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UNITED STATES ATOMIC ENERGY COMMISSION

LETTER

FROM THE

CHAIRMAN AND MEMBERS OF THE UNITED STATES ATOMIC ENERGY COMMISSION

TRANSMITTING

PURSUANT TO LAW THE SECOND SEMIANNUAL REPORT OF THE UNITED STATES ATOMIC ENERGY COMMISSION

JULY 23 (legislative day, JULY 16), 1947.—Referred to the Joint Committee on Atomic Energy

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LETTER OF SUBMITTAL

JULY 22, 1947.

The honorable the PRESIDENT PRO TEMPORE OF THE SENATE OF THE UNITED STATES:

The honorable the SPEAKER OF THE HOUSE OF REPRESENTATIVES OF THE UNITED STATES:

SIRS: We have the honor to submit herewith the second semiannual report of the United States Atomic Energy Commission, as required by the Atomic Energy Act of 1946.

There are a number of important phases of the atomic energy program which cannot be presented in a public report of this character. They are discussed at appropriate times with the Joint Committee on Atomic Energy, which was authorized by the Congress to receive information on all activities of the Commission.

Respectfully,

UNITED STATES ATOMIC ENERGY COMMISSION.
ROBERT F. BACHER.
SUMNER T. PIKE.
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WILLIAM W. WAYMACK.
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SECOND SEMIANNUAL REPORT TO THE CONGRESS BY THE UNITED STATES ATOMIC ENERGY COMMISSION

I. Summary

Congress has declared that it is "the policy of the people of the United States" that the Atomic Energy Commission shall carry out its broad statutory program "subject at all times to the paramount objective of assuring the common defense and security." Accordingly, it has been the determined purpose of the United States Atomic Energy Commission, during the relatively brief period of its functioning, to seek in every way to maintain and indeed to increase this Nation's present preeminence in the field of atomic energy.

The Commission believes that this is an objective that will require for its achievement nothing less than the very best scientific, industrial, and managerial skill that this country possesses.

It is the Commission's judgment, and it so reports to the Congress, that if this preeminence (so closely related to "assuring the common defense and security") is to be maintained and increased then many talented people and many well-managed industries and other private undertakings now otherwise engaged must actively participate in the atomic energy program, even if this requires that for a time they set aside what they are now doing.

During the brief period of its incumbency the Commission has pressed the production of fissionable materials and the improvement of atomic weapons as essential to the security of the country. It has pushed ahead in the search for the further development and wider application of atomic energy and its byproducts to peacetime uses that will increase the country's economic and industrial strength and improve its social and physical well-being.

Great effort is necessary if this country is to hold and extend its leadership. The continuation, or even improvement, of processes of present type is not enough. To rely on existing knowledge alone could be disastrous. New efforts in fundamental research must be made comparable in intensity and breadth of imagination to the wartime effort which produced the world's first nuclear chain reactor and first atomic bomb. The recently established frontiers of atomic physics must be greatly expended. Innumerable technological difficulties, now standing astride the road of progress, must be overcome. More effective production methods must be developed.

Although our long-range preeminence in the field of atomic energy requires major scientific and technical advance, our immediate national security demands that present operations continue without interruption. The assistance of the War Department made possible the transfer of the Manhattan Engineer District's activities to the Commission without interruption of operations. The Oak Ridge, Tenn., facilities for separating the uranium-235 isotope are operating steadily. The production of plutonium is continuing at Hanford, Wash. At these and other sites, improvements and economies have been made in production operations, and new processes have been developed.

The Commission has given principal attention to fulfilling the requirements, established by the President with the advice of the armed forces, as to production of fissionable materials and atomic weapons. The atomic weapons program is being carried forward at the Commission's Los Alamos laboratory near Santa Fe, N. Mex. We mean to maintain and increase the present preeminence of the United States in atomic weapons until such time as the Congress affirms that acceptable international agreements have been reached and the appropriate machinery has been established to insure that this activity can be relaxed without endangering the national security.

Basic raw materials are required to support and control the production of fissionable materials and the improvement of atomic weapons. Procurement of ore is supervised by the Commission's Office of New York Directed Operations. Known supplies of ore are being surveyed and new sources sought. Ores continue to move to the processing centers and quantity production of feed materials is being maintained. The Commission took affirmative action to control the transfer and use of source materials by issuing formal regulations effective March 31, 1947.

The vigorous support and stimulation of both fundamental and applied research activities are essential to the Nation's atomic energy program. Tomorrow's military and industrial applications of atomic energy depend upon today's research. With the continuing counsel of the General Advisory Committee and of various ad hoc review or advisory groups, the Commission is stimulating advances on a broad front in fundamental nuclear physics, chemistry, and metallurgy. In this way, it is expected that scientific and technical horizons can be expanded so as to permit eventual achievement of goals that are unattainable today.

Specialized facilities are necessary for this work. A number of well-equipped laboratories are already helping to meet this need and new laboratories are being developed. The majority of the larger laboratories are owned by the Federal Government; others are owned by industrial concerns, universities, and other research institutions. In some cases, privately owned laboratories are furnished with Government-owned equipment for use in the Commission's program.

The Commission's five principal laboratories are well distributed geographically. The Los Alamos laboratory, in addition to being the center of the atomic weapons program, is doing important research work in fundamental nuclear physics. The oldest of the Commission's principal laboratories is the Argonne National Laboratory, located just outside Chicago. Its facilities are exceptionally good and are being extended. They now include two experimental nuclear reactors. A third reactor, of unique characteristics, is now in the design stage. The Clinton laboratories at Oak Ridge, Tenn., possess extensive facilities which include the nuclear reactor responsible for producing the important quantities of radioisotopes now being distributed to qualified applicants in nearly every part of the country. The Brookhaven National Laboratory and the Knolls Atomic Power Laboratory, newest of the Commission's research centers, are being constructed at Patchogue, Long Island, N. Y., and Schenectady, N. Y., respectively.

In several of these laboratories research activities are not carried on exclusively by the resident staffs. There are already 29 universities participating in the work at the Argonne National Laboratory. Fourteen universities are becoming active in the Clinton laboratories program. Nine universities share the supervision of the Brookhaven National Laboratory. In this way, the fund of knowledge regarding atomic energy is being expanded, the interest of educational, industrial, and other research institutions is being further stimulated, and increasing numbers of young scientists are being trained in this new and growing field.

There are other excellent laboratories already in operation or being built. There are large laboratories operated under contract with the Commission at Berkeley, Calif.; Ames, Iowa; Dayton, Ohio; and Hanford, Wash. Important work for the Commission is being done at Columbia University in New York City, the Battelle Memorial Institute in Ohio, the Massachusetts Institute of Technology, and elsewhere.

Research is being carried forward not only in the physical and chemical sciences, but also in health physics. Despite a severe shortage of physicians and biophysicists competent in the nuclear field, continual improvement has been made in the ability to detect, and eliminate or reduce, health hazards; to detect the earliest signs of actual injury from radiation; and to provide effective treatment. Such advances result in greater safety for workers, improved morale, greater continuity of operation, and substantial dollar savings.

To obtain informed recommendations for improving its health physics program and for generally assisting medical research and training of students in this field, the Commission appointed a Medical Board of Review. In accordance with the recommendations of this Board, a permanent Advisory Committee for Biology and Medicine is being established.

The successful prosecution of the vast atomic-energy program depends upon the contribution of many and varied segments of American life. Government agencies, industrial concerns, universities, and other educational and research organizations are now participating in the Commission's research and production program under contracts and agreements with the Commission. Through such participation the recognized managerial skills and scientific and technical talents of many organizations are available to the enterprise. The Commission has more than 100 contractors, and these in turn have several hundred subcontractors. None of the Commission's major production and research programs is carried on by direct Commission operation.

To supervise and manage an undertaking of this character and scope requires that the Commission's agency be soundly organized and effectively managed. The organization inherited by the Commission from the Manhattan Engineer District is now being converted from an organization centralized at Oak Ridge, to a largely decentralized organization, with staff service headquarters in Washington. Five major centers of operations are to be established. Broad delegations of authority will be made to each center so that many problems may be handled and decisions reached on the spot. Two such centers (New York and Santa Fe) have already been thus created. Other centers shortly to be given comparably broad delegations of authority are at Oak Ridge, Chicago, and Hanford.

To provide security for properties and restricted data involved in the program, the security regulations in force when the Commission assumed operating responsibility on January 1, 1947, have been maintained, and a survey of their effectiveness has been instituted. As this very extensive survey and inventory of practices proceeds, changes to provide for greater security and workability have been made. Other changes will be made as required. This is a matter receiving continual review and consideration by the Commission.

An important beginning has been made at exploiting peacetime uses of atomic energy. Radioisotopes, a most promising research tool in chemistry, biology, and medicine and of great promise in agriculture and metallurgy, are being produced and distributed in ever increasing quantity. Shipments to hospitals and other research insititutions now exceed 100 per month. Heavy hydrogen, another isotope of particularly great use in many kinds of research, is now being made available for the first time at low cost. Nuclear radiation services, too, are now being provided to qualified research agencies.

Large scale production of power for industrial and community use continues to be a major, if long term, goal. The experimental reactors now being designed will provide much of the engineering data essential to such a power program. But a number of basic advances in physics, chemistry, and metallurgy will be required before power is produced at satisfactory efficiency and cost. The technical problems to be overcome are many, but we confidently expect them to be solved. It is speculative, at this stage of development, to estimate how long it will be until power production units feasible for large-scale commercial use will be available. Such power, when attained, will almost certainly supplement rather than supplant water power, and power derived from coal, oil, and gas.

II. Organization and Plan of Operation

The properties and operations of the War Department's Manhattan Engineer District were transferred to the Atomic Energy Commission at midnight of December 31, 1946, under terms of Executive Order 9816. As the Commission indicated in its January 31, 1947, report to the Congress, the cooperation of the Government agencies affected made it possible for the documents of formal transfer to be prepared by that date. So vast an enterprise as that managed by the Manhattan Engineer District could not, however, be turned over physically merely by a single act of formal transfer. Many problems incident to the transfer were encountered. They differed widely from one installation to another. The War Department has made a large contribution in planning and personnel to make sure there would be no break in the continuity of operations.

Since January 1, 1947, the Commission has been faced with many unusual problems due to the need for uninterruptedly continuing and improving its operations while at the same time recasting much of its organization and building a headquarters staff to meet the new and very extensive responsibilities placed upon it by the Atomic Energy Act of 1946. These responsibilities extend to procurement and processing of source materials, producing fissionable materials, and production and improvement of atomic weapons. In addition, they include improvement of present processes, development of new processes, advancement of fundamental research, and production and distribution of radioisotopes. Furthermore, they include assisting medicine, industry, and agriculture to make full exploitation of the new materials and methods being made available. To accomplish successfully a program of this size, complexity, and scope, the Commission must necessarily recruit and retain in its service the best available managerial and scientific skills, develop a sound organization, and adopt an effective and efficient plan of operation.

The Commission's activities must be carried on within the framework of a different kind of organization from that of the Manhattan Engineer District in order to meet the new responsibilities and to meet the demands of peacetime operations. The Manhattan Engineer District's organization was in many respects a highly centralized one, with Oak Ridge serving as the major control point. The Commission's present plans call for a decentralized organization wherein broad operational authority is delegated to five major centers of operation. Each of these centers will be responsible for a different part of the total program and will exercise its authority within clearly stated limits and subject to general policies established in the headquarters office in Washington, D. C. The new arrangement is designed to minimize much of the delay and procedural involvement that might accompany the continued centralization of the vast enterprise either in Oak Ridge or in Washington.

The first of the five major centers of operation to receive such new and broad delegation of authority was the Office of New York Directed Operations, which was thus established on June 9, 1947. The Office of Santa Fe Directed Operations was the second center to be thus established, on July 2, 1947. The three other centers which are to be given broad delegations of authority as soon as feasible are at Oak Ridge, Tenn.; Hanford, Wash.; and Chicago, Ill.

The headquarters organization in Washington, D. C., consists of the five Commissioners, the General Manager, and the staff.[1] The following four divisions were established by the Atomic Energy Act of 1946: Division of Research, Division of Production, Division of Engineering, and Division of Military Application. The Commission has established additional units to assist it in carrying on essential functions relating to organization and personnel, budget, accounting, legal services, security and intelligence, information, and administrative services. The Commissioners with the aid of their staff and field offices as well as other advisory groups established the general policies in accordance with which actual operations are supervised by the centers of operation.

To carry out necessary production and research operations, the Commission has followed the Manhattan Engineer District's practice of using contractor-operators. Contracts are made with industrial concerns to manage production operations; contracts are made with industrial concerns, universities, and other scientific organizations to carry out the principal research operations. As previously stated, the Commission has more than a hundred contractors, and these in turn have several hundred subcontractors. In making use of qualified

[1] The nominations of the Commissioners and the General Manager were confirmed by the Senate on April 9, 1947.

contractors, the Commission is extending a broad pattern of participation by industry, universities, and other private institutions in exploring the potentialities of the new field of atomic energy, and at the same time is benefiting by drawing on the recognized managerial and technical resources of these institutions. The Commission's activities, therefore, are carried out as the result of a cooperative effort among government, industrial concerns, and educational, scientific, and other private institutions. This involves many difficult and often novel relationships requiring imagination, good organization, managerial skill, and scientific and technical assistance for their satisfactory adjustment.

The Commission is convinced that there is opportunity for improving and at the same time simplifying relations with its contractor-operators. Accordingly, it has created a special board to examine current contracts and contractor relations and to recommend appropriate changes.[2] This board has already made important recommendations which will aid the Commission in its decisions on these matters. An example of improvement in contract provisions is the Commission's recently adopted practice, in arranging certain types of research contracts, of making commitments covering 3 years' salary of key scientists. Such commitments are expected to help the contractor attract and hold top-caliber scientists.

Some changes in the general plan of both organization and operation will undoubtedly be required from time to time. The Commission realizes that a process of trial and error is necessary in order to find the best form of peacetime partnership of government, industry, and educational and scientific institutions. The following pages describe, within the limits imposed by security considerations, the various types of operations being conducted.

III. PRODUCTION

SOURCE MATERIALS [3]

The New York office is responsible for procuring and processing source materials. Through its contractors, and with the help of several cooperating Federal agencies, it evaluates present sources of ore, seeks new sources, develops improved methods of ore assay, and is contantly seeking to improve yields and to decrease costs. Improvements made in one plant are immediately made known to any other plants performing similar operations. The unit cost of one raw-materials process has been decreased by approximately 75 percent during the past 4 years, and unit costs of the majority of the associated processes have also been decreased to important extents. Improvements recently accomplished in source-materials processing alone are expected to result in economies of several million dollars in the fiscal year 1948.

Regulations recently issued on control of source materials are discussed in part VII of this report.

[2] Members of this Advisory Board on Relationships of the Atomic Energy Commission with its contractors are Messrs. J. R. Loofbourow (chairman), J. W. Hinkley, W. A. W. Krebs, Jr., R. H. Robnett, A. Tammaro.

[3] Sec. 5 (b) (1) of the Atomic Energy Act states that the term source material "means uranium, thorium, or any other material which is determined by the Commission, with the approval of the President, to be peculiarly essential to the production of fissionable materials; but includes ores only if they contain one or more of the foregoing materials in such concentration as the Commission may by regulation determine from time to time."

FISSIONABLE MATERIALS[4]

Production of fissionable materials continues to be the Commission's largest activity and represents the largest single item in the Commission's annual expenses. The importance of these materials is particularly great in view of their unique applicability both to military and nonmilitary purposes. Uranium–235 and plutonium are basic to atomic weapons, but they are equally basic to power production and to application of byproduct materials to research in chemistry, biology, medicine, and other fields.

Production of fissionable material has continued without interruption. Under the general direction of the Commission, production of U–235 is continuing at Oak Ridge. The Carbide & Carbon Chemicals Corp., which has operated the gaseous diffusion plant since its erection, also took over the operation of the electromagnetic separation plant from the Tennessee Eastman Corp. on May 5, 1947.[5] This action has resulted in considerable economy by reduction in general overhead costs for the operation of the two plants. Further economies have been effected through improvements in processes and operating methods.

Production of plutonium is continuing at the Hanford Engineer Works, operated under contract with the Commission by the General Electric Co. The Commission has recently initiated an extensive expansion program, which will include new community facilities, chemical processing plants, research facilities, and improvements to production units. A major part of the program will consist of constructing chemical processing plants, for which considerable development work is being carried out.

WEAPON DEVELOPMENT AND PRODUCTION

In accordance with the Atomic Energy Act of 1946, the Commission's "paramount objective" is to assure "the common defense and security." Accordingly, major attention is given to development and production in the field of atomic weapons. The magnitude of the program has been fixed by the President acting with the advice of the armed forces. Carrying out the program is largely a function of the Commission's Los Alamos laboratory, which is located approximately 35 miles from Santa Fe, N. Mex. Activities at this point are necessarily conducted under severe security restrictions, and no details will therefore be presented in this report. The Commission, in secret sessions, has described to the Congressional Joint Committee on Atomic Energy some of the principal activities, problems, and prospects of weapon development.

The Atomic Energy Commission is establishing proving grounds in the Pacific for routine experiments and tests of atomic weapons.

[4] Sec. 5 (a) (1) of the Atomic Energy Act states that the term fissionable material "means plutonium, uranium enriched in the isotope 235, any other material which the Commission determines to be capable of releasing substantial quantities of energy through nuclear chain reaction of the material, or any material artificially enriched by any of the foregoing; but does not include source materials, as defined in sec. 5 (b) (1)."

[5] The contract with the Carbide & Carbon Chemicals Corp. has been extended for an additional term of 4 years, to June 30, 1951.

IV. Research and Development

INTRODUCTION

The field of atomic energy is young and is changing rapidly. Tomorrow's military and industrial applications of atomic energy depend directly on today's research. Recognizing this, Congress, in the Atomic Energy Act of 1946, has stressed research activities.

The Commission's research and development program is a large one by any standards. It includes work done at all major sites owned by the Commission, as well as work performed at various privately owned locations. It includes work conducted, under agreements with the Commission, by industrial corporations, universities, and various agencies of the Federal Government.

It is difficult to express the size of the research and development effort in numerical terms. Many of the Commission's activities are unprecedented and exploratory. Even the largest production plants are being continually surveyed and improved, and are thus parts of a great development program.

The following paragraphs discuss some of the major objectives of the research and development program; later paragraphs describe the facilities employed. Medical research is discussed in part V.

OBJECTIVES

Prominent among the short- and long-term objectives of the Commission's research and development program are developing and improving atomic weapons; improving present methods of producing fissionable materials and developing new methods; developing special reactors; effecting large-scale production of power for industrial and community use; and advancing fundamental knowledge.

Improving the methods of producing fissionable materials.—The importance of improving the methods of producing fissionable materials is obvious. These same materials are the basis of both military and nonmilitary use of atomic energy. Present methods of producing them involve exceedingly high costs per unit.

To achieve economies in the production processes now employed, many different kinds of steps are being taken, as by attempting to find how to decrease the rate of depreciation of equipment subject to wear and corrosion, or trying to make more effective use of manpower. In operating a plant which cost several hundred millions of dollars and has operating expenses of tens of millions of dollars a year, the savings which may result from process improvements are impressive. This is particularly true since the present plants were built rapidly, without benefit of precedent, and with economy of construction and operation necessarily subordinated to speed.

Another important objective, and one obviously calling for a longer term effort, is finding new methods of producing fissionable materials. If such methods are to be found, and this is not out of the question, they will be found only after considerable advances have been achieved in fundamental physics, chemistry, and metallurgy.

Developing special reactors.—Reactors, ordinarily in the form of nuclear chain-reacting piles, are already serving many different research purposes. They are producing radioisotopes for distribution to research groups; they are being used for neutron irradiation of biological materials; they are being used in studies of neutron capture and neutron optics; they are producing engineering data of value in work preliminary to designing large reactors for supplying power. Many different kinds of reactors will be required in the future. To produce radioisotopes, a reactor may operate at low temperature; but to permit high efficiency of thermal energy conversion a reactor must operate at high temperature and employ special coolants. In a reactor used for producing plutonium it is not necessary to use enriched uranium; but when the desire is to obtain highest possible intensity of neutron radiation, use of plutonium or enriched uranium is essential. Furthermore, reactors may employ different kinds of coolants, different kinds of moderators, different provisions for subsidiary experiments. A later section describes some of the reactors already in operation and others in the design stage.

Effecting large scale production of power.—The Commission considers the development of nuclear reactors for power production one of the more important tasks placed upon it by the Congress. It is a large and difficult undertaking. The scale and intensity of the effort that will be required to accomplish it becomes ever more evident as research on the problem continues.

A central difficulty concerns the materials of construction. The materials that go into a reactor must have certain special nuclear properties; they must be almost completely free of certain contaminants; they must be appropriate to the mechanical design of the structure; they must withstand the intense flux of neutrons and radiations seething within the reactor; finally, they must resist corrosion by the cooling medium. The researches of the war years succeeded in finding materials which satisfied these stringent requirements well enough for the limited purpose at hand: i. e., water-cooled or air-cooled reactors operating at low temperature for experimental purposes or for producing plutonium. But power production with satisfactory efficiency and economy calls for much higher reactor temperature, much higher heat flow through the reactor structure, much higher fluxes of neutron and gamma radiation, and different cooling media. Every requirement on the construction material is tightened, and the range of materials from which a choice is possible is correspondingly narrowed.

Advancing fundamental knowledge.—The organized efforts of the war years were directed toward the practical goal of developing an atomic weapon. However, the properties of the elementary particles composing the nucleus are still nearly as little known as in 1940. The forces that hold the elementary particles together in a nucleus, the processes that occur when a nucleus changes its energy content or its electrical charge, the nature of the fission event itself, are still largely mysteries. To reach a satisfactory understanding of the atomic nucleus is perhaps the foremost task now facing the science of physics. It calls for theoretical work of the highest order of difficulty, and for experimental work of great ingenuity. It involves, at some points, the construction and use of large and expensive special equipment.

The only immediate goal of this research on fundamental nuclear processes is increase of knowledge. It is not now a necessary step toward the building of an atomic bomb or a controlled nuclear chain reactor. These devices have passed from the research stage into the development stage. However, it cannot be forgotten that they had their beginnings in the fundamental studies of many years ago. From the activity of fundamental nuclear research may come the new findings and the new ideas which will make the present nuclear technology obsolete. To neglect the exploration of this path is to renounce the intention of progress beyond the horizons now visible. Failure to press this fundamental exploration is to yield this Nation's preeminence in atomic energy and atomic weapons.

Traditionally, fundamental research thrives in the atmosphere of universities, where students are trained in its methods and acquire familiarity with its results. This is the time-tested source of young recruits to advance scientific knowledge and to turn scientific findings to practical use. The Nation's supply of trained nuclear scientists and engineers is now woefully short; vigorous activation of fundamental nuclear research in the universities and in central laboratories accessible to university students will gradually remedy this shortage.

Making a wise selection of research programs and contractors is of prime importance. A balance must be reached between the desire to provide healthy competition among different groups and the desire to avoid expensive duplication. The desire to start a large number of different projects must be weighed against the desire to achieve the most effective utilization of the short supply of scientists.

Assisting a number of service research and training programs.—The Commission, through assignment of space and technical services at Oak Ridge, is continuing to assist the training of special groups of service personnel in nuclear physics. It is at present continuing to assist studies being made on behalf of the Army Air Forces by the Fairchild Engine & Airplane Corp., as to the possibilities of applying nuclear energy to propulsion of aircraft. In addition, it is giving appropriate assistance to the Navy in connection with exploration of application of nuclear energy to propulsion of ships.

LABORATORIES

The Commission is giving vigorous support to fundamental research through its laboratories and through contracts with private institutions. Wherever possible, the Commission endeavors to give its research contractors considerable freedom of action within the prescribed field and subject to the general policies established by the Commission. This freedom includes choosing specific problems within a general assignment, recruiting scientists, and obtaining equipment. Assistance is given by the Commission's managers of operations and central staff wherever needed.

The Commission now has five principal laboratories, located in different parts of the country. Each has a majority of those standard research tools which are necessary in almost any research program and which are necessary also to give the scientific staffs training in commonly used equipment. But in addition to such standard equipment, various unique facilities are provided in accordance with the assigned fields of specialization.

Los Alamos Laboratory.—The Los Alamos Laboratory, in addition to carrying on the development of atomic weapons, is doing considerable work in fundamental nuclear physics. It has a low-power, homogeneous "water boiler" reactor operated by means of enriched uranium in the form of a salt dissolved in water. As previously stated, activities at Los Alamos are necessarily conducted under severe security restrictions.

Argonne National Laboratory.—The Argonne National Laboratory is a laboratory now occupying various sites in or near Chicago. It is operated under the Commission's guidance by the University of Chicago with the participation of the following 29 Midwestern universities and research institutions:

Battelle Memorial Institute
Carnegie Institute of Technology
Case School of Applied Science
Illinois Institute of Technology
Indiana University
Iowa State College
Kansas State College
Loyola University of Chicago
Mayo Foundation
Michigan School of Mining and Technology
Michigan State College
Northwestern University
University of Missouri
University of Nebraska
University of Pittsburgh
Notre Dame University
Ohio State University
Oklahoma Agricultural and Mechanical College
Purdue University
St. Louis University
University of Chicago
University of Cincinnati
University of Illinois
University of Iowa
University of Michigan
University of Minnesota
University of Wisconsin
Washington University (St. Louis)
Western Reserve University

The facilities of this laboratory are very extensive. Of particular importance are two experimental reactors one of which is graphite-moderated and air-cooled, the other being both moderated and cooled by means of heavy water. The laboratory is to be considerably expanded, and additional land is now being acquired for that purpose in Du Page County, Ill. Design and construction of the new laboratory is to be carried out by the University of Chicago pursuant to direction by the Commission.

Clinton Laboratories.—A major research load is being carried by the Clinton Laboratories at Oak Ridge, Tenn. Work conducted here is currently administered under contract with the Monsanto Chemical Co. However, it has recently been agreed that this contract will be continued only until such time as other arrangements have been completed for managing the laboratories. The laboratories have an air-cooled, graphite-moderated reactor and are responsible for production of nearly all of the radioisotopes now being distributed. They have extensive facilities for chemical and physical research. They cooperate with the Oak Ridge Institute of Nuclear Physics, which is beginning to play a significant role in making arrangements whereby graduate students from 14 universities in the southeastern part of the country may do research work in the Laboratories' outstanding facilities. These institutions are as follows:

Alabama Polytechnic Institute
Catholic University of America
Duke University
Emory University
Georgia School of Technology
Louisiana State University
Tulane University of Louisiana
University of Alabama
University of Kentucky
University of North Carolina
University of Tennessee
University of Texas
University of Virginia
Vanderbilt University

Brookhaven National Laboratory.—The Brookhaven National Laboratory is situated at Patchogue, Long Island, N. Y., on the site of Camp Upton. This laboratory, still in an early stage of growth, is administered under contract with the Commission by Associated

Universities, Inc., a nonprofit organization of the following nine universities:

Columbia University
Cornell University
Harvard University
Johns Hopkins University
Massachusetts Institute of Technology
Princeton University
University of Pennsylvania
University of Rochester
Yale University

The laboratory will have a low-power experimental reactor and other equipment especially suited to exploring nuclear particles and conversion of matter into energy. Another purpose of the laboratory is the training of advanced students in nuclear physics and allied fields.

Knolls Atomic Power Laboratory.—The Knolls Atomic Power Laboratory, located near Schenectady, N. Y.; and operated under contract with the Commission by the General Electric Co., is also in an early stage of growth. Provision has been made for participation in this laboratory by other authorized scientific and technical groups.

Other major laboratories.—The Hanford Engineer Works contains important facilities for research in chemistry and physics. Included in its facilities are an experimental reactor.

The radiation laboratory of the University of California, near Berkeley, is also doing important basic research work for the Commission.

In addition, much valuable research work in metallurgy and other fields is being done at Iowa State College, at Ames, Iowa. The Government-owned facilities here are being expanded.

The Monsanto Chemical Co., operating under contract with the Commission, is carrying out an important research and development program in Government-owned facilities in Ohio. Here, too, the facilities are being expanded.

The Carbide & Carbon Chemicals Corp., besides operating the gaseous diffusion plant and the electromagnetic separation plant at Oak Ridge, is carrying forward a number of associated research projects.

The Battelle Memorial Institute, Cincinnati, Ohio, is attacking several metallurgical problems, particularly those associated with reactors. Massachusetts Institute of Technology is also working on metallurgical problems. Columbia University is engaged in various fundamental studies involving neutrons.

A number of other universities have expressed interest in the work of the Commission and additional university arrangements are under consideration.

V. Medical Program

The Commission has two broad responsibilities in biological and medical research. One, in the field now known as health physics, is the full responsibility for improving our knowledge of the potential dangers presented by fissionable materials, reactors, and fission products, and for proposing methods of eliminating or circumventing such dangers. The other is to assist in the general effort being made to extend fundamental knowledge of the interaction of nuclear radiations and living matter. In addition, through its program of distributing radioisotopes, the Commission is giving indirect aid to research in many fields of biological and medical research. (See appendix 2.)

The health-physics program is of unquestioned importance. From the outset of the atomic energy program it was realized that, unless proper safeguards were taken, unprecedented hazards to personnel would exist. Plutonium, for example, is toxic from a biochemical standpoint and is also radioactive. Nuclear reactors produce neutrons, gamma rays, and other dangerous rays in great abundance; the fission products are highly radioactive. Knowledge as to just how injurious these materials and radiation might be was meager, which meant that wide margins of safety were required in all operations concerned.

To improve the protection of workers' health and to reduce any excessive costs which may be entailed by excessive margins of safety, teams of physicians, biologists, chemists, and physicists have been at work from the earliest days of the Manhattan project to find how these radiations affect the body, what protective measures are most effective, and, in the event of mishap, what methods of diagnosis and treatment are most effective. Despite a shortage of scientific and technical personnel competent in these health-physics fields, the work has continued, outstandingly safe working conditions have been maintained, and significant advances have been made in our understanding of the problems involved. Recent accomplishments may be exemplified under the five following headings:

DETECTION AND MEASUREMENT OF RADIATION HAZARDS

Example: Entirely new types of electronic health instruments have been developed for detecting radiations of several different degrees of penetrating power.

DETERMINATION OF BIOLOGICAL EFFECTS OF NUCLEAR RADIATIONS ON LIVING TISSUE

Examples: A considerable extension has been made of our knowledge of utilization of tracer atoms in cellular physiology and in studios of cancerous tissue.

Active assistance and coordination was provided in the studies made by specialists from Army, Navy, and the National Research Council on the biological and medical effects of the atom bomb on the people of Hiroshima and Nagasaki. A detailed interim report has already been released to the public. (General Report. Atomic Bomb Commission, released March 25, 1947).

DETECTION AND TREATMENT OF ACUTE AND CHRONIC RADIATION INJURY

Examples: Improved techniques have been worked out for the morphological detection of evidence of early radiation damage.

Determinations have been made of the distribution within the body of the fission products inhaled, ingested, or absorbed through cuts in the skin, and also of the hazards presented by these materials.

ESTABLISHMENT OF HEALTH-PHYSICS TOLERANCE STANDARDS AND METHODS OF PROTECTION

Examples: Compilation of extensive data, based on large-scale experiments on animals, establishing more accurately the permissible daily tolerance dosages of nuclear radiations to which the total body may be exposed.

Development of entirely new biophysical units for expressing the intensity of ionizing radiations.

Establishment of tolerance dosages of alpha, beta, and gamma radioactivity of materials dispersed in air, in water, or on surfaces of floors, benches, etc.

Development of industrial-type masks and other equipment for reducing dangers in breathing air contaminated with radioactive materials.

IMPROVING DECONTAMINATION METHODS AND WASTE DISPOSAL

Examples: Development of improved methods for disposing of fission products.

Development of improved methods of decontaminating various operating facilities.

The health-physics projects under way or planned have recently been surveyed by the Commission's Interin Medical Advisory Board, composed of the Commission's principal biological, medical, and health-physics consultants and also directors of the individual health programs conducted in laboratories operated under Commission contract.

In carrying forward these projects, the Commission has received important support from the United States Public Health Service, Army, Navy, and the National Research Council. Much of the actual work has been done in the laboratories at Oak Ridge, Chicago, Hanford, and Los Alamos, and in various university laboratories including those of the University of Rochester, Western Reserve University, University of California, Washington University (St. Louis), University of Washington (Seattle), University of Chicago, and Columbia University.

The Commission is establishing an Advisory Committee for Biology and Medicine to formulate policies in this field. Such a course was recommended by a specially designated Medical Board of Review composed of seven men of outstanding qualifications in administration of medical research. This Board urgently recommended rapid expansion of the country's complement of physicians and health physicists in the atomic energy field. It recommended providing substantial aid to universities training such specialists, to the trainees themselves, and it recommended assisting the corresponding training programs within the armed forces. It urged provision of definite careers in this new field.

The members of the Board were Dr. Robert F. Loeb, Lambert professor of medicine, Columbia University, New York City, chairman; Dr. Detlev W. Bronk, director, Johnson Research Foundation, University of Pennsylvania, Philadelphia, and chairman, National Research Council; Dr. Wallace O. Fenn, professor of physiology, University of Rochester School of Medicine and Dentistry, Rochester, N. Y.; Dr. Herbert S. Gasser, director, Rockefeller Institute for Medical Research, New York City; Dr. Ernest W. Goodpasture, dean of the School of Medicine and professor of pathology, Vanderbilt University, Nashville, Tenn.; Dr. Alan Gregg, director for medical sciences, Rockefeller Foundation, New York City; Dr. A. Baird Hastings, professor of biological chemistry, Harvard Medical School, Boston, Mass.

VI. Control and Dissemination of Information

In section 1 (a) of the Atomic Energy Act, Congress declared it—

to be the policy of the people of the United States that, subject at all times to the paramount objective of assuring the common defense and security, the development and utilization of atomic energy shall, so far as practicable, be directed toward improving the public welfare, increasing the standard of living, strengthening free competition in private enterprise, and promoting world peace.

Section 1 (b) provides that it is the purpose of the act to effectuate the policies set out in section 1 (a) by providing, among the major programs relating to atomic energy—

a program for the control of scientific and technical information which will permit the dissemination of such information to encourage scientific progress, and for the sharing on a reciprocal basis of information concerning the practical industrial application of atomic energy as soon as effective and enforceable safeguards against its use for destructive purposes can be devised.

Section 10 of the act relates specifically to the control of information. It states that—

It shall be the policy of the Commission to control the dissemination of restricted data in such a manner as to assure the common defense and security. Consistent with such policy, the Commission shall be guided by the following principles:

(1) That until Congress declares by joint resolution that effective and enforceable international safeguards against the use of atomic energy for destructive purposes have been established, there shall be no exchange of information with other nations with respect to the use of atomic energy for industrial purposes; and

(2) That the dissemination of scientific and technical information relating to atomic energy should be permitted and encouraged so as to provide that free interchange of ideas and criticisms which is essential to scientific progress.

The maintenance and improvement of the United States position in the field of atomic energy requires a careful balancing of control and dissemination of information. In our desire to prevent unauthorized transmission of scientific information of military importance we must not go to the extreme of permanently locking up all our information. We must inspire talented men to enter the new field and we must give them the information they need in order to proceed. To overconfine today's knowledge is to stifle the development which would provide security tomorrow.

The Commission's program for the protection of restricted data is being ably supported by the Federal Bureau of Investigation and other agencies. Advice has been obtained also from the congressional Joint Committee on Atomic Energy. The security measures in effect when the Commission assumed operating control have been maintained; in addition these measures have been in process of careful review and they have been strengthened in a number of instances.

At the same time effort is being made to facilitate the appropriate declassification and distribution of information not essential to national security. The Commission's Technical Information Branch is currently studying and clearing for public release approximately 100 technical articles each month; a group of more than 100 leading scientists cooperate in this work. Articles are declassified only if determined to conform to carefully established criteria which were codified by the Manhattan Engineer District on the general basis of the report by the Committee on Declassification under the chairmanship of Dr. R. C. Tolman. The Commission has reaffirmed the declassification policy established by the Manhattan Engineer District.

During the past year approximately 1,200 scientific papers have been declassified. A large number of these have been published in scientific and technical journals and have been made available also through the Office of Technical Services of the United States Department of Commerce. As an illustration of the effectiveness of the declassification program, sufficient material on the fundamental theory of nuclear reactors has been declassified to permit elementary instruction in universities and colleges.

A comprehensive record of the scientific and technical information developed throughout this country's atomic energy program is being assembled in a 100-volume National Nuclear Energy Series. About half of these volumes will remain classified as restricted data for use only by authorized, cleared persons participating in the Commission's program. The material in the remaining volumes of the series is unclassified and is to be made generally available.

Recognizing that the control of information depends not only on a wide variety of security measures but also upon the cooperation of representatives of the various media of public information, the Commission furnishes security guidance to the press, radio, etc., and furnishes information through releases and in response to inquiries on the conduct of the unclassified phases of the program.

VII. Regulation of Special Materials and Facilities

Under the Atomic Energy Act of 1946 the Commission is responsible for developing and administering a number of licensing systems. In section 4 (e) the act provides that, unless appropriately licensed by the Commission, no one shall produce, transfer, or acquire any facilities for the production of fissionable material. A corresponding provision with respect to transfer of source material is contained in section 5 (b). A third licensing system is contemplated by section 7, which provides that, with certain exceptions, it shall be unlawful for any person to produce or export any device utilizing fissionable material or atomic energy or to utilize fissionable material or atomic energy with or without such device, except under license issued by the Commission.

The first formal regulatory action under these provisions occurred on March 17, 1947, when the Commission issued a regulation to control transfer of source material (uranium and thorium). This regulation, which became effective March 31, 1947, contains a number of stringent requirements designed to prevent any improper transfer or use. Reporting requirements are included also, to assist compilation of a complete record of stores and shipments of source materials. The regulation is being administered by the manager of New York Directed Operations.

The Commission is starting preparation of a regulation for controlling the manufacture and transfer of facilities for the production of fissionable material. In the meantime, a close control of exports of such facilities is being maintained by liaison with manufacturers capable of producing such facilities and through the use of the export-control system administered by the Office of International Trade, Department of Commerce.

In the exercise of its regulatory functions, the Commission is impressed with the need of obtaining the advice of the groups whose activities are affected. In the drafting of the source material regulation, representatives of almost every group affected were consulted. As a result, their acceptance of the regulation has been prompt and wholehearted.

VIII. Budget

Since the first meeting of the Commission on November 13, 1946, the President, acting in accordance with Public Law 663 of the Seventy-ninth Congress, second session, has made allocations of Manhattan project funds to the Commission totaling $644,916,353. Out of these allocations the sum of $40,000,000 has been restored to the surplus of the Treasury pursuant to the provisions of Public Law 20, Eightieth Congress, first session, and $263,822,945 was obligated by the Commission on January 1, 1947, to cover contracts and other obligations transferred to the Commission on that date by Executive Order 9816. Almost the entire balance of $341,093,408 was obligated by June 30, 1947, to cover fiscal year 1947 expenditure obligations, and to cover also contracts providing for operation and construction activities in the fiscal year 1948.

The President's budget (for the fiscal year 1948) now pending in the Congress recommends an appropriation of $250,000,000 and an authorization to enter into contracts for an additional $250,000,000. The new appropriation is to cover expenditure obligations which will be incurred in the fiscal year 1948; and the new contract authorization is to cover obligations to be incurred in the fiscal year 1948 providing for operation and construction activities in the fiscal year 1949.

IX. Accounting

The development of the atomic bomb by the Manhattan Engineer District was done in time of war. The emergency nature of the work and the security requirements apparently left little room for accounting systems that would meet peacetime standards. Fiscal records were kept; but although they may have been adequate for their purposes, they fall short of the Commission's present needs.

For its own managerial purposes and for presenting accurate accounts to the Congress, the Commission plans to establish more adequate and useful accounting practices. This will take time, since in a number of activities the new procedures must be built from the ground up. Competent accountants must be obtained, existing accounting practice must be analyzed, and new procedures must be developed. The new procedures must take cognizance not only of Government accounting practice, but also of the commercial, industrial, and university accounting systems used by the Commission's contractors. In addition to the urgent need for adequate general and cost accounting, the Commission's activities will require development of relatively simple yet effective systems of accounting for physical quantities and monetary values of materials and facilities.

X. Patents

In January the Atomic Energy Commission named Casper W. Ooms, Commissioner of Patents; William H. Davis, chairman of the Department of Commerce Patent Survey Committee; and John A. Dienner, former president of the American Patent Law Association, as members of an advisory board to recommend to the Commission policies, procedures, and staff organization for the effectuation of the patent provisions of the Atomic Energy Act of 1946. Mr. Hector M. Holmes has since been added to the board. The board has already made a preliminary survey to identify the patent problems with which the Commission is confronted. It is hoped that the board will be in a position to make specific recommendations within a few months.

The great majority of patent applications filed by the Commission or predecessor agencies contain restricted data; they are handled according to procedures worked out cooperatively by the Manhattan Engineer District, the Office of Scientific Research and Development, and the Patent Office.

Approximately 200 patent applications—a small fraction of the total number involved—have been declassified by the Commission's Technical Information Branch. They deal with certain types of instruments, chemicals, etc., which have been determined no longer to be peculiarly adapted to the atomic energy field and which are thought to be potentially useful in other branches of technology. More than 10 such applications have already matured into issued patents.

XI. Personnel

The Commission had on its pay roll 4,133 employees as of May 31, 1947. Roughly, half of these were at Oak Ridge; less than 200 were in Washington, D. C. In addition, the Commission had the services of more than 900 officers and enlisted men.

Including contractors' employees working on Commission projects, as well as Commission employees, total employment was 41,513 as of May 31, 1947. This figure includes production employees and also administration, research, construction, and incidental service employees. It will be considerably increased as the Commission's presently authorized construction program gathers momentum.

Much attention is being given to attracting to the new undertaking administrators, scientists, and engineers of first-rate ability, and to retaining these men. Adequacy of salaries is being studied, as well as other conditions, such as housing, retirement, and various professional working conditions. Men experienced in this field are relatively few in number.

To help solve the special personnel problems in this new field the Commission has created a Scientific Personnel Committee to study and advise on all phases of personnel management in Commission research facilities. Dr. F. W. Loomis, professor of physics at the University of Illinois, is chairman of the committee. Other members are: Mr. M. P. Carpenter, executive manager of the Whiting Laboratories of the Standard Oil Co. of Indiana; Dr. Farrington Daniels, chairman of the board of governors of the Argonne National Laboratory; Mr. L. D. Geiger, Iowa area manager of the Atomic Energy Commission; Mr. W. A. Hamor, associate director of the Mellon Institute; Mr. W. B. Harrell, business manager of the University of Chicago.

XII. Other Responsibilities

The Commission is charged with many responsibilities in addition to those discussed in previous pages. In analyzing its various responsibilities and preparing working programs, the Commission has encountered many problems, some of which have been accumulating since VJ-day or even before. During the war years every effort was made to speed the completion of the atomic bomb, and little attention was given to planning for the postwar period. It is also understandable that, even in the 20 months following VJ-day, basic policy decisions could not well be made until Congress had enacted the necessary legislation, until the Commission had been established physically, and until the Commissioners had been confirmed by the Senate. The Commission does not expect in the space of a few months to find optimum solutions to problems which have been accumulating for a year or two and which are in many cases without precedent. Thanks to the help of public and private agencies concerned, some progress is being made.

SECURITY AND PLANT PROTECTION

The Commission is responsible for guarding the restricted data involved in the program and for protecting production plants, laboratories, and other facilities costing in aggregate more than 2 billion dollars. In addition, there are special materials and products which must be protected. As previously stated, the Commission, when it assumed responsibility for the atomic energy program on January 1, 1947, immediately issued instructions to its entire organization to continue in full force the security system which had been in effect under the Manhattan Engineer District. It also initiated a comprehensive survey of security practices, and as a result many security practices have been strengthened. Protective measures are being constantly studied and reinforced.

Acting pursuant to the Atomic Energy Act of 1946, a program has been instituted, in collaboration with the Federal Bureau of Investigation, under which some 6,500 applicants for employment by the Commission, or by the Commission's contractors and licensees (where access to restricted data would be involved) have been investigated and screened. In addition, all individuals still employed who received clearance under the Manhattan Engineer District are being reinvestigated by the Federal Bureau of Investigation as rapidly as possible. Some 1,500 investigations of this latter type have been completed. The Commission believes that the investigations performed in this program by the Federal Bureau of Investigation represent the most thorough and comprehensive effort of this type ever made.

In connection with physical security, the Commission has established a continuing inspection program under which more than 400 facility inspections have now been completed. A thorough inventory of classified technical documents and the establishment of sound uniform document accounting procedures have been ordered. In addition, certain studies have been undertaken in collaboration with the Army relating to the physical protection of Commission facilities. Details of the entire security program have been, and will continue to be, discussed with the Congressional Joint Committee on Atomic Energy.

LABOR RELATIONS

The Commission has an implicit but major responsibility in helping maintain good labor relations in its plants and laboratories operated by private contractors under cost-reimbursement contracts. Requirements as to continuity of operation, protection of restricted information, and Commission review of wage rates greatly restrict the area of free collective bargaining between management and employees. For the past 6 months the Commission staff and outstanding consultants in the field of labor relations have been engaged in studies of this problem. The goal is a system which will guarantee as many of the established rights of labor as is consistent with the national security. The National Labor Relations Board and also various unions affiliated with the American Federation of Labor and the Congress of Industrial Organizations have recognized the unique problems faced by the Commission and have cooperated in seeking a solution.

SAFETY

The Commission has a wide variety of safety responsibilities arising from construction, operation, research, and community management. Its Safety Division, taken over almost unchanged from the Manhattan Engineer District, has continued to attack the problem vigorously. Thus, during the first quarter of 1947 the frequency of accidents among Commission and contractor personnel was only 3.32 persons injured for each million man-hours worked. These rates are appreciably below the corresponding rates for 1945 and 1946, which in turn were 60 percent below the national average for industrial employment. They represent an annual saving of at least a score of lives, a thousand disabling injuries, and a hundred thousand man-days of useful work. In addition, they represent large savings in equipment and improved efficiency of production. The program has been assisted by the National Safety Council, the International Association of Chiefs of Police, the War Department, the Department of Labor, and many other agencies. It embraces four branches: Training and Off-the-Job Safety Branch, Occupational Safety Branch, Fire Prevention and Protection Branch, Research and Management Branch.

COMMUNITY MANAGEMENT

The Commission, in taking charge of the atomic energy program, assumed broad responsibilities in community management. The communities of Oak Ridge, Tenn.; Richland, Wash.; and Los Alamos, N. Mex.; came into being during the war years, and exist solely to advance the atomic energy program; they are isolated; their buildings are Government-owned. Maintaining adequate living conditions in the communities is scarcely a technological or dramatic problem, but it is unquestionably a vital problem. Unless living conditions are comparable to those in normal communities it will be impossible to attract and hold able men to operate the plants and laboratories. Disregard of the human requirements would lead to deterioration of our vast field organization.

The requirements of each of these Commission-managed communities are diverse, as is, for example, the case of Oak Ridge, Tenn.

Here, on a 59,000-acre tract, 36,000 persons are living. They, like their fellow citizens throughout the country, need houses, stores, restaurants, laundries, milk delivery, schools, theaters, doctors, dentists, a hospital, hotels, a bank, a post office, a library, recreation facilities, roads, sidewalks, sewers, a traffic-control system, a police system, a fire department, a bus service, electricity, telephones, telegraph service, a trash- and garbage-collection system, filling stations, automobile-repair stations, taxis, barbers, beauty shops.

The area contains 300 miles of roads and 55 miles of railroad; it includes 21 restaurants and lunchrooms; it has 10 elementary schools in addition to 3 nursery schools and 2 high schools. There are 22 different religious groups. Arranging the maintenance of these diverse services, and doing so in a manner consistent with pertinent Government regulations and the recognized needs of security and continuity of operations, is far from simple. This is made clear from the illustrations contained in the following paragraphs.

The Oak Ridge dwellings, nearly all of which were built during the war, are mainly of temporary type. Expenditures for maintaining them are large, and will remain large, so that in the long run it will prove more economical to replace them with permanent dwellings.

Providing satisfactory stores at Oak Ridge has proved difficult. Because of the limited number of store buildings available, it has been necessary to allocate them among a few best-qualified private operators. The attempt has been made to assure reasonable quality and prices, and, insofar as possible, a reasonable measure of healthy competition. Plans are now being formulated to give more effective encouragement to private enterprise of this type. These plans, however, must be consistent with the unusual requirements obtaining, and must recognize that Oak Ridge is a vital adjunct to plants and laboratories whose operation must not be jeopardized in any way.

Reduction of Government aid to those community services no longer requiring such aid is an important general objective. During the war, Government aid was provided to many of the community services. For many years there will remain certain services in which support is not only justified by the peculiar circumstances but is actually demanded by the overriding importance of maintaining adequate staffs for carrying forward the Commission's program. An outstanding example is hospital facilities. The Oak Ridge Hospital, which has 313 beds, had an operating deficit for the fiscal year 1947 of several hundred thousand dollars. This hospital, unlike hospitals in normal communities, has no endowment; service comparable to that in normal communities cannot be maintained without Government aid.

XIII. Relations With the Statutory Committees and the Department of State

The Commission has had close working relationships with the three statutory committees created by the Atomic Energy Act of 1946; the Congressional Joint Committee on Atomic Energy, the General Advisory Committee, and the Military Liaison Committee. Memberships of these committees are indicated in appendix 1.

The Commission has met in several formal sessions with the Joint Committee on Atomic Energy and has had many less formal contacts with its members and staff. In these meetings the Commission has reported on its program and activities, and a number of its principal problems have been discussed.

The nine-member General Advisory Committee appointed by the President to advise the Commission on scientific and technical matters relating to materials, production, and research and development, has convened four times in Washington since January 1, 1947. This distinguished committee has rendered invaluable assistance to the Commission in reviewing and advising on its major programs, furnishing technical advice on many specific problems and recommending additional programs and policies on its own initiative. The General Advisory Committee has established several working subcommittees to provide the Commission with continued assistance and advice on individual technical and scientific matters of particular importance.

Through consultation with the Military Liaison Committee, appointed by the Secretaries of War and Navy pursuant to the Atomic Energy Act of 1946, the Commission is coordinating its programs with the military requirements and programs of the War and Navy Departments and is furnishing these Departments information regarding its plans and activities. Continual interchange of information between the Commission and these Departments on plans and progress is maintained. The chairman and present staff of the Military Liaison Committee now occupy office space in the Commission's headquarters building in Washington, D. C. The Commission and the Committee meet formally every 2 weeks, or more frequently as circumstances require. Informal discussions among individual members and staff assistants occur daily. Discussions between the Commission and the Committee are not confined to matters of direct military applications but cover many other major activities of the Commission.

The Commission has been glad to transmit to the Department of State such advice and information as has been requested by that agency as for use in connection with activities of the United States delegation to the United Nations Atomic Energy Commission. On June 2, 1947, acting on special invitation and with the concurrence of the State Department, the Commission's Chairman addressed Committee 2 of the United Nations Atomic Energy Commission. The Commission also receives assistance from the Department of State in those special areas where the activities of the two agencies converge.

APPENDIX 1

Memberships of Statutory Committees

JOINT COMMITTEE ON ATOMIC ENERGY

The membership of the Joint Committee on Atomic Energy is as follows:

Senator Bourke B. Hickenlooper (Iowa), chairman.
Representative W. Sterling Cole (New York), vice chairman.
Senator Arthur H. Vandenberg (Michigan).
Senator Eugene D. Millikin (Colorado).
Senator William F. Knowland (California).
Senator John W. Bricker (Ohio).
Senator Brien McMahon (Connecticut).
Senator Richard B. Russell (Georgia).
Senator Edwin C. Johnson (Colorado).
Senator Tom Connally (Texas).
Representative Charles H. Elston (Ohio).
Representative Carl Hinshaw (California).
Representative James E. Van Zandt (Pennsylvania).
Representative James T. Patterson (Connecticut).
Representative R. Ewing Thomason (Texas).
Representative Carl T. Durham (North Carolina).
Representative Chet Holifield (California).
Representative Melvin Price (Illinois).

MILITARY LIAISON COMMITTEE

There has been one change in membership of the Military Liaison Committee. Maj. Gen. L. R. Groves has replaced Maj. Gen. L. E. Oliver. Present membership is as follows:

Lt. Gen. Lewis H. Brereton, United States Army, chairman.
Maj. Gen. Leslie R. Groves, United States Army.
Col. John H. Hinds, United States Army.
Rear Adm. Thorvald A. Solberg, United States Navy.
Rear Adm. Ralph A. Ofstie, United States Navy.
Rear Adm. William S. Parsons, United States Navy.

GENERAL ADVISORY COMMITTEE

The membership of the General Advisory Committee is unchanged, being as follows:

Dr. J. Robert Oppenheimer, director of the Institute for Advanced Study, Princeton University; chairman.
Dr. James B. Conant, president of Harvard University.
Dr. Lee A. Du Bridge, president of California Institute of Technology.
Dr. Enrico Fermi, professor of physics at the Institute for Nuclear Studies, University of Chicago.

Dr. I. I. Rabi, chairman of the department of physics, Columbia University.

Mr. Hartley Rowe, vice president and chief engineer of the United Fruit Co.

Dr. Glenn T. Seaborg, professor of chemistry at the University of California.

Dr. Cyril S. Smith, director of the Institute of Metals, University of Chicago.

Mr. Hood Worthington, Carothers Research Laboratory, E. I. du Pont de Nemours & Co., Inc.

APPENDIX 2

Isotopes Program

Isotopes are being produced at an increasing rate and are already pointing the way to important advances in medicine, biology, physics, chemistry, metallurgy, and various branches of agriculture. In addition they are proving to be of unique efficacy in certain types of medical therapy.

More than 90 different kinds of radioisotopes, representing more than 60 elements, are now being produced for distribution to our country's scientists. These isotopes are produced in the experimental nuclear reactor at the Clinton Laboratories. Radioisotopes now regularly available are as follows:

REGULARLY AVAILABLE RADIOISOTOPES

Antimony 122	Hafnium 181	Ruthenium 97
Antimony 124	Indium 114	Ruthenium 103
Antimony 125	Iodine 131	Samarium 153
Argon 37	Iridium 192	Scandium 46
Arsenic 76	Iridium 194	Selenium 75
Arsenic 77	Iron 55	Silver 108
Barium 131	Iron 59	Silver 110
Bismuth 210	Lanthanum 140	Silver 111
Bromine 82	Mercury 197	Sodium 24
Cadium 109	Mercury 203	Strontium 89
Cadium 115	Mercury 205	Sulfur 35
Calcium 45	Molybdenum 99	Tantalum 182
Carbon 14	Neodymium 147	Technetium 97
Cerium 141	Neodymium 149	Technetium 99
Cerium 143	Nickel 59	Tellurium 127
Cesium 131	Osmium 185	Tellurium 129
Cesium 134	Osmium 191	Tellurium 131
Chlorine 36	Osmium 193	Thallium 206
Chromium 51	Palladium 103	Tin 113
Cobalt 60	Phosphorus 32	Tin 121
Copper 64	Platinum 197	Tin 123
Element 61, 147	Platinum 199	Titanium 51
Element 61, 149	Polonium 210	Tungsten 185
Europium 154	Potassium 42	Tungsten 187
Europium 155	Praeseodymium 142	Yttrium 90
Gallium 72	Praeseodymium 143	Zinc 65
Germanium 71	Rhenium 186	Zinc 69
Germanium 77	Rhenium 188	Zirconium 95
Gold 198	Rhodium 105	
Gold 199	Rubidium 86	

Costs of producing these isotopes by means of the nuclear reactor are far below the costs of prewar production by means of cyclotrons. A striking example of this reduction in cost is shown by that extremely useful radioisotope—carbon 14. It has been estimated that one millicurie of carbon 14, now being sold for $50, would cost about $1,000,000 to produce using a cyclotron.

Because radioactive isotopes are at present available only in limited amount, and because they present a distinct health hazard unless used with proper care, the Commission has a responsibility for insuring that these materials are distributed in accordance with plans capable of assuring effective use and safe handling. The procedure for distributing the radioisotopes is as follows: A scientist who is working in a recognized academic, medical, or industrial research institution in the United States writes the Commission's Isotopes Branch at Oak Ridge stating what isotope he wants and his purpose. The Isotopes Branch then transmits the application to the appropriate subcommittee of the Advisory Committee on Isotope Distribution Policy. When the application has been given formal approval it is returned to the applicant for transmittal to the contractor serving as distributor. The contractor, on receipt of the approved application, fills the order and bills the applicant according to a price schedule approved by the Commission. In this way the Commission exercises close control of recipients, uses, and prices.

Prices of radioisotopes cover incremental costs of preparation and shipping but no attempt is made to cover any part of the cost of reactor design or construction. Low prices should encourage the most rapid development of the many potential uses of these materials.

Requests for radioisotopes and irradiation service have continued to be received in increasing numbers from domestic groups. The numbers of shipments made in January, February, March, and April of 1947 were 79, 114, 102, and 155, respectively. Many of the requests are for radioactive isotopes of carbon (C 14), phosphorus (P 32), or iodine (I 131); but smaller numbers of requests have been received for many other radioisotopes. The majority of the requests come from educational institutions and hospitals. Nearly all parts of the country are represented, as indicated in the following table:

TABLE 1.—*Geographical distribution of requests received*

Location	Requests received through Apr. 30, 1947	Location	Requests received through Apr. 30, 1947
Alabama	1	Minnesota	14
California	72	Missouri	14
Connecticut	14	New Jersey	10
Delaware	3	New York	72
District of Columbia	14	North Carolina	1
Florida	4	North Dakota	2
Georgia	4	Ohio	37
Hawaii	6	Oklahoma	1
Illinois	27	Oregon	4
Indiana	10	Pennsylvania	34
Iowa	1	Tennessee	21
Kansas	2	Texas	7
Louisiana	7	Utah	5
Maryland	24	Vermont	1
Massachusetts	75	Washington	2
Michigan	27	Wisconsin	28

An important addition to the family of salable isotopes was made on May 1, 1947, when heavy hydrogen (deuterium) was made available for the first time in relatively large quantity. Policies as to price and method of distribution are much the same as for the radioactive isotopes. Prices range from $0.80 to $1 per liter of gaseous heavy hydrogen. There is every indication that heavy hydrogen, like radioisotopes, will be put to important uses in nearly every branch of chemical, biological, and medical research. At present the Stuart Oxygen Co. of San Francisco, Calif., is the Commission's only authorized distributor.

The cost of producing these radioactive and nonradioactive isotopes is a very small fraction of the cost of the atomic energy program as a whole; but the value of the benefits is incalculable. In the field of medicine alone it is possible and, in fact, probable that a number of developments of outstanding importance will result in the next few years. It is impossible to estimate what corresponding benefits may occur in the other sciences, and in industry and agriculture.

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