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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 THIRD SEMIANNUAL REPORT OF THE UNITED STATES ATOMIC ENERGY COMMISSION

FEBRUARY 2, 1948.—Referred to the Joint Committee on Atomic Energy and ordered to be printed, with an illustration

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LETTER OF SUBMITTAL

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 third 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 for reasons of national security cannot be presented in a public report of this character. These are discussed 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.
LEWIS L. STRAUSS.
WILLIAM W. WAYMACK.
DAVID E. LILIENTHAL, *Chairman.*

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Section I—The First Year—A Summary

In its first report to the Congress a year ago, within the month of the transfer of the United States atomic energy program from military to civilian management, the Atomic Energy Commission outlined its organizational policies and general operating plan. In July 1947 the second semiannual report to the Congress reviewed the status of preparations for the long-term program envisioned in the Atomic Energy Act of 1946, and reported briefly on the program for expansion of the project to maintain and improve the Nation's position in the field of nuclear development.

The Commission, in its third open report to the Congress, is able to report that this program is under way. The following pages are a summary of the first year of operation under legislative authority of a project of government in which the American people have invested heavily of their funds and their hopes.

Through the Joint Committee on Atomic Energy, the Atomic Energy Act provides the means for informing the Congress of those matters the open discussion of which might be prejudicial to the security of the United States. In this public report, however, we have attempted to provide sufficient unclassified information to enable the Congress and the people of the United States to appraise in general the management and progress of the Nation's atomic energy business.

During 1947 there was definite progress toward the repair of those areas of administrative and physical erosion which resulted from the period of national uncertainty following the cessation of hostilities of World War II. While a number of specific steps have been taken to establish the program on a sound, permanent basis of operation, in both physical plant and organization, it would be incorrect to assume that the project will become static either in facilities or in general activity for many years to come.

The paramount objective of "assuring the common defense and security," as defined in the Atomic Energy Act, required a major program of development at the Los Alamos Scientific Laboratory, where the weapons program is concentrated. An over-all plan was completed during the year and a number of important steps taken toward its fulfillment, including the construction of service and technical facilities, improvement and standardization of design of weapon components, development work on new designs, and the beginning of an extensive program of stabilizing production operations.

The work of the laboratory progressed to a point permitting field tests of indicated laboratory results at a proving ground established on Eniwetok Atoll in the South Pacific.

The production of fissionable materials was maintained throughout the year. A general program for the expansion of capacity was started along four main lines:

1. Through development of new sources of raw materials.
2. Through improvement of processes for the reduction of ores and the preparation of feed materials for the Commission's plants.
3. Through renovation and expansion of existing facilities for the production of fissionable materials, and advances in operating techniques.
4. Through the development of the nuclear reactor for more efficient utilization of the available fissionable material.

A major program of expansion and improvement of the Hanford plant for plutonium production was started in the fall of the year.

Research, both applied and fundamental, was reorganized and expanded. Increased emphasis in applied, or programmatic, research was placed on the work leading to an assured maximum supply of fissionable materials. With respect to fundamental, or basic, research, a plan and policy was adopted to obtain the greatest possible effort toward restoring the level of fundamental knowledge and replacing and increasing the flow of basic information which in years past came to the United States from a healthy science abroad.

While quantitative measurements of a research program are wholly inadequate, the Commission had more than 100 research contracts or subcontracts in effect during 1947 and inaugurated a $90,000,000 plan for the provision of new research facilities. The major accomplishment in the field of research during 1947, however, was the consolidation of programmatic research projects aimed at urgent objectives and the establishment of a research policy designed to utilize the full scientific potential of the Nation.

The continued production of radioisotopes at the Clinton National Laboratory made possible a Nation-wide program of tracer research in medicine, agriculture, biology, metallurgy, and industrial processing. The Commission does not report on the work done by the many agencies using this important research tool. These agencies are required to publish the results of this work, and some of the most significant advances in human welfare may result from the work done in nearly 300 public and private institutions which last year received more than 1,800 shipments of radioisotopes.

The Commission established a Division of Biology and Medicine to direct the work done in Commission facilities in this field and to effect the proper coordination with the work of other agencies. By year's end, the Division had completed an industrial hygiene survey and laid plans for still further improvement in health protective measures; developed a program for the training of scientists and technicians in medical, biological, and health physics fields; arranged for the operation of two medical and biological training centers to be established by the Commission; and completed plans for the Commission's support of cancer research.

The security of the project has been strengthened. Physical security measures include the establishment of special guard forces, installation of new facilities and equipment, and more adequate controls of classified materials. The Federal Bureau of Investigation has completed more than 40,000 personnel investigations [1] of "char-

[1] Full background investigation.

acter, associations, and loyalty," as required by the act. To insure adequate review of decisions based on evaluation by the Commission of investigative reports, a Personnel Security Review Board headed by former Supreme Court Justice Owen J. Roberts, was appointed.

The dissemination of scientific and technological data necessary to the growth of American science was continued under the system of declassification established early in 1946. A technical information service for the Commission and contractor organizations was established, and public information service was provided to supply information requested by press, radio, pictorial media, and citizen groups. The availability of security guidance to these media has been helpful in maintaining the security of information.

In appraising the United States atomic energy program, it should be recognized that the basic structure is determined by the location and characteristics of the physical plant built during the war to accomplish the single objective of developing and producing a weapon in the shortest possible time, and by the plans and programs initiated by the Manhattan project prior to the passage of the Atomic Energy Act of 1946, including the establishment of the Knolls Atomic Power Laboratory and the broad National Laboratories program.

Section II—Raw Materials

The Commission established in October a Division of Raw Materials to plan and carry out the exploration, procurement, and processing program in this field. A group of eight well-known mining men was appointed as an Advisory Committee on Mining and Exploration. Members are:

- Donald H. McLaughlin, president, Homestake Mining Co., Lead, S. Dak., chairman.
- G. Temple Bridgman, consulting engineer, San Francisco, Calif.
- Everette L. DeGolyer, petroleum geologist, DeGolyer & McNaughton, Dallas, Tex.
- Anton Gray, geologist, Kennecott Copper Co., New York, N. Y.
- Wilber Judson, vice president and director, Texas Gulf Sulphur Co., New York, N. Y.
- Robert E. McConnell, trustee, McConnell Foundation, New York, N. Y.
- Fred Searls, Jr., president, Newmont Mining Corp., New York, N. Y.
- Clyde Williams, director, Battelle Memorial Institute, Columbus, Ohio.

The staff of the Raw Materials Division, composed of mining engineers, geologists, and metallurgists, has recently been recruited.

The supplies of source material used in the atomic energy program to date have come predominantly from certain foreign countries whose uranium deposits are richer than any in the United States. No production of uranium from the United States other than the recovery of byproduct uranium from the vanadium industry of the Colorado Plateau was feasible during the war period. In the field of raw materials, however, as in other fields, the Commission now must plan for the indefinite future in which the requirements of national defense and of peacetime industrial applications of atomic energy will bring unpredictable demands for uranium ores.

One of the objectives of the Division of Raw Materials is to determine the extent of the uranium resources of the United States. A solution to the problem of assuring adequate supplies of fissionable materials is not confined to the discovery and development of ore reserves. Equally important objectives are improvement in the ore refining and recovery processes, development of reactors that will more efficiently utilize the fissionable material with which they are fueled, and the development of processes to utilize uranium contained in materials which now go from the various stages in the process to storage. Intensive research is directed toward each of these goals.

Research is also being directed toward the development of new radiation detection instruments and field prospecting techniques.

DOMESTIC RESOURCES

The first appraisal of domestic reserves of uranium ores was undertaken during the war by the Manhattan Engineer District, which carried on a program of exploration in many parts of the United States.

In addition to exploration, the program included purchase and refining of residue products from current operations of vanadium-ore mills as well as of waste tailings which had accumulated. These were treated for the recovery of their uranium content. In that period vanadium-ore mills were operating at Durango, Uravan, and Naturita, Colo., and Monticello, Utah. Following the war, the Government-owned facilities for treating tailings in residues from these mills were dismantled by the Manhattan Engineer District, and Government-owned plants for processing vanadium ores were declared surplus. Privately owned plants in this area also curtailed or suspended operations. The only operations at the present time are those sustained by Government purchases of vanadium and uranium.

As a result of the Manhattan Engineer District program, deposits of very low-grade ore were discovered. These are now being studied from the point of view of developing methods for the recovery of their uranium content. Their utilization, however, depends upon the solution of difficult and complex research and industrial problems, which for security reasons cannot be described in detail. Exploration for additional deposits is continuing.

The Commission believes new reserves of source materials can best be developed by competitive private industry, under the stimulus of profits, and the means of accomplishing this are under study.

In general it will be Commission policy to purchase ores for its program from private sources and limit direct Government production as far as possible. It is desirable, however, for the Commission itself to carry on certain activities for the purpose of determining the most efficient methods of ore extraction and beneficiation. The Commission recently purchased the vanadium plant at Monticello, Utah, from War Assets Administration and plans to put these facilities into operation after necessary repairs and alterations have been made and an ore stock pile has been accumulated. Consideration will be given to operating or encouraging the operation of other plants in the area.

The scope and extent of the ore-buying program to be recommended will be determined after a survey and full consideration of the entire raw-materials picture. The survey is actively under way. It should be emphasized that mine operators should not make commitments for supplying ore to the Commission except on the basis of definite contracts or publicly announced purchase schedules.

A raw-materials office has been opened at Grand Junction, Colo., where a new office building will be constructed.

Section III—Production

FISSIONABLE MATERIALS

Production operations are by far the major portion of the total United States atomic-energy program, accounting for about 70 percent of construction expenditures and about 80 percent of operating expenditures. A public report of the Commission's work, however, can reflect only those phases of the production effort which do not reveal operating information.

The year's record of production work is reflected in activities throughout the project, including specific research assignments to the laboratories, improvements in operating techniques, higher standards of quality of materials produced, and construction of new production facilities which take into account both new developments and the deterioration and obsolescence of plants and equipment. While restrictions on information as to production operations are wholly justified and will be maintained, it is clear that effective security really depends upon technological advancement and production achievement.

Processing of source materials

All processing of source materials done at the point of extraction from the earth is under the direction of the Commission's Division of Raw Materials. All subsequent steps, through the reduction to metal and the preparation of feed materials, the separation of fissionable isotopes, production of fissionable materials in reactors, the separation of radioactive materials, and the manufacture of components of weapons are production operations. This work takes place at a number of locations and is coordinated through the Division of Production.

Experience gained in the processing of source materials in the plants of the contractors handling this work has been reflected in both improved quality of product and increased efficiency. The program is demanding an ever-increasing output of feed materials, but unit costs to the Government have been reduced.

The organization for the feed-materials preparation is designed to maintain current production at maximum levels and to insure as far as possible against future contingencies which might reduce the flow of materials to feed isotope separation plants and production reactors. In addition, certain residue materials potentially valuable for other purposes are stored for possible additional processing.

Production of fissionable materials

Immediately prior to the transfer of the properties to the Commission, the Manhattan project began the reduction of operations at the Oak Ridge electromagnetic plant for the separation of fissionable isotope of uranium, U–235, and initiated a program of increased production at the gaseous diffusion plant at Oak Ridge. While much of the production equipment in the electromagnetic plant is maintained in stand-by condition, its powerful magnets and research facilities are used for limited production and process-improvement purposes.

Plutonium is produced by the transmutation of uranium metal in the reactors at Hanford, where facilities are being substantially expanded, taking into account both new developments and the normal deterioration and obsolescence of this type of facility. The plant additions at Hanford, with necessary residential, administrative, service, technical, and production auxiliaries constitute one of the largest construction programs ever undertaken by the Government in peacetime.

The General Electric Co., contract operator of the Hanford Works, also has the prime contract for the construction program, which will require a greater expenditure of funds than the original building of the plant. The prime contractor has mobilized a strong technical and construction group and under some difficulty has organized the procurement of the many nonstandard items of equipment needed in the plant. Assembly of materials is now under way. Under a carefully planned schedule of work, a construction camp to house some 15,000 workers and their families is nearing completion. Special development work is going on in a number of laboratories, industrial plants, and Government installations.

Quality control

Since the materials used, at every stage of the production process, must be of a purity never before achieved outside the laboratory, an elaborate system of quality control and specification testing is necessary. Every factory supplying materials must maintain testing facilities and constantly analyze the product. The more difficult tests are performed in laboratories of the Commission, the National Bureau of Standards, or in cooperating universities.

A great variety of new instruments has been developed for these purposes and for the detection of radiation, many of which are now proving useful in other kinds of industries and laboratories. To insure a continuing supply for the Commission's work and for others, the manufacture of these instruments is being licensed to commercial firms wherever security considerations will permit.

WEAPON PRODUCTION

The atomic weapons produced during the war were literally laboratory products, experimental devices not only designed but also largely fabricated and assembled by the distinguished scientists who conceived them, in the mesa-top laboratory, at Los Alamos, N. Mex. And with the ending of the war there came an inevitable interval of readjustment during which weapon development was carried on under very difficult conditions. It became clear that for the longer-term operation it was necessary to establish a much broader base for production operations and take steps to insure against "bottlenecking" at any stage.

During its first year, therefore, the Commission's weapon program was directed toward furthering this project, converting the productive system from the unit fabrication of a laboratory device to a different scale of weapon production. This conversion necessitated basic changes in organization and planning for production, handling, and utilization of weapons, with these primary objectives:

Expansion of production facilities, to effect a continuous flow of component parts.

Development of new designs, stemming partly from work done during the war.

Improvement and standardization in the design of component parts.

Standardization of procedures—and provision of standard instructions—for storage and handling.

Progress is being made toward all of these objectives. The continued development of production facilities is being executed in accordance with an over-all plan. In the procurement phases of this work, the assistance of the Army and Navy has been of the highest order. Preliminary plans of the Manhattan project were incorporated in the weapon stabilization program.

PRODUCTION OF ISOTOPES

Artificial radioactive isotopes were first manufactured in cyclotrons, in minute quantities and at very great expense. Now, as a result of the development of atomic energy, there are more than a hundred kinds available for research work, and in adequate quantities—more than adquate, in fact, in view of the number of technicians qualified to use them. Radioisotopes for off-project distribution are produced in the reactor at Clinton National Laboratory, Oak Ridge.

The stable isotopes are separated from their brother atoms in the great magnetic machines built during the war at Oak Ridge to extract the fissionable U–235 isotope from common uranium. The radioactive isotopes are manufactured by irradiation of materials in nuclear reactors constructed for the production of fissionable plutonium or for research. Thus, isotopes are byproducts of the manufacture of the atomic bomb.

But although byproducts, isotopes are generally regarded as the most valuable new research tool since the invention of the microscope. If the development of atomic energy had produced nothing else, its cost would undoubtedly have been balanced within a few years by the gains in knowledge that the Nation is making with isotopes—gains that are already becoming tangible in medicine, chemistry, industry, and agriculture.

The Commission considers it to be of vital importance to make isotopes available to all qualified users in quantities as large as can be profitably used, in variety as great as can be developed, and at the lowest possible cost.

Nearly 2,000 shipments of radioactive isotopes have been made from the Commission's Isotopes Division at Oak Ridge since August 1946, more than 1,600 of them within the past year. Close to 100 different kinds are available. Production and distribution methods have been brought to the point where it is certain that all reasonable future demands can be met. Costs are being reduced rapidly and, for most types, are now well within the range that the average laboratory can afford to pay.

The Commission provides advice on the utilization of radioactive isotopes, together with film badges and other safety equipment, and hopes soon to expand this service to the point where all inexperienced prospective users are instructed in the most productive and safest research techniques.

In September 1947 the President, in a message to the International Cancer Research Congress at St. Louis, announced a program of foreign distribution of isotopes by the Commission. Twenty varieties, particularly those most important for biological and medical research, are now being made available in limited quantities to foreign laboratories and medical-research groups, upon prior agreement by the recipients to make 6-month reports to the Commission on results obtained and freely permit publication of such results; to use the isotopes only for purposes stated in the original requests; and to permit qualified scientists of all nations to visit their institutions and freely obtain information about the work, in accordance with the best scientific tradition. By the year's end, 20 shipments had been made to foreign users in Argentina, Australia, Denmark, and the United Kingdom. To date, as the result of requests received, the Commission has approved future distribution to Belgium, Canada, Cuba, France, Ireland, Italy, the Netherlands, New Zealand, Peru, Sweden, and the Union of South Africa.

Intensive development work in the Oak Ridge electromagnetic separation plant made possible the recent announcement of the availability of more than 100 types of stable (nonradioactive) isotopes for distribution in the United States, and some 200 shipments were made in 1947.

Liaison is maintained with the National Bureau of Standards on radioactivity standards and safety, the United States Department of Agriculture and State agricultural experiment stations on agricultural utilization, the National Research Council on cancer research, and the medical agencies of the armed forces.

A new Committee on Isotope Distribution was named to advise the Commission's Isotopes Division on the most productive and safest distribution, particularly where therapeutic treatment was planned. Members of this advisory committee are:

- Dr. G. Failla, of the Columbia University Medical School; chairman.
- Dr. H. A. Barker, plant nutrition, University of California, Berkeley, Calif.
- Dr. Henry Borsook, department of biochemistry, California Institute of Technology, Pasadena, Calif.
- Dr. Robley D. Evans, Massachusetts Institute of Technology.
- Dr. Hymer L. Friedell, Lakeside Hospital, Western Reserve University, Cleveland, Ohio.
- Dr. J. G. Hamilton, University of California, Berkeley.
- Dr. Joseph W. Kennedy, Washington University (St. Louis).
- Dr. Robert F. Mehl, Carnegie Institute of Technology.
- Dr. Paul C. Aebersold, Chief, Isotopes Division, AEC, Oak Ridge.
- Dr. Austin M. Brues, Argonne National Laboratory, Chicago.
- Dr. A. H. Holland, Jr., medical adviser, AEC, Oak Ridge.
- Dr. L. N. Nims, acting head of department of biology, Brookhaven National Laboratory, Patchogue, Long Island, N. Y.

Details of the distribution and utilization of isotopes are included in appendix 4.

Section IV.—Research and Development

Since submission of its last report to Congress, the Commission has made progress toward reorganization of the atomic energy research program. Recognizing that aggressive and almost continuously changing research, both applied and basic, is vital to the national defense and welfare, the Commission has established a program in accordance with the following major requirements:

1. Concentration of immediately available facilities and personnel on the most urgent problems. This has required selective planning in programmatic or applied research and extensive direction of applied research activities under way at the time of the transfer of the properties.
2. Adequate support and stimulation of fundamental, or basic, research in order to restore the levels of fundamental research activity reduced seriously since the period before the war.
3. Maximum utilization of the national research potential: Governmental, academic, and industrial.
4. Provision for expanding the supply of qualified research personnel.

Within the policy framework, the Commission has directed its current research program in the physical sciences toward increased production and more efficient utilization of fissionable materials and the development of military and nonmilitary applications of atomic energy. Medical and biological research, including health physics, is covered in a separate section of the report.

PROGRAMMATIC RESEARCH

This research report covers the principal areas of research operations in both programmatic (or applied) research and basic research. Under the former is included a discussion of new reactors and of the outlook for useful power from nuclear energy.

Raw materials

A raw-materials research program was designed to assist in the exploration for ore deposits by the most modern methods, improve the efficiency of recovery methods for treating ores, and develop methods capable of beneficiating very low-grade ores. In this work, the Commission has the active assistance of the United States Geological Survey and other Government agencies, private contractors, and educational institutions. Exploration research includes geological investigations to determine the origin of various ore deposits and radiometric experimental work to develop improved methods and instruments for exploration and laboratory analytical procedures. The development work includes the operation of plants adjacent to the ore sources, one of which is now working in the Colorado Plateau region on the extraction of uranium from the low-grade carnotite ores there available.

Feed materials

Intensive research continues in the field of processing of source materials. Changing and tightening of specifications for the feed materials used in reactors requires unceasing study of the properties of the materials involved, the methods and efficiencies of refinement and processing, and the means of improving quality of the final fuel product.

Fissionable material separation

One of the largest and most important phases of research in chemistry and chemical engineering is that directed toward the development of improved methods for fissionable material separation and purification. Current emphasis is on the development of improved methods of plutonium separation, and on a system for the recovery of fuel materials from reactors now in the design stage.

Weapons research

Problems relating to atomic weapons research and development are dealt with mainly at the Commission's laboratory at Los Alamos.

The Commission's principal goal in this field is the scientific and engineering perfection of improved designs. The past year has seen definite progress toward this goal.

During 1946, a year in which the country abruptly reoriented itself following the end of the war, it was inevitable that much of the technical talent assembled during the war should depart from weapons work. Some of this talent again became available for the work in 1947.

An over-all long-range weapons research program has now been rounded out. Specific projects that had been interrupted are again directed toward tangible ends, and new projects have been instituted. The Los Alamos Scientific Laboratory has been restabilized and has regained an effective scientific "tone." It is the Commission's intention that this laboratory shall be operated in the spirit of a permanent research center. Building construction is now under way to that end.

Proving ground.—Thorough testing of weapons and components under simulated operation conditions is necessary to improved design.

The procurement of materials and the installation of facilities, instrumentation, and other equipment are well under way at Eniwetok Atoll, site of the proving ground mentioned in the Commission's second report to Congress. The purpose of this proving ground will be the testing of atomic weapons from time to time as part of the program of improvement. The scientific and technical operations of the proving ground will provide new fundamental data and a broader understanding of the phenomena of nuclear fission, for peaceful as well as military application of atomic energy.

The major part of the construction program has been undertaken for the Commission by the armed forces. Full security restrictions of the act are in force, and only participating official observers are permitted. Public warning has recently been issued against the entry by nonparticipating individuals into a specified area surrounding the test location. The Security Council of the United Nations has been informed by the United States Department of State, which also officially notified representatives of other nations.

Reactors

1. *General.*—The research and development on nuclear chain reactors is shaped by three primary considerations:

(*a*) Requirements of the Military Establishment.

(*b*) Reactors for research and development purposes.

(*c*) Special and large scale industrial applications.

The work aimed at providing reactors for these purposes does not separate, nor will operation necessarily be independent, even though the reasons for and principal objective of each may be quite distinct.

The requirements of the Military Establishment involve reactors to provide fissionable materials and reactors for military power requirements.

Industrial applications of reactors may be for the large-scale generation of electrical power, for the production of high-temperature-process heat, and for special purposes such as remote stationary power installations or for the irradiation of materials.

At present, reactors under development may combine purposes serving several of the ultimate objectives outlined above. This report on reactor research covers for the most part work on problems common to all reactors, regardless of purpose or, if not common to all reactors, problems which must be answered before specialized applications may be realized.

2. *Working materials.*—The working materials in the construction of reactors fall into six principal categories:

1. Fuel elements.
2. Moderators required to slow the neutrons in reactors utilizing neutrons of low energy.
3. Coolants, required to remove the heat generated by fission within the pile.
4. Structural materials, which form the supporting framework of the reactor, or pile.
5. Shielding, required to confine the intense radiation.
6. Auxiliaries, such as pipes, valves, blowers, pumps, instruments and controls, feeding and removal mechanisms, protective casings for feed materials, and others.

These items cover the engineering problems in the design and construction of piles. The specifications for all of the materials to be used cover: Neutron absorption characteristics; resistance to corrosion; chemical and physical stability under high temperature and intense radiation; and workability into shapes which will withstand high internal and external pressures of liquids or gases, and other stresses.

Sufficient research progress has been made on a number of these problems to permit the design of medium high-temperature reactors using various coolants and with several variations in the moderator. These reactors may be operated at temperatures high enough to produce power on an experimental basis. One of such should be in operation by the end of 1950, and perhaps earlier.

3. *Reactors for military use.*—Studies of reactors for military power requirements are presently carried out by the Department of the Air Forces and by the Department of the Navy. The Commission is cooperating with these programs.

4. *Research and development reactors.*—Many of the problems encountered in finding the working materials for the construction of reactors involve the use of reactors themselves in testing and developing such working materials and auxiliary equipment. In addition to the reactors at Hanford, the Commission has available two reactors at Los Alamos, two at Argonne National Laboratory, and one at Oak Ridge.

These reactors are excellent for the various purposes for which they are used: To produce plutonium, to produce isotopes, and for research. No one of them produces usable power and no one of them operates at a high temperature. The "fast" reactor at Los Alamos uses plutonium as its nuclear fuel. The others are uranium reactors, operating at relatively low temperature.

Construction was started this year on a uranium, graphite-moderated, air-cooled reactor for research purposes at Brookhaven National Laboratory. This will provide much-needed research facilities in the Northeastern United States. Basically similar to the existing reactor at Clinton National Laboratory, the new Brookhaven reactor will be somewhat more powerful. It should be in operation within a year.

Argonne National Laboratory has completed the design and is nearly ready to start construction of an important new type of reactor. It may be operated at temperatures sufficiently high to make possible production of useful power.

A special type of reactor is under design at the Knolls Atomic Power Laboratory operated for the Commission by the General Electric Co. at Schenectady. This reactor will be similar in purpose to the new Argonne reactor but will be of different design. The new Knolls reactor will provide further information on coolants and will permit special studies of both components and power production.

Clinton National Laboratory at Oak Ridge has carried to an advanced stage the design of a high-flux reactor for general research and development purposes. The specification calls for a neutron intensity far greater than those now available and will include provisions for testing reactor components at high temperatures. It will be a most important research and development tool for the entire reactor program, and will be constructed at Argonne National Laboratory.

General power reactors have been studied at Clinton National Laboratory for many months. The primary objectives of this work is to survey the possible usefulness of a wide range of reactors and components. The studies completed thus far constitute an important store of knowledge of the power problem, and particularly of components and auxiliaries.

5. *"Breeding"*.—Underlying the entire field of atomic energy today, or, more specifically, the utilization of nuclear energy through the chain reaction process, is the problem of the availability of fissionable materials. This availability depends not only on the actual stores in the earth's surface, but on the time and energy consumed in obtaining them in quantities sufficient to permit full-scale development of atomic energy. These are limiting factors which it is believed can be removed only by an intensive long-range scientific and engineering effort.

In this discussion of research on the reactor program, it should be kept in mind that intensive research is going on in the field of reduction and processing of ores for the feed materials upon which reactors depend. Solution to the problem of assuring adequate supplies of fissionable materials may lie in one or more of several directions: (1) Discovery of new deposits of ores; (2) improvement in the recovery processes; (3) development of new recovery processes for different types of source material, and (4) development of the nuclear reactor for more efficient utilization of the available fissionable material.

Research is under way in each of these fields. One important line of work in the direction of improved reactors is aimed at development of a "breeder" type of reactor. This is a nuclear chain reactor which over a period of time will actually create more fissionable material than is put into the reactor as fuel to sustain the reaction.

The word "fuel," when used in this connection, denotes the fissionable material put into the reactor as a source of energy and the source of neutrons on which the fission process depends. The material which is put into the reactor for conversion or transmutation into fissionable material is known as fertile material. The fuel is consumed through fission, which at the same time may create new fissionable material from the fertile material, as a result of the absorption of neutrons by the fertile material. If more fissionable material is thus produced than is consumed, there would be a net gain of fissionable material, or a "breeding" of the fuel.

The significance of the breeder type of reactor is directly related to questions of the stores of uranium and thorium in the earth's surface and the problems of their recovery and use, whether economic, political, or technological. Both the military and industrial potential of atomic energy justify the effort to solve the problems of "breeding."

The process of the accumulation of fuel through operation of a breeder-type reactor may be likened to the compounding of interest on money. In this analogy, the reactor is a bank. The initial stock of fuel can be compared to the capital which the depositor puts into a savings account. That capital—in this case fissionable material—is put to work producing power. But at the same time, additional fissionable material (interest on the capital) is accumulating and therefore increasing the original capital, just as compound interest increases the depositor's capital in savings account.

6. *Power.*—Because of the relationship between the rate of reproduction of fuel in a breeder and the power of the reactor, the development of breeders and of reactors for power will go hand in hand. There is, in effect, a complete interlocking of the scientific and engineering problems of the breeder and the power reactor, with both heavily influenced by our ability at any given time to procure, recover, and process efficiently and with reasonable economy the required fuels.

The generation of significant amounts of useful power from nuclear energy depends upon no single factor of availability or utilization of fissionable materials, but upon a complex pattern of developments in the fields of exploration and processing of raw materials, reactor working materials, chemical separation systems, and reactor design and operating techniques. The development work to be done in these fields and the periods of time required to produce usable amounts of new fuel through "breeding," introduce a time factor measured in years into any discussion as to when nuclear energy can make a significant contribution to the supply of power now available from other sources.

It was with these facts in mind that the Chairman of the Commission expressed the Commission's views on these prospects in an address before the Detroit Economic Club on October 6, stating that "the first commercially practical atomic power plant is not just around the corner, not around two corners," and that a common estimate of the time schedule for the development of nuclear power "is from 8 to 10 years to overcome the technical difficulties and have a useful, practical demonstration plant in operation."

A reasoned view of the prospects for significant amounts of useful power from nuclear energy—at least for limited practical applications—is an encouraging one. But the timetable extends through two decades.

In a recent paper discussing the scientific and engineering problems of power, the General Advisory Committee said:

> Assuming even a most favorable and rapid technical development along these lines a word of caution is needed as to time scale. We do not see how it would be possible under the most favorable circumstances to have any considerable portion of the present power supply of the world derived from nuclear fuel before the expiration of 20 years.

BASIC RESEARCH

Future developments in atomic energy will depend on new knowledge—not only new knowledge of nuclear forces and general nuclear behavior, but new knowledge in all of the supporting sciences: Chemistry, metallurgy, physics, health physics, biology, etc. This knowledge will be the product of basic research, which at the same time will provide opportunities for the training of scientists and technicians.

Basic research is carried on in AEC facilities as well as in other Government and university laboratories. AEC laboratories conduct all basic research involving reactors and other fundamental studies required to give balance to the program.

Arrangements are being made with the Office of Naval Research for joint sponsorship of a wide range of basic research in a program which will insure efficient utilization of facilities, personnel, and results.

Basic research was expanded during 1947 in the fields of physics, chemistry, and metallurgy. Much of this work is being done in Commission facilities where reactors are available, and includes studies of nuclear properties of elements important to reactor, weapon, and other work; the chemistry of the transuranic elements and of radioactive materials; and the metallurgy of both fuel elements and reactor working materials.

Basic studies of the interaction of elementary particles are being done chiefly through the use of particle accelerators.

The principal facilities where basic work is under way are:

- Argonne National Laboratory, Chicago, Ill.
- Batelle Memorial Institute, Columbus, Ohio.
- Brookhaven National Laboratory, Patchogue, Long Island, N. Y.
- Clinton National Laboratory, Oak Ridge, Tenn.
- Columbia University, New York, N. Y.
- Iowa State College, Ames, Iowa.
- Massachusetts Institute of Technology, Cambridge, Mass.
- Radiation laboratory, University of California, Berkeley, Calif.
- United States Bureau of Standards, Washington, D. C.

Nuclear reactions investigated in cyclotrons

The operation under contract with the Commission of the 184-inch cyclotron at the radiation laboratory, University of California, has provided a source of alpha particles and deuterons with which to investigate nuclear structure. So-called "spallation" or splintering reactions, have been observed, in which as many as 15 primary particles have been ejected from the nucleus of a single heavy element subjected to bombardment.

Fission can also be induced in certain heavy nuclei by high energy alpha particles and deuterons, and has been observed in bismuth, lead, thallium, platinum, and tantalum.

The cyclotron has indicated the existence of the so-called "exchange forces" operating between protons and neutrons in the atomic nucleus and has thus made a step toward answering the question of what holds the nuclear particles together.

Linear accelerator

A new linear accelerator designed for accelerating protons, was built at the University of California and operated to produce protons with an energy of 32,000,000 electron volts.

Research reactors

New radioactive substances and concentrated beams of neutrons are produced in the Commission's experimental nuclear reactors now available to the research workers at Oak Ridge, Los Alamos, and Chicago. Such reactor products are now indispensable to the fundamental investigation of materials. Other new experimental reactors—especially, the one now under construction at the AEC Brookhaven Laboratory—will still further expand the area of basic research which can be carried out with neutron beams.

Trans-uranic elements

While physicists explore the interior of the atom, chemists in many of the Commission's laboratories are studying its behavior as a whole—how the newly created elements combine with, and react upon, the materials that are already understood. To utilize new materials, or to make new use of familiar materials, understanding of their chemical behavior is essential. All of the "trans-uranic elements," such as neptunium, plutonium, americium, and curium hitherto nonexistent upon earth, are still largely mysteries.

Rare earths

The rare earth elements, a group comprising those from atomic No. 57 (lanthanum) through atomic No. 71 (lutecium), have long been practically unavailable for physical and chemical research except as mixtures of the group. Separation of individual rare earth elements is extremely difficult because of their chemical similarity.

The development of special methods for chemical separations of radioactive isotopes has led to the successful application of these methods to the problem of rare-earth separation, and as a result, the individual differences in these elements can now be systematically explored and both their physical and chemical properties determined.

Synthesis of organic compounds labeled with carbon–14

Radioactive carbon-14 has been available for the last year to laboratories in this country through the Isotopes Division of the Commission. It is now available also for foreign distribution. Since carbon is an element contained in all organic compounds, its chemical behavior plays an exceedingly important role in all plant and animal processes and in all synthetic organic chemical researches.

To be useful, however, the carbon atom must be incorporated, or synthesized, into a molecule so constituted that it will undergo the organic reactions under study. To aid research in the application of carbon-14 to such problems, many organic "intermediates" or basic compounds more suitable as starting materials have been synthesized in Commission laboratories, and these compounds are being used to study many biological problems and to investigate the exceedingly important plant process of photosynthesis. It is expected that several such compounds will be available soon for distribution. One, methanol, is currently being distributed.

Publications

One measure of the contribution to basic research during the past year in laboratories working under the auspices of the Commission is the volume of publications and reports which have been issued. The subjects covered embrace many of the fields of interest in the Nation's atomic energy program excepting only those aspects of atomic energy research that cannot be discussed publicly at the present time.

Current work is covered for the most part in nearly 3,000 reports in the fields of chemistry, physics, metallurgy, biology and health, and others.

SECTION V—BIOLOGY AND MEDICINE

During its first year of operation, the Commission—while encouraging and assisting wherever possible the research work already in progress and undertaking such work in its own laboratories—laid the groundwork for a Nation-wide program of biological and medical research and education. The major steps taken were:

1. *Appointment of a Medical Board of Review, composed of seven experienced scientists in the field of biological and medical research.*

In June 1947 the Commission requested the President of the National Academy of Sciences to nominate a panel of qualified advisers to review the medical and biological aspects of the program. This Medical Board of Review recommended the continuance and expansion of research and training in the various fields, appointment of a permanent advisory group, and establishment of a broad training program.

2. *Appointment of a permanent Advisory Committee for Biology and Medicine.*

This committee, appointed in September 1947 is composed of seven distinguished scientists in the various medical and biological fields and convenes at monthly intervals at the various installations in an unusually active advisory capacity. The committee is composed of the following members:

- Dr. Alan Gregg, director for medical sciences, Rockefeller Foundation, New York City; chairman.
- Dr. G. W. Beadle, division of biology, California Institute of Technology, Pasadena, Calif.
- Dr. Detlev W. Bronk, director of the Johnson Research Foundation, University of Pennsylvania.
- Dr. Ernest W. Goodpasture, dean of the school of medicine and professor of pathology, Vanderbilt University.
- Dr. Baird Hastings, professor of biochemistry, Harvard Medical School.
- Dr. E. C. Stakman, chief, division of plant pathology and botany, University of Minnesota.
- Dr. Joseph T. Wearn, dean of the school of medicine, Western Reserve University.

3. *Establishment within the Commission's Washington headquarters of a Division of Biology and Medicine.*

The Division will correlate the medical and biological research programs related to atomic energy in the Commission's, in other Government, and in private laboratories; initiate needed investigations and review all contracts entered into and allocations of funds for research; and direct for the Commission its health physics work and industrial hygiene activities.

4. *Arrangement with the National Research Council for joint sponsorship of the Council's Committee on Atomic Casualties, which will make a long-range study of the effects of atomic bombing on Japanese survivors in Hiroshima and Nagasaki.*

The study of the actual effects—immediate and long-term—of exposure of human beings to an atomic bomb is one of our most important sources of information for the future. Besides the effects on general physiological functions, the relations of genetics and cancer are primary concerns. The president directed the National Research Council to undertake this study and authorized the cooperation of Government agencies.

5. *Maximum development of the production and distribution of isotopes for medical and biological investigations and the appointment of a Committee on Isotopes Distribution composed of experts in the field.*

Radioactive isotopes continued to hold the center stage in medical and biological research. With these tools, for example, new methods of treating heart dropsy were developed and encouraging results were obtained in various disorders of the blood. (See sec. III, Production.)

6. *Support of research through the administrative organization of the Office of Naval Research.*

7. *Planning of a fellowship program for the training of personnel for atomic energy work in medical and biological fields.* (See sec. VII, Training and Information.)

8. *Formulation of a cancer program, in accordance with the policy of assisting established medical research to explore the application of atomic energy to the various aspects of cancer treatment.*

The Commission's cancer program, developed in 1947, includes special assistance for cancer research at such institutions as the New York Memorial Hospital, Harvard University, and the University of California; the development in the Commission's laboratories of radioactive materials for cancer treatment; and the provision of beds for selected cancer patients in hospitals at the Clinton, Brookhaven, and Los Alamos Laboratories, and elsewhere.

9. *Authorization of funds for building and equipping a medical and biological training and research center at the University of Rochester, Rochester, N. Y.*

These new facilities will permit the extension of the medical and biological research program conducted for the Government at this institution and particularly of the work now being done under contract with the Commission, centering around the medical and biochemical aspects of radioactive substances and processes.

THE MEDICAL AND BIOLOGICAL RESEARCH PROGRAM

The Commission through 1947 had research contracts with the University of California, Columbia University, Harvard University, the Massachusetts Institute of Technology, and the University of Rochester, providing for research not only on the biological effects of radiations and radioactive materials but also in the utilization of isotopes for the investigation of life processes in plants and animals. A great many other institutions in all parts of the country conducted similar work.

At various of the Commission's own installations, intensive work was carried out in these fields—at the Clinton National Laboratory, studies on the effects of atomic energy on hereditary traits and other biological phenomena, and at the Argonne National Laboratory, extensive toxicologic studies on the various products of fission of the nucleus. This latter study revealed new methods of producing tumors experimentally and thereby provided new avenues in cancer research. At Los Alamos, N. Mex., several drugs and vitamins were made radioactive and studied in the human body, and methods of treatment of radiation sickness were evaluated. The Brookhaven National Laboratory started to investigate the relation of atomic energy to cancer and to carry out basic research.

The initial task of the Commission in 1947, and specifically of its Division of Biology and Medicine and the Advisory Committee, was to inventory the research and educational work now going on in this field, select the areas where the effort should be stimulated, and take positive action—by assistance through contracts, participation in the work of other institutions, the construction of facilities, and the establishment of laboratories—to enlarge and coordinate the national program. This work continues.

INDUSTRIAL HEALTH

Unprecedented safety measures have been developed to meet the equally unprecedented hazards to health involved in the atomic energy production process—from the novel respirators used for uranium work to the remote control "fingers" used by the Los Alamos operator who views his work through television.

Many of the materials that must be handled are organically poisonous, aside from any danger of radiation. Protective measures must be based upon an understanding of why the materials are toxic and a determination of tolerance standards. These investigations were carried out during 1947 at a score of universities and medical institutions and Government and industrial laboratories, and have resulted in more effective utilization of protective clothing, respirators, dust-removing systems, cleaning methods, and analytical techniques for the continuous testing for danger.

Investigations of the effects of radiations on living things are still so new and tentative that they have the character of a search after fundamental knowledge. But the application of health physics cannot wait the results of this search; therefore, the safety measures adopted against radiation are now largely of the kind that can be instituted without the guidance of well-established standards. The policy has been to take no chances. A small fraction of what is calculated to be the minimum safe tolerance dose has been the limit for workers. Shielding—of reactors, particle accelerators, and radioactive materials—has been designed with ample safety factors.

The Commission's Offices of Directed Operations maintain medical divisions to coordinate safety operations in contractor's plants. A remarkable safety record has been achieved in 1947 throughout the Commission's organization. (See sec. IX, Organization and Administration.)

SECTION VI—ENGINEERING AND CONSTRUCTION

The construction and engineering work required during the early years of the peacetime development of atomic energy represents a very large proportion of the total development expenditure in the current phase of the program. The work has accelerated rapidly. In early 1947 there were broad program determinations and detailed planning. Actual new construction got under way in the summer of 1947.

Production plants and facilities are taking by far the largest share of construction effort in this stage. Indirectly, production requirements are the occasion for a substantial share of the extensive construction of housing and community facilities.

CONSTRUCTION NOW UNDER WAY

Production facilities

A large share of all construction undertaken in 1947 was at Hanford in preparation for the building of production facilities in the period immediately ahead. A construction camp to accommodate 15,000 men was nearly complete by the year's end. Progress of this project was greatly accelerated by the acquisition, through the War Assets Administration, of a completely equipped Navy hospital with 65 buildings, barracks, and various types of service equipment, which was moved to the camp site in North Richland.

Also at Hanford, new storage facilities for process materials were completed in 1947, and additional facilities went into an advanced design stage. A great variety of preparatory alteration and construction of operating and maintenance facilities—office buildings, machine and carpenter shops, warehouses, and other service structures—was continually in progress through the year.

Construction of research facilities

Nearest to completion of major research facilities is the new metallurgy building on the campus of Iowa State College at Ames, one of the Commission's most important research and development centers for metallurgy. The laboratory, fully equipped to apply the new techniques in this field, and for the study of production processes of uranium and thorium, was started during the year and is now about half complete. The property on which it stands has been leased by the State of Iowa to the Federal Government for 99 years. Another project brought close to completion during 1947 was a developmental laboratory at Miamisburg, Ohio.

In the radiation laboratory of the University of California at Berkeley, a new synchrotron is under construction in a recently completed special building.

At the Commission's Knolls Atomic Power Laboratory at Schenectady, a $15,000,000 construction program, begun in August 1947, is 10 percent complete. A 70,000-square-foot building in Schenectady, acquired from the War Department, was converted to the use of laboratories, shops, and offices previously crowded into inadequate space in the General Electric plant.

Construction of housing and community facilities

The Government community at Los Alamos, which now has a permanent population of nearly 8,000, was built during the war in an isolated and physically confined area, a piece at a time, as needed to meet the urgent and secret demands of the weapon program. Living conditions, as a result, are far below the standard acceptable, on a long-term basis, to the scientists and other workers and their families who must now make their homes at the critically important project; and furthermore, maintenance costs of the hastily constructed community are abnormally high. During 1947, therefore, an emergency program of community renovation was pushed with all possible speed. A generating plant, sewage-disposal system, and several markets, shops, and warehouses were completed, and roads and street additions are well under way. Other town buildings and stores were about half completed. About 550 permanent houses were finished, and another group of 113 living units in houses and apartments was about one-quarter done. Installation of an improved water system was undertaken. Additionally, a great deal of remodeling and renovating of existing facilities was accomplished during 1947.

At Oak Ridge, population 35,000, a construction program to provide immediately needed public works, safety installations, and school facilities was about 60 percent complete at the close of the year.

At Hanford, a $14,000,000 permanent housing project was about one-fifth completed.

ENGINEERING AND PLANNING

Engineering and design of facilities to be constructed in the expanding program of 1948 went ahead in 1947 under more than a score of major contracts. Most of these plans were developed to the stage where actual construction would soon begin.

Planning of production facilities

Engineering work at Hanford involves every kind of planning required in the preparation for a construction project that is big by any peacetime—or wartime—standards, and expansion of the town into a good-sized city. Contracts were let for the enlargement of electric power and telephone facilities; plans were completed on projected railroad and highway connections, both of which will bridge the Yakima River to reach the project. Heavy construction equipment sufficient to meet 80 percent of future needs was obtained from other Government agencies. About $5,000,000 worth of building materials and equipment was obtained from the War Assets Administration and about $11,000,000 worth from the Army, Navy, and Department of the Interior. The Pasco Army Depot was obtained by transfer from the War Department to provide space for receiving and storage of construction materials.

Los Alamos is the center of an expanded production program, which will require the expenditure of more than $23,000,000 during the next fiscal year.

Planning of research facilities

Plans were well advanced in 1947 for full-scale construction—to get under way in 1948—on the two new National Laboratory establishments that the Commission will build: Argonne, in Du Page County outside Chicago; Brookhaven, on the site of the former Camp Upton at Patchogue, Long Island. Contracts for the construction of both laboratories were let, and design was carried to an advanced stage.

At Brookhaven, ground was broken in August 1947 for the construction of the experimental reactor that will make the laboratory a center of nuclear physics research in the Northeast. Design of the reactor was completed, and construction begun. Design of laboratory buildings was completed.

The contract for the design and construction of the Argonne National Laboratory, was let in May 1947 to the University of Chicago, which in turn entered into subcontracts for architectural, engineering, construction, and management services. Actual construction is scheduled to begin in the spring of 1948, and the entire installation is scheduled for completion in 1950.

Planning of housing and community facilities

Community development at the Government atomic energy production and research center at Oak Ridge involves long-term planning for an efficient and livable city of 35,000 people or more. The Commission in 1947 started the preparation of a master plan to provide for city development on a sound and economical basis. The plan has four phases: The preparation of maps showing geographical and environmental features of the area and present utilization; analysis of present utilization; development of plans for improved utilization, prepared with full attention to the functional relationships of each land-use area to the others and the most advantageous location of housing, community, school, and all other permanent facilities; and finally, the development with Government authorities of definitive plans covering zoning, transport, utilities, recreational features, and other necessities of city government.

Similar long-range studies were started at Hanford and Los Alamos. A 114-bed community hospital, for Los Alamos, was approved by the Federal Bureau of Hospitalization; plans and specifications will be entirely completed by May 1948. The hospital will have a wing set aside for medical research, where selected cancer patients will be provided with care and treatment without charge, as part of one of the Commission's cancer research programs.

SECTION VII—TRAINING AND INFORMATION

TRAINING

An inseparable part of the Commission's responsibility for the development of atomic energy relates to the training of men who will do the work. During 1947 a fellowship program was developed in the Division of Biology and Medicine, designed to train qualified persons for careers in the medical and biological aspects of atomic energy. The Commission will finance the program and establish the operating policies and training goals to be met. Actual administration, including selection of candidates, will be undertaken by the National Research Council of the National Academy of Sciences, which has had broad experience in the administration of fellowship programs. The AEC has budgeted approximately $1,000,000 for the first year.

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Fellowships

The initial fellowships will be distributed among three broad classes of candidates:

Doctors of medicine.

Doctors of philosophy in the biological sciences.

Bachelors of science and of arts, who will receive training in health physics and related subjects.

Post-doctoral fellowships will extend for a period of 2 years, with annual stipends, depending upon marital status, commensurate with other fellowship programs. Graduate training in health physics will extend for a period of 1 year or longer depending upon the qualifications of the candidate and his need or desire for additional training.

It is anticipated that fellows trained under the program will become leaders in future development of medical and biological education in the atomic energy field. An opportunity to utilize their training at AEC research and production centers will be offered, although the fellows will not be committed to such work. Insofar as possible, they will be afforded an opportunity to elect the type of training desired and the means by which it will be obtained, and will have a certain amount of latitude in selecting the universities or laboratories at which their studies will be pursued.

Selection of institutions will depend in part upon geographical location and in part upon availability of adequate educational and physical facilities. Special consideration will be given institutions in which it is possible to integrate medical and biological training with physics, chemistry, and mathematics. Since conditions allowing this combination are limited, special facilities are being provided at the Commission's regional laboratories and at certain universities. However, fellowship training will not be limited to these institutions. Fellows may receive all or part of their training at other laboratories, universities, hospitals, or foundations having necessary facilities.

Results of work carried out by a fellow will be available to the public through approved scientific channels, without restriction, except as may be required for reasons of security.

A similar plan for research fellowships in the physical sciences is under development.

Other training

The three national laboratories at Chicago, Oak Ridge, and Patchogue, Long Island, with their total of 52 associated universities are important training as well as research centers. The broad base of participation in atomic energy research by academic institutions is in itself important from an educational standpoint. All of the research programs at educational institutions are training programs as well.

THE NATIONAL LABORATORIES

The Commission has three national laboratories, established to provide a common ground for teamwork in research and training between the Nation's private educational institutions and the Government.

In section 1, under the title of "Purpose," the Atomic Energy Act of 1946 makes the Commission responsible for:

> A program of assisting and fostering private research and development to encourage maximum scientific progress; and * * *

A program of federally conducted research and development to assure the Government of adequate scientific and technical accomplishment. * * *

To some extent this objective, of scientific and technical advancement, is being pursued individually by the universities and the Government, but there is an unmistakable need also for large-scale continuance of the cooperative effort that proved so enormously fruitful in wartime. The universities have—and must have—the major share of scarce scientific manpower today; the students essential to tomorrow's progress; and the tradition of effective fundamental research and education. The Commission has a Nation-wide program directed toward the ends specified in the act, and the facilities and the tremendously expensive equipment—reactors and particle accelerators, for instance—that must be used. Obviously, both groups of resources must be used if the program is to produce the greatest results.

The National Laboratory program was developed during 1947 to combine these sources of strength; at the three laboratories, at Chicago, Oak Ridge, and Patchogue, Long Island, a total of 52 universities and institutions are cooperating in scientific research and education. (See appendix 3 for names of cooperating institutions.)

Argonne National Laboratory is successor to the Metallurgical Laboratory established early in the war for atomic energy development at the University of Chicago, where the first operating nuclear reactor was built. It is still operated for the Commission by the university; and 29 participating Midwest institutions are represented on the Council. Argonne is today the center for the Commission's reactor development program and all the research and development accessory to it—reactor theory and design, study, and development of necessary materials and components, and general coordination of the Nation-wide effort. It has two operating reactors and extensive facilities for the use of its 10 divisions: Biology, chemistry, health physics, instrument research and development, mass spectroscopy and crystal structure, medical, metallurgy, experimental physics, theoretical physics, and reactor research and development. A good deal of fundamental research is conducted in most of these divisions. The laboratory, now scattered over the campus of the University of Chicago, is to be consolidated at a single Government site. Land is being acquired in Du Page County, and designs are under way.

The *Clinton National Laboratory* at Oak Ridge is an outgrowth of the huge wartime development of the production of fissionable materials at this location. Laboratory facilities include more than a hundred buildings equipped with a great variety of specialized equipment and an experimental reactor. In addition to much work in physics, metallurgy, and biology, the laboratory serves as a center for the Commission's Nation-wide program of chemical and chemical engineering research, both basic and programmatic, with emphasis upon industrial applications. From this laboratory, the Commission's Isotopes Division distributes to all parts of the country and abroad the experimental isotopes produced in its reactor and in the electromagnetic separation plant located at Oak Ridge.

Cooperating with the Clinton National Laboratory are 14 southern universities, combined, under charter from the State of Tennessee, into the Oak Ridge Institute of Nuclear Studies, under contract to the Commission for extensive research and training. The institute has developed several programs. The graduate training program permits selected graduate students from various universities to complete their thesis research by work done at Oak Ridge; during the 1947 fall semester 198 students registered for courses in chemistry, chemical engineering, mathematics, physics, and zoology. A supplementary graduate training program enables regular employees of the local operating contractors to continue work while studying subjects required for their theses at Oak Ridge instead of going elsewhere. The school of nuclear science of the institute provides advanced study at the post-doctorate level in special problems related to nuclear reactor development. The research participation program will make it possible for scientific staff members of educational institutions to take part in the research programs of the operating contractors. Also, the institute will conduct a special school in radioactive tracer techniques, beginning in the summer of 1948.

Brookhaven National Laboratory at Patchogue, Long Island, was established to enlist the scientific cooperation of the great educational institutions of the Northeast. It is operated by Associated Universities, Inc., a corporation formed by nine universities of the region, and is being provided with a full range of laboratory equipment, sufficient to supply the needs of advanced work in the atomic energy aspects of physics, chemistry, biology, and medicine, including a nuclear reactor and a number of particle accelerators. A staff of about 140 scientists from universities, industrial research laboratories, and other institutions was appointed to the laboratory; and in addition about 180 consultants agreed to assist the work. Conferences on subjects connected with the research are regularly held and were attended during 1947 by close to 1,000 scientists.

A major purpose of the laboratory is to provide exceptional facilities to young scientists for training in nuclear research. Although Brookhaven neither awards degrees nor grants academic credit, selected graduate students are permitted to carry out their doctorate investigations, using its special facilities.

PUBLIC AND TECHNICAL INFORMATION

Directly supporting not only the research and training activities of the Commission's facilities, but also the work of educational and industrial institutions throughout the country, is the provision of technical information on work done in the atomic energy program.

The Commission established late in 1947 a unified Public and Technical Information Service to insure, in accordance with the Atomic Energy Act, adequate control and dissemination of the information that is the lifeblood of scientific and engineering progress—and of public understanding of that progress and its implications. The Public and Technical Information Service combines five interdependent functions relating to the control and dissemination of information:

1. Preparation, reproduction, and controlled distribution within the project of classified reports to personnel requiring such information.
2. Declassification through analysis by qualified scientific reviewers of material which then becomes available for public use.
3. Editing, preparation, and reproduction of technical information materials, including indices, abstracts, project reports, and declassified papers.

4. Security guidance service—aid to publishers, editors, reporters, broadcasters, leaders of citizen groups, or others issuing material relating to atomic energy—in order to prevent compromise of restricted data; and assistance to contractors of the Commission and other agencies of Government to safeguard restricted data.

5. Public information service—assisting representatives of the press, radio, picture services, citizen and trade organizations, and educational agencies, in obtaining the full range of declassified and unclassified data currently available from the national atomic energy program.

Declassification of information

The declassification system developed under the Manhattan District and continued under the Atomic Energy Commission during 1947 received some 1,200 documents for declassification. Of those, the 120 scientists and engineers serving as reviewers recommended declassification and general release of over 1,000, after the making of necessary changes and deletions. A number of these declassified documents have been published in scientific and technical journals and have also been made available to the public through the Office of Technical Services of the United States Department of Commerce.

In order to insure uniform application of declassification policies with respect to information shared by the United Kingdom, Canada, and the United States, as a result of their combined wartime efforts, and in the interests of maintaining maximum security of information, the Commission arranged a 3-day conference between representatives of the atomic energy agencies of the three nations in November 1947. The conference was concerned with the application of uniform declassification policies for atomic energy information. Discussions were limited to technical data held jointly by the participating nations as a result of their cooperation during the war. Canada and the United Kingdom now use the Declassification Guide developed in the United States and made available to them in April of 1946.

Technical information

Congress in the Atomic Energy Act recognized that—

> the dissemination of scientific and technical information relating to atomic energy should be permitted and encouraged so as to provide that free exchange of ideas and criticisms which is essential to scientific progress.

The system for providing information to the scientific and technical community, both inside and outside the Commission and its contractors' organizations, developed extensively during the year.

Of prime importance in this program is the distribution of restricted data originating within the atomic energy project to those within the project who have need of such information and are authorized to receive it. In 1947, an average of 50 copies each of 3,000 such classified reports were distributed in accordance with distribution lists carefully compiled. Each laboratory received those categories of information it needed for the successful accomplishment of its program. In addition to this routine distribution, 34,000 individual copies of such reports were distributed to laboratories requiring them, after careful screening to insure that no unnecessary distribution of restricted information resulted.

To insure that project laboratories have access to all information in the field of atomic energy which originates outside the atomic energy project, a continuing Guide to Published Research on Atomic Energy and allied fields was prepared in the Technical Information Service by assembling abstracts in this field from all of the published abstract journals. During the year, 2,223 such abstracts were assembled and circulated throughout the Commission's contractor groups.

In order to make certain that all project scientists have access to the information contained in the Research and Development Reports prepared at each laboratory, the Technical Information Service prepares abstracts of each of these reports that can be circulated to all project laboratories; 507 such abstracts were prepared and incorporated in the Abstracts of Research and Development Reports which was issued monthly during the year. This publication is classified Secret.

To furnish adequate reference service for the mass of information contained in the 18,000 individual classified research and development reports deposited in the Commission's libraries, an extensive card index system was developed by the Technical Information Branch; 906,000 index cards were prepared and distributed in the past year.

Over the past year also, nearly 1,700 individual declassified documents were distributed, including those declassified prior to January 1947. So that the information contained in these documents would be of maximum usefulness to the scientific community, the documents were reproduced and distributed to project laboratories, Government agencies, and 150 depositories of the Library of Congress, and were made available to the public through the Office of Technical Services of the Department of Commerce. Nearly 162,000 copies of these documents were distributed.

A program was instituted to make the information in these declassified documents more readily accessible through abstracts, 700 of which have now been prepared for the same distribution as the documents themselves.

Much progress was made toward completion of the National Nuclear Energy Series, a 110-volume compilation of scientific treatises based primarily on research in the field of atomic energy conducted under Government auspices. By the year's end, material for six volumes had been declassified and prepared for reproduction and public sale. An additional 20 classified volumes are ready for reproduction and distribution within the project. The Commission entered into a contract with Columbia University to handle the publication of the series, and it is expected that a publisher will be announced shortly. The first issuance of the National Nuclear Energy Series will be known as the Manhattan Project Technical Section, covering work done under the Manhattan project. Approximately half of the total number of volumes are expected to be declassifiable and available for public use and will aggregate approximately 25,000 pages.

Public information

In response to the very great public interest in and concern with the progress of the Nation's atomic energy development program, the media of public communication and information during 1947 continually devoted large amounts of space and time to reporting all that could be reported on the program, explaining the basic nature of atomic energy, and counseling readers and listeners on public policy toward control and use of this new force. At the Commission's offices in Washington and the five Offices of Directed Operations, there was a mounting volume of demand by reporters, editors, broadcasters, picture men, and leaders of citizen groups, for information from the Commission and for guidance on the security aspects of information on atomic energy obtained elsewhere.

To meet this demand the Commission authorized a small public information staff—four professional employees in Washington and one at each of the five Offices of Directed Operations. Through the declassification system this staff obtained for all who asked such service—writers, publishers, periodicals, newspapers, broadcasters, citizen groups—judgment on whether copy proposed for publication contained restricted data. The volume of requests for such service grew steadily. It was—and is—evident that the public communications media of the Nation desire overwhelmingly to avoid harm to the national defense and security through publication of restricted data. There is a heavy continuing demand for security guidance service in Washington and at the Offices of Directed Operations.

Security guidance service constituted only a part of the public information requests handled by the Commission's offices. An even larger volume of requests called for positive information, declassified or unclassified, to be used as news, in radio broadcasts, in books, pamphlets, periodicals, or talks by a great range of people. Additionally, the Commission issued at its Washington office 75 statements for press and radio giving the facts about new developments in the national atomic energy development program. Through such public releases the Commission is able to discharge to some small extent the public accountability which rests upon all Government agencies and which is especially important in the case of an agency under heavy security restrictions.

The public demand for information direct from Commissioners and staff members through talks upon numerous occasions was far greater than could be satisfied, and only a small fraction of the requests could be filled.

It is the Commission's hope that the contractor organizations and the associated universities and colleges will redouble their efforts to provide speakers, visual materials, etc., to help satisfy this intense and extensive public demand for basic information on atomic energy and the progress of the national program for its development. The Commission's own activities in this field were small in 1947 and will be on a limited scale in the future. This educational need can and should be met by the press, the radio, the schools and colleges, and the organized groups of the country.

The extent and the urgency of the demand for both security guidance and positive information service from the publishing group in the United States was indicated by three developments of the last quarter of the year: (1) The appointment by the American Society of Newspaper Editors of a special committee on atomic energy to develop recommendations for editors and for the Commission on how to give fullest service to readers on atomic energy development and at the same time to avoid breaches of security; (2) the appointment of a special committee on atomic energy by the American Textbook Publishers' Institute to speed the development of textbooks dealing with this field; (3) the appointment of a special committee by the Association of Secondary School Principals to develop a broad program for school and community education in the fundamentals of atomic energy development and control through a project called "Operation atomic vision."

The membership of these three groups is as follows:

American Society of Newspaper Editors Committee on Atomic Energy Information

Gideon Seymour. executive editor, Minneapolis Star-Journal and Tribune, chairman.
W. S. Gilmore, editor in chief, Detroit News.
B. M. McKelway, editor, Washington Star.
Paul C. Smith, editor-manager, San Francisco Chronicle.
C. G. Wellington, managing editor, Kansas City Star.
Laurence L. Winship, managing editor, Boston Globe.

American Textbook Publishers Institute Special Committee on Atomic Energy

Lee Eighton, Harcourt, Brace & Co., Inc.
Charles Griffith, Silver Burdette Co.
Henry McCurdy, Macmillan.
Lloyd W. King, American Textbook Publishers Institute, executive secretary.

Association of Secondary-School Principals Advisory Committee on "Operation Atomic Vision"

Kenneth Benne, Teachers College, Columbia University, New York, N. Y.; member of the department of adult education of the National Education Association.
Claude V. Courter, superintendent of schools, Cincinnati, Ohio; member of the American Association of School Administrators.
Stanley E. Dimond, director, Citizenship Education Study, Detroit Public Schools, Detroit, Mich.; member of the National Council for Social Studies.
Paul E. Elicker, executive secretary, National Association of Secondary-School Principals, Washington, D. C.
Will French, professor of education, Teachers College, Columbia University, New York, N. Y.; chairman, committee on curriculum planning and development, National Association of Secondary-School Principals.
George L. Glasheen, executive director, National Committee on Atomic Information, Washington, D. C.
Harold C. Hand, professor of education, University of Illinois, Urbana, Ill.; member of the Association for Supervision and Curriculum Development.
J. Dan Hull, Chief, Secondary School Instructional Problems, Division of Secondary Education, United States Office of Education, Washington, D. C.; member, committee on curriculum planning and development, National Association of Secondary-School Principals.

Philip Johnson, specialist in science, Division of Secondary Education United States Office of Education, Washington, D. C.

Morris Meister, principal, Bronx High School of Science, New York, N. Y.; member of the National Science Teachers Association.

Morse Salisbury, Director, Public and Technical Information Service, United States Atomic Energy Commission, Washington, D. C.

The Commission or members of its staff have met with each of the three groups and have started to develop programs of service to reporters and editors, writers and publishers, schools, and—through them—to pupils and the public. Specific requests for service in the way of security guidance and information will be forthcoming shortly from these groups. These are organized manifestations of the public desire for facts and for aid in reporting what may be reported about the goals and the progress of the Nation's atomic energy development program.

Section VIII—Security

Soon after taking office, the Commission enlisted the services of Rear Adm. Sidney W. Souers, USNR, former Deputy Chief of Naval Intelligence and first head of the United States Central Intelligence Group, and of Frank J. Wilson, former Chief of the United States Secret Service, as special consultants to assist in a survey of the long-term security problem. Meanwhile, the security system of the Manhattan project remained in effect.

As a result of the study, the Commission established in its staff headquarters an Office of Security and Intelligence to direct all of the security activities of its program. The Office maintains close liaison with the Central Intelligence Agency, the Federal Bureau of Investigation, and other security and intelligence agencies of the Government, as well as with the staff of the Congressional Joint Committee on Atomic Energy.

Following its establishment, the new Office took many significant measures to insure the security control of plant, personnel, documents, and information in addition to the establishment of standards, policies, and procedures.

The policy and procedures with respect to administrative review of personnel clearance decisions were developed to a point where by the year's end a five-member Personnel Security Review Board, composed of prominent citizens, was being established, to make recommendations to the Commission for further definition and codification of standards and criteria used in determining ineligibility for employment by the Commission and its contractors and to provide for administrative review.

Members of the Board are:

- Owen J. Roberts, former Associate Justice of the United States Supreme Court, Chairman.
- Dr. Karl T. Compton, president, Massachusetts Institute of Technology.
- Hon. Joseph C. Grew, diplomat and former Under Secretary of State.
- George M. Humphrey, president, M. A. Hanna Co.
- H. W. Prentis, Jr., president, Armstrong Cork Co.

Security staffs of the Managers of Directed Operations made 844 detailed inspections and surveys during 1947. The scope of this report does not permit a detailed presentation of physical security improvement resulting from these surveys. However, all major and many lesser facilities were improved in this respect. Protective devices to provide adequate mechanical safeguards were installed and, pending the completion of the construction program, an expanded guard force was created to maintain optimum levels of plant protection.

In building a guard force of 3,100 men, a high level of personnel standards and indoctrination was set and is being maintained; as an example, at Los Alamos, out of 14,000 applicants for guard duty, only 1,000 were able to qualify. Further, in connection with the development of guard forces, emergency defense plans were made for all major facilities. For this purpose close liaison was maintained with the National Military Establishment.

An integrated survey system was established to provide a regular coverage of facility surveys. A Headquarters Inspection and Survey Unit was formed to advise the Commission in achieving an effective and consistent security policy and to assist the Managers of Directed Operations in the accomplishment of that end. The unit operates independently in checking the status of security in the field, consulting with the Offices of Directed Operations and recommending to the Commission revisions and supplementations in security policies, standards, and procedures.

Preparation of a set of maps, for all key Atomic Energy Commission installations, was begun. These maps show all standard natural and cultural features and graphically stress physical security aspects.

All Commission employees are given full background investigation.

In order to protect restricted data and at the same time allow maximum progress in construction at the Commission's installations, access to restricted work is allowed to as few cleared construction workers as possible, the security and construction plans being so integrated as to provide for classified work being started only after the nonclassified construction has been completed. Considerable progress was made in 1947 in reducing the number of construction workers who have access to restricted work.

In connection with the information control and security education program, a Classification and Document Control Board was set up to establish criteria for the classification of restricted data, to supervise procedures involved in the accounting for classified documents, and to define such areas of Commission information and activity as should be free from security restrictions. Field units were set up by the Managers to work closely with the Board.

There was no complete inventory of classified documents available when the atomic energy program was transferred to Commission management. The task of inventorying such documents was begun in July 1947. The magnitude of the inventory may be illustrated by an operational and statistical outline. In the highest category of classified data over 25,000 documents were identified and are in the process of inventory. Technical and scientific reports totaling over 450,000 are also in the process of a detailed inventory and were about 75 percent complete by the end of the year. Part of the problem involved in inventorying documents is the several million less highly classified papers, which must be scanned in various repositories, to separate the two named groups of material from other less highly classified documents being studied, and to set up an improved system for handling and accounting for documents. One location has more than 25,000 linear feet of files in which 20 percent of the material is estimated to be classified.

In the security education activities, vigorous efforts were made to indoctrinate all personnel having access to restricted data with a full knowledge of their duties and responsibilities. At regular meetings, local security officers achieved, through personal contact, the cooperation of plant and laboratory personnel in understanding and executing the requirements of security. Security kits containing training material and copies of Security Education Outline, a guide to the procedures involved in security, were distributed to all Managers of Directed Operations.

Ten thousand copies of a general manager's instruction, "Responsibility for Security," were also distributed. This document describes precisely the personal obligations of all Commission and contractor personnel for security obligations. It defines the responsibilities of administrative officers—the Director of the Office of Security and Intelligence, the Managers of Directed Operations, and the heads of Washington divisions and offices.

Section IX—Organization and Administration

By Executive order, the AEC assumed responsibility from the Manhattan Engineer District of the War Department for the organization and administration of the atomic energy program on January 1, 1947. During the past year a large amount of Commission and staff time has been devoted to the establishment of the basic structure of the organization, to the recruitment and selection of principal members of the staff, and to the necessary assignments of responsibility and essential procedures for effective administration. The military authorities were extremely helpful in facilitating the administrative transition to civilian operations provided for by the Atomic Energy Act. This work is now essentially complete.

PRESENT ORGANIZATION OF THE COMMISSION

Policy review and formulation

The five-man Commission established under the Atomic Energy Act acts as a policy formulation body. The five Commissioners meet with the several bodies established by the act—namely the Congressional Joint Committee on Atomic Energy, the General Advisory Committee and the Military Liaison Committee. In addition, the Commission and the General Manager have sought the advice of several other groups on specific policy and administrative problems.

General Advisory Committee.—The members of the General Advisory Committee have made themselves continuously available to the Commission and staff in handling a wide range of scientific and technical matters. In addition to many meetings of subcommittees and special surveys by individual members, the full committee met formally eight times during the year for a total of 20 days.

The members are:

Dr. J. Robert Oppenheimer, director of the Institute for Advanced Study, Princeton, N. J., chairman.

Dr. James B. Conant, president of Harvard University.

Dr. Lee A DuBridge, 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.
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 for the Study of Metals, University of Chicago.
Hood Worthington, Carothers Research Laboratory, E. I. du Pont de Nemours & Co., Inc.

The value of an advisory group of this type cannot be overemphasized in the management of an enterprise which frequently is operating in almost unexplored areas of science and industrial technology. Not only has the General Advisory Committee assisted in the solution of specific problems, it has provided a most helpful evaluation service in the reorientation of research and development programs. As a result of its own surveys and studies, the Committee has recommended specific projects and made suggestions to strengthen the program at several points. The membership of the Committee, of course, insures the most competent appraisal of those phases of the United States atomic-energy program which, under the act, are reviewed by the General Advisory Committee.

Joint Committee on Atomic Energy.—The Joint Committee on Atomic Energy is the medium established by law whereby the Commission reports fully on its activities on a current and continuing basis, including the reporting of secret matters. The joint committee, working closely with the Commission, has assisted materially in making progress toward reconciling the requirements of maintaining the secrecy of information and at the same time assuring the necessary accountability of the Commission to the Congress.

Members of the joint committee and the Commission have discussed many matters relating to the Commission's activities in both formal and informal meetings. Representatives of other agencies of the Government such as the State Department and the National Military Establishment have also participated in some of these meetings.

The Commission has also informed the joint committee of its activities by means of many letters, memoranda, and written reports. Furthermore, the Commission's staff is in almost daily contact with the staff of the joint committee, and members of the joint committee and of the committee staff have visited the major installations of the Commission throughout the country.

Members of the committee are:

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 Lyndon Johnson (Texas).
Representative Carl T. Durham (North Carolina).
Representative Chet Holifield (California).
Representative Melvin Price (Illinois).

Military Liaison Committee.—The Commission meets regularly with the Military Liaison Committee on alternate Wednesdays and oftener when required, and the staffs of both work closely together. The Committee is housed in the Commission's headquarters. Twenty-two formal joint conferences were held during the year, 14 of these since July 1, 1947, and there were numerous staff and informal conferences. Working relationships were maintained with the armed services at various levels in Washington and in the field and were much broader than the activities involved in establishing and meeting military requirements.

The mutual interests of the Commission and the services extend throughout the broadest range of subjects: Security of information and facilities, production, procurement, construction of facilities, biology and medicine, certain field operations, intelligence, support of basic research, appropriations and other fiscal matters, export controls, mobilization planning, and participation of industry in the atomic energy program. Organizing for effective relations with the Military Establishment in these many fields—relations which recognized the responsibilities, explicit and implied, of the Commission and the services—was a major objective of the Commission during 1947, and progress toward this objective has been substantial, in a year which was a formative period for the Commission and a period of reorganization for the services.

Differences arising in initial presentation of matters considered jointly have thus far been resolved by discussion and thorough analysis by the members and staffs of the Military Liaison Committee and the Commission. Of the wide range of matters relating to the entire atomic energy program that have been discussed with the Military Liaison Committee, no case has yet arisen where it has been necessary to refer any disagreement to the President for decision as provided for in section 2 (c) of the Atomic Energy Act.

Members of the Committee are:

Lt. Gen. Lewis H. Brereton, United States Air Force, Chairman.
Lt. 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.

Organization

The General Manager is responsible to the Commission for the effective functioning of the organization. The small Washington office is essentially a staff organization concerned largely with the development and evaluation of programs and policies. The operations of the Commission are carried on by private and governmental research, construction, and production contractors under the direction of five decentralized Offices of Directed Operations headed by managers.

The Washington organization includes the four statutory program divisions: Engineering, Military Application, Production, and Research. To round out the organization necessary to cover the extensive spread of program responsibility and to assure the Commission of highly skilled specialized talents, two divisions have been added and partially staffed during the past 6 months: The Division of Biology and Medicine and the Division of Raw Materials. Directors of the six divisions function as the technical program staff and are empowered to advise managers and contractors on the technical phases of their operations directly on behalf of the General Manager and the Commission. A program Council, made up of the General Manager, the directors of the six divisions, and the Assistant General Manager, assures full consideration of all aspects of the highly complex technical problems which require joint judgment of the Commission and staff.

Responsibility for the development of managerial policies, standards, and service rests with seven offices established by the Commission: Administrative Operations, Budgets, Comptroller, General Counsel, Organization and Personnel, Public and Technical Information Service, and Security and Intelligence.

Operating responsibility except in the field of raw materials is decentralized to the five Offices of Directed Operations established at Chicago, Hanford, New York, Oak Ridge, and Santa Fe (Los Alamos). Three of these Offices of Directed Operations were established, and managers appointed, during the past 6 months.

The positions of directors of the divisions and offices and the managers of the five operating establishments, as well as most other principal positions, are currently filled with experienced personnel.

DEVELOPMENT OF PROGRAM AND ADMINISTRATIVE POLICY

The scope of governmental direction of the atomic energy program and the new problems associated with its administration in times of peace demand creation of sound base-line policies in a number of complex fields. During the past year, and more particularly during the past 6 months, the Commission and the General Manager have established a variety of temporary or permanent advisory bodies of unusually competent experts to examine operations and needs of the program. These advisory bodies have made reports of their findings and recommendations, all of which are currently under consideration or have been acted upon by the Commission.

Advisory Committee for Biology and Medicine

The Commission established a permanent Advisory Committee for Biology and Medicine on September 12, 1947, after its program and needs had been examined by a temporary Medical Board of Review. The permanent Committee is charged with the continuing study of the basic policies of the Commission in the medical, biological, and health physics aspects of the atomic energy program. The members of the committee are among the leading medical and biological scientists of the country. (Their names are listed in sec. V, Biology and Medicine.)

Advisory Committee for Exploration and Mining

The importance of the discovery, development, and procurement of raw materials required in the Commission's program led to the appointment of an Advisory Committee for Exploration and Mining to assist the newly established Division of Raw Materials in this work. The committee was charged with the responsibility of studying the Commission's present program and advising on questions of exploration and development with a view toward integrating and coordinating present programs and policies. (Membership is listed in sec. II, Raw Materials.)

Patent Administration and Patent Advisory Panel

The Atomic Energy Act contains provisions relating to inventions and discoveries which were adopted by the Congress in view of the special patent problems in the atomic energy field. Thus, under the act, patent rights to inventions will not be conferred to the extent that the inventions are used in the production of fissionable material or in the utilization of fissionable material or atomic energy for a military weapon; at the same time the Commission is authorized to make awards to such inventors. In addition, the Commission is authorized under certain circumstances to declare a patent to be affected with the public interest and to license its use in the atomic energy program subject to the payment of a reasonable royalty fee.

To assure that the administration of the patent provisions of the act does not restrict free operation of business or interfere with incentive, the Commission during the first month of its operation appointed a Patent Advisory Panel to study and report on these phases of its activities. The panel now has five members:

William H. Davis, chairman of the Patent Survey Committee, Department of Commerce.

John A. Dienner, former president of the American Patent Law Association.

Casper W. Ooms, until recently United States Commissioner of Patents.

Hector M. Holmes, of Boston, Mass.

H. Thomas Austern, of Washington, D. C.

The initial report of the Patent Panel was submitted to the Commission in September 1947. The panel concluded that the impact of the patent provisions of the act upon the patent system and upon the normal process of industry had been made as small as possible consistent with the needs of common defense and security and the other purposes of the Atomic Energy Act. The panel also concluded that the practice of the Commission in this field is to avoid any unnecessary interference with the normal functioning of the patent system. The panel found evidence of general satisfaction on the part of the Commission's contractors with the fairness with which the patent provisions in contracts had been negotiated and administered, and was of the opinion that the types of patent clauses employed appeared to be generally satisfactory.

The panel is continuing to serve as an advisory board to the Commission on patent matters. Following the submission of its initial report, it undertook to consider proposed regulations to govern proceedings which will be heard before the Patent Compensation Board to be established under section 11 (e) of the Atomic Energy

Act. Such regulations are expected to be ready for publication in the near future.

By the end of 1947, there had been docketed by the Patents Branch of the Commission's Office of General Counsel (and by its predecessor in the Manhattan District) more than 6,500 records of inventions covering scores of different technical classes. Filing of a patent application was recommended in 2,375 cases, and most of these already have been filed. Over 11,500 project technical reports and 6,600 notebooks have been examined for evidences of inventions.

Industrial Advisory Group

More than 3,000 contractors, subcontractors, and suppliers are already taking part in the atomic energy program. Many more must be induced to participate—for unless the initiative, technical skill, and managerial ability of American business are brought to bear with maximum effect on the problems of atomic energy development, the people of the United States will not realize full benefits from this new field of endeavor. It is the policy of the Commission, subject to congressional supervision as provided by the act, to move away from the present Government monopoly provided by law as rapidly as feasible, having in mind the paramount consideration of the national security. The Industrial Advisory Group will explore opportunities for increased individual participation for profit and methods of developing incentives for industry to get into the field. The objectives are to:

1. Utilize fully the Nation's industrial research and development capacity.
2. Keep the industries directly concerned fully informed as to the developments in their fields within security limitations.
3. Insure the opportunity for technical training in atomic energy of as large a part of American industry as possible in order to prepare the industrial community for the job it must do if America is to continue to be strong in atomic energy development.

An interim Industrial Advisory Group was appointed and began its task of getting the necessary background acquaintance with the project in October 1947. In the following 3 months the members, fully cleared for access to secret data necessary for their deliberations and recommendations, visited all major Commission installations involving potential industrial applications, consulted with present and potential AEC contractors, and started preparing their first report to the Commission. This report will offer recommendations as to the permanent advisory groups needed in the field of industrial participation in the atomic energy program.

The members are:

James W. Parker, president and general manager, Detroit Edison Co., Detroit, Mich.

Oliver E. Buckley, president, Bell Telephone Laboratories, New York City.

Donald F. Carpenter, vice president, Remington Arms Co., Bridgeport, Conn.

Bruce K. Brown, vice president, Standard Oil Co. of Indiana, Chicago, Ill.

Gustav Egloff, director of research, Universal Oil Products Co., Chicago, Ill.

Paul D. Foote, executive vice president, Gulf Research & Development Co., Pittsburgh, Pa.

Gabriel O. Wessenauer, manager of power, Tennessee Valley Authority, Chattanooga, Tenn.

Robert E. Wilson, chairman of board, Standard Oil Co. of Indiana, Chicago, Ill.

Isaac Harter, executive vice president and director, the Babcock & Wilcox Tube Co., Barberton, Ohio.

Jerome C. Hunsaker, chairman, National Advisory Committee for Aeronautics.

Safety and Industrial Health Advisory Board

The safety and health protection record of the Manhattan Engineer District and the Commission has been excellent, as measured by the standard indices in this field. During the first 10 months of 1947, the frequency of accidents among Commission and contractor personnel was 4.91 persons injured for each million man-hours worked, a rate more than 50 percent below the 1946 national average for all industries. The fire loss record was even better by comparison. In all of the plants operating in the refinement and processing of source materials for the Commission, the accident frequency rate was only half that of the nonferrous metals industry as a whole.

But the deterioration of wartime structures, equipment, and facilities; the problems arising from expanded operation; and the difficulty of fitting the work of the Commission into a normal peacetime economy have led the Commission to seek the independent judgment and recommendations of competent and experienced analysts in these vitally important aspects of its operations. Accordingly, the Commission, in consultation with the National Safety Council, secured the services of such a group to constitute its Safety and Industrial Health Advisory Board. The Board made an extensive survey of AEC and contractor practices and problems of safety and industrial health. Members are:

Sidney J. Williams, assistant to the president, National Safety Council, Chicago, Ill., chairman.

Horatio Bond, chief engineer, National Fire Protection Association, Boston, Mass.

Dr. Philip Drinker, Harvard School of Public Health, Boston, Mass.

Robert H. Albisser, safety director, Merck & Co., Inc., Rahway, N. J.

William F. Brown, safety director, Consolidated Edison Co. of New York, New York City.

Bernard R. Caldwell, deputy chief of police, Los Angeles, Calif.

Dr. Abel Wolman, head, department of sanitary engineering, Johns Hopkins University, Baltimore, Md.

Arthur E. Gorman, sanitary engineer, Office of the Housing Expediter, Washington, D. C.

Herbert M. Parker, assistant superintendent, medical department, General Electric Co., Hanford, Wash.

Dr. Hymer L. Friedell, director, department of radiology, University Hospitals of Cleveland, Cleveland, Ohio.

Richard Fondiller, president, Woodward & Fondiller, New York, N. Y.

Jack J. Smick, associate actuary, Woodward & Fondiller, New York, N. Y.

Advisory Board on Relationships of the Atomic Energy Commission with its contractors

This temporary five-man board was established in February 1947. It conducted a thorough investigation of Commission-contractor relationships, particularly in the field of research, and made numerous valuable suggestions for establishing more effective working relationships with the contractors. Members were:

Dr. John R. Loofbourow, professor of biology of the Massachusetts Institute of Technology; chairman.

Dr. John W. Hinckley, director of the patent management division of the Research Corp., New York, N. Y.

Dr. Ronald H. Robnett, professor of business administration of the Massachusetts Institute of Technology.

Alfonso Tammaro, Atomic Energy Commission.

Committee on Scientific Personnel

The full support and active participation of scientists and workers in scientific laboratories now engaged, or potentially equipped to engage, in atomic energy work is of vital importance to the Commission. Recognizing certain handicaps including those which derive from the necessity for security practices, which are new to the pursuit of scientific inquiry in peacetime, the Commission felt the need for a fresh consideration of the special problems of this very important group. A Committee on Scientific Personnel was therefore established in May 1947 to examine the problem. The committee after a canvass of practices, standards, and attitudes of scientists and administrators of scientific laboratories completed its work and reported to the Commission in October 1947. Valuable recommendations for guide-line policies were made with respect to: Classification of employees; salaries; promotion and salary control; interchange of employees between institutions; tenure and retirement; consultant policies; vacations and sick leave; hazard pay and insurance; organization.

These recommendations, combined with staff appraisal and recommendations for putting them into practice, are now before the Commission. (Membership was listed in the second report to the Congress, and is repeated in this report in appendix 2.)

ADMINISTRATIVE DEVELOPMENTS

Accounting and finance

Two significant steps have been taken during the past 6 months to provide the Commission with essential facts necessary for the creation of financial policy and the development of more effective accounting procedures, for its industrial and scientific—rather than typical governmental—operations.

An analysis of obligations and expenditures for production, research, construction, town management, and administrative functions for the fiscal year 1947 and through November of 1947 has been completed and will provide the basis for the development of a system of accounts on accepted industrial and cost-accounting principles.

Five of the Nation's leading public-accounting firms were employed to review the accounting for five prime contracts, covering a cross section of Commission operations. Their reports, which are now being submitted, will assist the Commission in clarifying certain aspects of its relationships with industrial contractors.

Personnel

The Commission's dual policy of working through contractors for construction, production, research, and other operations, and of decentralizing all supervision of contract operations to the five Offices of Directed Operations, is reflected in the distribution of personnel associated with the project. There are approximately 500 employees in the Washington office, including the military personnel in the Division of Military Applications. Almost 10 times this number, or approximately 4,800 employees, are located in the operational centers. Approximately 10 times the total number of Government employees—about 55,000 persons—are employed by contractors at AEC installations.

During the Commission's first year of operation, Government employees were decreased by approximately 1,100 while contractor employees increased by about 14,000. The increase in contractor employment reflects increased scope of operations and would have been greater if not offset by considerable savings in manpower from increased efficiency in certain operations, particularly at Oak Ridge.

Labor relations

Continuing efforts have been made to evolve a labor-relations policy which would provide an essential framework within which contractor-employee relations may operate. At present the wartime arrangement with the National Labor Relations Board, whereby the Board will not certify labor organizations as representatives of employees of processing and research contractors other than at Oak Ridge, continues.

Requests for recognition were renewed during the period, however, by the International Association of Machinists (independent) at Argonne National Laboratory and by the Metal Trades Department of the AFL at Hanford. New requests for recognition were made of the contractors by Building Service Employees International Union, AFL, and International Brotherhood of Teamsters, Chauffers, Warehousemen and Helpers, AFL, at Argonne National Laboratory. Action on all of these requests was deferred. But a new agreement was entered into at Hanford between the principal construction contractor and the Building Trades Department of the AFL for construction work at that location.

At Oak Ridge, another NLRB election was held at the gaseous diffusion plant which was again won by the United Chemical Workers, CIO. Following the election, successful collective bargaining negotiations between the Carbide & Carbon Chemicals Corp. and the UCW resulted in a new 18-month contract effective December 10, 1947, the date of expiration of the previous contract. A vote of the local union membership authorizing the union officers to call a strike in the event negotiations were unsuccessful was taken the day after demands were presented to the contractor, but in view of agreement and the signing of a new contract 7 days later no strike resulted.

The Commission is working closely with the Joint Committee on Atomic Energy in considering how best to assure that work stoppages will not occur at AEC installations.

Regulation of special materials and facilities

In November the Commission issued a regulation governing the export of facilities and equipment for the production of fissionable materials. In preparing for this action, the Commission solicited the advice of the manufacturers of the equipment to be controlled in a series of industry meetings and invited a representative group to sit with the Commission's staff as an interim Equipment Advisory Board transmitting the industry's views on regulation and related matters. The Commission made it clear that in the administration of the regulation it will be the policy to interfere as little as possible in the conduct of normal business activities and, so far as is practical, to design licenses to fit the normal business requirements of the licensee.

The new regulation strengthened existing controls on the export of equipment adapted for use in atomic energy research and production work. Other controls, including the use of the powers of the Department of Commerce under the Export Control Act of 1940, continued. The regulation provided effective control over the export of two specific classes of equipment:

Class I includes any facility capable of producing any fissionable material; e. g., nuclear reactors, cyclotrons, or other particle accelerators.

Class II includes component parts or equipment suitable for service as component parts of a class I facility; e. g., radiation detection equipment, mass spectrometers and component parts, high vacuum equipment.

Other equipment may be added to this list from time to time as the need arises.

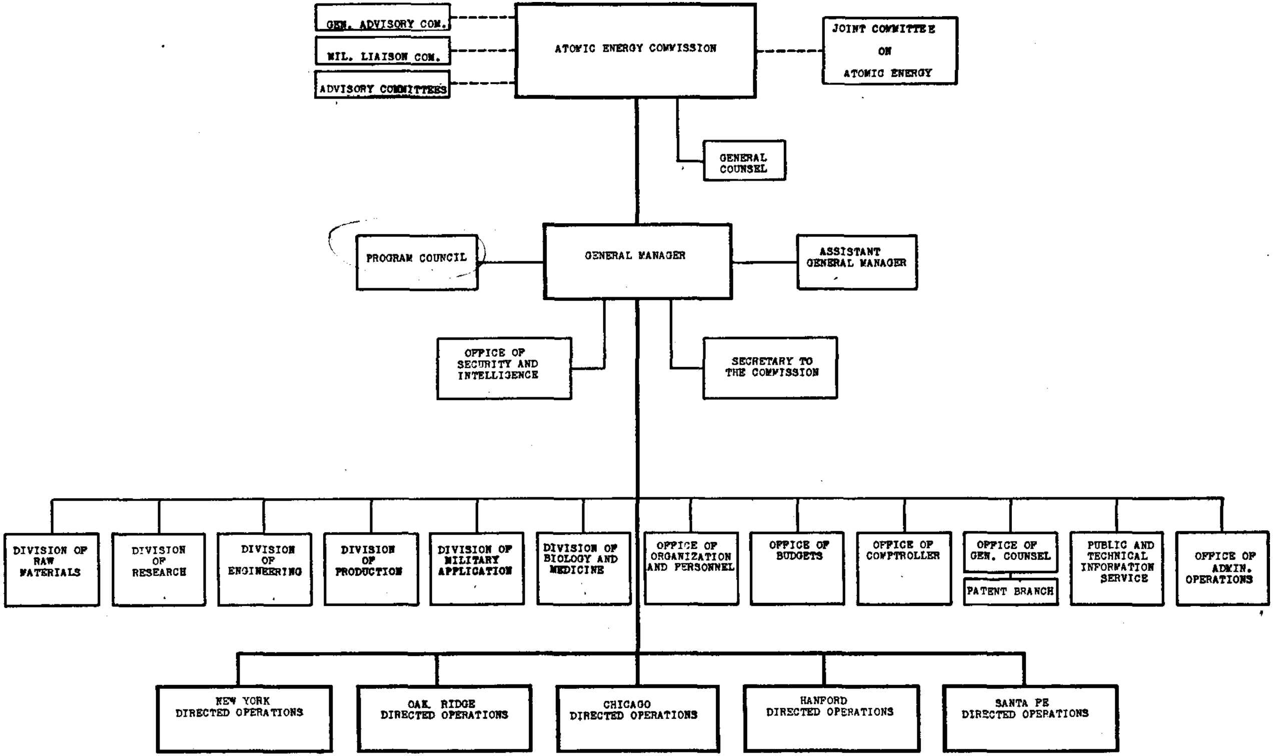
Under the new regulation a specific license issued by the Commission is required of persons intending to manufacture or produce for export any facilities for the production of fissionable material, to transfer or acquire such facilities for export, and to export such facilities from the United States. Also incorporated in the regulation is a general license issued for manufacture, production, transfer, and acquisition of such equipment within the United States.

Administration of the Commission's earlier regulation, issued in May 1947 for the control of source materials, has been assisted by the wholehearted cooperation of industry. All essential industrial uses of uranium and thorium are being provided for.

Services

Engineering plans were completed for new telephone facilities between the five Offices of Directed Operations and the Washington office to meet increased needs of speedy communication and to effect savings in staff time devoted to coordination of the whole program. A new crypto-teletype system was installed between Washington and field installations to provide the highest obtainable degree of security for the automatic encoding and decoding of messages. Radio facilities were also installed for emergency communication with aircraft in the vicinity of the Commission's restricted areas and with guard and patrol motor vehicles.

U. S. ATOMIC ENERGY COMMISSION



APPENDIX 1

United States Atomic Energy Commission, Principal Staff and Managers of Offices of Directed Operations

General Manager	Carroll L. Wilson.
Assistant General Manager	Fletcher C. Waller.
Assistant to the General Manager	John A. Derry.
Special Assistant to the General Manager	Richard O. Niehoff.
Secretary to the Commission	Roy B. Snapp.
General Counsel	Adrian Fisher.
Associate General Counsel	Joseph Volpe, Jr.
Managers of Offices of Directed Operations:	
Chicago, Ill	A. Tammaro.
Hanford, Wash	Carleton Shugg.
New York, N. Y	W. E. Kelley.
Oak Ridge, Tenn	John C. Franklin.
Santa Fe (Los Alamos), N. Mex	Carroll L. Tyler.
Director, Division of Research	James B. Fisk.
Director, Division of Production	Walter J. Williams.
Director, Division of Engineering	Roger S. Warner, Jr.
Director, Division of Military Application	Brig. Gen. James McCormack, Jr.
Director, Division of Biology and Medicine	Dr. Shields Warren.
Director, Division of Raw Materials	John K. Gustafson.
Director, Office of Administrative Operations	Malcolm E. Pitts.
Director, Office of Budgets	Paul W. Ager.
Director, Office of Comptroller	Paul M. Green.
Director, Office of Organization and Personnel.	Donald E. Bostock, Acting.
Director, Public and Technical Information Service.	Morse Salisbury.
Director, Office of Security and Intelligence	Rear Adm. John E. Gingrich, USN.

APPENDIX 2

MEMBERSHIP OF COMMITTEES—STATUTORY COMMITTEES

Joint Committee on Atomic Energy

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 Lyndon A. Johnson (Texas).
Representative Carl T. Durham (North Carolina).
Representative Chet Holifield (California).
Representative Melvin Price (Illinois).

Military Liaison Committee

Lt. Gen. Lewis H. Brereton, United States Air Force, chairman.
Lt. 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

Dr. J. Robert Oppenheimer, director of the Institute for Advanced Study, Princeton, N. J.; chairman.
Dr. James B. Conant, president of Harvard University.
Dr. Lee A. DuBridge, 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.
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 for the Study of Metals, University of Chicago.
Hood Worthington, E. I. du Pont de Nemours & Co., Inc.

PERMANENT ADVISORY BODIES APPOINTED BY THE COMMISSION

Advisory Committee on Biology and Medicine

Dr. Alan Gregg, director for medical sciences, Rockefeller Foundation; chairman.
Dr. G. W. Beadle, division of biology, California Institute of Technology.
Dr. Detlev W. Bronk, director of the Johnson Research Foundation, University of Pennsylvania.
Dr. Ernest W. Goodpasture, dean of the school of medicine and professor of pathology, Vanderbilt University.
Dr. Baird Hastings, professor of biochemistry, Harvard Medical School.
Dr. E. C. Stakman, chief, division of plant pathology and botany, University of Minnesota.
Dr. Joseph T. Wearn, dean of the school of medicine, Western Reserve University.

Advisory Committee for Exploration and Mining

Dr. Donald H. McLaughlin, president Homestake Mining Co., Lead, S. Dak.; chairman.
G. Temple Bridgman, consulting engineer, San Francisco, Calif.
Everette L. DeGolyer, petroleum geologist, DeGolyer & McNaughton, Dallas, Tex.
Dr. Anton Gray, geologist, Kennecott Copper Co., New York, N. Y.
Wilbur Judson, vice president and director, Texas Gulf Sulphur Co., New York, N. Y.
Robert E. McConnell, McConnell Foundation, New York, N. Y.
Fred Searls, Jr., president, Newmont Mining Corp., New York, N. Y.
Clyde Williams, director, Battelle Memorial Institute, Columbus, Ohio.

Advisory Committee on Isotope Distribution

Dr. G. Failla, of the Columbia University Medical School; chairman.
Dr. H. A. Barker, plant nutrition, University of California, Berkeley.
Dr. Henry Borsook, department of biochemistry, California Institute of Technology.
Dr. Robley D. Evans, Massachusetts Institute of Technology.
Dr. Hymer L. Friedell, Lakeside Hospital, Western Reserve University.
Dr. J. G. Hamilton, University of California.
Dr. Joseph W. Kennedy, Washington University (St. Louis).
Dr. Robert F. Mehl, Carnegie Institute of Technology.
Dr. Paul C. Aebersold, Chief, Isotopes Division, AEC, Oak Ridge.
Dr. Austin M. Brues, Argonne National Laboratory, AEC, Chicago.
Dr. A. H. Holland, Jr., medical adviser, AEC, Oak Ridge.
Dr. L. N. Nims, acting head of department of biology, Brookhaven National Laboratory, AEC, Patchogue, Long Island.

Patent Advisory Panel

William H. Davis, chairman of the Patent Survey Committee, United States Department of Commerce.

John A. Dienner, former president of the American Patent Law Association.
Hector M. Holmes, Boston, Mass.
Casper W. Ooms, until recently United States Commissioner of Patents.
H. Thomas Austern, Washington, D. C.

TEMPORARY ADVISORY BODIES APPOINTED BY THE COMMISSION

Advisory Board on Contractual Relationships (reported finally to the Commission in December 1947)

Dr. John R. Loofbourow, professor of biology of the Massachusetts Institute of Technology; chairman.
Dr. John W. Hinckley, director of the patent management division of the Research Corp., New York, N. Y.
Dr. Ronald H. Robnett, professor of business administration of the Massachusetts Institute of Technology.
Alfonso Tammaro, Atomic Energy Commission.

Industrial Advisory Group

James W. Parker, president and general manager, Detroit Edison Co., Detroit, Mich.
Oliver E. Buckley, president, Bell Telephone Laboratories, New York, N. Y.
Donald F. Carpenter, vice president, Remington Arms Co., Bridgeport, Conn.
Bruce K. Brown, vice president, Standard Oil Co. of Indiana, Chicago, Ill.
Gustav Egloff, director of research, Universal Oil Products Co., Chicago, Ill.
Paul D. Foote, executive vice president, Gulf Research & Development Co., Pittsburgh, Pa.
Gabriel O. Wessenauer, manager of power, Tennessee Valley Authority, Chattanooga, Tenn.
Robert E. Wilson, chairman of board, Standard Oil Co. of Indiana, Chicago, Ill.
Isaac Harter, executive vice president and director, the Babcock & Wilcox Tube Co., Barberton, Ohio.
Jerome C. Hunsaker, Chairman, National Advisory Committee for Aeronautics.

Medical Board of Review (reported to the Commission in July 1947)

Dr. Robert F. Loeb, Lambert professor of medicine, Columbia University; chairman.
Dr. Detlev W. Bronk, director, Johnson Research Foundation, University of Pennsylvania, and Chairman, National Research Council.
Dr. Wallace O. Fenn, professor of physiology, University of Rochester School of Medicine and Dentistry.
Dr. Herbert S. Gasser, director, Rockefeller Institute for Medical Research.

Dr. Ernest W. Goodpasture, dean of the school of medicine and professor of pathology, Vanderbilt University.
Dr. Alan Gregg, director for medical sciences, Rockefeller Foundation.
Dr. A. Baird Hastings, professor of biological chemistry, Harvard Medical School.

Safety and Industrial Health Advisory Board

Sidney J. Williams, assistant to the president, National Safety Council; chairman.
Horatio Bond, chief engineer, National Fire Protection Association.
Dr. Philip Drinker, Harvard School of Public Health.
Robert H. Albisser, safety director, Merck & Co., Inc., Rahway, N. J.
William F. Brown, Safety director, Consolidated Edison Co. of New York.
Bernard R. Caldwell, deputy chief of police, Los Angeles, Calif.
Dr. Abel Wolman, head, department of sanitary engineering, Johns Hopkins University.
Arthur E. Gorman, sanitary engineer, Office of the Housing Expediter, Washington, D. C.
Herbert M. Parker, assistant superintendent, medical department, General Electric Co., Hanford, Wash.
Dr. Hymer L. Friedell, director, department of radiology, University Hospitals of Cleveland, Ohio.
Richard Fondiller, president, Woodward & Fondiller, New York, N. Y.
Jack J. Smick, associate actuary, Woodward & Fondiller, New York, N. Y.

Committee on Scientific Personnel (reported to the Commission in October 1947)

Dr. F. W. Loomis, professor of physics at the University of Illinois, chairman.
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, AEC.
L. D. Geiger, Iowa area manager of the Atomic Energy Commission.
W. A. Hamor, associate director of the Mellon Institute.
W. B. Harrell, business manager of the University of Chicago.

APPENDIX 3

United States Atomic Energy Commission, National Laboratories

ARGONNE NATIONAL LABORATORY

Chicago, Ill.

Contractor operator: The University of Chicago. Participating institutions—members of the Council:

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

Director: Dr. Walter H. Zinn

BROOKHAVEN NATIONAL LABORATORY

Patchogue, Long Island, N. Y.

Contractor operator: Associated Universities, Inc., a nonprofit organization of the following institutions:

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

Director: Dr. Philip M. Morse

CLINTON NATIONAL LABORATORY

Oak Ridge, Tenn.

Contract operator: Monsanto Chemical Co. Participating institutions:

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

Assistant director: Dr. E. J. Murphy

APPENDIX 4

Distribution of Isotopes From Isotopes Division, Oak Ridge, Tenn.

	Number of shipments			
	July 1 to Dec. 31, 1946	Jan. 1 to June 30, 1947	July 1 to Dec. 31, 1947	Total, Dec. 31, 1947
Shipments classified by broad field of utilization:				
Radioactive isotopes:				
Medical therapy	88	319	397	804
Animal physiology	78	202	306	586
Chemistry	27	47	91	165
Physics	17	65	69	151
Plant physiology	16	33	29	78
Industrial research	14	18	33	65
Bacteriology	4	7	26	37
Metallurgy	2	8	2	12
Total	246	699	953	1,898
Stable isotopes:				
Physics		27	77	104
Chemistry		12	45	57
Animal physiology		16	19	35
Industrial research			7	7
Plant physiology			5	5
Bacteriology			1	1
Total		55	154	209
Shipments classified by kind of isotope:				
Radioactive isotopes:				
Phosphorus 32	48	212	325	585
Iodine 131	68	208	287	563
Carbon 14	47	41	67	155
Sodium 24	1	31	49	81
Gold 198	17	46	6	69
Sulfur 35	12	19	20	51
Calcium 45	5	17	25	47
Iron 55, 59	5	21	20	46
Potassium 42	6	17	14	37
Cobalt 60	4	20	12	36
Strontium 87, 90	3	4	5	12
All others (49)	30	63	123	216
Total	246	699	953	1,898
Stable isotopes:				
Deuterium oxide (heavy water)		31	60	91
Deuterium		22	58	80
Boron 10		2	22	24
Oxygen 18			14	14
Total		55	154	209

Distribution of Isotopes From Isotopes Division, Oak Ridge, Tenn.—Continued

	Total number of shipments to Dec. 31, 1947	
	Radioactive	Stable
Shipments classified by State, Territory, and foreign country:		
Alabama	2	----------
California	185	16
Connecticut	69	9
Delaware	11	3
Florida	21	----------
Georgia	16	1
Illinois	101	24
Indiana	32	8
Iowa	2	----------
Kansas	2	1
Louisiana	24	2
Maryland	57	5
Massachusetts	264	27
Michigan	81	6
Minnesota	99	5
Missouri	75	3
Montana	----------	1
Nebraska	7	----------
New Jersey	26	7
New York	275	32
North Carolina	10	1
Shipments classified by State, Territory, and foreign country—Continued		
Ohio	142	14
Oklahoma	----------	1
Oregon	15	----------
Pennsylvania	124	21
Tennessee	88	----------
Texas	50	8
Utah	8	1
Virginia	4	1
Washington	11	----------
Wisconsin	57	4
District of Columbia	37	8
Hawaii	3	----------
Total	1,898	209
Argentina	1	----------
Australia	17	----------
Denmark	1	----------
United Kingdom	1	----------
Total	20	----------