Radiation Control in Public Health

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PUBLIC HEALTH PROGRAMS in the field of radiation control in the United States have grown rapidly in recent years, and their growth is expected to continue.

The first record of a budgetary appropriation in the field of radiological health in the Public Health Service was in fiscal year 1948. The amount set aside was $17,000. By 1952, appropriations had grown to an annual level of approximately $350,000, a twentyfold increase in a period of 4 years. During the next 6 years, growth was slow, as previous gains were digested. Then in 1958, radiological health activity burst forward again with the creation in the Public Health Service of a full Division of Radiological Health headed by Dr. Francis J. Weber. At about the same time there was established within the Office of the Surgeon General the National Advisory Committee on Radiation, a group of scientists from many disciplines, to consult with and advise the Surgeon General on questions of policy related to the control of radiation hazards.

With these developments, the budgetary growth of radiological health was again resumed. In fiscal year 1960, expenditures exceeded $2,500,000 and in the present fiscal year, 1961, outlays will rise above $6,700,000. Furthermore, if program development proceeds in the next few years according to the blueprint established by the National Advisory Committee on Radiation in 1959, the level of activity will approach the $50 million mark in 3 more years.

The radiological health program which is developing in the United States is rather unique in public health annals. Historically, major public health programs have developed after it has been amply demonstrated that a health problem involving substantial mortality and morbidity exists. In the radiation field, however, the total number of deaths which may be directly attributed to excessive exposure to ionizing radiation in the United States has been less than the number of persons killed on our highways in a single weekend. Also, a check of our hospitals reveals few persons whose presence is related to morbidity resulting from known radiation injury. Indeed, the overt evidence of a radiation health problem in the world today is so small that one may be justified in asking why it is receiving so much attention.

There are a number of answers to this question. One of the most important is worldwide awareness of the incredible devastation to human values which results when nuclear systems of even modest proportions, deliberately or accidentally, go out of control. The bombings of Nagasaki and Hiroshima have left an indelible mark on the minds of all people. The potential dangers to life and health which are inherent in the large peacetime programs in nuclear engineering, currently under development in this country and abroad, are well known. The intense activity in radiological health, therefore, is quite justified.

It is interesting, however, that this activity represents more a concern for the future than a concern for the present. This is not to say, of course, that all the problems in the field of radiological health lie in the future. Most of

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us are aware that substantial radiation hazards exist today. However, the burgeoning programs now underway find justification in the scope of the enormous nuclear developments which will take place in the years ahead. It is expected that by the middle of the 1970's nuclear power will be competitive with power produced from fossil sources. When this time comes, the public health problems in our industrial complex and in our environment are likely to become substantial unless sound measures of preventive medicine are applied today.

In speaking of the nuclear industry, I speak not only of reactors, and their associated problems (that is, the processing of fuel elements, the mining of radioactive materials, reactor operation, and the disposition of reactor wastes) but also of the uses of their byproducts in medicine, industry, and other areas of human activity. These byproducts, being radioactive, pose a whole set of new control problems for the public health officer whether he be engineer or physician.

The basic program for dealing with radiation in defense of public health will be concerned with (*a*) the exposure of the population to ionizing radiation, (*b*) prevention of such exposure where possible, (*c*) minimization where exposure, either deliberate or accidental, is inevitable, and (*d*) care of the injured and restoration to safety of a seriously contaminated environment which presents a public threat. Those responsible for such a program will need to have comprehensive knowledge of the sources of radiation affecting the population, the degree of risk to public health from any one of these sources, the biomedical effects of exposure to ionizing radiation, the methods of caring for an exposed population, and the management of radioactive contaminants of the atmosphere, water, soil, and food, according to the nature of the contaminants and the form in which they appear.

Sources of Radiation

The sources of ionizing radiation which are of public health concern are manifold and in general may be divided into two categories: one, those sources which generally may expose the individual externally and, two, those sources which when inhaled, ingested, or received through the skin surface irradiate the body from within.

The external sources of greatest importance today are (*a*) the X-ray machine and other particle accelerators of medicine and industry, (*b*) critical assemblies, (*c*) useful reactor products either in the form of sealed radioisotope sources (for example, cobalt 60 teletherapy sources), reprocessed fuel elements, or unsealed radioisotope products for use in medicine, industry, and other fields of science, (*d*) reactor wastes, and (*e*) a number of naturally occurring radioactive materials. All of these sources, with the exception of the X-ray machine, may cause external exposure either by irradiation of the individual from a distance or by surface contamination.

The term "critical assembly" as used here refers to any system which contains fissionable material and which becomes critical when the number of neutrons produced in the system equals or exceeds those lost by capture or leakage. Under these conditions, a self-sustained chain reaction occurs with the production of relatively large amounts of fast neutrons and gamma radiation. Nuclear reactors constitute the typical critical assembly. However, a critical assembly may develop during the manufacture or reprocessing of the fuel elements of a reactor and under other experimental conditions where fissionable material may unexpectedly become concentrated.

Of the several external sources, the greatest contribution of radiation to the population of the United States has been the medical X-ray machine. The greatest cause for concern as to acute doses of radiation to small numbers of individuals, on the other hand, is the critical assembly and its fission products.

The internal sources of radiation include all of the radioactive elements, manmade or natural. By inhalation, ingestion, or absorption through abraded skin, these materials may lodge in the tissues and subject the cells to radiation at intimate range, delivering a concentrated sustained dose to a small region.

Biomedical Effects

The biomedical effects of human exposure to ionizing radiation fall into two broad categories: (*a*) the effects of repeated exposures to

relatively small doses of radiation and (*b*) the effects of exposure to single large doses. For convenience, the small-dose effects may be further classified into two major subdivisions: genetic effects and somatic effects.

Small-Dose Effects

Genetic effects, caused by irradiation of the reproductive organs, are marked by appearance of mutations in succeeding generations. Their significance is that an inapparent injury to the present generation may be conveyed to many generations to come. Furthermore, the genetic changes induced by a given dose of radiation appear to be irreversible; that is, they do not correct themselves. Hence, the genetic effects of small doses of radiation delivered over a period of time are cumulative. Also, the changes in the genes appear to be proportional to the dose, becoming more severe as the dose increases.

The somatic effects of small doses of radiation are produced by the irradiation of certain critical organs and may lead to the development, after the elapse of a variable amount of time, to a number of neoplastic states including leukemia (blood-forming organs), skin cancer, and bone cancer. In general, the somatic effects may be expected to be greater when the dose of radiation is high than when it is small. However, it is not at all certain that the magnitude of somatic damage is entirely proportional to radiation dose. It is quite possible that at extremely small doses, little or no somatic damage may be created; that is, there may be a threshold dose below which no somatic effect may be expected. However, the scientific data on this point are so uncertain that one must assume the existence of no somatic threshold dose until conclusive evidence to the contrary is forthcoming.

In addition to the specific effects of ionizing radiation on critical organs, radiation exposure may produce a more generalized effect on the individual such as early aging and premature death. The basis of this phenomenon is not understood. When death comes, it is usually due to a cause quite unrelated to identifiable exposure to radiation.

The quantitative relationships between low doses of radiation and their biomedical effects are not established with satisfactory precision. Indeed, almost every value which has been suggested for a particular dose-effect relationship has been challenged. However, as a guide, it may be worthwhile to cite at this time a few data to give some impression of the magnitude of the damage which may be produced by various levels of population exposure. It must be emphasized that these data are not based upon well-controlled comprehensive experimental investigation. Indeed, the future may prove some of these data to be incorrect by factors in excess of ten.

In regard to genetic effects, it has been estimated that an exposure dose of 30 roentgens to the gonads of an individual prior to reproduction is required to double the probability that a mutation will occur in the individual's children. Since the spontaneous mutation rate of the population is of the order of 2 percent, an exposure dose of 30 roentgens to the prereproductive segment of the population may be expected to increase the mutation rate to 4 percent.

It has been estimated that the probability of developing leukemia after a radiation exposure is 1 to 2 parts per million per roentgen of whole-body exposure dose for each year of survival after the exposure takes place. The probabilities for the development of most other neoplastic states appear to be smaller although this is not at all certain. In the phenomenon of life-shortening by radiation exposure, the data are particularly weak. Quantitative estimates of this dose-effect relationship vary through a wide range. One of the more widely quoted values is a life-shortening of 1 week per roentgen of whole-body exposure dose.

The foregoing data indicate that the genetic hazards of ionizing radiation are the most important for persons who have not completed the formation of their families. Current estimates of the exposure dose received by the reproductive organs of the population in the United States indicate that the contribution from medical X-ray sources is of the order of 5 roentgens prior to and during the family formation period of an average individual. This dose may be expected to increase the mutation rate of the population by 16 percent of the spontaneous level.

Large-Dose Effects

In the discussion of the effects of small repeated doses of radiation, it was noted that a considerable period of time usually elapses following an exposure before changes of any kind appear; that is, there are no immediate clinical manifestations of disease. When the whole-body dose exceeds 100 rads, however, clinical changes are likely to appear within a few hours to a few days. Indeed, a characteristic syndrome is produced whose severity is a function of the dose received and the sensitivity of the irradiated individual. This syndrome, often called the acute radiation syndrome, should be fully understood and easily recognized by anyone working in the field of radiological health. When serious radiation accidents occur, those people who have had the misforture to be exposed will manifest this syndrome and the success of one's treatment often depends upon its early recognition.

One of the most important problems which a physician faces when called upon to care for persons who have received acute large doses of radiation is the evaluation of the magnitude of the biomedical problems at the accident site. Reliable data on the exposure fields which prevailed during the accident are often absent or incomplete. No simple laboratory examination is available with which the exposed individual may be examined for a precise determination of the radiation exposure he has received. Instead, much rests upon the clinical skill of the physician to judge the seriousness of the situation from early clinical signs. Such judgments often are made difficult by an air of panic which frequently develops when radiation accidents have occurred. Not only do those who have been irradiated exhibit lapses in normal behavior, but unfortunately many of those who come to assist do so as well. It is the responsibility of the physician to restore order, to make a calm appraisal of the extent of the accidental exposure, and to proceed with clinical care of irradiated individuals.

It is difficult to overemphasize the value of a well-trained physician in a situation where there has been acute exposure to radiation. Here is an opportunity for public health action at its best. The clinical observations of the public health physician have substantial value in assessing the total condition. By working closely with the engineer, the physician is often the first to determine how serious a particular accident may be. If careful evaluation indicates that the damage is not great, the physician may do much to eliminate unnecessary apprehension. On the other hand, if the exposures have been high, a good physician will be able to move with confidence to take care of the injured and to give assurance to both the injured and their associates that the situation is well in hand.

The procedures to be carried out by the public health physician when a radiation accident occurs are relatively simple and are based principally on common sense. These procedures include: (*a*) evacuation of all exposed individuals to a nearby uncontaminated area where the injured may be isolated from one another and given first aid carefully, (*b*) survey of exposed persons for surface contamination by radioactive materials, (*c*) simple decontamination of body surfaces, (*d*) estimation of the radiation dose received, (*e*) saving of clothes, urine, feces, vomitus, and blood samples of the irradiated individuals for dosimetric study, (*f*) taking of a careful history of the accident, and (*g*) confining of the irradiated people to hospitals with careful evaluation and clinical study where the whole-body dose is suspected to be in excess of 100 rads.

Those who exhibit the acute radiation syndrome may be conveniently divided into five broad groups according to the whole-body dose of radiation received and the clinical manifestations exhibited. The first group includes individuals whose dose is under 200 rads. These individuals usually are asymptomatic or at most exhibit mild nonspecific prodromal symptoms. The second group includes those persons who have received a whole-body dose ranging from 200 to 400 rads. The acute radiation syndrome here is mild with transient prodromal nausea and vomiting and minimal laboratory and clinical evidence of hematopoietic damage. The third group is that which has received a dose ranging from 400 to 600 rads. Here, the course is more serious, with hematopoietic damage and gastrointestinal disorders manifested relatively early. The fourth group includes those who have received doses ranging from 600

to 1,400 rads. The acute radiation syndrome under these circumstances is accelerated, with gastrointestinal damage dominating from the beginning. The final group is that with doses in excess of 1,400 rads. The individuals in this category suffer a fulminating course with marked damage to the central nervous system arising within a short time after exposure.

The acute radiation syndrome may be divided into four stages: a prodromal stage, 8 to 48 hours in length, a latent stage of 2 to 3 weeks' duration, an overt illness stage lasting from the second or third week to about the sixth week after irradiation, and a recovery stage ranging to 15 weeks or more in length.

The prodromal symptoms include anorexia, nausea, vomiting, prostration, fatigue, and sweating. If these symptoms begin within a few minutes after exposure, one may expect a fulminating course. This is particularly true if these symptoms become progressively worse in a short period of time. If improvement occurs soon after the onset of the initial symptoms, a more benign course may be anticipated. The physician often finds it difficult to evaluate many of these symptoms because they may be produced by anxiety and apprehension as well as by radiation exposure. It is therefore important that calm and order at the accident scene be restored as quickly as possible after the accident occurs. Isolation of the injured from one another is helpful in the prevention of fear.

Diarrhea in the prodromal stage is an indication that the individual has received a serious radiation dose, probably in excess of 600 rads. Oliguria should similarly be taken to indicate that serious exposure has occurred.

Evidence of damage to the central nervous system is the most ominous of the many clinical symptoms which have been observed. Ataxia, disorientation, and autonomic collapse are three such manifestations which have been followed uniformly by death within a few hours or days.

During the latent stage of the acute radiation syndrome, symptoms often regress to the point where the individual is asymptomatic. The length of the latent period varies from 2 to 3 weeks and is usually shorter when larger doses have been received.

The stage of overt illness may exhibit a variety of symptoms. The principal findings, however, include fever, infection, and purpura as manifestations of hematopoietic damage, diarrhea and paralytic ileus as evidence of gastrointestinal derangement and paresthesia, motor disorders, and autonomic collapse as evidence of injury to the central nervous system. Epilation, lethargy, and weakness also may prevail. Again the extent of these clinical symptoms is a function of the radiation dose.

The laboratory findings of the acute radiation syndrome are particularly valuable in assessing the injury. Studies of blood and bone marrow permit one to determine with some quantitation the extent of the injury. If neutron exposure has occurred, examination of the sodium 24 levels of the blood gives valuable information regarding the magnitude of the dose experienced.

Treatment for the acute radiation syndrome includes strong supportive care with use of antibiotics when infection occurs. Bone marrow transplants with cells from a homologous donor, matched in sex and in major and minor subgroups, have been used by some in the hope that they will restore the hematopoietic systems of patients exposed to severe doses. The value of such therapy is not entirely clear, however, at this time. When considerable inhalation or ingestion of radionuclides has occurred, colloidal ion exchange carriers and chelating agents may be employed to increase the excretion of some of these radioactive materials.

Environmental Exposure Hazards

The exposure of the population from environmental radioactive contaminants poses a substantial problem in terms of both prevention and control for the public health officer. At the present time, environmental contamination is small and is due almost entirely to natural sources. A small component has been added in recent years from the fallout products of nuclear weapons testing. On occasion, malfunctioning nuclear reactors have produced substantial contamination of the environment immediately surrounding these reactors and in the environment downwind or downstream. Fortunately, these accidents have not resulted in

substantial population exposure. As the population of our world increases and as it becomes necessary, therefore, to place reactors closer to centers of population concentration, such accidents will have greater public health significance.

In addition to the regions surrounding reactor sites, environmental contamination may occur about industrial plants where substantial amounts of radioactive material are prepared, processed, or used in various industrial processes. The disposition of waste products from reactor facilities also constitute control problems. It is the responsibility of the public health officer to know the location and use of all radiation sources in his region, to be certain that these sources are being handled correctly and are operating safely, and to be continuously aware of environmental levels of radioactive contamination in the air, water, and soil.

Today's Important Tasks

The National Advisory Committee on Radiation has been reviewing the Public Health Service programs in radiological health to determine those tasks which urgently require attention. It appears that there are eight.

Research

First is the need for additional research in the field of radiation dosimetry. Although a great deal of work has been done in this field by a large number of able investigators in years gone by, much more must be done to provide the instrumentation by which radiation fields may be conveniently plotted in medicine and in industry for the evaluation of radiation risk.

A second important need is additional research to determine the precise metabolic pathways through which specific radionuclides pass when inhaled, ingested, or admitted through the skin. Information provided by this research will help to refine the dosimetry of critical tissues exposed to internal emitters so as to provide a more satisfactory basis of experience and observation for setting permissible limits of contamination. The same information will be valuable to those concerned with the care and treatment of persons bearing a burden of such emitters.

The third task is further research on the relation of radiation dose to biomedical consequences. For the most part, so far, only gross relationships have been investigated, and the quantitative data developed have been meager. A comprehensive study of the influence of many secondary factors on the biological effects of radiation, including the dose rate, and the metabolic status, age, and sex of those exposed, will strengthen the biological basis for permissible dose limits.

A fourth task is that of assessing environmental radioactivity. It may be expected that from time to time in the future, certain regions of our Nation may be contaminated by accidental or deliberate dissemination of radioactive elements. The assessment of current levels of radionuclide distribution, if comprehensive, could be of critical value in determining what control measures may be required in the future.

The possibility of radioactive contamination focuses attention on the need for research in still another direction. This concerns the development of processes whereby food, air, and water supplies may be quickly and effectively relieved of significant radioactivity. Without such techniques of decontamination, a reactor accident may affect enough of the atmosphere, water, and food of a region to impose serious hardship.

Since medical uses of X-rays produce the greatest contribution to the total dose of the population in the United States today, it is important to find methods of reducing such exposure without sacrificing the great benefits of X-ray diagnosis or therapy. Although much is being done along these lines, this aspect of public health requires continuing attention. A sixth important task, therefore, is research on methods of reducing exposure to medical X-rays.

Standard Permissible Limits

The two remaining tasks which I should like to discuss concern radiation standards and the training of public health men for work in the field of radiological health.

Historically, the need for a system of radiation standards or exposure guides for the control of ionizing radiation was first recognized by radiologists and physicians who soon after

the discovery of the X-ray, realized that such radiation presented a number of hazards associated with its use. Precautions were needed to guard patient and physician alike against any substantial amounts of unnecessary exposure. The Advisory Committee on X-ray and Radium Protection (later known as the National Committee on Radiation Protection) was therefore established in the late 1920's to make recommendations concerning safe operating practices in the field of radiology. Through the years, this body, composed of outstanding members of the radiological and associated sciences, has made a large number of recommendations which, as the applications of radiation techniques affected increasingly large groups of people, have been extended to fields of activity well beyond medical radiology.

One of the first recommendations by the committee has become known as the maximum permissible dose (MPD) or the weekly dose which individuals working with ionizing radiation may be expected to receive without the development of serious biological damage. In the beginning the maximum permissible dose was set at a rate of approximately 1 roentgen per week. Over the years, this value has been reduced until now the maximum permissible dose in most situations is only 0.1 roentgen per week.

It is interesting to observe the methods which have been used in setting the permissible maximum. Although the members of the NCRP were of scientific discipline, scientific data were by no means the only consideration. Practical factors have had a profound influence as well. For example, the maximum permissible dose for radiation workers has been reduced over the years not because new information has come to hand which indicates radiation to be substantially more dangerous than once thought to be, but because it has been found that with reasonable operating skill, radiologists and their technicians could easily limit exposure well below 0.1 roentgen per week. Furthermore, such a limit could be observed without added expenditures of time and money. I daresay that if the contrary had been true, the maximum permissible dose would still be at its former level today. This point is emphasized because it is frequently felt that scientific factors alone have determined the limits specified in radiation protective standards. Actually, practical considerations have often played an equally important role.

Since it is prudent to assume that there is no threshold dose of radiation below which biological damage may be avoided, it follows that there is a large philosophical element in the development of radiation protection standards. The specification of a permitted radiation dose in a given standard carries with it the possibility that some biological damage will result when the standard is applied. Hence, those who are charged with the formulation of radiation standards must continually balance biological risk against radiation benefit. If the dosage level is set too high, human damage may outweigh socioeconomic, medical, or other benefit; if the dose is set too low, developments in nuclear science and medicine may be curtailed. These judgments are not without their difficulties because it is necessary to compare unlike quantities when the balance between risk and benefit is evaluated. For example, in occupational exposure, the risks are biological but the benefits may be economic. Certainly, an evaluation of these two factors requires careful judgment of men not only with a sound scientific background, but with broad philosophical insight as well.

As noted earlier, the biological damage produced by ionizing radiation increases progressively as the dose increases. That is, when the dose is small the probability of damage is small, but as the dose becomes larger the probability of damage becomes greater. It therefore follows that when a radiation protection standard covering a given set of occupational or environmental conditions sets forth a maximum possible dose, the standard does not mean that there is complete safety when the dosage levels are below the MPD or that there is complete absence of safety when the MPD is exceeded. Instead, it means that those formulating the standard considered the probability of damage at the maximum permissible level to be so small as to be inconsequential.

In the past, the maximum permissible levels have been set sufficiently low that the probabilities of serious damage either to an individual or to the population at large are small even at dosage levels several times the maximum

permissible dose. It is important that the public and those working in the field of public health appreciate this fact, for it will permit a better understanding of radiation protective measures wherever they may be required. Many times in the recent past, the public has become quite apprehensive when, under certain circumstances, the maximum permissible levels have been approached or exceeded. Such a reaction has not often been consistent with the scientific facts.

The manner in which biological risk increases progressively with radiation dose makes questionable the continuation of radiation protection standards which are expressed in terms of maximum permissible dose. Instead, it seems wise that standards in the future be formulated in a framework in which measures to control radiation exposure become increasingly stringent as radiation dosage levels rise; that is, standards should be based on a concept of graded action to meet increasing risk. Specifically, protective standards should establish a set of guiding principles which include in each case the specification of a lower dosage limit below which biological risk is so small that it may be neglected. Above this limit, the standards should specify a series of dosage levels, each one of which calls for the application of a set of specific public health measures to meet effectively the problems the dosage level imposes. These measures may be expected to become more extensive as the dosage levels increase. Radiation protection standards developed in this manner would not only do much to erase confusion which has resulted from misunderstanding of the term "maximum permissible dose," but would also set the stage for effective public action through a wide range of conditions of exposure.

As an example of how standards based on the "graded action" principle might operate, consider a problem which presented itself in 1960 in several communities because of extensive nuclear testing in the preceding year. The strontium 90 levels in milk rose to substantial fractions of the maximum permissible concentration established by the NCRP. The rise had been rapid and it appeared that the maximum permissible concentration might be exceeded. The prospect of such an event alarmed many people. Although this situation should be and was of concern to public health authorities, it need not have caused public apprehension. Contrary to expressed fears, the risk to the population would not have suddenly worsened if the maximum permissible concentration for strontium 90 had been exceeded. Indeed, these risks would have been only slightly greater than those which prevailed at the levels actually reached.

Nevertheless, with the protective standard for strontium 90 based on the concept of a permissible maximum, a substantial number of people feared that the danger to the population was sufficiently serious that milk supplies should be confiscated. That such a viewpoint was quite unjustified may be illustrated by the fact that intake of milk products containing strontium 90 at the maximum permissible concentration would be required for a period of several decades for an individual to receive a dose to bone approaching the whole-body dose received by properly protected radiation workers during their daily occupation. Since no case of bone cancer has been found in such workers in the past, the public danger from the temporary rise in strontium 90 concentration in milk certainly did not call for the heroic measures that were suggested.

I do not in any way wish to belittle the potential hazards created by fallout. This is not a problem to be considered lightly. However, since risks are proportional to dose, radiation protective standards should not be based on a principle which might be interpreted as calling for no concern below a given radiation level and drastic action above this level. Instead, radiation protective standards should be based on concepts which recognize the scientific facts that increased dosages bring increased risks which in turn call for increasingly stringent controls. The reevaluation of present radiation exposure guides or protective standards seems to be one of the most important matters facing the scientific community in the field of radiation control today.

Training

The last of the eight critical tasks is the training of public health specialists in radiological health.

The requirements for trained personnel fall in two broad categories. The first is a group of individuals whose backgrounds are principally in the physical sciences and who with suitable training in atomic physics, radiation chemistry, and nuclear engineering are able to assume a high order of responsibility in the field of radiation protection design and in the handling of the physical problems associated with accidental exposure of the population. Training programs for these individuals have been in operation for some time under the excellent guidance of the Atomic Energy Commission. Such individuals are usually known under the title, health physicist.

The Public Health Service has also contributed heavily to the training of personnel in health physics. The programs given by the Service, however, have been directed principally to short-course training of supporting technical personnel.

The second category of personnel includes those individuals whose backgrounds are principally biomedical. This group, too, must be capable of assuming a high order of responsibility, but in the broad biomedical aspects of radiological health. Ability to evaluate radiation problems clearly, to make decisions forthrightly, and to lead radiation research and control programs effectively are a few of the characteristics required. We are speaking here of public health physicians who in their fields are as well trained and as capable as the specialists of such fields as surgery, internal medicine, and pediatrics. For convenience, I shall call these men radiation health specialists.

The need for radiation health specialists in this country is particularly acute at the present time because so few have been trained. Almost all the organized training in radiological health has been directed in the past toward the health physicist with little being done to establish programs which will insure adequate numbers of the biomedically oriented. It has been estimated by the National Advisory Committee on Radiation that 1,200 such men will be required in the United States during the next 10 years.

To meet these objectives, there is considerable urgency that proper curriculums for radiation health specialists be established in our schools of public health as soon as possible. Attention is called to the use of the term "proper curriculums." There has been a tendency in some schools of this country to provide the same courses for the radiation health specialist as are given the health physicist. This, I believe, is a serious mistake. The work in physics which is suitable for a physician will be generally unsatisfactory for men with backgrounds in the physical sciences. Also, the biomedical work required for the physician will be much too sophisticated for the engineer or physicist. As a result, if the same curriculum is used for both specialities, the work must be so simplified that it will not attract the best men from either field, nor will it produce individuals who are able to satisfy the requirements of a radiological health program.

At a recent conference on radiological health curriculums sponsored by the Division of Radiological Health at Princeton, N.J., several academic physicists expressed concern that the courses which they were required to present in the field of radiological health were so "watered down" that they found the students ill prepared to assume their prospective duties and responsibilities. The avoidance of substandard educational programs, I believe, can only be achieved by the provision of one curriculum for the health physicist and another for the radiation health specialist. This is not to say that there may be no occasional introductory course which is suitable for both groups. However, the advanced work in atomic physics, radiation chemistry, and nuclear engineering required for the health physicist is quite inappropriate for the radiation health specialist. So, too, the advanced work in radiation biology, radiological biochemistry, and nuclear medicine needed for the radiation health specialist is inappropriate for the health physicist.

It appears that the schools of public health of this country are particularly well suited to provide advanced postgraduate work for biomedically oriented men in the radiation field. With their rich contacts with academic medicine these schools should be able to provide a superb climate for training in radiological health. The challenge is there. I hope it will be accepted. If a serious nuclear accident were to occur tomorrow, I would have little fear that

the physical problems associated with the accident would be taken care of quickly and with distinction by the many well-trained health physicists of our country. I have great doubt, however, that the accident's biomedical problems would be so well handled.

If training programs for radiation health specialists are to be fully effective, it is essential that the climate provided these men in radiological health be stimulating and intellectually interesting. There is nothing more demoralizing to a well-trained man than to find himself working in an atmosphere which limits his opportunity to grow. To insure a satisfactory climate for any biomedically oriented man in public health, two factors must be present. First, the man must have the opportunity to fulfill his aspirations as a physician. For this he must have contact with disease in the laboratory and in the hospital. He must not be relegated to wholly administrative positions where his principal duties are confined to such limited matters as radiation source registration and surveillance. This is not to belittle these important aspects of a radiological health program. However, additional biomedical opportunities must exist for the radiation health specialist if he is to be happy. The second important factor for a satisfactory climate in the radiation field is the provision of adequate research facilities for the investigation of the many problems arising in the field. Not all radiation health specialists will wish to pursue careers in research, but all should be sufficiently close to the research laboratory to benefit from its stimulating rewards.

In many ways, the needs which I have been citing for the radiation health specialist apply equally well to others in public health. Indeed, the absence of a satisfactory climate may be expected to cause deterioration in any public health program. In this connection, it may be well to examine the reasons why public health is not attracting today the best men from our medical schools. There are some who believe that this deterioration in the quality of candidates going into public health is due to a lack of leadership on the part of our schools and health agencies. However, the problem seems more fundamental. Those who work in public health must do so in a climate that is conducive to their growth and stimulation. For most biomedically oriented men, this requires an intimate relationship with the practical problems surrounding the care and treatment of disease. It requires also close association with the research laboratory, with clinical colleagues, and with men in academic medicine.

All of this is particularly cogent for radiation health specialists. Since the fields of radiobiology and nuclear medicine are moving rapidly, it is essential that these men, regardless of position, retain intimate contact with the research laboratory, with the teaching institution, and with clinical services associated with nuclear medicine. This means that the radiological health program developed in State and local health departments should, at the outset, be arranged in such a manner that the professional staff have direct laboratory, teaching, and hospital responsibilities in the regions where they are located.

I should like to make a plea that the health department's laboratories and administrative framework in radiological health be established in close relationship with an outstanding medical environment. Under these circumstances, even those who have onerous but necessary administrative positions may continue to receive the stimulation needed to bring happiness in their positions. This is the pattern which I hope will be followed in the field of radiological health. It perhaps is a pattern which should be followed in many other areas of the public health complex.

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Health Needs of the Aged

It is well-nigh impossible to gather statistics on the care people fail to get. There are indications, however, that many old people are prevented by the cost of hospital services from getting as much care as they ought to have. Utilization generally goes up when a new source of financing is provided—for example, through a public assistance health program. Insured people use more care than uninsured. These facts indicate that financial barriers do stand in the way of care—and in my opinion of needed care, for my own belief is that physicians do not send many people to hospitals for care they do not need.

Let me make sure that you recognize the difference between saying that no one is denied hospital care and saying that no one, for financial reasons, goes without hospital care that he ought to have. It may be largely true, as is often stated, that no one in need of care is turned away from our hospitals for inability to pay. But we must not forget those who are too proud to ask for charity, those who will postpone indefinitely dipping into their little savings, those who cannot bring themselves to burden the limited resources of their children. Who is to say how much hospital care is foregone or how many tragedies flow from its postponement because old people are unwilling to face the financial consequences of seeking the care that they need?—*Excerpt from an address by Alanson W. Willcox, General Counsel, Department of Health, Education, and Welfare, at the annual convention of the Texas Hospital Association, Dallas, May 16, 1961.*

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Program Notes

A unit in which persons who have been accidentally exposed to radioactive substances will be scrubbed and decontaminated before receiving medical treatment has been set up in the Fairview Park Hospital in Cleveland, Ohio. More than 150 industries and agencies in this metropolitan area use radioactive materials.

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New York State put its first mobile air sampling unit into operation recently. It will be used to investigate pollution complaints and will be available for loan to county and municipal health departments.

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Blood studies of residents of five New Jersey communities show that about 2.2 percent of the population were infected with eastern encephalitis in the 1959 outbreak. However, only 1 out of every 18 persons infected developed sufficient symptoms to lead to a diagnosis.

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Maryland's department of mental hygiene estimates that nearly $30 million has been been saved by the decline over the past 5 years in the average daily number of patients in its mental hospitals per 100,000 Maryland residents. The rate declined from 414.2 in 1955 to an estimated 344.6 in 1961.

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At least 37 State health departments are expanding staff to improve nursing home services with the support of Federal grants.

« »

Responsibility for Kentucky's program on alcoholism has been transferred to the department of health from an independent commission on alcoholism. Members of the former commission will serve as advisers.

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Eleven accident prevention rules for trampoline tumblers are offered by the Greater New York Safety Council.

"Procedure for Investigation of Food-Borne Disease Outbreaks," published by the International Association of Milk and Food Sanitarians in 1957, has been distributed to more than 11,000 health agencies, educational institutions, and food service establishments. It is used by food establishments to improve employees' understanding of the nature of food-borne diseases. Single copies of the 32-page document sell for 50 cents.

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Central Islip State Hospital on Long Island, N.Y., opened a unit for treatment and rehabilitation of narcotic addicts in April 1961. The unit has a 30-bed ward for intensive detoxication treatment and a 50-bed ward for continued treatment and rehabilitation.

A similar unit will soon be established at Utica State Hospital to serve upstate New York.

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An institute for basic research in mental retardation will be established by New York State on Staten Island, adjacent to the Willowbrook State School.

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A recreation and guidance center in Prince Georges County, Md., for former patients of mental hospitals is the goal of the county mental health society. The center's staff would consist of a paid professional director and volunteer psychiatric workers supplemented by lay persons who have completed a 2-year course in group therapy. Clubs for ex-patients have been organized recently in Shreveport, La., and Columbia, S.C.

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A leaflet titled "Hold His Hand" lists rules parents should follow in supervising and training their children in order to prevent traffic accidents. The leaflet was prepared and distributed by the Baltimore City Health Department, the Maryland Traffic Safety Commission, and the Safety Engineering Club of Baltimore.

The true causes of fatal auto accidents are often unsuspected, according to evidence collected by a Harvard Medical School research group and reported by Don Ross in the *New York Herald Tribune* (March 13, 1961). Alfred Moseley, a psychologist, and Dr. Richard Ford, chairman of the department of legal medicine, are directing the group, which is now in the second year of a 5-year study supported by a $810,000 Public Health Service grant.

The investigators have found that in some fatal accidents reported by the police as "driver asleep," the driver had actually tried desperately to avoid crashing. Evidence indicating possible suicide was uncovered in other cases. Chronic illnesses that can interfere with safe driving were factors, often very subtle ones, in a number of accidents.

Autopsies of victims, immediate physical examinations of survivors, detailed studies of accident locations, and periodic compulsory inspection of motor vehicles were recommended by Moseley and Ford on the basis of their studies so far.

Ross reported also on a recently completed Northwestern University study directed by J. Stannard Baker, which concludes that automobile accidents result from combinations of factors. Baker's group has compiled a list of 800 such factors.

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Sales of bottled spring water and distilled water have been rising; in 1960 they totaled $30 million. Officials of bottled-water companies say that increased sales of spring water can be attributed in part to the unpleasant taste of chemically purified public water in many areas. Many persons on low sodium diets are drinking distilled water. A Los Angeles company is adding fluoride to some of its bottled water.

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Kitanning, Pa., is planning a $500,000 waterfront recreation area on the banks of the Allegheny River, now that it is relieved of the untreated sewage of upstream communities.