State Control and Administration of ATOMIC RADIATION

Institute of Public Affairs
of the State University of Iowa

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Foreword

What shall be the role of state government in the development of the uses of atomic energy for peace time purposes?

This work seeks to point up some of the complex problems that must be faced if an intelligent answer to the question is to be found. It poses no panacea, but it does bring together a review of the approaches made by some of the states as they begin to assess their responsibilities. Our hope in publishing this work is that it will be of particular value to the citizens and public officials of Iowa. We believe it will be of value to citizens and officials in other states as well.

The author has minimized his references to the biological and social effects of atomic radiation. He has drawn upon public documents of highly regarded scientific and governmental sources only to the extent necessary to indicate their relation to the problems of public administration that he treats.

In essence, the thesis here is that everything possible ought to be done at the earliest possible time to encourage peace time uses of atomic energy as a great social blessing. To do so will require a new look at the role of the states as protectors of the public health and safety and as regulators of commerce and industry. Because the development of atomic science has been so much the responsibility of the federal government, the relation of the states to the problem is complicated even more.

A well-informed and understanding citizenry will undoubtedly demand state policies of cooperation with the federal government that will assure protection of public health and safety along with maximum state promotion of the social and industrial benefits the atom promises for the future.

If this booklet serves to acquaint the people and public officials of Iowa with actions taken by other states that will be helpful in seeking our course for the future it will have served its purpose well.

This booklet was written by William C. Ellet who now holds the position of Director of Personnel Development and Training in the Atomic Energy Division of the Babcock and Wilcox Company of New York.

Mr. Ellet wrote the booklet while serving as a Research Associate in the Institute of Public Affairs during the summer of 1956. From 1953 to 1955 he served as a Research Assistant at the University of Michigan in the Memorial Phoenix Project concerning the peaceful applications of atomic energy. His doctoral dissertation, prepared during that time and completed in 1955, concerned "The States and the Atomic Energy Act." In the academic year 1955-56, Mr. Ellet was an Instructor in the Department of Political Science at the State University of Iowa, and has served as an Assistant Professor and Research Assistant in Public Administration at the University of Virginia in the academic year 1956-57.

The booklet has been read critically in manuscript form by Dr. James A. Jacobs, Director of Nuclear Research and Professor of Physics, and Mr. Joseph C. Stoltzfus, a graduate assistant in that department; by Dr. Peter F. Buri of the Department of Zoology; by Dr. Titus C. Evans, Head of the Radiation Research Laboratory and Professor of Radiology and Radiobiology—all of the State University of Iowa; and by Mr. Sutherland Dows, President of the Iowa Electric Light and Power Company and a member of the Panel to Study the Impact of the Peaceful Uses of Atomic Energy on the American Economy appointed by the Joint Congressional Committee on Atomic Energy. To each of these persons the Institute expresses its gratitude for the many fine suggestions made during the editorial processing of the manuscript.

ROBERT F. RAY, Director
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Introduction

Some of the most perplexing and complicated problems currently confronting state governments involve atomic radiation and its relations to public health and safety. These problems are becoming more urgent because of the increasing commercial and industrial use of atomic radiation sources and materials. In the past, radiation was not an issue of any real magnitude for most states. Atomic energy was, of course, the sole concern of the national government. Of late, and particularly since the passage of the Atomic Energy Act of 1954 which allows private ownership of atomic materials and production facilities, there has developed an ever-widening use of radiation sources and radioactive substances. Since these materials have properties that endanger health and safety, their control always has been a troublesome matter. Now, however, control is of even greater importance and failures could have wide ramifications. The seriousness of the matter is demonstrated in the latest scientific evidence on the effects of radiation on humans. Because our federal form of government assigns primary responsibility for the protection of the public health and safety to the states, it seems proper at this time to question the assumption that extensive federal interest and participation in atomic energy precludes the states from action or concern.

While the technical and jurisdictional questions by themselves are complicated enough, it appears that only a few of the states are adequately prepared to take an active role. For one reason or another, only a minority of them have embarked upon a program of any scope; the rest seem to be waiting for further developments or are ignoring the whole business.

In view of the rapidly growing number of uses for radiation, and considering the opinions of radiation specialists, states should seriously question how much longer they can afford to wait before taking some form of action, even if only to make their workmen's compensation laws square with the realities of the atomic era. The extent to which a state should establish a system of standards concerning such matters as maximum exposures to radiation, methods of handling of radioactive materials, disposal of radioactive wastes, etc., must be determined by each state. Nevertheless, whatever actions are taken should be pegged on a policy of protecting the public while at the same time not retarding the use of radiation in agriculture, medicine, or industry.

It is the purpose of this book to pull together some of the facts about radiation, the extent of federal jurisdiction, and the various legislative and administrative concepts underlying current or probable state action so that the informed layman will have some knowledge of the issues facing his state with respect to this vital subject. This brief discussion is intended only as an introduction to one of the most important matters affecting the welfare of the people of the United States—atomic energy.

Atomic Radiation

Fundamentally, there are two aspects of the effects of radiation on human beings: the effects of direct exposure and the effects of indirect exposure, or radiation reaching man through his environment.

It has been known for a number of years that some radiation is harmful to living organisms; the extent of harm, however, has been only dimly understood until recently. Now we are beginning to grasp the full significance of the possible damage. Individuals can be injured by radiation, even fatally injured, and there is also a probability of grave repercussions on unborn individuals.

Unfortunately, atomic radiation gives no warning when it strikes. It cannot be seen, heard, smelled, or felt. While radiation holds the possibility of manifold benefits for the health and welfare of man, misused, it could spell his doom. Through intelligent use of radiation, the life span of man can be extended, his diet enhanced, and a whole host of new materials and chemicals can be produced for his material welfare. Therefore, it behooves us to harness and control radiation just as primitive man did fire.

The Nature of Atomic Radiation

Atomic radiation, or more precisely "ionizing radiation" to distinguish it from such other forms of radiation as radio waves and visible, ultraviolet, and infra-red light, is released from the atom by natural radioactivity, atomic fission, or the bombardment of atomic targets in high voltage accelerators (X-ray machines and particle accelerators).

In its widest sense, radiation is nothing more than the way in which energy moves from one place to another. In the instance of so-called atomic radiation, an atom acquires more than its normal complement of energy, thus becoming an "excited atom," and returns to the normal state by radiating the excess energy in the form of particles or rays.

All elements in nature are composed basically of atoms; atoms, in turn, are comprised of three fundamental particles: electrons, protons, and neutrons. Elements differ in the numbers of particles of which their atoms are composed. Every atom is something like our solar system: there is a central nucleus, like our sun, around which electrons whirl like planets. You might think of an atom as a massive nucleus surrounded by a cloud of much lighter electrons. The nucleus contains two of the three basic particles, positively charged protons and neutrons which have no charge. Because of the protons, the nucleus carries a positive charge. Electrons, on the other hand, are negative, and the negative charge of an electron equals the positive charge of a proton. A normal atom has as many electrons as protons, so the net charge of the atom is zero. An atom is mostly space; there are vast relative distances between the particles. And the electrons are continually in motion revolving around the nucleus. The atom itself, of course, is minute; it would require more than a half million of them to span one human hair.

Negative and almost weightless, the electrons are the sources of energy for what we call chemical reactions. Since an atom has as many electrons as it has protons in its nucleus, the nucleus and the number of protons it carries determine the chemical properties of a given atom. This is the reason why a gold atom differs from a lead atom. The nucleus of an atom of ordinary uranium has 92 protons and 146 neutrons; the nucleus of a plutonium atom has 94 protons and 145 neutrons. The neutron numbers may change, however, and the atom will still retain the same chemical properties as before. For example, should our uranium nucleus acquire an additional neutron giving it a total of 147, it remains uranium chemically, but has different physical characteristics. There exists in nature, along side our ordinary uranium atom, another form of uranium that has only 143 neutrons. Both of these forms or "isotopes" of uranium are somewhat radioactive, while uranium with 147 neutrons in its nucleus is very strongly radioactive. Thus, there are several forms of uranium: uranium 238, uranium 239 (which transmutes to plutonium when the two additional neutrons become protons), uranium 235, and others. When struck by a neutron, uranium 235 divides into two roughly equal parts and forms two new and lighter elements. This is an example of the process with which we are all now familiar—atomic fission.

What happens in this process is that an atom receives more than its normal complement of energy and becomes excited. Excitation of an atom often results when it is struck by some sort of an atomic projectile. This is something like what takes place when a bullet is fired from a pistol and strikes a metal target. As the bullet leaves the gun it carries with it the energy generated in the cartridge. When the bullet strikes the target, this energy is radiated from the target in the form of sound and heat waves. Also, small pieces of the target fly off into space. This analogy is quite close to what actually occurs in an X-ray machine. Instead of a bullet, however, a stream of electrons is fired at a metal target. Agitation of atoms in the metal target produces X-rays instead of heat and sound waves. Particle accelerators, the so-called atom-smashing machines, function in much the same manner. Instead of firing electrons, they are usually designed to shoot other types of subatomic particles at target atoms. The target atoms then emit gamma rays or atomic particles or both.

In atomic fission, a nucleus does not produce radiation upon impact but, instead, it absorbs the bombarding particle and then splits into two approximately equal parts. When a neutron strikes a uranium or plutonium nucleus, it produces such a division, and an enormous burst of energy is released. It is this burst of energy that makes possible the atomic bomb. This energy also can serve as a source of power for submarines, or for producing electrical energy. But what happens to the two parts of the split nucleus? These nuclei are now the centers of other atoms of elements different from and lighter than uranium or plutonium. At first, these newly formed atoms are always radioactive and unstable; they emit alpha particles, beta particles, neutrons, or gamma rays. Because an atom is always characterized by the numbers of neutrons and protons in its nucleus, each such transformation in one of the fission products results either in another isotope of the "parent" element, a different "excited state," or in a different element entirely. These transformations continue in each atom until it arrives at a stable state and ceases to emit particles or rays.

There are sources of radiation other than these products of atomic fission. Cosmic rays that filter down to the earth from outer space are sources. In addition, there are substances in the earth's surface that are naturally radioactive. Much the same sequence of events transpires in naturally radioactive materials as in the fission products discussed above. Here, as in atomic fission, the nucleus emits a gamma ray and changes to a less excited state, or emits a particle and is transformed to a different isotope or a different element. At any rate, the natural material, like the fission product, may go through several stages before it reaches stability. Radium, for example, passes through a whole series of transmutations until it ultimately becomes lead.

A series of transmutations such as this is called radioactive decay. We use the term half-life in measuring the rate of decay; that is, the time required for half of any given amount of material to transmute itself to a stable state is its half-life. This concept of half-life is of utmost importance in taking measures for protecting the health and safety of the public from radiation. By knowing the rate, we can estimate the time required for a certain fraction of a quantity of radioactive material to become stable, and thus determine the danger from the material after a given time. Hence, if an element has a half-life of one hour, we know that in the first hour, half of the original amount will have transmuted itself; in the second hour, half of the remainder will have undergone transmutation, and so on. Half-lives of various substances have a wide range; some only a fraction of a second, others must be measured in years. One common fission product, for example, has a half-life of twenty-five years. This means that an amount of the material sufficient to give a lethal dose in a given time now would give a lethal dose in twice that time after twenty-five years.

Because man must continually contend against the natural radiation over which he has little or no control, he must limit carefully the dosage he receives from artificially produced radioactive materials. For this reason, serious attention must be given to measures that prevent radiation from escaping from its source. Fortunately, we can construct our protective measures on the facts we know about the peculiarities of each type of ray or particle.

X-rays are highly penetrative, and thus require heavy shielding. Gamma rays are even more penetrating. Gamma rays are usually produced when a free proton collides with the nucleus of an atom. Upon the impact, the proton is captured by the nucleus; the transfer of energy results in the emission of a charged particle or gamma ray or both. A gamma quantum differs from a particle in several ways. First, it moves with the speed of light. Second, it has no separate existence: it comes into being only when energy is transferred from one atom to another. Third, it has no electrical charge and, therefore, may travel a comparatively long distance through matter before it collides with an atom and knocks an electron free.

Beta and alpha particles, on the other hand, are definite parts of the atomic structure. A beta particle at rest is identical with an electron, the elementary negative particle that circles around the nucleus at high speeds. On the contrary, an alpha particle is positive and is composed of two protons and two neutrons. It differs from the beta particle not only in its charge, which is twice as great, but in its mass, which is about 7,500 times larger. Since the velocity with which particles are emitted is determined, as for the bullet, by the quantity of energy originally given and the mass, the alpha particle has a much lower velocity for the same energy.

Because they are electrically charged, beta and alpha particles exert electrical forces as they move through matter. As a result, they ionize (free electrons from) a small fraction of the atoms or molecules in their paths. Because of its lower velocity an alpha particle frees many more electrons in a given distance than a beta particle of the same energy does. The alpha particle thus loses its energy more rapidly, and penetrates to a much smaller distance. Alpha particles, from radium, for example, can penetrate only the outer layer of skin of the human body, while beta particles of the same energy can penetrate about an inch.

Neutrons, like gamma or X-rays, have no charge, but they do have tremendous penetrating ability. They produce much the same type of biological effect as gamma or X-rays, but the amount of effect is five to ten times greater.

Since the vital organs of a living creature usually are located deep within the body, radiation protection must be directed toward developing measures to prevent penetration of gamma and X-rays and neutrons. As external sources, beta and alpha particles are of little concern except that over-exposure to them might result in severe superficial burns.

Internal radiation is something else again when alpha or beta particles are considered. Should a man or animal eat or breathe radioactive material, alpha or beta particles then can reach the vital organs of the being and do great and perhaps fatal damage.

Effects of Radiation on Humans

Radiation effects on men and animals are of two different orders: the direct effects on the individual who receives the radiation, and the indirect effects that may be transmitted from parent to future generations.

When a ray or particle strikes an individual, an electron may be knocked loose from some molecule or atom in a tissue. The delicate chemical balance maintained in the body cell consequently may be upset, and this may result, perhaps, in a serious malfunctioning of the cell or its death. A substantial dose of radiation would impair the functioning of the organ of which the cells are members, or possibly destroy it completely. The consequences for the individual concerned are obvious.

Substantial evidence has been collected demonstrating that exposure to radiation may appreciably shorten life if the amount received is sufficiently great. It is known that radiation also can induce cancer or leukemia, and can produce ulcers, burns, tumors, and cataracts. Individuals who have been exposed to significant doses of radiation are much more susceptible to various diseases or disorders.

Internal radiation may produce similar effects, only much more rapidly, since the individual is continually exposed and is unable to escape from the source of the radiation. One way in which internal radiation can be acquired is for humans to eat plants grown in soil in which there are radioactive materials, or to eat animals that have eaten such plants. Radioactivity also can be introduced into the body by inhalation or ingestion of air or water that contains radioactive gases, vapors, or dusts.

Unfortunately, once an individual has been over-exposed to external radiation or has acquired an internal source of radiation there is little that can be done for him, except to treat the secondary effects and wait and see if the body can repair the damage and rid itself of the internal source.

One of the most serious and controversial aspects of radiation is its effects on future generations. Even a small amount of radiation is capable of producing mutations (changes) in the genes of an individual; these changes will be transmitted to his offspring. The changes may not be apparent in the children of the individual, but they will be transmitted to future generations and at least some of these subsequent offspring may show the harmful effects of the mutant genes. Mutations are carried along from generation to generation until the genetic line dies out.

In the experience of geneticists the vast majority of detectable mutations have proven harmful. Among the harmful effects of radiation induced mutations are increased mortality at all ages and a lowering of the birth rate. Persons carrying mutant genes may produce fewer children and these children may show congenital defects which either can be seen as specific disorders or which reduce the child's chances of survival.

These genetic effects thus can produce tragedy for individuals and families. When we consider the population as a whole, the social consequences and the implications for the survival of the species are serious indeed.

There is no minimum amount of radiation below which mutations do not occur, and a given dose will produce a proportionate number of mutations, no matter what the duration of the exposure. Since reproductive cells are present throughout the lifetime of the individual, what we are concerned with here is the total cumulative dosage which these cells receive from the time of conception of the individual until after the birth of his last child.

From the genetic point of view, there is no "safe" level of radiation to which people can be exposed without causing some genetic harm. Geneticists are nearly unanimous in their opinion that any increase in man-made radiation ought to be avoided, and that whatever efforts are possible should be made to reduce the amount of man-made radiation to which the population as a whole is exposed. In particular, steps should be taken to limit the amount of radiation to which persons under thirty years of age are exposed.

The problem is indeed a complex one. We are exposed constantly to "natural" or "background" radiation in the form of cosmic rays and naturally-occurring radiation. Nearly all of us are exposed to medical X-rays in various amounts. Then there is the matter of radioactive fallout from tests of atomic weapons. Now to these sources we must add radiation from atomic installations of all kinds. We must consider the radiation to which all members of the population are exposed, and the additional radiation to which workers in atomic installations are exposed.

Instruments have been developed that are capable of measuring any given amount of radiation with substantial precision. With their use it is possible to know in an instant the amount of radiation to which an individual is being exposed. The most common and widespread unit of measurement is the roentgen. Roughly speaking, the term is a measure of the ability of a given quantity of radiation to knock electrons out of an air molecule, that is, to ionize the atoms of the air molecule. For example, the average dental X-ray delivers about five roentgens to the jaw but only about five-thousandths of a roentgen to more remote parts of the body.

In addition to the roentgen, there are several other units of measurement in use, such as the *rad* and the *rem.* A rad measures a radiation dose in terms of its ability to knock electrons out of tissue. Ordinarily, we can say one rad equals one roentgen. On the other hand, a rem measures radiation in terms of its biological effect. To complicate matters even more, a dose of a certain amount of radiation to a man in one situation would have different effects from the same dose given under other circumstances. For example, should an individual receive a dosage of 600 roentgens to his whole body, death within a short time is highly probable. Should he get the same radiation on his foot, the consequence is apt to be far less severe. Therefore, dosages are specified for a given area of the body in most radiation charts of maximum exposures.

Measurement of direct radiation is one thing; measurement of radioactive substances in water or air is another. Instead of measuring radiation directly, we measure the concentration of the material in the given substance. Establishment of standards of concentration for various materials is based on their radioactivity with an adjustment for the fact that the quantity of material retained in the body depends upon the quantity entering the body and the subsequent rate of excretion. On this basis, it is possible to devise standards for concentrations of quantities which, if inhaled or ingested, will be in equilibrium in the body. Reasonable estimates can be made regarding the maximum concentrations of each material a man who is chronically exposed to radiation can tolerate without ill effect.

The manufacture of instruments to measure radiation and air- and water-borne concentrations of radioactive materials is a business that grosses more than $25,000,000 annually in the United States today. The sensitivity of these instruments, in a large measure, has enabled the Atomic Energy Commission to maintain its excellent safety record. While radiation may be one of the most deadly products handled by industry, the atomic industry has a safety record that is difficult to equal.

Through experiment and experience, science and industry have been able to design and install protective shields that are so effective that they reduce high intensities of radiation to safe amounts. Moreover, industry is in a position to provide all types of inhalation equipment, ventilating systems, waste disposal processes, and decontamination techniques to keep radiation at a reasonable minimum. In short, man's greatest enemy in employing radiation is himself. By trying to skimp on safety equipment to cut costs, an employer is only signing the death warrants of his workers. Likewise, the worker who fails to heed instructions or fails to use the equipment at his disposal is not only endangering himself but the public as well.

This raises the questions of occupational safety and protection of the community. Protection of the environment and safe working conditions are two different matters. In the first place, it is difficult to control the radiation in the environment unless there is some means by which we can establish standards regarding the amount of radiation that can be permitted to escape into the environment. In the second place, establishing such a standard must take into account the fact that even low levels of radiation can do substantially more harm to children than adults. Some form of knowing and controlling the amount of radiation to which each individual is exposed should be considered. Obviously, the number of persons involved in environmental exposure is much greater than in occupational situations, and this makes the problem even more difficult. Contamination of the environment is a very serious matter, since it is entirely possible for many persons, over their lifetimes, to receive cumulative doses from the environment of far greater magnitude than an individual employed in an installation utilizing radiation sources would receive from those sources.

In the light of our knowledge of the harm radiation does, in terms of its effects on individuals, and considering its probable genetic effects, we must give serious consideration to what we can do to reduce these hazards. A careful study of the matter was conducted by a committee of eminent scientists; let us consider briefly some of the facts, comments, and recommendations of this Committee on Genetic Effects of Atomic Radiation in its summary report prepared for the Study of the Biological Effects of Atomic Radiation by the National Academy of Sciences.

A summary of the committee report notes: ". . .although the science of genetics is as precise and as advanced as any part of biology, it has in general, and particularly in human genetics, not yet advanced far enough so that it is possible to give at this time precise and definite answers to the questions: just *how* undesirable, *how* dangerous are the various levels of radiation; just *what* unfortunate results would occur?

"Second, even if the relevant questions concerning radiation genetics could be answered definitely, that would be only part of the story. The over-all judgment (how much radiation should we have?) involves a weighing of values and a balance of opposing aims in regard to some of which the techniques of physical and biological science offer little help.

"What is involved is not an elimination of all risks, for that is impossible—it is a balance of opposed risks and of different sorts of benefits. And the disturbing and confusing thing is that mankind has to seek to balance the scale, *when the risk on neither side is completely visible.* The scientists cannot say with exact precision just what biological risks are involved in various levels and sorts of radiation exposure (these considerations being on one pan of the risk scale); nor can anyone precisely evaluate the over-all considerations of national economic strength, of defense, and of international relations (all on the other pan of the scale)." (*Science,* June 29, 1956, Vol. 123, No. 3209, p. 1158)

The committee estimates that the population as a whole is exposed to 4.3 roentgens of "natural" radiation on the average over a thirty-year period. This radiation comes from cosmic rays, naturally-occurring radiation, and so on. We have no control over the amount of this type of radiation we receive. In addition, the average person receives three roentgens of radiation in the form of medical X-rays over a thirty-year period. But, if we reduce the use of X-rays, we run the risk of poorer medical diagnosis and less effective treatment of disease.

Radioactive fallout from tests of atomic weapons appears to be a minor source of radiation for the whole population. Based on the rate of testing over the past five years, it is estimated that the total cumulative dose over a thirty-year period would be less than one roentgen.

On the basis of its studies, the committee makes these recommendations:

1. Steps should be taken to set up a national system of record-keeping so that for every individual there would be a complete history of his total record of exposure to X-rays and to all other gamma radiation.

2. Medical use of X-rays should be reduced to the lowest limit consistent with medical necessity.

3. Radiation from all humanly controllable sources should be so limited that members of the general population do not receive a total accumulative dose of ionizing radiation to their reproductive cells in excess of ten roentgens from conception to age thirty.

4. This ten-roentgen limit should be reconsidered periodically with the view of keeping the reproductive cell dose at the lowest practicable level.

5. Individual persons should not receive a total accumulated dose to the reproductive cells of more than fifty roentgens up to thirty years of age, and not more than fifty roentgens additional up to age forty.

6. Every effort should be made to assign persons to tasks that involve higher radiation exposures who, for age or other reasons, are unlikely to have more offspring.

Clearly then, radiation can be controlled and, for the sake of the nation's health and safety, it must be controlled. Should this control be exercised by private individuals or by the public? In times past, the answer might have been private control, but in view of the number of radiation sources that now exist and the many more that soon will come into being and the need for some centralized and integrated control, the obvious answer is governmental control. But then we must ask, which level of government, national or state? And, how extensive and intensive should governmental action be? These questions involve a number of political issues which cannot be discussed here.

In part, the first question has been answered through the Atomic Energy Act of 1954 with its assignment of certain regulatory functions to the Atomic Energy Commission for the protection of the public health and safety. The Act does not spell out, however, where federal jurisdiction ends and that of the states begins. Except for a few cases, the assumption is that the two levels of government have concurrent jurisdiction. Consequently, there is some confusion in the several states regarding just where their responsibilities lie.

Radiation Regulation: Federal and State Jurisdiction

Without discussing the constitutional issues involved, we can safely say that the national government has ample authority in the atomic area to protect the public health, safety, and welfare, even though states ordinarily have this responsibility. In pegging the Atomic Energy Act on the war, commerce, and disposal of federal property clauses of the Constitution, Congress leaves us with little doubt of the source of this unusual and more or less untraditional use of federal regulatory power.

Nevertheless, federal administrative interpretation does not regard this field as pre-empted for the national government, although the boundary line between federal and state jurisdiction is difficult to define. In certain aspects, the two jurisdictions overlap and blend, and in other areas definite state or federal responsibility can be determined.

A survey of the Atomic Energy Act and the regulations issued under that Act and other pertinent federal statutes shows that the following matters can be regulated solely by the states, except, of course, when interstate commerce is involved:

1. Naturally occurring radioactive substances, such as radium and radon and their daughter products, but excluding such atomic source materials as uranium and thorium.
2. X-ray machines, fluoroscopes and particle accelerators.
3. Radioactive isotopes that have been produced in particle accelerators.

Atomic source materials are subject to federal control; however, when they are in their place in nature, they fall to the jurisdiction of the state. State control ends when the materials are removed from their natural repository.

Through a system of licenses and regulations authorized by the Atomic Energy Act, the Atomic Energy Commission is able to control the construction and ownership of atomic production and utilization facilities and the possession, use, and trade of special nuclear, source, and atomic byproduct materials.

When these materials are owned privately, even though ownership is federally authorized and controlled, it does not follow that state jurisdiction and authority is without meaning. Recognition of this fact is manifest in the several legislative measures now before Congress or about to be introduced. These proposals would relieve the Atomic Energy Commission of some responsibilities for regulating health and safety aspects of radiation. It has been proposed that upon certification by the governor, a state could assume responsibility in certain areas that were the concern of the Atomic Energy Commission. Another proposal would have the Atomic Energy Commission determine when a state was prepared and competent to regulate certain aspects of radiation and then turn the entire responsibility over to the state.

The Atomic Energy Commission has proposed still a third possibility. Under the AEC proposal, the Atomic Energy Act's cooperative clause (cooperation with federal, state, and local agencies) would be clarified to permit the AEC to contract with states that have qualified personnel and agencies to perform some of the AEC's inspection duties. In furtherance of this program, the commission plans to request the Congress to delineate more clearly the respective spheres of the two governments, national and state, in the regulation and control of the atom.

In anticipation of such action by the federal government, or because of other considerations, four states already have enacted comprehensive regulatory systems. Other states that are contemplating such a course should recognize the prospects and pitfalls of the present situation. Until the Atomic Energy Act is amended, comprehensive state regulations that overlap federal regulations are really redundant. Furthermore, state action of this type is valid only so long as it is consistent with the federal program, statutes, and regulations. Therefore, states that wish to adopt a program that allows a maximum of cooperation with the federal government or one that merely purports to blanket those areas not regulated by the Atomic Energy Act would be well advised first to attempt to find out what the boundaries of federal and state jurisdiction are.

In trying to define federal and state jurisdiction we must distinguish between radioactive materials and radiation sources. *Radioactive materials* include naturally occurring radioactive substances—thorium, uranium, radium, and radon—and artificially produced radioactive materials, such as certain isotopes of cobalt, cesium, iodine, and so on. *Radiation sources* include atomic production and utilization facilities, particle accelerators, X-ray machines, and fluoroscopic devices.

For jurisdictional purposes, radioactive materials must be divided between what are called source materials and other naturally occurring radioactive materials. Source materials come under federal jurisdiction and the determinant of what is a source material and what is not is the thorium and uranium content. As of now, any material that contains more than .05 per cent of uranium or thorium or combination of the two is defined legally as a source material. Material of this type cannot be privately possessed, utilized, or traded without a license from the Atomic Energy Commission. Other radioactive materials naturally occurring in the earth are subject to the state police power except, of course, when they enter interstate commerce.

Radiation sources also are legally divisible. Atomic production and utilization facilities come under federal authority; these facilities include atomic reactors, plants that separate isotopes of uranium, chemical processing installations that separate uranium, plutonium and fission products, and works that fabricate elements for atomic reactors. Devices that employ radioactive materials (atomic byproducts) that have been produced in reactors also are subject to federal licensing and control. On the other hand, radiation sources, such as particle accelerators, X-ray machines, and fluoroscopic devices that are in nonfederal hands, come under state responsibility.

In a class by itself is the product legally classified as special nuclear material. This is a highly radioactive source and it is the heart of both the atomic bomb and the atomic reactor. Special nuclear material, as of now, is defined as plutonium, uranium enriched in the isotopes uranium 233 or uranium 235, or pure uranium 235 or 233. Regardless of whether this material is produced in federally or privately owned facilities, title to it belongs to the United States.

Artificially produced radioactive materials are classed according to their origin. If they are the products of any process that is subject to federal licensing, primary control and licensing of their use, possession and traffic lies with the national government.

Broadly speaking, therefore, the federal control system over radiation materials and sources is of the following order:

1. Every licensee or his staff must have had suitable training or experience to possess or use the material or facility (source material, atomic production and utilization facilities, special nuclear and byproduct materials) safely for the purpose for which it is licensed.

2. Equipment and facilities of each licensee must be appropriate to protect health and minimize danger to life and property.

3. The location must be approved by the Atomic Energy Commission as suitable for the purpose.

4. The material or facility may be used only for the purposes set forth in the license.

5. The material or facility may not be transferred except to persons authorized by the Atomic Energy Commission to receive it.

Accompanying the restrictions and requirements in the regulations governing the issuance of licenses and the specific terms of the license itself are the regulations dealing with the control of radiation. Basically, these regulations have three substantive sections.

The first deals with the standards which must be followed in handling radioactive materials, and the maximum dosages and concentrations to which workers may be exposed. In the second section, the subjects of interest are the methods of disposal of radioactive wastes and the levels of radioactivity beyond which a waste cannot be deposited in a specified depository, that is, in sewers, streams, the air and so on. The final section deals with a variety of subjects including such important ones as: making continual surveys of the installation for radiation hazards; monitoring workers to ascertain their daily radiation dose; erection of caution signs, labels, and signals; storage of radioactive materials; and instructing workers regarding safe procedures for handling and utilizing radioactive materials.

There now appears to be a possibility of federal-state cooperation in inspection of licensed atomic installations. The unfolding policy of the AEC is to encourage state agencies to participate with the commission inspectors in the inspection of federal licensees. In furtherance of this policy, the AEC is contemplating a series of conferences with the governors of the states for the development of a broad program of cooperation between the states and the AEC. The goal of this approach is to develop a basis upon which the available technical resources of a given state may be employed in assisting the commission in its inspectional activities.

As stated by Mr. Harold L. Price, Director, Division of Civilian Application, AEC, in testifying before the Congressional Joint Committee on Atomic Energy:

> . . . our inspection would contemplate that we would only use State inspectors to the extent that we would work out an agreement with the States to have qualified people which we would work with and in the States which had not adopted any inspection program and did not have people to do this work, we would do it directly. This is just a matter of supplementing our own forces in those States that have a contribution to make. (U.S. Cong., Joint Committee on Atomic Energy, *Development, Growth, and State of the Atomic Energy Industry,* 85th Cong., 1st sess., Part 2, p. 702)

The preponderance of federal authority in the field of atomic energy does not necessarily exclude the states from responsibility for the health and welfare of their citizens. As one important example, let us consider some of the many unusual problems radiation poses for the ordinary civil law which is, after all, one of the major responsibilities of state government under our form of government. The fundamental difficulties lie in three areas. One is the lack of knowledge we have concerning the extent of injury a given radiation accident might produce and, therefore, the size of the judgment to be rendered. Second, radiation is such a novelty that the law has not provided a method for determining responsibility. Third is a subject that turns on the second, the extent of liability: does it cover every party that somehow might be connected with the accident, making each of them liable? Unfortunately, statutory law is not apt to give us clear-cut answers to these questions. Also, in many states non-profit organizations are not legally liable to the extent that other parties are. If, for example, a hospital dumped dangerous radioactive materials into the sewer, possibly through the negligence of one of its employees, conceivably it could not be held liable in a civil suit for the damage it has done.

Consideration of these problems leads logically to questions involving workmen's compensation. Today, a number of states have workmen's compensation statutes that are poorly adapted to cope with the many unique problems surrounding atomic or radiation injuries. Actually, in several states radiation injuries are not legally regarded as disabilities for which claims may be filed.

Finally, there is the matter of the environment itself. To some extent the national government concerns itself with this by requiring that no more than a certain radiation level or concentration be permitted to escape from a licensed activity; it also sets rigid requirements governing the disposal of radioactive wastes by licensed installations or users. However, the determination of the accumulated dosage the public receives remains, under existing conditions, the responsibility of the state.

And by no means are these the only problems. There are many others, including the matter of state and federal consent for the construction and location of atomic power reactors, the regulation by state agencies of the rates charged for electric power made by an atomic power reactor, and so on. However, power reactors probably will be a relatively rare sight on the American scene for at least another decade. Particle accelerators and X-ray machines, on the other hand, will be much more numerous; installations that use various radioactive materials will become commonplace.

Today more than 445 firms are using radioactive materials for gauging, another 128 are applying them for radiographic inspection, while close to 400 firms are employing them for their radiation effects. Moreover, not one state in the union is without an industrial user of radioactive isotopes. As for the number of firms that use X-ray equipment, there are no reliable statistics, but they number well into the thousands, spread all over the land. Particle accelerators are becoming increasingly useful in industry and present experimental work shows that, in a matter of time, they may be fairly common in the food processing industry for preservation purposes.

Both medical and agricultural research are profiting by the use of radioactive materials; several different types are used in medical therapy. Direct application of radiation in agriculture is of little use, at this time or in the foreseeable future, but its implications for agricultural research are quite startling.

For these reasons, state legislation and administrative regulations are becoming more justified as each day passes. Hence it is legitimate to ask as to the direction state policy should take.

State Legislative and Administrative Programs

Today about twenty-eight of the states have administrative agencies that have some authority to take action for the control of radiation hazards or to fix standards on human exposure to radiation. Nevertheless, even the states whose agencies have the most comprehensive authority are not in position, except for about eight of them, to know the number or location of radiation sources or the quantity of radioactive materials in their territory. Also, it is unusual for a state to have any established requirements concerning the qualifications of personnel who handle or use radioactive materials or sources. Furthermore, quite a number of the states do not provide adequate workmen's compensation coverage for people employed in occupations using radiation.

Before the states take any further action, it probably would be well for each of them to study their needs in relation to existing administrative and legal deficiencies and prospective developments.

Study Groups and Commissions

While some twenty states have undertaken studies of atomic energy, the organizational forms for pursuit of the investigation have varied from state to state. Despite this diversity, several rudimentary forms are discernible. Generally speaking, there are approximately four different approaches. The legal derivation of their authority—legislative or executive—also varies.

One method is to have the governor appoint an atomic coordinator to study the state's over-all needs in the area of atomic energy and radiation. Other states have a commission, also appointed by the governor, that serves in the same capacity.

Perhaps the signal advantage of these two forms is the fact that such organizations are permanent and are charged with responsibility to make continuing studies. In view of the swift changes that have occurred in atomic energy and will probably continue to occur, the legislature and executive of the states that have such agencies probably will be better informed. Some states achieve the same end by requiring their regular administrative establishments to make continuing studies.

A second study device is to create a temporary commission for the specific purpose of making the study. Membership of such commissions varies from state to state. Some commissions are composed exclusively of legislators or executives or administrators; others include representatives of the public, experts, and special interest representatives.

Assigning the responsibility for making a study to existing state agencies is another concept. This has, in common with the first, the advantage of becoming a permanent fixture that may well serve to keep the elective officers and the administrative agencies advised of the latest developments in radiation and atomic energy generally. However, this plan may suffer from a lack of coordination because of the number of agencies involved.

Finally, appointment of an advisory committee to the legislature or to the governor is employed in several states. The former is more common and when the committee has legislative members it probably will prove to be a more effective instrument.

What are some of the areas that need study group investigation and subsequent legislative or administrative action?

Workmen's Compensation

This subject, as much as any other, needs close examination. Surprising as it may seem, a radiation injury is not an injury in nine states. That is, a worker who suffers a radiation injury because of conditions of employment would not have a legal right to make a claim in these states. This condition exists because of the early practice of including in workmen's compensation statutes a schedule of diseases and injuries for which compensation could be collected. The gross inadequacy of this practice was recognized by many legislatures and corrective steps have been taken. A number of states instituted the so-called full-coverage clause which takes into account, by broad definition, almost every conceivable disease or injury that might arise from conditions of employment. Similarly, other states have amended their schedules by adding full-coverage clauses. However, nine states still have not adopted full-coverage provisions.

Another feature of some existing compensation laws that may be regarded as an inadequacy is the practice of setting limits on the amount of medical aid an injured person may receive, or limiting the length of time he may undergo treatment. Radiation injuries are of such a nature that limitations of this sort could prove to be tragic. In the first place, the cost of treatment might easily exceed $50,000 in many instances. Also, the nature of radiation injuries is such that they require long periods of treatment and observation.

Of even greater difficulty is the question of proving the causal relationship between the disability and the employment conditions when radiation is involved. The fact is that the symtoms of radiation illness may not become apparent for a number of years. Here is one suggestion for overcoming this obstacle that has been advanced: it would be presumed that an illness or injury is radiation caused, either directly or by the aggravation of the underlying pathology of the condition, unless substantial evidence proves otherwise. Obviously, inclusion of such a provision in a statute cannot be undertaken lightly. Therefore, recognition of the existence of such a problem is probably the first order of business and once this is accomplished, a solution satisfactory to all may follow.

In much the same channel is the existence, in some states, of a fixed time limit during which the worker may file a claim for compensation. These filing dates range from 120 days in several states to three years in others. However, in many radiation cases, even the latter time specification may be inadequate. Recognition of a radiation illness may not occur until as long as thirty years after the exposure. It is not at all unusual for two to five years to pass before there is an awareness of the existence of a radiation injury. Overcoming this statutory barrier is not easy because of the difficulty of fixing a satisfactory solution in the law that will insure adequate flexibility while retaining equity. Somehow, the statutes need to be amended so that administrative discretion can be employed in determining the time when an employee knows or ought to know that he is suffering from a radiation illness. In other words, this is the sort of situation where each case must be judged separately and for which a rigid formula is practically impossible.

Finally, there is the question of fixing or apportioning the liability. When a worker has been employed by a number of employers, several states apportion the liability among all prior employers. Other states assign liability to the last employer. Each of these situations poses a number of problems; the latter especially may work a grave injustice on the last employer. On the other hand, what do you do when you discover that one or more of the previous employers have gone out of business or have left the state and are no longer carrying compensation insurance? A fair solution appears to lie in the establishment of a fund that would compensate a worker for injuries sustained in previous positions, while his last employer would be responsible only for injuries that were proved to have occurred during employment there. By this method, the worker would be assured of some compensation and the last employer would not be required to carry a burden that was not his.

All of these issues point up the need for a radiological code that will reduce the probability that such injuries will occur in the first place.

Radiological Codes

Only four states have what might be called comprehensive radiological codes. While it is true that a number of states have statutes that grant broad rule-making powers to administrative agencies, permitting them to take some action to protect workers and the public from radiation hazards, the agencies appear to be reluctant to act because of the lack of precedent in their states for detailed administrative codes.

In other states, however, the statues granting the rule-making power are so narrow that the only means of protection available is for an administrative officer to take an owner of a radiation source into court and charge him with maintaining a public nuisance. This is like locking the barn after the horse has been stolen, for the damage may be so extensive that sending the proprietor to jail or fining him serves little purpose. On the other hand, the lack of standards involved here is enough to discourage widespread use of radiation sources or materials after a case or two of this type has been prosecuted. The "public nuisance" doctrine might have been satisfactory for another day, but it is of little utility in exerting public control over radiation hazards today.

Therefore, assuming that the use of radiation sources will become increasingly widespread, a radiological code seems to have high priority. In establishing means of control, one of the first questions is how to identify and locate the existence of radiation sources and materials now within the state and any subsequently brought in. This immediately raises the further question of licensing or registration. Without going into specifics, it can be said that both serve the same purpose but licensing is apt to be more costly to administer. Through a license or registration, it will be possible to ascertain the type and number of radiation sources and their locations within the state. Since we require registration of firearms, automobiles, and dogs, registration of radioactive sources and materials does not seem to be asking too much.

A precedent for the states to establish a registration system exists in the present AEC practice of reporting to each state federal licensing actions within that state's jurisdiction. Further, each applicant for a nuclear facility license is urged to discuss his plans with the appropriate state agencies.

The actual drafting of the code should not concern the legislature. All the legislature needs to do is to fix the broad outlines, authorize a rule-making power, and establish certain procedural rights. Any attempt by the legislature to fix in the statutes such things as maximum radiation dosages, permissible concentrations of radioactive materials in air or water, or the specific type of safety and protective equipment may prove a sad mistake because later findings may show these statutory standards to be unsound or too strict. Because of the nature of the legislative process, amending existing legislation may require so much time that untold harm might result or progress might be hindered because of unreasonable restrictions. The legislature would be better advised to leave the drafting of the code to the proper administrative agency, then check periodically to see that the agency is incorporating the latest changes.

In broad outlines, most present-day state radiological codes, and the model ones as well, are constructed around three major points: 1. the types and amounts of exposure a worker may be subjected to with respect to the whole body and its various parts, the maximum permissible concentrations of various radioactive materials in the air and water, and standards regarding the amount of radiation to which the general public may be exposed; 2. standards and concentrations of radioactive materials in waste products and the methods of their disposal, and 3. stipulations concerning the erection of various warning signs and signals, monitoring workers, training and employment requirements for personnel engaged in handling radioactive materials and sources, criteria for the storage of radioactive materials, types of shielding for various radiation sources, procedures to be followed in the event of accidents, kinds of surveys to ascertain the existence of radiation hazards, standards for ventilating equipment, respiratory masks, and protective clothing, and rules and regulations on eating and smoking in rooms where radiation may be water, air, or surface borne.

Neither technically nor scientifically is there anything to fear about the availability of the latest information required to keep such regulations up to date. It is the official policy of the Atomic Energy Commission to cooperate with the states on radiation problems and to keep them posted on its findings. Further, the

National Bureau of Standards, with the advice and assistance of the National Committee on Radiation Protection, compiles periodically a series of handbooks pertaining to radiation and its control. Most radiological codes in existence today are based on the following handbooks: "Maximum Permissible Amounts of Radioisotopes in the Human Body and Maximum Permissible Concentrations in Air and Water" (no. 52) and "Permissible Doses from External Sources of Ionizing Radiation" (no. 59). The easy access to these documents assures the states of being able to keep up with the latest scientific findings without any substantial expenditures of funds.

This by no means concludes a state's responsibility. Sooner or later municipal or county building, zoning, fire, electrical, and plumbing codes, for example, will need to be concerned with radiation matters. Is the state going to maintain a hands-off policy on local conditions or will it attempt to provide some sort of guidance for local governments? The obvious answer would be to develop some sort of integrated program that would provide a reasonable degree of uniformity throughout the state. In view of our strong tradition of local self-government, this may be rather difficult to do. Yet unless we are prepared to accept a patchwork of varying ordinances, some sort of advisory service must be established to assist local governments in order to avoid excessive fragmentation while not giving an appearance of substantial centralization.

Civil Liability

Of late there has been considerable discussion, particularly among the legal fraternity, concerning the matter of civil liability for radiation damage. The question that must be answered is whether or not our existing civil law is prepared to cope with radiation matters.

Will a radiation facility be considered under the doctrine of strict liability for using dangerous substances and engaging in dangerous activities? Considering the fact that under strict observance of safety rules, radiation is not nearly as dangerous as an automobile, to which this doctrine has not been applied. We have a really difficult legal issue for under this doctrine the owner is liable for all damage and is held responsible for all events regardless of the degree or lack of negligence. Instead of this, the court might apply the doctrine of *res ipsa loquiter* which holds that the probability of an accident is remote if satisfactory precautions had been taken. Therefore, when an accident occurs, negligence is assumed and the injured party could recover damages without having to prove actual negligence.

Another aspect of this problem lies in the area of so-called third party liability. For example, a defect in a radiation source or a mishandling or misuse of radioactive material might result in an accident causing widespread damage and giving many bystanders cause for suit. Liabilty of the manufacturer, the contractor, the supplier, or other groups connected with the installation can be taken into account. Under the present interpretation they all could be liable. Under this doctrine, as contrasted to the former two, negligence must be established by the injured parties.

The existence of these doctrines has made it extremely difficult or impossible for users of radiation sources or materials, their suppliers, and the manufacturers and fabricators to obtain adequate insurance coverage. Therefore, should the state provide a remedy through legislation? The lack of any clear landmarks here has resulted actually in a reluctance on the part of many industries and businesses to consider entering the radiation or atomic energy fields.

Other Problems

In the next ten or twenty years, the states will be confronted continually with questions of whether or not they will allow the construction of atomic power reactors within their territory, where they will be located, the methods by which they may be financed or owned, and the rates to be charged for the energy offered for sale.

Use of radiation for preserving food and for sterilizing drugs is a factor that must be considered in future amendments to state food and drug laws. In addition, radioactive isotopes used in medical therapy must be taken into account. Some existing laws might ban such products implicitly or explicitly, while others might permit the sale of unsafe food or drugs prepared by unscrupulous manufacturers or processors. Radiological regulations on the disposal of radioactive wastes in the air or water must be considered in light of state policy on water and air pollution, stream control, and existing interstate compacts. Some conflict between policies is a probability.

But perhaps most important at this time is the manner in which the state proposes to administer its police power with respect to the effects of atomic energy on the public health and safety. A satisfactory solution to this may resolve many of the questions cited above.

Administering Atomic Energy Policies and Programs

Substantive legislation governing the possession, use, and disposition of radiation sources and materials need not be too extensive. Probably all the legislature needs to do is to set up some broad statutory outlines or to amend the basic laws governing existing agencies. Fundamentally, the type of legislation depends on the legislative policy concerning the administration of atomic energy control. In other words, shall the legislature create a new agency or utilize the existing organization? In the latter case, a few amendments may be all that will be necessary. Establishing a new agency would, of course, require a statute creating the agency, granting it powers, and providing for the appointment and tenure of its officers. Briefly then, there are two apparent approaches: utilizing existing agencies or creating new ones.

Use of existing agencies immediately raises a number of problems. First, of course, are the questions of conflict of jurisdictions, overlapping and duplication of regulations, and possible issuance of contradictory orders. After all, radiation control does cut across a number of agencies' jurisdictions; under their organic statutes each may have a claim to some responsibility. It is entirely possible that the public utility regulatory agency, the health department, the labor agency, the insurance commission, and the conservation agency each might have a legitimate interest in the regulation of a given radiation installation. The results of such a situation could be comical if it were not for the deadly material involved. Such a situation hardly would be conducive to atomic progress.

Then there is the question of personnel. Supervisory and policymaking positions in the agencies should be filled by men who have considerable educational background, some perhaps who hold doctorates. Personnel of this caliber are in short supply nationally and competition for their services is keen. The situation is not improved when four or five additional agencies join the manhunt. And of course, efficient use of trained personnel and economical use of state funds must be considered.

Awareness of these considerations has led to two administrative developments. One is to retain the existing agency approach but to utilize a coordinator—either an individual, a committee, or a commission. The other is to create a separate agency. The latter is still only a recommendation and has yet to be employed, while coordinating devices are now being used in five states.

Coordinating Committee

First implemented in New York, this seems to be a successful method of coordinating and integrating actions of the various agencies, at least so far. The governor last year appointed the heads of three key agencies to serve him as an advisory and coordinating body. The committee has become a forum in which to exchange informal views, review and coordinate regulations, and settle jurisdictional issues. Whether it can solve personnel problems remains to be seen. But once the committee has been in operation for a period of time it may be able to develop some sort of system for allocating technical people throughout the administrative establishment.

The next step in this organization's evolution no doubt will be the establishment of a staff to coordinate its work. How to overcome agency insularity and professionalism probably will be the committee's major problem in the next decade, rather than the control of radiation *per se*.

Executive Coordinator

This plan, now in use in several New England states, also works within the framework of the existing administrative organization. Unlike the committee method it does require some legislation and adds at least one new employee to the state rolls. Under the New

England scheme, the governor appoints a coordinator to serve as his advisor and the coordinator of the state's atomic energy policy. The legislation requires existing state agencies to make continuing studies and to recommend new legislation if necessary; the studies and recommendations must be submitted to the coordinator for final integration and presentation. Further, the agencies are required by law to keep the coordinator informed of all their activities relating to atomic energy. Although each of the agencies is vested with rule-making powers, they cannot issue any regulations or orders until they have been reviewed by the coordinator and his views have been made known.

Either of these two devices—committee or coordinator—is apt to appear more attractive to smaller and less industrialized states. Neither plan adds greatly to the taxpayers' burden, nor does either expand the existing administrative structure. Such is not the case with the following two recommendations. On the other hand, creation of agencies of this second type probably will assure a superior level of performance.

Central Agency

The National Committee on Radiation Protection (National Bureau of Standards Handbook no. 61) has recommended the passage of state legislation that, among other things, would create a central and independent agency. The director of the agency would be assisted by a technical advisory board of five members who are experts in various scientific fields. The functions of the agency would be to develop various policies and programs, determine hazards, issue regulations and orders, make inspections, report deficiencies, and take legal action when its orders and regulations are disobeyed or violated.

This approach has been rather severely attacked on the grounds that it would be nothing more than an atomic bureaucracy. Be that as it may, this plan would assure that the program was professional in its outlook, and also it would economize on the number of professional personnel required to staff the state regulatory functions. After all, inspectors need not be highly educated, just well trained. Thus people who have advanced education are used for purely policy-making positions.

Specialized Rule-Making Agency

The specialized rule-making agency plan combines certain features of the central agency approach with the use of existing agencies. Conceived by the Michigan Memorial Phoenix Project of the University of Michigan Law School, this proposal envisions separation of the regulatory from the enforcement functions. Rule-making functions would be assigned to a specially constituted independent agency of experts on radiation and atomic energy who would be responsible for issuing all regulations dealing with atomic energy. Enforcement of these regulations, however, would be left to existing state agencies. Apparently the board would resolve any jurisdictional conflicts and assign responsibilities where the law was unclear. This plan seems to have the unique advantage of minimizing jurisdictional conflict without disturbing the equilibrium of the existing state administrative pattern.

Officially, the Atomic Energy Commission has advised the several states, via the Council of State Governments, that it favors the adoption by the states of the New England type of legislation. The rationale of the commission for this view rests on the following points:

1. The legislation serves the purpose of directing the attention of state officals to the problems of the atomic era and requires them to make continuing studies that would encourage the development of an atomic industry without jeopardy to the public health and safety.

2. In creating the office of coordinator, the legislation assures the integration and coordination of a given state's activities and provides a device for cooperation with the national government and sister states.

3. The legislation creates machinery for the development of regulations to cover forms of radiation not regulated by the Atomic Energy Act.

4. The legislation provides a means for enforcing federal li-

censing requirements without imposing additional burdens on AEC licensees and avoids the possibility of conflicting interpretations of the necessity for a federal license.

Commission encouragement of the states to take legislative and administrative action in the field of atomic energy is predicated upon recognition of the growing importance of atomic energy to the nation's economy. Recommendation of a particular form of action stems from the commission's fear that unless the states act in a more or less uniform manner, confusion and conflict will prevail. As a consequence, the health and welfare of the public may be jeopardized while applications of atomic radiation are frustrated. Regulatory uniformity is possible, however, without administrative uniformity in the several states. The attractive feature of the New England plan is that it accommodates administrative diversity without compromising the prospects for regulatory uniformity throughout the land.

Summary

Atomic radiation can provide the nation enormous benefits in medicine, agriculture, and industry if it is properly used and controlled.

Radiological applications in medicine promise to give us many answers about life processes, to serve as diagnostic aids with a high degree of precision, and to provide a source of therapy for many conditions where treatments in the past were inadequate. Some experts now believe that the present life span may be extended considerably because of radiation.

Agricultural research has much to gain from the use of atomic radiation. Through it our scientists can acquire greater knowledge of the life processes in plants and animals, develop new and stronger strains of plants, employ fertilizers more effectively and control insect infestation of growing and stored commodities. Further, radiation appears to have certain attributes for preserving various food products so that perishability will no longer be a major factor in distribution and marketing. In short, radiation may be able to provide the population a better and more varied diet at reasonable cost.

Radiation has widespread applications in industry. Many companies have found radiation to be a precise tool for quality control of their product, thus assuring the consumer a superior product at less cost. In addition, radiation may prove to be a real boon in the coming decades as we run short of many scarce materials. With the use of radiation, many new materials and chemicals may come on the market either as substitutes for or as substantial improvements over those widely used in the past.

We now are able to harness the energy of the atom to produce electricity, to run ships and to provide heat for various industrial processes; we are putting radiation to work in medicine, agriculture, and industry. Because of its lethal qualities, rigid control is required to utilize radiation without harm to humanity. For the time being, the national government is regulating and controlling some of the more dangerous radiation sources and materials, but by no means all of them. As a result, the Atomic Energy Commission is obligated to exercise many of the functions that ordinarily would be performed by state and local governments. However, the commission has other responsibilities, such as providing the Air Force, Army, and Navy with the latest atomic weapons with which to protect us from any aggressor, and conducting research programs for the development of the peaceful applications of atomic energy. In a word, we are asking or expecting the commission to divert many of its energies from these tasks to exercise functions that traditionally and normally have been the responsibilities of our states and their subdivisions. To this end, the AEC is striving to relieve itself of some of its existing administrative burdens by requesting congressional action that would encourage state participation and cooperation. Essentially, the commission desires to achieve two objectives: one, to clarify its authority to enter into agreements with the several states to utilize the services of the states in connection with the commission's inspection activities, and two, to clarify the roles of the states and the AEC in protecting the public health and safety from the hazards of radiation.

In order to prepare the states for this eventuality, the commission has been and is continuing to take steps to train state and local officials in various aspects of atomic energy. The nature of our federal system, however, is such that unless the states take corresponding action, federal legislation of this order has little meaning.

In the past, the lack of state activity could be justified both on legal grounds and the lack of technical knowledge. Justification of this position becomes less and less tenable as the years go by. Therefore, if the states of the union desire to assure their citizens of the maximum benefits of the atom with the maximum protection to the public health and to the health and safety of workers employed in atomic installations, then the time has arrived for all forty-eight states, not fifteen or twenty, to cooperate and work with the Atomic Energy Commission to relieve it of some of its responsibilities and to assume responsibility for areas not embraced by the commission's statutory jurisdiction.

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