays the Federal Government's major role in radiation protection. The operating arms of AEC dealing with civilian uses of nuclear energy are the Division of Licensing and Regulation, the Office of Industrial Development, and the Division of Inspection.

The Division of Licensing and Regulation handles all regulatory matters, other than inspection activities. Among these are the preparation, issuance, and administration of regulations, issuance of licenses, development of standards, guides, and codes for the safe design, containment, and operation of reactors, and evaluation of the safety aspects of all proposed reactors. Included is responsibility for developing regulations and licensing procedures for the safe handling and use of radionuclides, source material, and special nuclear material.

The division is also responsible for assessing the requirements of the private nuclear energy industry for nuclear materials such as uranium, thorium, and plutonium, and for administering the allocation and distribution of these nuclear materials to licensees.

The Office of Industrial Development, in consultation with other offices and divisions, develops AEC policy and procedures for encouraging the growth and development of peaceful uses of atomic energy. It advises private groups on opportunities open to them. It seeks to identify industrial activities, including those now performed by AEC, which lend themselves to private undertakings, and assists in encouraging industry to enter these fields.

A major function of the office is the develop-

ment of programs to accelerate the use of radionuclides and applied radiation in industry, agriculture, and medicine, and to encourage industrial production and distribution of radionuclides and other radiation sources. In addition, it administers AEC's program for granting access to restricted data pertaining to civilian uses of nuclear energy.

The Division of Inspection is responsible for inspecting license holders to determine compliance with the terms of their licenses. As a general rule inspectors from the division will work with State agencies or keep them advised of their activities.

The basic function of the Public Health Service is to strengthen the capacity of the States to use their powers for the protection and promotion of the public health through radiation protection. The Service also performs activities beyond the powers, competence, or financial ability of the individual States. Thus the functions of the Service may be divided into the following major components:

- Assistance to States: training, consultation, and technical assistance.
- Dealing with interstate problems: pollution of air or interstate streams.
- Collaboration with other Federal agencies or scientific groups on problems which have a health component and need to be dealt with at the national level: exposure tolerances, safe transport, uniform reporting, model legislation, and codes, for example.
- Research, development, and research training: in PHS installations and by extramural grants and stipends.
- Public information.
- Radiological intelligence: nationwide collection, analysis, and dissemination of data useful in conducting radiological health programs.

The Department of Agriculture has a general interest in radiological health to the extent that individuals who produce, handle, process, and market farm products, and the animals and plants upon which this country depends for food, fiber, and other agricultural materials, are affected adversely by radioactive materials. Adverse effects include not only the impairment of health and comfort but the retardation of normal growth and development and accumulation of radionuclides in animals or plant products destined for the food market.

In the Department of Commerce, the National Bureau of Standards is concerned with the measurement of radiation dosages, and physical methods of assessment and control through proper design. The Bureau also sponsors the National Committee on Radiation Protection and Measurement, which is the major authority in the establishment of radiation protection standards in the United States.

The Weather Bureau constitutes an important resource in providing an understanding of the dynamics of natural and manmade radioactivity in the atmosphere. Its forecasting services predict local meteorologic conditions which guide design and operations in minimizing radiation exposure.

The Department of Defense's interests are related to the development, transportation, and detonation of nuclear weapons in peace and war; the effects of nuclear war; and the military applications of nuclear energy for propulsion, food preservation, and packaged power. Operators of military sources of nuclear energy tend to be of ages at which genetic injury has implications more grave than it does for the average industrial or medical users of radiation.

The National Science Foundation has a direct interest in radiation stemming from its statutory responsibilities. Many problems of basic physics, biophysics, genetics, and biology must be solved before a truly scientific approach can be made to the development of health standards suitable for an economy utilizing nuclear energy extensively. Certain grants and fellowships awarded by the National Science Foundation encourage fundamental research in the field of radiological health.

The Food and Drug Administration is interested in the potential contamination of foodstuffs and the assimilation of radioisotopes of elements naturally absorbed by crops grown for food. It is also interested in the effects of radiation used to process foods.

The Children's Bureau of the Social Security Administration has an interest in radiation as it affects the health of children.

The Office of Education's interest lies in the need for training of personnel in nuclear energy and in radiological health.

The Department of Labor is interested in protecting employees exposed occupationally to radiation.

Role of State and Local Governments

Much of the work of the 48 State health departments is advisory and consultative. They establish standards and program policies which are used as guides by local health departments, to whom they have delegated much of the responsibility for applying protective measures. They also provide technical services which are beyond the resources of the local health department.

The States have universally retained final authority with respect to approval of plans for construction and operation of public water supplies, treatment and disposal of sewage and industrial wastes, and control of water pollution. Many are now becoming interested in the control of air pollution. Many also review and approve building plans to assure that the industrial hazards to health are adequately controlled before operations are started.

A pattern may now be developing in the relationship between the Government-sponsored nuclear energy industry and the State agencies. It is urgently desired that the industry be supplied with design and operational health and safety criteria which permit the least restrictions on economy of operation. These, in part, are furnished by the AEC Standards for Protection Against Radiation, which establishes the maximum operational levels acceptable to AEC.

State health agencies, with a broad concept of radiological health, are concerned with the total radiation exposure of the population, no matter what the sources of exposure might be. At present, for example, the principal sources of exposure to radiation of a community are, probably, natural background radiation and medical diagnostic X-ray. Health agencies, if they desire to restrict public exposures to a practical minimum, will admit additional sources of radiation only when it is demonstrable that little increase is anticipated and that the possibility of individual hazard is minimized by adequate control procedures.

Obviously, the workload facing the inspection division of the AEC is sizable. The need for time and experienced personnel will impede its development of a nationwide system designed to relate the levels and effects of radiation to the multitude of public health hazards. The only experts today on integrating the nuclear industry into local situations are the State and local people who deal with public health matters exclusively. The Atomic Energy Commission and the nuclear industry need the assistance of the States and their ability, knowledge, and authority, even as the States need the specialized skills in organizations sponsored by the Federal Government.

The Atomic Energy Commission, by means of its proposed health and safety standards, is showing commendable concern over the eventual effects on the public health that radioactive material may have. No matter how intensive AEC's inspection of its contractors and licensees may be, however, its actions cannot be construed as the practice of public health, although they may make substantial contributions. The responsibility for safeguarding the public health, in any event, still lies with the States and the State and local health agencies.

State Programing

The States, in this position, are looking to their individual problems and equipping themselves to meet them. Their first action in going into the field of radiological health is to seek technical competence in staff. Ideally, they would prefer 1 or more years of graduate training for 1 or more staff members, depending on the needs within the State. Alternatively, and on an interim basis, competence is cultivated in present staff members working on programs, such as water pollution control, associated with nuclear energy. Such staff members may attend short, topical courses of the type offered by the Public Health Service at the Robert A. Taft Sanitary Engineering Center in Cincinnati.

Another early step is to define the needs. Some agencies have utilized existing programs to secure information on radiation sources. Others have enacted legislation specifically authorizing State agencies to conduct a radiation survey. Still others require all users of ionizing radiation to register.

Detailed regulations can best be considered after the needs of the State have been defined. National Bureau of Standards Handbook 61, Regulation of Radiation Exposure by Legislative Means, forms as good a basis as is currently available for the development of such regulations. However, this handbook was not designed to be adopted in toto or verbatim, but to be used as a guide. At the same time, all regulations must be based on the same standards, the recommendations of the National Committee on Radiation Protection and Measurement, which is uniquely qualified to appraise radiation hazards. An impossible situation would develop if individual States and AEC adopted conflicting standards.

The specific organization within a State agency for radiological health will vary, depending on a number of factors. If a significant problem exists in a State, it appears advantageous to designate a person or a specific administrative unit as the central point for radiological health. This person or unit may then be the principal point of contact with other interested agencies and can furnish technical assistance to other programs.

In some States, it is perfectly possible that a satisfactory program can be established by adding to each program, such as water pollution control, air pollution control, and milk and food sanitation, the necessary radiation protection responsibilities. This method would be particularly likely if the only radiation protection required were, for example, related to occupational exposure.

A program of radiation protection is complex both technically and administratively. However, with their wealth of experience in public health and with the resources available to assist them, health officials are in a position to move forward in this field as they have in others.

Institute of Veterinary Public Health Practice

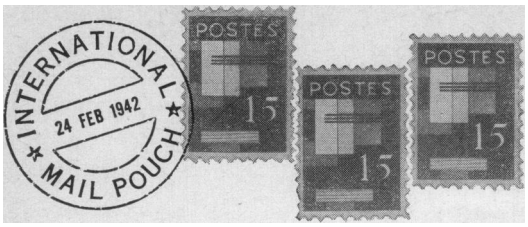
The first institute of veterinary public health practice, to be held October 6–9, 1958, at the School of Public Health, University of Michigan, will stress the use of veterinary resources in disciplines of human health.

Speakers include Margaret G. Arnstein, Dr. Gaylord Anderson, Dr. James H. Steele, Dr. H. J. Stafseth, Dr. W. W. Armistead, Dr. T. J. Francis, Jr., Dr. Mark W. Allam, Dr. Albert E. Heustis, Dr. E. H. Cushing, and Dr. R. E. Rebrassier, among a number of others.

Topics scheduled for discussion are the possible contributions of veterinarians and veterinary research to such fields as nursing, geriatrics, mental illness, human cancer, heart disease, industrial hygiene, and radiation hazards.

In separate working sessions under the leadership of five section committees, participants will discuss the most effective ways of using public health veterinarians, private practitioners, regulatory officials, and industrial veterinarians in official and voluntary health programs. The conclusions will be presented in general session.

For more information write to H. E. Miller, Director, Continued Education, School of Public Health, University of Michigan, 109 South Observatory Street, Ann Arbor, Mich.



After the Earthquakes

Continued shocks, horror, grief, hunger, and bitter cold nights virtually paralyzed the people after a series of earthquakes in the provinces of Kermanshah and Hamadan in western Iran in December 1957.

An avalanche of vague, conflicting rumors reached the health department in Kermanshah after the quakes. The more serious seemed to generate from Farsinage, Assadabad, Fash, and Sarab-Sahneh. We dispatched a doctor and a nursing team with first aid supplies, medications, and powdered milk to each location.

I visited Sarab-Sahneh and Fash and later went to the Assadabad area where I found our team in Sirvan, a badly devastated village. We borrowed a tent from the army troops sent there to assist in relief work, and set up a first aid shelter. Nurses prepared hot milk in a salvaged *deeg*, or pot, for the children and mothers. They gulped the milk hungrily; it was the first real nourishment they had had since the disaster some 30 hours before. They had devoted the previous daylight hours to burying more than 40 people killed in the quakes, and the villagers had neither time nor facilities to feed their children or themselves.

From Teheran the U. S. Operations Mission headquarters sent three trucks loaded with 5,000 kilograms of dried milk, perchlorine, and DDT dusting powder. The head of the General Department of Public Health of Iran came from the capital with a crew of engineers, nurses, nurse aides, and sanitary aides. They brought tents, blankets, dried milk, vaccines, biological supplies, DDT, and bandages to the stricken areas.

Luckily the water supply was not damaged; almost all the villages used mountain springs, which, if affected at all, regained their original quality and volume within a few hours after the tremors.

Sanitary aides worked to provide safe excreta disposal. Under the chaotic conditions, conservative farmers were reluctant to use the unfamiliar latrines. In the press of construction, the privies were not always built in accordance with religious requirements, not always equipped with elevated foot rests, and sometimes lacked even a solid roof.

However, a mere 13 sanitary aides with leadership, a bit of salesmanship, a measure of health education, and a willingness to work with their own hands dotted the landscape with sanitary latrines. Sanitary aide Rostenpour alone was instrumental in building 65 at Farsinage.

—ARLENE WALDHAUS, *public health nurse, and* GLEN W. MCDONALD, M.D., *chief, Public Health Division, U. S. Operations Mission, Iran.*

Chilean Plan

Chile may be the first nation in the world to have at each of its normal schools a faculty member trained in public health.

The Ministry of Education has arranged to have 5 professors from teacher training institutions study at the University of Chile's School of Public Health each year until all 15 of the country's normal schools have a faculty member so trained. A member of the ministry's staff, who is already studying at the school, will develop a department of health education to serve the schools of Chile.

—G. HOWARD GOWEN, M.D., *chief, Health and Sanitation Division, U. S. Operations Mission, Chile.*

Typhoid in Pusan

More than 30,000 people visited an exhibit entitled "Rodents and the Damage They Cause" last winter in Pusan, Korea. The exhibition in the Republic of Korea Information Building and the distribution of a million packages of rodenticide and 50,000 rat traps were part of a rodent eradication campaign.

Pusan had an outbreak of typhoid fever, with 153 cases reported in less than 3 months. To curb transmission of the agent, we cleaned and chlorinated wells and stressed the need to boil drinking water. Efforts to give typhoid vaccinations, particularly to people in the refugee areas, however, met with considerable resistance.

—ALFRED S. LAZARUS, PH.D., *acting chief, Health and Sanitation Division, U. S. Operations Mission, Korea.*