UNITED STATES ATOMIC ENERGY COMMISSION

Fifth Semiannual Report

OF THE

U.S. ATOMIC ENERGY COMMISSION

January 1949

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LETTER OF SUBMITTAL

The honorable the PRESIDENT 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 Fifth Semiannual Report of the United States Atomic Energy Commission, as required by the Atomic Energy Act of 1946.

Respectfully,

UNITED STATES ATOMIC ENERGY COMMISSION.
ROBERT F. BACHER.
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DAVID E. LILIENTHAL, *Chairman.*

JANUARY 31, 1949.

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FOREWORD

Atomic energy development in the United States is now 10 years old. It was in the last week of January 1939 that the phenomenon of nuclear fission was first confirmed in the United States.

In one decade, a whole new body of knowledge has been built up. Frontiers of science have been pushed ahead. Atomic energy has been used as a weapon of war, but it also holds promise of great benefits to mankind. Men are diligently seeking the means of developing the new knowledge and of controlling this force in order to realize those benefits.

Two years ago, the United States Atomic Energy Commission was established under the Atomic Energy Act of 1946, which sets forth the broad policies and objectives of the national atomic energy program.

During these 2 years the trouble spots which threatened continuity of production of fissionable materials have been largely eliminated. The weapons situation has been greatly improved. Important additions have been made to scientific and technical knowledge. A program for the development of nuclear reactors aimed at the possible production of power and the breeding of new fissionable materials has been formulated and is being vigorously prosecuted.

A reorganization of the Commission's principal office to meet operating requirements is nearly complete, and the addition of new key personnel has materially strengthened the Commission's staff. The Office of the Director of Intelligence has been established to correlate and evaluate information on foreign atomic energy developments. This office maintains close collaboration with other intelligence agencies of the Government.

This Fifth Semiannual Report of the Commission to the Congress, recording an expansion of effort in all phases of atomic energy development, is prepared against a background of world affairs which makes it necessary for the American people to maintain self-imposed restraints on the dissemination of a vast amount of data acquired since the beginning of the atomic energy enterprise in 1939.

Since that time, the American people have invested more than $3,000,000,000 in atomic energy, starting with the first allocation of $6,000 in 1940 and including $342,000,000 expended by the Commission in 1947 and about $525,000,000 in 1948. The accounting to the American people for the expenditure of such sums, under restrictions which preclude normally free and open analysis, places the Commission in a position not fully consistent with the traditional

methods of public accountability and management. Nevertheless, as the scope of this and earlier Commission reports indicates, a wide area of reporting is entirely feasible.

This report, and a subsequent special report on Reactor Development which the Commission will submit to the Congress in the near future, are an attempt to provide information on plants and on operations essential for an understanding of the purposes and results of the Nation's heavy expenditures for atomic energy development, and the problems and difficulties encountered in the program.

The report indicates expansion and improvement all along the atomic energy development chain from the mines to the ultimate use made of fissionable material. Activity has stepped up steadily in 1948. The first year of the Commission's stewardship of the atomic energy project, 1947, was largely spent in analysis and planning, with a start made on needed expansion. In 1948 the full program of long-range development got under way. Actual production operations were improved and output increased. The fact is, however, that the important research and development problems in atomic energy have yet to be solved.

By the year's end the United States atomic energy program had attained a momentum which, if sustained, the Commission believes will maintain and increase the Nation's lead in atomic energy development.

But there are a number of phases of the operations where the rate of progress has not been satisfactory. These include: Adequate budget and accounting reporting; cooperation and exchange of information with industrial firms not actually participating in the program; personnel security clearance procedures; recruitment of scientific and technical talent; policies, procedures, and operations in both the issuance and the control of information. In addition, work on the solution of a number of research and development problems referred to in the report has not progressed as rapidly as it can and will.

One of the first requirements of a well-managed undertaking, public or private, is a modern accounting and budget system providing cost and budget data to increase efficiency and make management more fully responsible. No industrial accounting or budget procedures existed when the Commission assumed responsibility.

The Commission's program to establish such a system has made considerable progress, but still falls short of its objectives. Several nationally known firms in this field were called to assist the Commission's Controller in this work. By the time its next semiannual report is issued, the Commission hopes to have in operation a reporting system which will adequately meet the needs of the atomic energy

program and better satisfy the requirements of accountability for public funds.

Among the matters reflected in this report which are of special concern to the Congress are the results achieved with the assistance of, and in cooperation with, other agencies of the Government. The Commission desires to report to the Congress its satisfaction with these relationships.

The Department of Justice has worked with the Commission in a cooperative spirit. In particular, the Federal Bureau of Investigation has carried out the large investigative responsibilities assigned to it under the Atomic Energy Act with great thoroughness.

The General Accounting Office has shown broad understanding and aided in the working out of the special accounting problems of the atomic energy program.

The United States Geological Survey and the United States Bureau of Mines, both of the Department of the Interior, have assumed heavy responsibilities in the raw-materials program. Their services have relieved the Commission of the necessity of directly carrying out major raw-materials projects, at savings to the Government.

Improved staff coordination, better understanding of common problems, and the work of the Military Liaison Committee have strengthened mutually helpful relationships between the Commission and the National Military Establishment. This report details many instances of efficiently coordinated staff work and evidences of the desire of the representatives of the National Military Establishment to give every possible assistance in the conduct of the atomic energy program.

The Commission has worked closely with the Department of State in carrying out programs that involve relationships with the governments of other nations. Such programs include export control, procurement of raw materials from foreign sources, the control of information shared with the United Kingdom and Canada, and technical cooperation with these two nations in certain specified areas.

Relationships with the United Kingdom and Canada in the field of atomic energy have continued under the guidance of the Combined Policy Committee of the three nations, of which the Secretary of State of the United States is Chairman. This Committee was first established in 1943. The members for the United States, in addition to the Secretary of State, are the Secretary of Defense and the Chairman of the Atomic Energy Commission.

In fulfillment of its responsibility to keep the Joint Committee on Atomic Energy of the Congress fully and currently informed, the Commission furnishes the Committee with a top-secret quarterly progress report; a number of recurring reports on specific activities;

and many letters, memoranda, and special reports. The staffs of the Commission and the Joint Committee are in almost daily contact. Representatives of the Committee and its staff have visited the major installations of the Commission and attended the tests of atomic bombs at Eniwetok last spring.

The General Advisory Committee, appointed by the President as provided by the Atomic Energy Act, has counseled the Commission on the major scientific and technical developments in the program. The guidance they have given has substantially contributed to the progress of the past 2 years.

The Commission has continued to make extensive use of advisory committees, a practice which has been highly effective in obtaining for the Government the part-time services of outstanding men in many fields of activity related to atomic energy development. Many of these men, whose names are listed in the appendixes of this report, have devoted considerable time and effort to this work, at sacrifice and inconvenience to themselves. They have made substantial contributions to the national atomic energy program.

As the Members of the Congress know, Mr. W. W. Waymack resigned from the Commission for personal reasons, effective December 21, 1948. During the first 2 years of the existence of this Commission—two arduous years climaxing a far longer period of public service which Mr. Waymack has rendered to his countrymen—he endeared himself to us by his personal qualities and earned our admiration for his mature judgment and our respect for his impartiality and objectivity.

I

PRODUCTION

Introduction

Uranium 235 and plutonium are the fuels of atomic energy. The amount of these fissionable materials available is a significant measure of the national wealth. It determines how many atomic weapons the American people can build for defense and the number and the power of the atomic machines—nuclear reactors—they can operate for the application of the new energy to all departments of the national life.

In consequence, the production of these fissionable materials is of key importance in the United States atomic energy program. It is a huge and complex undertaking, beginning with the search for uranium ores and ending with uranium 235 and plutonium. It is at the same time one of the largest integrated industrial operations in the world and the newest. Eight years ago many of the mines from which uranium ore is dug were not even staked out, and none of the gigantic plants where production of uranium 235 and plutonium takes place had been designed or even imagined.

The wartime builders of these plants worked without any precedent or pattern, without proof that the product would have any value. Considerations of economy or maximum yield or durability did not govern the planning for plants. Time was the governing requirement: The single over-riding necessity was to get pure uranium 235 and plutonium in a hurry. The builders knew that if these substances actually did release atomic energy in useful quantity, the concentrated efforts of scientists and technologists all over the world would probably be able to develop better processes and plants. Even if they succeeded, therefore, they believed that most of the giant structures they built were expendable. Actually, many of the plants are still serviceable. Others, as expected, have nearly outlived their usefulness.

After the explosion of the bombs over Japan, the future of the entire enterprise came under discussion in Congress. For a period of more than a year, the Manhattan project continued to operate the existing equipment, making only the necessary replacements, additions, and improvements. Major projects were necessarily deferred. As a consequence, by January 1, 1947, the time when the Atomic Energy Commission became responsible for the enterprise, some of this orig-

inal equipment and even entire plants had already been made obsolete by the advance of nuclear science and technology.

THE AEC PROGRAM

During its first 2 years of operation, therefore, the Commission has carried on two full-scale operations simultaneously—maintaining and increasing output of fissionable materials and modernizing facilities and increasing production capacity for the future. The Commission began by renovating and improving those facilities that were most essential. These improvements enabled the Commission to close certain inefficient plants and thus reduce personnel and other costs.

At the same time, the Commission enlisted the help of scientific institutions and industrial concerns in study and improvement of every stage of the production process from mineral exploration to the final purification of uranium 235 and plutonium. Dividends from this work have come rapidly. Improved operating techniques and equipment already have gone into operation. At many stages of production, however, knowledge gained could be put to work only by building major additions to existing plants or entirely new units that could make use of new methods or materials discovered.

Furthermore, in order to increase capacity for, as well as efficiency of, production, it was necessary to carry through a major plant construction program extending over a period of 5 years. By the end of 1947, the Commission had drawn the broad outlines of this program; some designing had been completed, many engineering problems solved, quantities of materials and equipment procured, several contracts let; and preliminary construction was under way.

THE SECOND YEAR

By the spring of 1948, the building of these new major facilities for the production of fissionable materials had become the greatest single construction program in American peacetime history. Work which eventually would cost more than 700 million dollars was under way. It centered at the Hanford (Wash.) Plutonium Works. The construction there now employs close to 15,000 workers. By late 1948, in the Nation as a whole, 20 plants were under construction or major alteration. Improvements were completed or well advanced on others.

With better facilities and processes, the production system turned out more fissionable materials during 1948 than in 1947, and in spite of higher wages and greater costs of materials, the average cost of product is less per pound today than it was a year ago. The

yield of product from each ton of raw material continued to grow because of a reduction of the amount of uranium lost in factory wastes. During 1947, the fissionable materials industry had faced the possibility that the break-down of worn, corroded, and outmoded equipment might interrupt production. But by the end of 1948, the additions and repairs made to plants had reduced this danger.

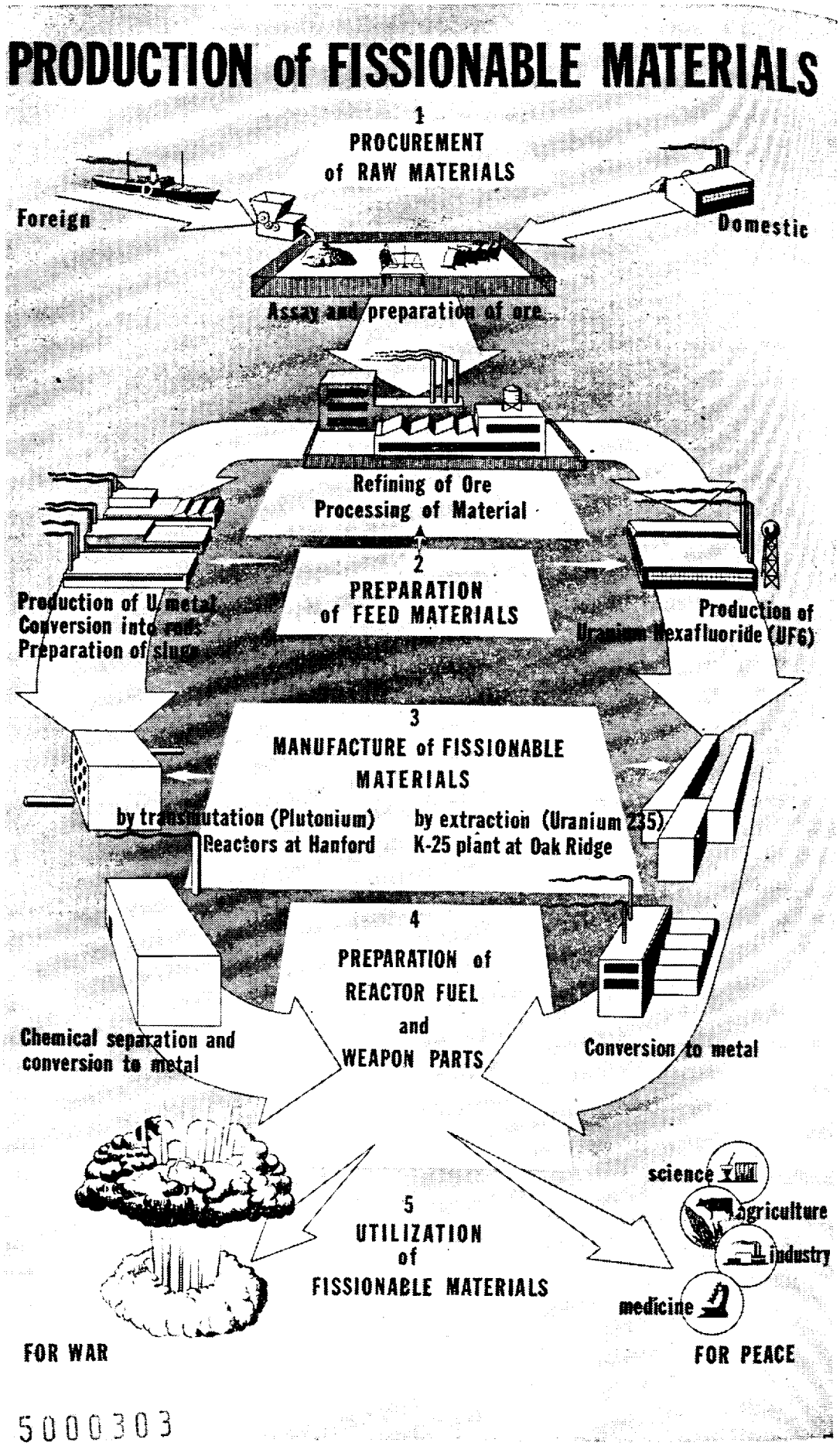
In the production speed-up of 1948, the Commission put equal emphasis on construction and repair of plants and on research and development work aimed at greater efficiency in the operation of the expanding plant. During the year, the scientists and technicians working on process studies pointed the way toward new economies and better yield; they redesigned equipment and worked out alterations to plants and new designs that would further increase production and reduce cost.

Today, at the close of 1948, fissionable-materials production extends into at least 15 states of the Nation from coast to coast. It is carried on in 30 separate plants at 25 locations. It employs tens of thousands of workers. To house and sustain people who work in its major plants requires two large communities with a combined population of more than 50,000. At 285 million dollars, the cost of this operation is about 45 percent of the Nation's atomic energy budget for the fiscal year 1949.

The success of this gigantic production program depends upon the participation of American industry. Nine out of every 10 of the people in the program work for the Commission's contractors, who perform the specific tasks assigned by contract. There are now some 20 of these operating and service contractors, in addition to hundreds of suppliers of materials, equipment, and services. Major contractors and suppliers of special equipment are becoming acquainted with the unique problems and skills of the new industry. In some important parts of the work, such as the mining of raw materials, the making of radiation detection instruments and the synthesis of compounds containing radioisotopes, it is now possible for private industry to take the lead—to develop independently materials or equipment required in the atomic energy business.

THE PRODUCTION CHAIN

The diagram on page 4 shows the successive steps in the production and use of uranium 235 and plutonium: The procurement of raw materials, their refinement into feed material for the main plant units at Hanford and Oak Ridge, Tenn., the creation or extraction from them of fissionable materials, and the utilization of the fissionable materials in weapons and nuclear reactors. Engineers, industrialists, workers,


PRODUCTION of FISSIONABLE MATERIALS
1
PROCUREMENT
of RAW MATERIALS
Foreign
Domestic
Assay and preparation of ore
Refining of Ore
Processing of Material
2
PREPARATION
of FEED MATERIALS
Production of U metal
Conversion into rods
Preparation of slugs
Production of
Uranium hexafluoride (UF6)
3
MANUFACTURE of FISSIONABLE
MATERIALS
by transmutation (Plutonium)
Reactors at Hanford
by extraction (Uranium 235)
K-25 plant at Oak Ridge
4
PREPARATION of
REACTOR FUEL
and
WEAPON PARTS
Chemical separation and
conversion to metal
Conversion to metal
5
UTILIZATION
of
FISSIONABLE MATERIALS
science
agriculture
industry
medicine
FOR WAR
FOR PEACE

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and scientists, by their combined efforts in the past 2 years, have brought about substantial gains in efficiency and yields at various stages of these processes. Considerations of national security make impossible detailed public reporting of much of this progress. It is possible in this report, however, to recount only in outline the advance in the manufacture of fissionable materials; detailed reports could supply to a potential enemy the key to important processes evolved by this Nation's effort.

Raw Materials

Uranium, the raw material of atomic energy, is not a rare metal; it is distributed widely throughout the earth's crust, in the proportion, roughly, of four parts to every million. But few ore deposits rich in uranium have been found. Before the war, it was used principally as a pigment in the ceramics industry and was essentially a byproduct of radium or vanadium ore.

Uranium first acquired a commercial interest about the beginning of the century when radium was discovered and put to use. Radium is always associated with uranium. Following the discovery of the rich uranium-radium desposits in the Belgian Congo about 1920, there was very little interest in the search for uranium until its use in atomic energy was understood. Since then, uranium has been the object of intensive search in every part of the world. Nearly every country is sponsoring exploration for it, and in most countries any production is under government control. (See Appendix 11 for Executive Orders 9908 and 9829.) The search is not for high-grade deposits only, but also for low-grade materials containing only a few pounds of uranium per ton. Scientists and mining engineers are developing and improving methods for extracting uranium from low-grade ores—from carnotite ores in the United States, for example; from Swedish oil shales; from South African gold ores; and from other materials containing small quantities of uranium.

The United States continues to receive most of its uranium from the Belgian Congo and Canada.

Our own country has produced little uranium. Such production as we have had has come from the low-grade carnotite ore of the Colorado Plateau, which has been mined primarily for vanadium, with uranium recovered as a byproduct. In the past, much of the uranium was allowed to go to waste. During the war, the Manhattan project operated two plants for extracting uranium from the waste material or "tailings" from these mills. The plants were dismantled after the accumulated mill tailings had been processed.

THE RAW MATERIALS PROGRAM

The raw materials situation faced by the Nation in early 1947, therefore, when the Commission became responsible for the program was as follows:

> The vital atomic energy enterprise was largely dependent upon remote sources of uranium; only insignificant amounts of by-product uranium were being obtained domestically.
>
> Known domestic sources were principally in the form of low-grade material, and economical methods of extracting uranium had to be developed.

The program since initiated by the Commission includes extensive exploration throughout the continental United States and Alaska, incentives to prospectors and mining companies, and research to develop and improve methods for processing uranium ores. The United States program is still dependent upon foreign sources of uranium, and the Commission is doing everything possible to increase supplies procured from abroad.

The purpose of the domestic program is to develop production to the fullest extent consistent with a sound economic policy. Plans also are being prepared for utilization of low-grade marginal deposits.

The organization and first steps of the Commission's program are described in its Third and Fourth Reports to the Congress (issued in January and July 1948). A Raw Materials Office was established at Washington headquarters, assisted by an Advisory Committee on Mining and Exploration, both staffed by experienced mining engineers and geologists. (See Appendix 2 for list of members.) A local office was opened in the Colorado Plateau area at Grand Junction, Colo. Programs of exploration and research were expanded: The former to develop sources of ores, the latter to discover how best to extract uranium from these ores, particularly low-grade ores. To enlist the American mining industry and prospectors in the activity, the Commission, early in 1948, established Government-guaranteed prices for domestic ores and a bonus for production from newly discovered deposits. (See Appendix 4 for regulations.)

THE PROGRAM TODAY

During the latter half of 1948, progress was made in all phases of the program: Exploration, research, process development, and procurement of ores. Private industry was taking active part.

Exploration

Government exploration in the United States for uranium and other ores needed in atomic energy development is carried on by the Commission's own geological staff and by the United States Geological Survey of the Department of the Interior, an agency well fitted by experience, equipment, and personnel for the task. The Government exploration consists of regional mapping, extensive geological investigations, investigation of mine and mill residues, and diamond drilling for new deposits. It is exploration of a "long-shot" nature, which would not be economic for private industry, and is conducted mainly on public lands.

Recent general reconnaissance has resulted in the finding of two formations of uranium-bearing shale. Several areas were found in Alaska that warrant further investigation. Major exploration, however, was carried on in the Colorado Plateau region. The United States Geological Survey stepped up its diamond drilling to a rate of 200,000 feet per year. AEC's own Exploration Branch prepared to enter this work on a smaller scale.

Meanwhile, the announcements of guaranteed prices and bonuses stimulated a large public interest in the search for uranium. During the third quarter of 1948 alone, prospectors sent to the AEC for examination close to 800 samples, some of which contained enough uranium to warrant field investigation. (Appendix 4 explains the procedures to be followed in submitting samples.)

Research and Investigation

The Commission's contractors for raw materials research—the Battelle Memorial Institute, the Massachusetts Institute of Technology, the Carbide and Carbon Chemicals Corporation, the Dow Chemical Company, and the United States Bureau of Mines among others—are developing methods for processing low-grade uranium-bearing materials.

Of the five vanadium plants that operated in the Colorado area during the war, only two are now at work; and these are selling by-product uranium to the Government. The Commission's plan is to put the three idle plants back to work with production of uranium as their primary purpose. As a first step, it purchased the mill at Monticello, Utah, in June 1948 and engaged the Galigher Company of Salt Lake City to redesign the plant to improve uranium extraction. The Monticello plant is expected to be in operation by July 1949.

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Procurement of Ore and Uranium Concentrates

First shipments of ore were received July 12, 1948, at the Monticello plant, where the American Smelting and Refining Company is doing the purchasing for the Commission under a cost-type contract. Before the Government prices were announced in April, miners were able to get only 35 cents a pound for uranium; now the price is about $3.50 a pound including haulage and certain allowances.

It is expected that the new price schedule will bring out sufficient ore to enable the five plants in the area to operate at capacity. Present ore reserves do not justify additional plants, and the exploration program must be vigorously pursued in order to assure a reasonably long operating period for existing plants. If sufficient quantities of additional ore are discovered, expansion of milling operations can be considered.

During the year, the Commission extended its contracts with the U. S. Vanadium Corporation and the Vanadium Corporation of America for Government procurement of the uranium precipitates which these two companies produce in their vanadium mills. The new contracts provide that the companies pay the miners for ore at rates no less favorable than those obtaining in the Commission's own ore procurement program.

Feed Materials

The huge and complex plants that produce fissionable materials—the isotope-separation plants at Oak Ridge, and the nuclear reactors at Hanford—work on very different principles. Each group does require at the start of the process large quantities of extremely pure natural uranium. The uranium, however, has to be fed into the plants in very different forms—as a gas at Oak Ridge plants, as metal at Hanford. As late as 1942, pure uranium in any form was a laboratory curiosity. Less than 3 years later, chemical and processing plants at a dozen locations in various parts of the country were turning out tons of uranium feed material, pure beyond any normal industrial standards. Like most facilities in the wartime atomic energy project, these plants had to be designed to use the processes that looked best at the moment, and built in a hurry. In the year following the war, some of the less efficient units were closed. Some plants still operating became obsolete as researchers found more efficient processes for making the uranium slugs and gases for Hanford and Oak Ridge.

When the Commission took over in January 1947, therefore, it took on a twofold task of improving the then available plants and processes for making these feed materials, and of getting under way

a long-range program for continuing improvement. Immediate necessities were:

1. Repairing most of the wartime plants then in operation, and putting others back in operation—to increase production capacity, assure uninterrupted production, and reduce health and safety hazards to workers;

2. Installing in the existing plants improved processes that could be made to work by changing and adding equipment—to increase production capacity, improve the purity of the product, reduce process losses of uranium, and reduce operating costs;

3. Installing improved methods of recovering uranium lost in process and an accounting system for keeping track of minute quantities of this important substance;

4. Speeding up the search for better methods and machinery.

At the same time, for the longer term, it was essential to plan and design new and greatly improved plants to make uranium feed materials and to develop better production methods for all of the materials, strange to normal industrial operation, that are important to the atomic energy program.

FEED MATERIALS CONTRACTORS

These tasks are being accomplished with the aid of the most talented industrial concerns and research institutions of this Nation. More than 30 contractors are today engaged in producing feed materials and in research aimed at improvement in plant and methods of production. Among them are such organizations as: Battelle Memorial Institute, Electro Metallurgical Company, Harshaw Chemical Company, Linde Air Products Company, Mallinckrodt Chemical Works, Massachusetts Institute of Technology, and Vitro Manufacturing Company.

TWO YEARS OF PROGRESS

The efforts of the men of these organizations have stepped up the current output of feed materials and pointed to the first steps of the long-range development. In 1948, they have enlarged production capacity, cut operating costs, and made or planned major improvements at each of the several stages of feed materials production. Intermediate inventories in the production chain have been raised to sound operating levels.

Assay and First Processing of Ore

The production of feed materials starts with raw uranium ore and ore concentrates. These come from either foreign or domestic sources. The process starts when the raw material is delivered to the Com-

mission or its contractors at various points in the United States for storage and preliminary handling. This consists, in general, of drying, crushing, grinding, weighing, sampling, packaging the ore, and chemical analysis of it. The analysis (or assay) establishes the uranium content of each batch of ore. Assay must be very exact. It determines payment to the ore-producer and is the basis for the record used in accounting for the uranium through the subsequent chain of processes.

In 1948, the Commission was engaged in building additional facilities for the storage and processing of the ore and began renovating and improving older plants. Contractors have developed various process improvements which raised output per man-hour, cut costs, and improved safety and health conditions for workers.

Production of Brown Oxide (UO_2)

For the second step in producing uranium gas or slugs, the raw feed material, which contains many unwanted chemical elements, goes to chemical refineries. There, a series of complex reactions separate the uranium from the impurities, and convert it into a highly purified uranium oxide—a powder called "brown oxide" (UO_2).

An entirely new plant for extracting and purifying brown oxide was built and put into operation in 1948. With this addition, the brown oxide plants operated for the Commission by contractors at various locations occupy 14 buildings. Thirteen of the buildings and all of the equipment used for this process are Government-owned. Approximately 25 percent of the land involved is held by the Government on long-term lease. The other building and the rest of the land are contractor-owned.

In the past 2 years, the contractors and the Commission have worked out improvements to guard the health of workers, increase production capacity, and reduce costs. Taking 100 as the 1946 level of cost per unit, for 1947, it was 83, and for 1948, 79.

Production of Green Salt (UF_4)

The third process in the production chain is conversion of the purified brown oxide into a green powder, "green salt" (uranium tetrafluoride, UF_4). This stage involves a novel industrial chemical process.

The green-salt plants, contructed under the extreme pressure of war, were not intended to be permanent. One plant was taken out of operation after the war but was reopened late in 1947 to provide additional capacity. The Commission is working toward early replacement of substandard facilities by efficient, safe plants. A major part of the processing equipment and some of the buildings are Gov-

ernment-owned; the remainder, either contractor-owned or under long-term lease to the Government.

Within the past 2 years, research and operating contractors have developed improvements, both in processes and in the operation of the plants, that have lowered costs. Taking 100 as the cost level for 1946, that for 1947 was 91, and for 1948, 84.

Development work is proceeding on plans for permanent facilities. Research, now in the pilot-plant stage, will undoubtedly result in more efficient, safer, and more reliable manufacturing methods.

Through a considerable part of the feed material processing the production chain is the same regardless of the ultimate use of the material. Some of the uranium goes through one series of operations and emerges as feed material for the process producing uranium 235 at the gaseous diffusion plant at Oak Ridge, or it goes through a different series and comes out as the pure metal used in the reactors which produce plutonium at Hanford. The metal may, of course, also be used in other reactors for other purposes.

Production of Uranium Hexafluoride for Oak Ridge

For use in the gaseous diffusion plant, the feed material is converted to uranium hexafluoride (UF_6), which, at somewhat elevated temperatures, becomes a gas.

The hexafluoride plants were constructed under wartime stress and were not intended for permanent operation. The Commission has under way studies on design of more efficient, and less costly hexafluoride plants capable of long-term operation. These studies should be substantially complete by the spring of 1949. In the meantime, the Commission, to maintain output, has made additions to existing plants, and the contractors have developed some improvements in processes and equipment. The plants and land are contractor-owned, and the equipment is Government-owned.

During 1947 and 1948, production has increased markedly and costs have declined. Taking the cost level for 1946 as 100, it was 97 for 1947, and 87 for 1948.

Production of Uranium Metal for Hanford

In the second, and parallel, series of operations, the feed material is shipped to processing plants to be reduced to extremely pure uranium metal.

To provide additional capacity for metal production, the Commission, in 1948, reopened one of the wartime plants which had been shut down in 1946.

Because some of these metal-production facilities are unsuitable for long-term operation, construction of a new metal plant was

started in 1948. The new plant will incorporate all the technological improvements resulting from 5 years' operating experience; it will greatly enlarge production capacity, and will provide for safer, cheaper, and more efficient operation. The total capital investment for this plant is estimated at $2,500,000, of which $350,000 had been expended by the end of 1948.

Some of the buildings of the metal-production facilities and all of the equipment are Government-owned, and the remaining buildings are on long-term lease to the Government.

Since 1946, process improvements incorporated in the metal-production program have decreased operating costs. With the cost level of 1946 taken as 100, the corresponding level for 1947 was 79, and for 1948, 75.

Conversion to Rods

For the final step in this second series of operations, the metal billets are shipped to various metal-working plants where they are converted, by ordinary industrial operations, to rods of suitable size and shape for use in reactors. Costs of the process have been considerably reduced during 1948.

Recovery of Scrap

Because of the great importance of uranium, production methods are, of course, designed to reduce to a minimum any process losses of the metal. But some loss is inevitable. Hence, it has been necessary to develop a system of salvage for various process sludges, fluids, concentrates, dusts, dross, slags, and sweepings. Waste is recovered at all steps in the processing chain.

A reasonable amount of recovery is possible by recycling certain materials through the various steps of the main production chain, and a study made in 1948 developed processes that increased this recovery by recycling. There are some forms of scrap material, however, which are not suited for recycling, and these must be shipped to plants where they are converted to a form suitable for return to the process.

These facilities occupy six buildings; land, buildings, and equipment are entirely contractor-owned and operated.

In 1948, process improvements in the conversion of waste to feed material resulted in increased recovery.

NEW ANALYTICAL LABORATORY

The value of uranium materials and the requirement for high purity obviously call for precise analytical controls at each step of the production chain. Furthermore, since in many cases the price of the product to the Commission is computed on a basis of uranium content

and purity of the material, analysis and assay are necessary to protect the financial interest of the Government.

During the war years, various universities provided analytical service under contract. Since the war, however, universities have generally felt unable to accept semicommercial assignments on the scale required. Commercial laboratories normally have neither the facilities nor the background for determining the minute degrees of purity which are required in atomic energy work.

Therefore, in 1948, the Commission authorized the construction of a laboratory for analytical control of uranium and other special materials. A 27,000-square-foot building has been purchased at New Brunswick, N. J. Alterations to this building and construction of additional ones commenced in the fall of 1948. Laboratory operations by the Commission should get under way in early 1949.

Fissionable Materials—U 235

Although much higher standards of purity are required for uranium feed materials, the atomic industry is not very different from many other refining and chemical industries up to the point of conversion of feed into fissionable materials. But from that point onward, it resembles no other manufacturing process.

To get fissionable material from pure uranium, the wartime makers of the bomb proceeded simultaneously upon two very different courses: The extraction from natural uranium of the fissionable isotope U 235 in the great plants at Oak Ridge, and the transmutation of U 238 into fissionable plutonium in the giant nuclear reactors at Hanford. Both operations were new; both were successful; and both are being continued and improved upon today.

PRODUCTION OF U 235

The amount of U 235 in natural uranium is very small—only about one part in 140. An obstacle to its production even more serious than its scarcity is the difficulty of separating it from the more abundant U 238. Both are isotopes of uranium; that is, they do not differ chemically one from the other, but they do differ very slightly in mass or weight. It is obvious, then, that the only difference upon which a separation process can be based is this slight difference in weight—a little less than 1 percent.

To take advantage of this slight weight difference between an atom of U 235 and an atom of U 238, the Manhattan Engineer District built an aggregation of plants costing almost $800,000,000, together with the supporting city of Oak Ridge which, at the peak of construction activity, had a population of 75,000—third largest in Tennessee.

There were three large plants. Each made use in a different way of the slight variance in weight. The *thermal diffusion* process used tremendous quantities of heat to bring about a separation of U 235 and U 238. This process proved less efficient than the other two, and the plant has now been dismantled. The *electromagnetic separation* process whirled uranium atoms in large semicircular arcs in a magnetic field. The atoms of U 235 followed a slightly different course from that followed by the heavier U 238 atoms. Thus it was possible to collect U 235 and U 238 at different points at the end of the arc. This plant is now in stand-by while improvements of the process are being studied. For the present, the third process, *gaseous diffusion*, is proving efficient enough to satisfy requirements for the extraction of U 235.

The Gaseous Diffusion Process

According to accepted physical law, the molecules of a gas are in continual motion and the kinetic energy* is constant for all gases at the same temperature. This energy (K) is expressed in terms of the mass, or weight (M), of the molecule and the velocity (V) of its motion in the formula $K = \frac{1}{2} MV^2$. In a gas which is a mixture of two isotopes such as U 238 and U 235, the lighter isotope will travel at a higher velocity than the heavier isotope. If the mixture is confined in a box, these lighter, faster-moving molecules will strike the sides more often than the heavier molecules. Thus, if these side walls had holes just large enough to allow passage of the molecules, more of the lighter molecules would escape from the box.

This principle is applied in the gaseous diffusion process. The gaseous uranium compound, uranium hexafluoride (UF_6), is permitted to come in contact with a barrier with many minute holes in it. If the gas were allowed to remain for long in the vicinity of any one barrier, passing and repassing through it, the lighter and heavier isotopes would soon be thoroughly mixed on both sides of the barrier. But if the gas on the far side of the barrier (the "diffusate") is removed quickly, it will contain a little more of the lighter isotope (U 235) than normal uranium. It follows, of course, that the gas left on the near side of the barrier will contain a little less of the lighter isotope than the original gas. Obviously the gain in richness in U 235 made by the diffusate at any one passage through the barrier is very small. To get a diffusate highly enriched in U 235, it is necessary to pass the gas through a very large number of successive barriers. At each stage, the residual gas, depleted in the U 235, is also withdrawn and recycled through successively lower stages of barrier. (See diagram p. 16.)

*Kinetic energy is the energy that a body has by virtue of its motion.

K–25, THE GASEOUS DIFFUSION PLANT

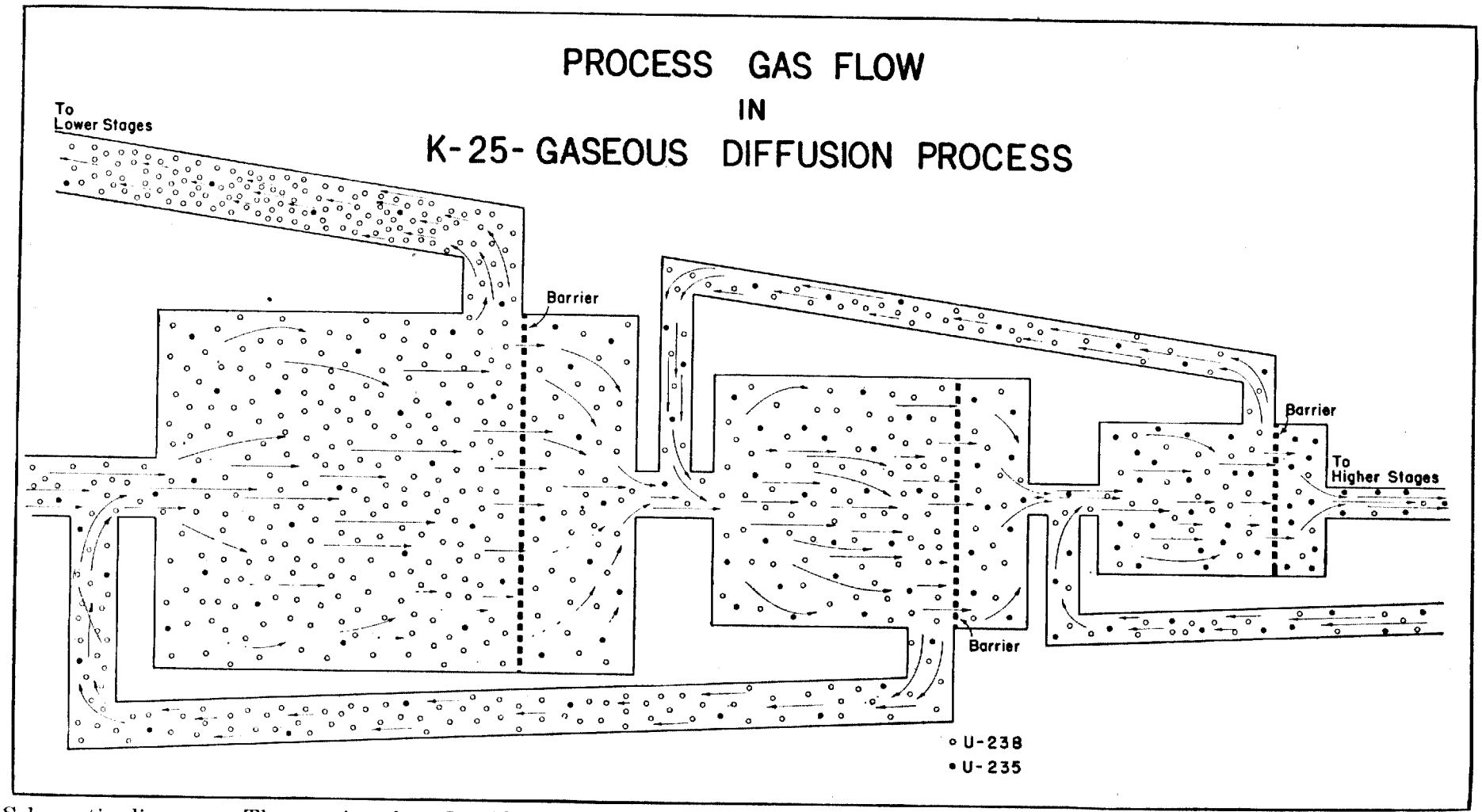
K–25, the gaseous diffusion plant at Oak Ridge, consists essentially of thousands of such barriers, through which uranium hexafluoride gas is continuously cycled, recycled, and finally drawn off when it reaches a certain state of enrichment in the U 235 isotope. This process requires thousands of miles of pipe, thousands of pumps and motors, and myriads of intricate electrical and electronic mechanisms for control of the whole complex process. Because uranium hexafluoride is intensely corrosive, the entire system must be leakproof and corrosion-proof. K–25 is the largest continuous process plant in the world under a single roof—a 60-acre roof. The plant is approximately 1 mile long, a twelfth of a mile wide, four stories high, and U-shaped. K–27, a companion process building, is approximately one-fourth as large. The accompanying steam power plant is the largest plant of its kind ever constructed at one time. All told, auxiliary structures number more than 70 and the plant occupies an area of 600 acres.

The contract operator for K–25 is the Carbide and Carbon Chemicals Corporation. During the past 2 years the men of this company have worked persistently and effectively to increase the yield of precious U 235 and to lower the cost of operation. The year 1948 has seen considerable progress toward these goals.

Improvement of Barriers

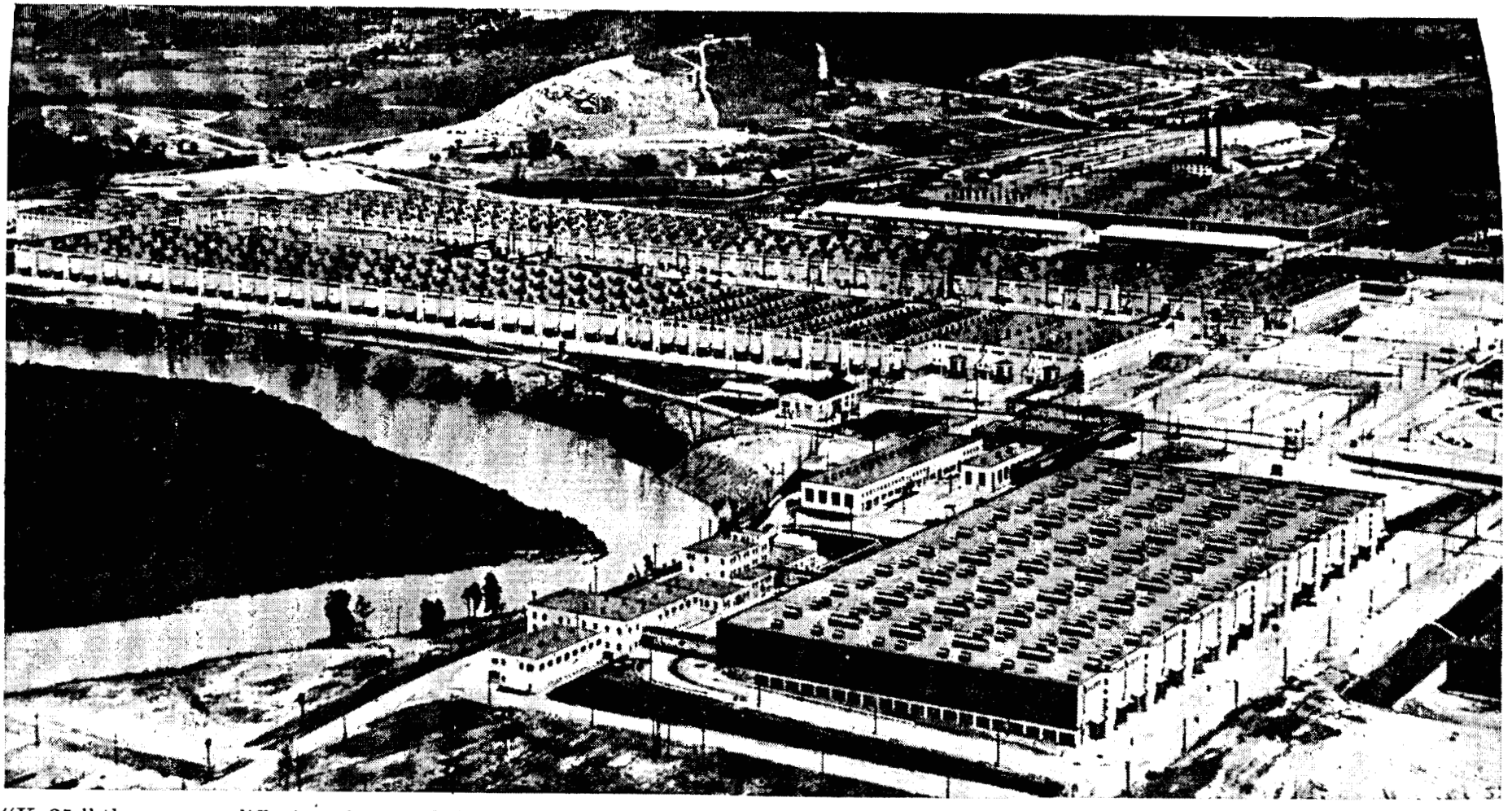
The porous barriers through which uranium gas is diffused probably are unlike anything ever before devised by man. They must contain billions of holes per square inch, each one a few ten-millionths of an inch in diameter. They must be very thin and therefore fragile, yet must withstand a considerable pressure. They must be supplied in enormous quantities; the total area of barrier used in the plant is measured in square miles.

The engineers and scientists who developed the first barriers in haste during the war achieved remarkable success, but of course much room remained for improvement. Soon after its establishment, the Commission set up a program aimed at improving barrier quality. Research groups at Oak Ridge undertook this task. Some of the barrier-manufacturing equipment used during the war was shipped to Oak Ridge and reinstalled on pilot-plant scale. Barrier manufacture since its inception has been a "batch-type" operation; recent developments, however, have pointed the way toward a more efficient process for continuous production of barriers. Efficiency of production of U 235 would be greatly increased by this change. Meanwhile, certain of the originally installed barriers are being replaced by higher



Schematic diagram. The uranium hexafluoride gas that passes through the barriers becomes enriched in its scarce U 235 atoms (black dots) as it moves through successively higher stages. Gas not passing through barriers, containing mainly the unwanted U 238 atoms (white dots) is returned to lower stages. K–25 plant uses hundreds of acres of barriers, thousands of miles of pipe.

Schematic diagram. The uranium hexafluoride gas that passes through the barriers becomes enriched in its scarce U 235 atoms (black dots) as it moves through successively higher stages. Gas not passing through barriers, containing mainly the unwanted U 238 atoms (white dots) is returned to lower stages. K–25 plant uses hundreds of acres of barriers, thousands of miles of pipe.



"K–25," the gaseous diffusion plant at Oak Ridge, with the "K–27" auxiliary process plant in the foreground. K–25, built during the war to extract fissionable U 235 from normal uranium, is the largest continuous process plant in the world under one roof—a 60-acre roof. Each side of the giant "U" (center) is half a mile long and four stories high.

quality material and a substantial increase in production yield is expected from this step.

Development of Fluorothene

Uranium hexafluoride, the unique feed material of the gaseous diffusion process, is a most difficult substance to handle, being so reactive that it eats through glass. Yet in K–25 it must pass through tens of thousands of pumps, valves, and couplings without leakage. No ordinary pump packing or valve seat can contain it. An entirely new substance was needed. During the war, a corrosion-resistant plastic compound, fluorothene, was developed. Because of the potentialities this plastic offered during 1947 and 1948, the Commission and the contractor have developed new and improved methods of using it at various points in the K–25 process.

Fluorothene production by private industry for commercial purposes is now permitted and the chemical industry is already making use of its special properties. This new plastic is one of a number of new products growing out of atomic energy development that are benefiting other industries.

Natural Gas for Power

The K–25 steam power house is essential to the maintenance of full production of uranium 235 by the gaseous diffusion process. At present it operates on coal. Because of the great importance of steady production, the Commission decided early in 1948 to provide another source of fuel. Natural gas was chosen for several reasons, including the fact that it uses a different transportation medium from coal. Successful negotiations were completed with a gas supplier who is presently arranging to secure the necessary allocation from the Federal Power Commission and also to secure steel for a gas pipe line to Oak Ridge.

Reduction of Personnel

At the outset of K–25 production operations in 1944, while the plant was being tested, some 11,000 workers were employed in operation and maintenance. As steps in the process have been proven, personnel requirements have been steadily reduced. Plant data are continuously and automatically reported by a vast complex of instruments into a central control room. From it, by motor-operated valves, the flow of the process can be governed. The use of this control room has made it possible to cut operating personnel, and improved equipment has permitted reduction of the maintenance force as well.

On January 1, 1947, there were some 7,000 workers at K–25. Today, although output has been increased, the number of workers is less than 5,000.

RESEARCH ON GASEOUS DIFFUSION PROCESS

The sum total of improvements that have been effected in the gaseous diffusion plant during the past 2 years, has increased the production yield by a substantial factor. Improvements immediately in prospect will bring further increase. At the same time, a reduction of 15 percent in operating expenses has been accomplished during a period when costs of both labor and materials were steadily increasing.

There is continuous investigation into possible improvement of the gaseous diffusion process. Two major design studies were completed in 1948—one for an addition to K–25, the other for an entirely new plant of greatly increased efficiency.

Addition to K–25

Now definitely projected is a large addition to the K–25 plant, which will facilitate the stripping of U 235 from the gaseous feed. Preliminary design studies were completed in 1948 by Carbide & Carbon Chemicals Corp., and an architect-engineer contract was awarded in December 1948, to Giffels & Valet, Inc. Construction is expected to start in the summer of 1949, and the plant should be in operation by late 1951. When this addition is complete, U 235 production will be increased considerably.

New Gaseous Diffusion Plant

The proposed new gaseous diffusion plant would be much smaller than K–25. It is expected that the new plant will produce U 235 much more economically than K–25. The Commission is now undertaking economic, material, and other surveys to determine the feasibility of constructing such a plant.

OAK RIDGE COMMUNITY

When the decision was made to locate U 235 production facilities in the Tennessee Valley, it was apparent that the construction of a supporting community would be necessary to house and provide for operating personnel who had been recruited from all parts of the country. Such a community was desirable, also, to concentrate the key operating personnel under Government protection and permit easy access to the plants. The President, in initiating the Manhattan project in June 1942, approved the recommendation that an immediate start be made on the construction of the necessary fencing, housing, utilities, and other features required.

Because of uncertainties as to the ultimate scope or continuity of the atomic energy project, the town of Oak Ridge was developed without any integrated long-term plan. As presently constituted, it occupies some 9 square miles in the northeast corner of the 93-square-mile Government reservation known as the Oak Ridge area. The

town itself lies within the borders of Anderson County, Tenn. At the end of 1948, its residential population was nearly 36,000, and employment of all kinds within the Oak Ridge area approximated 21,000. The communities of the region are already crowded, and absorption of the entire operating staff of the Oak Ridge project by off-site towns is impossible. Furthermore, the Oak Ridge community already has facilities that can be effectively and economically used in providing permanent living accommodations for a large part of the operating staff. Present plans, therefore, are to continue operating the town of Oak Ridge indefinitely.

During the past 18 months, the Commission has carried on a comprehensive program to make Oak Ridge a more normal and agreeable community in which to live.

PRESENT FACILITIES

Oak Ridge is a mixture of permanent, semipermanent, and submarginal housing and facilities. While meeting wartime requirements, the town as it stood in 1945 could not be expected to be satisfactory as a permanent home for the thousands of scientists, engineers, administrators, and craftsmen upon whom the atomic energy program at Oak Ridge depends. In order to plan intelligently the large-scale improvements necessary to convert Oak Ridge to a permanent community, the Commission in 1947 let a contract for the preparation of a comprehensive plan both to evaluate existing facilities and to set a pattern for orderly future development. This so-called "Master Plan" was in its final stage of completion at the end of 1948. Essentially, the plan provides for conversion of Oak Ridge from a temporary war-built town to a permanent community, by replacement, without expansion, of a portion of the present housing supply.

OPERATION

The principal contractor in the operation of the town of Oak Ridge is the Roane-Anderson Co., a subsidiary of the Turner Construction Co. Other contractors give specialized services such as operating the transit system, distributing coal, managing dormitories, collecting refuse, etc. This leaves in the hands of Roane-Anderson the operation of most municipal functions, including maintenance of Government-owned housing, roads, walks, utilities, and warehouses. Roane-Anderson performs procurement, property maintenance, and pay-roll services for the police, fire, hospital, and public health departments, with technical direction of these functions remaining with the Commission. The schools, while technically a part of the Anderson County school system, are financially supported entirely by the Commission, by special agreement with the county government.

In addition to supplying municipal services and maintaining residential housing, the Oak Ridge community management cares for virtually all services for research and production operations, including provision of freight and passenger transportation services, supply of water to production areas, maintenance of roads, general care of the Government reservation grounds (except the technical areas), operation of the motor pool serving all Oak Ridge plant areas, and similar functions.

Community Administration by Government

Since shortly after the Commission became responsible for Oak Ridge in 1947, administration of the town operation has been exercised by a city manager and his staff, responsible for carrying out three principal programs:

a. The provision of housing;

b. The maintenance and operation of buildings and utilities;

c. The carrying out of the functions normally handled by a municipal or county government.

Under a reorganization effected in the last 6 months, these functions have been split into three distinct units—Construction-Engineering, Community Service, and City Management—which are coordinated by an Office of Community Affairs.

Reorganization of Budget and Accounts

In order to provide a more precise accounting of costs and revenues related to the town's operation and to provide insofar as possible for reducing or eliminating unwarranted subsidies, a completely revised system of budget and accounting classifications was initiated during the last 6 months. It is hoped that the operation of Oak Ridge will thus be brought more closely in line with fiscal conditions prevailing in comparable normal communities.

Private Investment in Commercial Operations

A vigorous effort is being made to interest private business enterprises in building their own structures in the new main business district on sites leased from the Commission. Again, this is a step toward more nearly normal conditions in Oak Ridge.

Citizen Participation

The community of Oak Ridge is not an incorporated or chartered municipality; it is an area set aside on federally owned land. The residents of Oak Ridge participate only through advisory committees in managing the affairs of the city. They do, however, participate in state and county elections and some of them have held public office in Anderson County.

In general, the community program is being directed toward providing residents with more of the responsibilities and privileges of political and personal democracy. The feasibility of municipal incorporation and of private ownership of property is being examined.

CONSTRUCTION ACTIVITIES

Substandard housing and community service buildings which require increasingly heavy maintenance expense, and other serious community deficiencies made it necessary to proceed with some construction before completion of the Oak Ridge Master Plan. The construction follows the pattern of the plan insofar as it has been developed. Typical of construction activity in Oak Ridge during 1948 are such things as additional school classrooms, fire-sprinkler systems in schools, street construction, erosion-control measures, hospital improvements, water supply, permanent warehousing, and housing. Plans were made during the year for a new senior high school and a permanent business section.

FISSIONABLE MATERIALS—PLUTONIUM

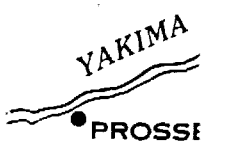
Plutonium, the fissionable material produced at Hanford, is not simply extracted from the feed material. It is a new element created by nuclear fission. During the war, for the first time in history, men succeeded in transmuting substantial amounts of one basic element (uranium) into another (plutonium). This large-scale modern alchemy produces a substance far more precious and more useful than gold.

Plutonium is also a dangerous substance. The process of its manufacture and the materials with which it is associated give off deadly radiation. In addition, plutonium itself is chemically poisonous. And, of course, a "critical mass" brought together will sustain a chain reaction, the process by which the energy of the nucleus is harnessed by man, in a weapon or in a power reactor.

THE HANFORD PLUTONIUM WORKS

The men who developed nuclear fission and demonstrated the first nuclear chain reaction in the experimental uranium-and-graphite pile (reactor)* at Chicago had reason to believe that nuclear reactors, if large enough, would produce usable amounts of plutonium. And they knew that any such plutonium would be chemically separable from the parent uranium, since it was a different chemical element. They built a pilot plant at Oak Ridge to try out the whole idea, both the

*At first, all nuclear reactors were called "piles" because they were actual piles of uranium and graphite. The term is still correctly applied to this type of reactor, but "nuclear reactor" is now generally used to mean all types of self-sustaining nuclear chain-reacting assemblies.



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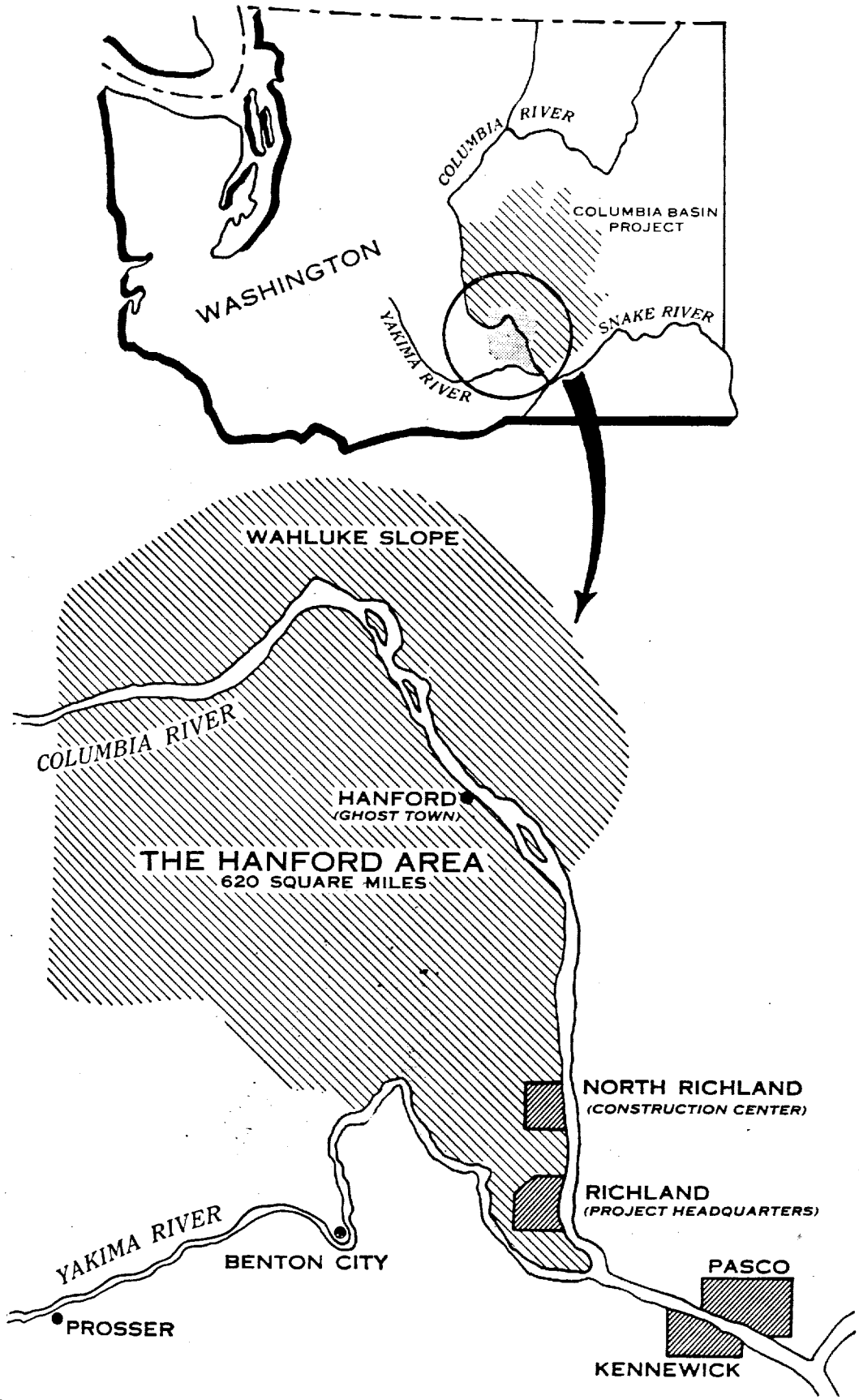

The peculiar requirements of the plutonium-producing piles necessitated the purchase and lease by the Government during 1943 and 1944 of a tract of land in southeastern Washington, more than half the size of Rhode Island. Formerly farm and ranch land, the Hanford area now contains widely separated plants, as well as a town of 20,000 persons.

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transmutation and the chemical separation. Even before the process had proved workable, the E. I. duPont de Nemours and Co., Inc., began to build Hanford.

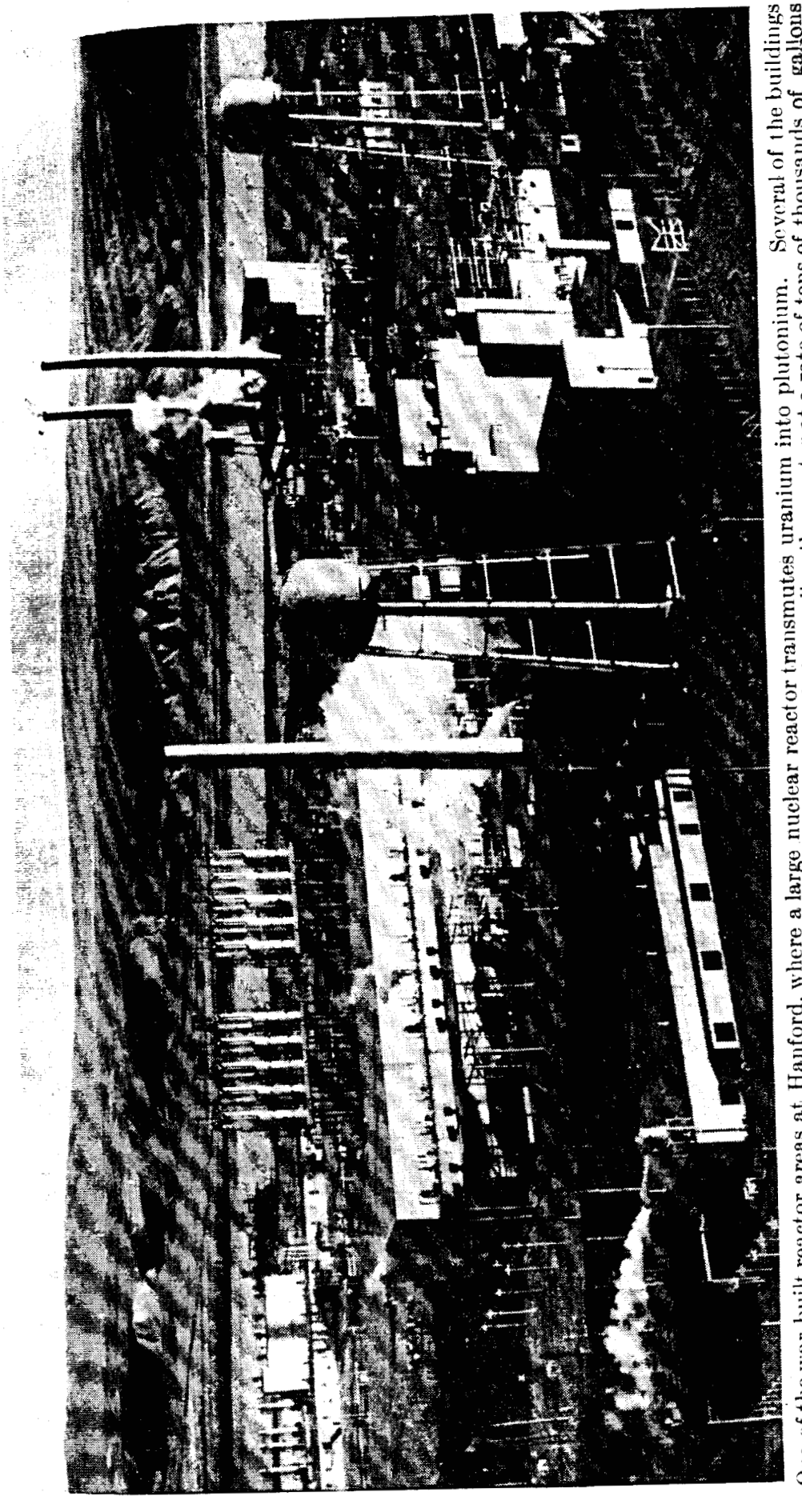
The Hanford Engineer Works, as constructed during the war, consisted of three reactors and the necessary chemical separation plants, together with a multitude of supporting facilities, including the plants for canning uranium slugs in aluminum before they are fed into the reactor, and the community of Richland to house the plant operators. The reactors were isolated and widely separated from one another in the Hanford reservation, which comprises some 400,000 acres—more than half the area of Rhode Island. The water of the adjacent Columbia River diverted to cool the reactors would equal the water consumption of a city of over a million inhabitants. The temporary construction camp housed 60,000 people, and the reservation town of Richland 15,000. Cost of the project was nearly $350,000,000.

The Building of Hanford

The staff of the Metallurgical Laboratory at the University of Chicago (now Argonne National Laboratory), builders of the first pile, performed the basic research and assisted in the design of the Hanford reactors. The duPont company was the Government's contractor for the design, construction, and operation of the plants and continued to operate them until September 1946, when the General Electric Co., the present contractor, took over.

Ground was broken for the Hanford works in March 1943, and the first pile was operated in September 1944. The designers and builders raced against time with only laboratory demonstrations to guide them; when they started, the only plutonium ever produced was such a small amount as to be invisible to the naked eye. Virtually every problem they faced, from the selection of structural materials to the shielding of personnel from deadly radiation, was a new one. A single mistake could have nullified the whole effort and created a severe hazard as well.

The builders of Hanford were successful because they concentrated upon one objective: the production of an atomic bomb. There was no time for full evaluation of design features. Many assumptions had to be made, and it is a tribute to the skill of those responsible for design that the reactors, though somewhat deteriorated, are still in operation today. In the original design of the separation plants, there was no plan to provide for recovering the unused uranium. Laboratories, offices, shops, stores, and living quarters were designed to satisfy minimum needs and no more.



One of the war-built reactor areas at Hanford, where a large nuclear reactor transmutes uranium into plutonium. Several of the buildings belong to the waterworks, which uses the Columbia River (background) for cooling the reactor at a rate of tens of thousands of gallons per minute.

THE HANFORD PROGRAM TODAY

The serious deterioration of the reactors resulting from more than 3 years of intensive operation required a major overhaul and reconditioning program at Hanford. At the same time the national interest required an increasing supply of fissionable material.

The Commission's program at Hanford, therefore, shaped itself around three major objectives:

1. Rehabilitating existing equipment and operating it more efficiently to prolong its useful life and raise the rate of output.
2. Building plants to replace existing facilities plus additional plants for greater production capacity.
3. Developing new and more efficient processes and operating techniques.

The past 2 years have seen marked progress toward all these goals. Late in 1948, the production rate of the original reactors was greater than any achieved in wartime. New chemical processes that should bring great savings in uranium are now in the pilot-plant stage. The resulting construction of new plants and supporting facilities is comparable in size to the original wartime project.

OPERATION AND CONSTRUCTION OF REACTORS

In its simplest terms, a plutonium-producing reactor is a pile, or solid mass, of graphite pierced at intervals by tubes that run from one side of the pile to the other. Uranium, in the form of slugs, is fed into these tubes, where nuclear fission transmutes a small portion of it into plutonium. Under the severe conditions of high-level operation, serious operating difficulties had developed. During 1948, however, by replacement of parts and changes in operating techniques, progress was made in overcoming these difficulties.

Reactor Repairs

By late 1947, it was clear that a major repair program was urgent if the reactors were to be kept in operation. Repairs were started before the end of 1947. Production of plutonium could not be interrupted. Therefore, portions of the repair job were scheduled during each period of normal operating shutdown for the insertion and discharge of slugs. By mid-1948, the work was essentially completed, and production of plutonium in a given reactor during the latter half of the year compared favorably with the highest wartime rate.

A nuclear reactor cannot be taken apart for repairs. The residual radioactivity that infects all its components makes this normal

maintenance operation impossible. The Commission's contractors, however, have learned a number of maintenance devices which have already prolonged the usefulness of the reactors. Others will be developed. There can be no certainty about the ultimate useful life of the reactors; sooner or later their failure may cause permanent shut-down.

Reactor Construction

New reactors, therefore, would be required even to assure the maintenance of present output. Schedules, however, call for increased production. To provide the additional capacity needed, a reactor construction program was authorized late in 1947 and was brought to peak of activity in 1948. More than 15,000 construction workers are employed on the new reactors and on supporting facilities for research, transportation, storage, housing, and community needs. Important units are scheduled for completion during 1949.

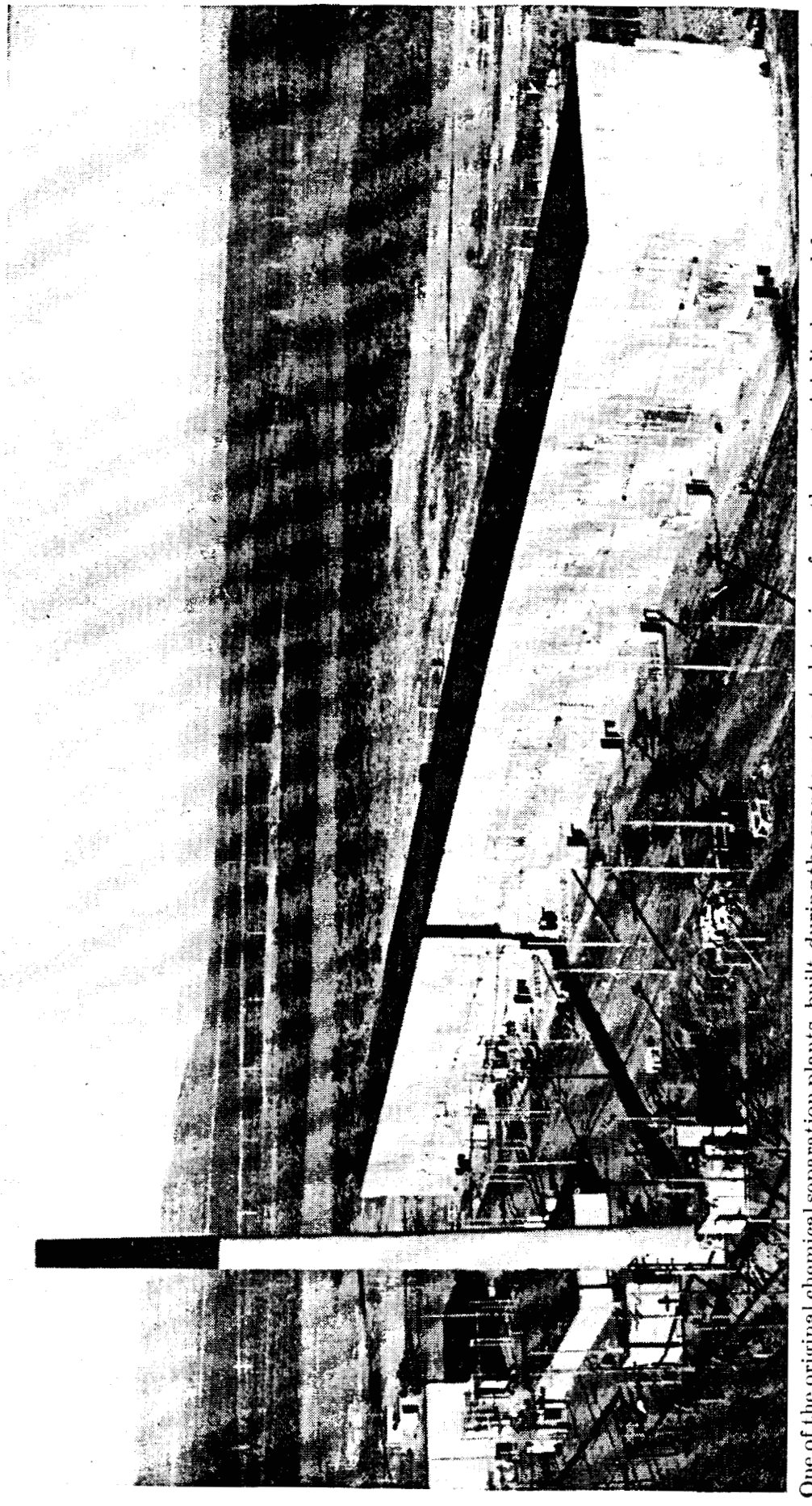
CHEMICAL SEPARATION

After irradiated slugs have been discharged from the reactors, they are chemically treated to extract and purify the plutonium. The chemical plants devised for this purpose are large and of novel design. They are, essentially, long, deep canyons of concrete (approximately 90,000 cubic yards of concrete for each plant—enough for 30 miles of highway), containing processing cells within which the necessary series of chemical operations can be carried on by remote control. The slugs which they process are intensely radioactive. Personnel remain behind heavy shields several feet thick and view the work through periscopes. Residues must be very carefully handled. After the plutonium has been extracted, the remaining uranium, contaminated with highly radioactive fission products, is held in storage.

Better Chemical Separation

The Commission and its contractors are devoting much research, development, and construction effort to the improvement of these processes. More efficient use of the available material will be realized through improved separation and recovery processes and will produce great economies in manufacture.

In 1947, the Commission acted to speed up this research program. By early 1948, a large aggregation of scientific and engineering talent was at work on the problem. The Commission's Argonne and Oak Ridge National Laboratories and Knolls (Schenectady, N. Y.) Laboratory conducted major investigations, together with the General Electric Co., Standard Oil Development Co., Carbide & Carbon



One of the original chemical separation plants, built during the war to extract plutonium from the material discharged from the reactors (see cut, page 25). Entire process is remotely controlled. The structure, including radiation shielding, uses enough concrete for a 30-mile highway. Stack for discharge of waste gases is 200 feet high.

Chemicals Corp., Kellex Corp., Blaw-Knox Co., Monsanto Chemical Co., and Dow Chemical Co.*

CONSTRUCTION FOR EXPANDING NEEDS

The continuation and expansion of operations at Hanford has required a large amount of construction of supporting services, both to increase capacity and to replace war-built facilities. Laboratories, warehouses, shops, roads, railroads, bridges, utilities, fencing and other security installations, additional storage facilities for radioactive wastes—all have been under construction in 1948, together with the additional housing and other facilities required to serve the residents of a permanent community of over 20,000.

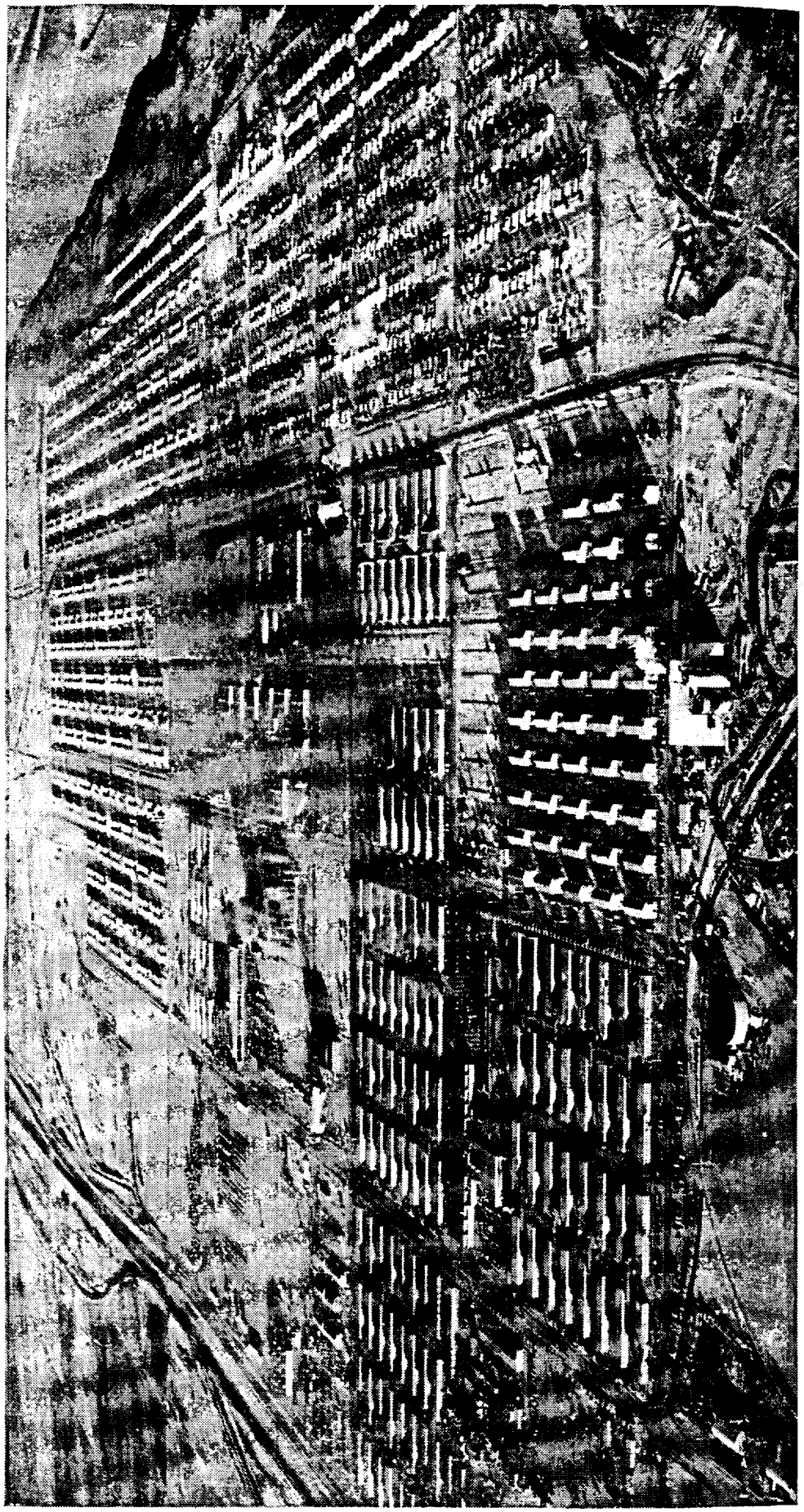
Laboratories provided in the original project were limited strictly to those needed to perform only routine control analyses. In the subsequent years of operation, the need for research facilities for investigation of major plant problems increased. Some expansion of the original laboratories was authorized from time to time to get the necessary development work started for the new plant. A detailed survey of need for adequate permanent laboratories was made in 1948, and plans are now being completed for the building of additional laboratories.

Hanford-Richland Community

The town of Richland, located near the junction of the Yakima and Columbia Rivers in the State of Washington, is built on the land acquired by the Federal Government in 1943 for the Hanford works. The community was initially built and operated by the duPont Company, under the supervision of the Manhattan Engineer District. In the spring of 1945, the town reached a total population of about 15,400 persons. After the war, population declined to a low of about 13,000 during 1946. At present, Richland has an estimated population of 20,000, of whom 1,500 are temporarily crowded in with other families. As at Oak Ridge, the size of the town is predicated on the number of Hanford works employees and their families unable to find living accommodations in towns nearby. The closest towns to Richland—Pasco and Kennewick—are also overcrowded. Additional housing and community services are being built to serve the larger working population needed for the expanding plant.

*In December 1948, the E. I. duPont de Nemours and Co., Inc., of Wilmington, Del., agreed to survey the total problem of research and engineering involved in improving the chemical processes used in production of plutonium.

One of the original chemical separation plants, built during the war to extract plutonium from the material discharged from the reactors (see cut, page 25). Entire process is remotely controlled. The structure, including radiation shielding, uses enough concrete for a 30-mile highway. Stack for discharge of waste gases is 200 feet high.



The new construction camp at North Richland on the Columbia River in the Hanford area (see map, p. 23), built since January 1947, which houses 12,000 persons—construction workers and their families. More than two thousand trailer spaces are shown at right and in background, 121 barracks for single workers, center and left.

OPERATION OF THE COMMUNITY

During 1948, the Commission and the contractor have taken steps to expand the community and to make it a pleasant place to live and, as nearly as feasible, a normal one. In contrast with Oak Ridge, Richland has been and is now being operated by the same contractor who operates the plant facilities which the community supports. DuPont, the original operator, was succeeded in September 1946 by the General Electric Co., and Government supervision of this contract operation passed from the Manhattan project to the Commission on January 1, 1947. Here, too, the Government must conduct a wide variety of activities that are performed in normal communities by landlords and local governments. Such activities include the provision, operation, and maintenance of housing accommodations; the provision and maintenance of police protection, fire protection, garbage disposal, utility operation, and transportation service. Commercial establishments operating within the reservation are licensed and operated under the supervision of the General Electric Co., which acts for the Government in these matters. By agreement with local authorities, the school system in Richland is operated as a regular district in the Washington school system, with financial support from the State. The Commission, however, also supports this operation by payments to the school district and by providing the physical plant.

Community Administration by Government

The Commission plans that Richland, like Oak Ridge, shall be a normal community. Steps already taken are the reorganization of the budgets and accounts.

Richland differs from Oak Ridge in one respect: The town was never confined within guarded barriers. Commercial interests are now building stores and are currently discussing with the contractor the building of rental housing in Richland. The Commission is encouraging this interest.

Citizen Participation

A committee of Richland residents recently developed a charter for a town advisory council for presentation to the citizens for a referendum vote. While this council would of necessity be advisory at this time, its existence would enable residents to take a more significant part in the management of the community and should lead to more responsibility for municipal government.

The new construction camp at North Richland on the Columbia River in the Hanford area (see map, p. 23), built since January 1947, which houses 12,000 persons—construction workers and their families. More than two thousand trailer spaces are shown at right and in background, 124 barracks for single workers, center and left.

MASTER PLAN

The housing deficiency in the vicinity of the Hanford plants continues acute. Whereas at Oak Ridge the principal problem is the replacement of marginal and submarginal housing, at Hanford the Commission faces the task of supplementing existing housing in order to accommodate the personnel required to staff the expanding operations.

In late 1948, a preliminary draft of a master plan for Richland was ready. This plan will describe, in text and maps, the basis for planning the community; the probable directions of its growth; proposals for land use; location of regional and local thoroughfares; and development of the school system, community facilities, commercial and industrial areas, public utilities, and public transportation.

Construction began in the summer of 1948 under the guidance of the preliminary studies then available on such badly needed improvements as additional school classrooms, expansion of the hospital, new power lines, housing and dormitories, and dust control measures.

Other Functions Related to Production

RADIATION DETECTION INSTRUMENTS

Radiation detection instruments are essential nearly everywhere in the atomic energy project; the Commission and its contractors are using about 60,000 today. For several years, project workers had to invent these instruments for themselves and then manufacture them. Today, however, there are more than a score of competing American industrial firms developing instruments and supplying them directly to the Commission's contractors. The multiplying requirements of an atomic age will soon demand that this new industry expand to do a business running into many millions of dollars of annual sales.

Uses of the Instruments

Nuclear radiations enter into nearly all the production processes and research projects of atomic energy; and the instruments that detect, analyze, and measure these radiations are essential in both plant and laboratory. They are essential for the control of processes—to measure, for instance, the intensity of the chain reaction inside a plutonium-producing reactor; for the control of product quality—to analyze, for example, the radiations emitted by reactor-produced

radioisotopes as an indicator of their purity; for health physics monitoring—to measure and analyze the radiations to which workers may be exposed; for fundamental research—to reveal nuclear activities, or to follow the movements of tracer isotopes; and for a great many allied purposes, wherever nuclear radiation is released.

There are dozens of types of these instruments adapted to different purposes. Most of them collect the electrically charged particles produced in the air or gases by nuclear radiations, as contrasted with the principle of detection of electrical currents induced in conducting solids (wires) of a radio detector or a light meter. To get the sensitivity and flexibility required for the many different atomic energy applications, electronics engineers have devised a great variety of novel devices—special low-grid-current electrometer tubes, proportional counter tubes, Geiger counter tubes, ionization chambers, and insulating materials.

Growth of an Industry

Up to 1945, only six commercial firms had manufactured complete instruments for sale. During the war years, their sales to the atomic energy project averaged about a third of a million dollars a year. By the beginning of 1947, their output for this purpose had mounted to about a million dollars a year, and it has just about doubled each year since, so that today it stands at some four million dollars a year. Today there are 24 companies that manufacture complete instruments and others that produce various components.

During the past 2 years, the Commission has taken many steps to promote this development of the industry.

The Future

Up to July 1948, the Commission had purchased all instruments for the atomic energy project through a central procurement office. By that time, however, the output of industry was satisfactory in quality and adequate in quantity. It was then possible to authorize AEC contractors to purchase direct from manufacturers in a thoroughly competitive market. Although it now appears that the volume of instrument procurement for the Government atomic energy program may not increase greatly from this time on, it is certain that the requirements of atomic science and technology and of national defense will provide an expanding market for the firms that are today acquiring skill and experience in the new industry.

ACCOUNTING FOR ATOMIC ENERGY MATERIALS

The two main safeguards against loss or misappropriation of uranium and plutonium are physical protection and accounting control. Both safeguards are important, and neither is adequate alone.

Physical protection (plant design, operating methods, fences, guards, etc.) is designed to prevent misappropriation and similar physical losses. Accounting is needed to tell how much material is on hand and to check on the efficiency of the production process. Accounting controls also determine the effectiveness of the physical safeguards against diversion of material and hold to a minimum material lost in the manufacturing wastes.

The quantitative measurement of these materials is complicated. It is necessary to measure and account for the metal content of various gases, chemical sludges, and heterogeneous mixtures in the production processes. It is also necessary to check the nuclear properties of the materials to insure that no theft has been masked by substitution of other materials. In many instances, the items are highly radioactive or dangerously toxic, and in other instances production processes are such that materials must be measured, inventoried, and accounted for while in process or in use in closed systems.

Procedures

In 1947, the Commission established preliminary procedures for obtaining and summarizing the needed inventory and loss information. Actual experience at the different plants was next studied. During 1948, the procedures were revised to incorporate improvements which field experience had shown to be desirable. Although satisfactory measurement methods and control procedures have not yet been developed for all materials at all stages of production, a fairly comprehensive system was in operation by the end of 1948. Additional refinements and improvements will be adopted as they become available.

Analysis

The second problem is to determine whether these materials are properly controlled and accounted for by the contractors who operate the processing plants. This determination requires a comprehensive on-the-scene examination, which must go beyond ordinary auditing procedures. The reliability of material-accounting reports depends upon the underlying measurement methods and inventory procedures. Therefore, a satisfactory examination must include a review of these methods and procedures, as well as a review of the records.

During 1947, audit, statistical, and analytical methods of examination were developed, necessary personnel recruited, and examinations made at representative plants. During 1948, many additional examinations were made, the methods were improved, and the program has been expanded to cover each major plant at three month intervals in 1949.

LICENSING AND EXPORT CONTROL

Licensing of Transfers of Source Material

In accordance with the requirements of section 5 (b) of the Atomic Energy Act of 1946, the Commission on March 17, 1947, issued regulations effectuating the act's requirement that "Unless authorized by a license issued by the Commission, no person may transfer or deliver, receive possession of or title to, or export from the United States any source material after removal from its place of deposit in nature." (See Appendix 4 for complete regulation.)

Specifically prohibited is the use of uranium for decorative or nonproductive purposes such as photography and the coloring of ceramics and glassware. About 3,500 pounds of uranium, as uranium oxide (U_3O_8), are licensed and consumed annually in the United States as a chemical reagent, in the manufacture of certain special glasses, in certain electrical equipment parts, and in research. Thorium compounds totaling 30,000 pounds, as thorium oxide (ThO_2), are licensed each year for use in the manufacture of incandescent gas mantles within the United States. Other uses of thorium totaling 6,000 pounds, as ThO_2, are for alloys, reagent chemicals, and research.

Limited quantities of uranium are authorized for export from time to time, largely for use as a reagent in chemical determinations of sodium. These uranium exports are permitted only in instances where the ultimate receiver can be identified and the use determined. The licensing office of the Commission exchanges information with the Canadian Atomic Energy Control Board, for example, in connection with uranium and thorium compounds which are transferred between the two countries for nonatomic-energy purposes.

Exports of thorium nitrate, $Th(NO_3)_4$, solely for use in the manufacture of incandescent gas mantles, have been authorized by the Commission since September 1947, under certain safeguards established by the Commission in conjunction with the Department of State. The present limited importance of thorium in the Nation's atomic energy program, as well as the essentiality of thorium in producing light for a large part of the world, have led the Commission to permit the export of limited quantities of thorium nitrate for this purpose. The quantities authorized for export, of course, represent thorium in excess of the needs of the national atomic energy program.

As in the case of uranium exports, the thorium nitrate is licensed for export to foreign incandescent gas mantle manufacturers only after a careful survey of the facilities in which the thorium nitrate will be used, the inventories of the mantle manufacturers, their

During 1948, in addition to handling a large volume of export license applications, the Commission sought to extend the effectiveness of its control over equipment under the regulation. To check the possibility of clandestine export shipments, monthly reports of domestic sales of such equipment are obtained from the various manufacturers. In appropriate cases, inquiries are addressed to consignees to determine the final use of the equipment, and information is furnished regarding regulations governing export of such items.

At the time of issuance of the regulation, it was realized that some controls should continue to be exercised over exports of materials and equipment which are required for an atomic energy program but which are not covered by the licensing procedures of the Commission. The various atomic energy projects were reviewed and a list prepared of the more important items required for their construction or operation. Through the cooperation of the Department of Commerce, action has been taken to control the export of such items.

During the year, the Commission named representatives to several interagency committees established by the Secretary of Commerce, which rate the strategic importance of all commodities in foreign trade and advise the Secretary on the formulation and implementation of export-control policies. These representatives direct attention to the strategic importance of those materials that can be utilized in an atomic energy program.

CONSTRUCTION AND ENGINEERING POLICY

Engineering and construction efficiency is helped by standard practices. Steps toward standardization in practice and policy were taken in 1948 throughout the construction-engineering program.

A Contract Manual is being prepared which specifies practices and procedures to be followed by the Commission and its contractors for construction and engineering, methods of formal advertising, invited bid procedures, and ground rules for cost-plus-a-fixed-fee contracts and fee negotiations. The men writing the manual first made extensive studies of the practice of other Government agencies and various contracting offices of the Commission. After issuance the manual will be supplemented from time to time with sections covering additional phases of contract administration.

MOBILIZATION PLANNING

In the event of national mobilization, the requirements of the Commission would be in competition with the suddenly expanded and urgent demands of the military and other agencies. With this eventuality in view, the Commission has undertaken a planning pro-

gram which would anticipate and provide for its material, industrial, and manpower requirements under such circumstances. This program requires continuing liaison with other Government agencies engaged in similar planning, such as the National Security Resources Board, and the Munitions Board of the National Military Establishment.

Mobilization planning by this agency involves analyzing present and proposed plans for AEC operations and determining:

1. Material, industrial, and manpower requirements;
2. The existence of weak links in supply lines;
3. Measures required to correct such weaknesses;
4. The stock-pile levels which should be maintained for production materials, operating supplies, and equipment;
5. The earmarking of industrial and utility capacities which would be required to assure the operation of the atomic energy program.

Requirements Studies

During 1948, the Commission completed initial studies of estimated requirements in the following categories: Electric power, manpower, machine tools, automotive equipment, construction equipment, automotive and construction-equipment maintenance and operating items, organic chemicals, inorganic chemicals, radiation detection instruments, and construction materials. Other studies are under way.

A study also was made to secure and record detailed individual information on Commission and contractor personnel for possible use in connection with justifiable requests for draft deferment and the retention of reserve officers.

Arrangements were made for AEC participation in the Munitions Board program for the voluntary allocation of private industrial capacities.

Allocations of Materials

On March 29, 1948, Commission representatives met with the Director of the Office of Industry Cooperation of the Department of Commerce and requested him to place the steel requirements of the AEC under Public Law 395, Eightieth Congress. At the request of OIC, steel requirements for the period July 1, 1948, to February 28, 1949, were supplied and on June 22, the over-all plan was approved by the Attorney General and the Secretary of Commerce. The plan apparently has worked out to the general satisfaction of all concerned up to the present time.

On September 1, 1948, AEC submitted its steel requirements for the 6-month period March 1 to August 31, 1949, to OIC with the request that the existing plan be extended to cover this amount. On

October 6, the Steel Products Advisory Committee met in the Department of Commerce and unanimously approved an extension to August 31, 1949.

Individual arrangements are being made with producers designed to insure the delivery of other critical materials in short supply.

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REACTOR DEVELOPMENT

One of the two major methods of producing fissionable materials is in nuclear reactors, as at Hanford. The program of development of nuclear reactors—not only for the production of fissionable material but for the generation of power and for nuclear research—comprises a substantial part of the Commission's activity. The intensive effort being put into the development of reactors is of such great importance and scope that the Commission is preparing a special report to the Congress on this subject.

The past year has brought considerable progress in the formation and starting of the reactor development program. Both the technical and managerial phases of reactor development work will be covered in the forthcoming special report.

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II

MILITARY APPLICATION

Introduction

The activity of the Atomic Energy Commission receiving major attention has continued to be the production and improvement of atomic weapons. This has three principal aspects: Production of fissionable material, manufacture of weapon components, and development of new designs of weapons. Important advances have been made in all these fields in 1948. The production of fissionable material is being expanded. New designs of weapons have been tested and found to be successful, and further developments are now in progress.

What is an atomic weapon?

The fundamental ingredients of atomic weapons are the fissionable materials uranium 235 and plutonium. These are heavy metals, which are similar in appearance to ordinary metals. They are nonexplosive in small quantities. But an explosion can be produced by bringing sufficiently large masses of fissionable material together rapidly. An atomic weapon is a device for doing this. There are limitations on the size and weight of an atomic weapon if it is to be carried in an airplane and dropped on a target. It must be capable of being produced in quantity. It must be reliable in performance. A total of eight atomic weapons have been detonated: In the test at Alamogordo in July 1945, at Hiroshima and Nagasaki in August 1945, in the two tests at Bikini in July 1946, and in the three tests at Eniwetok in April and May 1948.

Los Alamos Scientific Laboratory

The center for the development of atomic weapons is the Commission's Los Alamos Scientific Laboratory, operated under a contract with the University of California. Los Alamos is about 35 miles from Santa Fe, N. Mex. It is in rugged country on an isolated mesa, 7,500 feet above sea level. The operations of the laboratory were initiated in April 1943 by the Manhattan project, and all the facilities constructed there were of a temporary nature. The site was selected because its isolation made possible the necessary security precautions and because it provided space for the extensive testing

facilities required. The site continues to be a good one for these reasons. In addition, the Los Alamos laboratory has an important branch called the Sandia Laboratory near Albuquerque, N. Mex., which works closely with the armed forces.

A large and eminent group of scientific and technical personnel came to Los Alamos to work during the war. The wartime activities of the laboratory culminated in the atomic weapons which were used against Hiroshima and Nagasaki. After the war, many of the key personnel returned to their previous peacetime activities at considerable cost to the morale and efficiency of the laboratory. However, during the last 2 years, the strength and stability of the laboratory have greatly increased; the high capabilities of the staff are indicated by the recent successes in weapon development and basic research. There are now about 2,700 people employed by the laboratory, including those at Sandia, and over half of these are scientists, engineers, and technicians. In addition, there are a number of specially qualified consultants who spend part of their time at the laboratory, especially during the summer when they are free from teaching duty, and work closely with the regular staff.

Research and development by the Los Alamos laboratory over the past few years resulted in new designs of atomic weapons which were successfully proof tested in 1948. Work has also been done on the engineering development of weapons for greater ease of production and greater serviceability. The research and development program is a continuing one and has the goals of improving present weapons, devising new weapons, and increasing the basic knowledge required.

In order that the Los Alamos laboratory may effectively carry out the program assigned to it, new technical facilities are necessary. The facilities now in use are largely those built during the early days of the Manhattan project, when emphasis was on speed of construction of temporary buildings. These structures are crowded into a small area and are highly unsatisfactory from the standpoints of economy, efficiency, security, and safety. Some additional structures have been built in this area since the war, but the limit of use of this space has now been reached and further construction must be carried out elsewhere. The construction of new technical buildings at another location at Los Alamos is needed for future progress and flexibility in the atomic weapons program and for eventual dollar economy. Initial construction projects of immediate urgency have been authorized for the fiscal year 1949, and these will be integrated into a longer range plan for the construction of the new technical area.

A number of other laboratories of the Commission, of other Government agencies, and of industrial contractors also contribute in important ways to various portions of the work on atomic weapons.

RESEARCH AT LOS ALAMOS

The work at Los Alamos includes research on the physical, chemical, metallurgical, and nuclear properties of fissionable materials and other materials of interest. Such research leads to the discovery and the understanding of the fundamental facts and principles involved and thus provides the basis both for immediate development of atomic weapons and for broad advances in the future on both the military and the peaceful applications of atomic energy. Often, very specialized equipment is required for these purposes. The laboratory has a cyclotron, a betatron, a Cockcroft-Walton accelerator, and a 2½-million-volt electrostatic accelerator. A 12-million-volt electrostatic accelerator, authorized in March 1948 and now under construction, will furnish precise data on high-energy interactions between atomic nuclei. There are two small research reactors in operation, one employing enriched uranium 235 and the other plutonium, which provide neutrons of low and high energies for experimental investigations. By such means, numerical data of importance to weapon development may be obtained. Research at Los Alamos includes investigations of certain subjects of general scientific interest, ranging from the nature of nuclear forces to the effects of radiation on living organisms. Some examples of these activities are given in the chapters on research and biology and medicine.

DEVELOPMENT AND TESTING OF ATOMIC WEAPONS

By 1948 the atomic weapons program at Los Alamos had progressed to the point where new designs of weapons had been developed, and full-scale tests were necessary to "prove in" the new designs. Consequently, three atomic weapons were exploded during Operation Sandstone at the Eniwetok Proving Ground in the Pacific in April and May 1948. Unlike the tests at Bikini in 1946, the primary purpose was not to determine the destructive effects of atomic weapons on ships or other structures, but (1) to ascertain the energy of explosion of weapons of new design and (2) to measure certain physical phenomena which occur during the explosion. The organization of these tests is described in the Commission's Fourth Report to the Congress issued in July 1948. The statement is made there that: "Operation Sandstone confirms the fact that the position of the United States in the field of atomic weapons has been substantially improved." Extensive study and analysis of the results of the tests have firmly established that a substantial gain in energy release was obtained. The measurements made during the tests have furnished a much sounder basis for the understanding of atomic explosions, which is necessary for the further development of atomic weapons.

PRODUCTION OF ATOMIC WEAPONS

The developments at Los Alamos and the tests at Eniwetok pointed the way to the production of improved weapons. In order to take full advantage of these achievements, a considerable expansion of the production program was required. Many parts go into a completed weapon. These are manufactured by various industrial contractors or by special Government facilities throughout the country. The manufacture of the various parts must be carefully scheduled and the parts brought together, inspected, and assembled. During 1948, these activities were systematized, and the construction of several additional facilities for the manufacture of weapon components was completed.

CUSTODY OF STOCK PILE OF ATOMIC WEAPONS

According to section 6 of the Atomic Energy Act of 1946:

> The President from time to time may direct the Commission (1) to deliver such quantities of fissionable materials or weapons to the armed forces for such use as he deems necessary in the interest of national defense. . . .

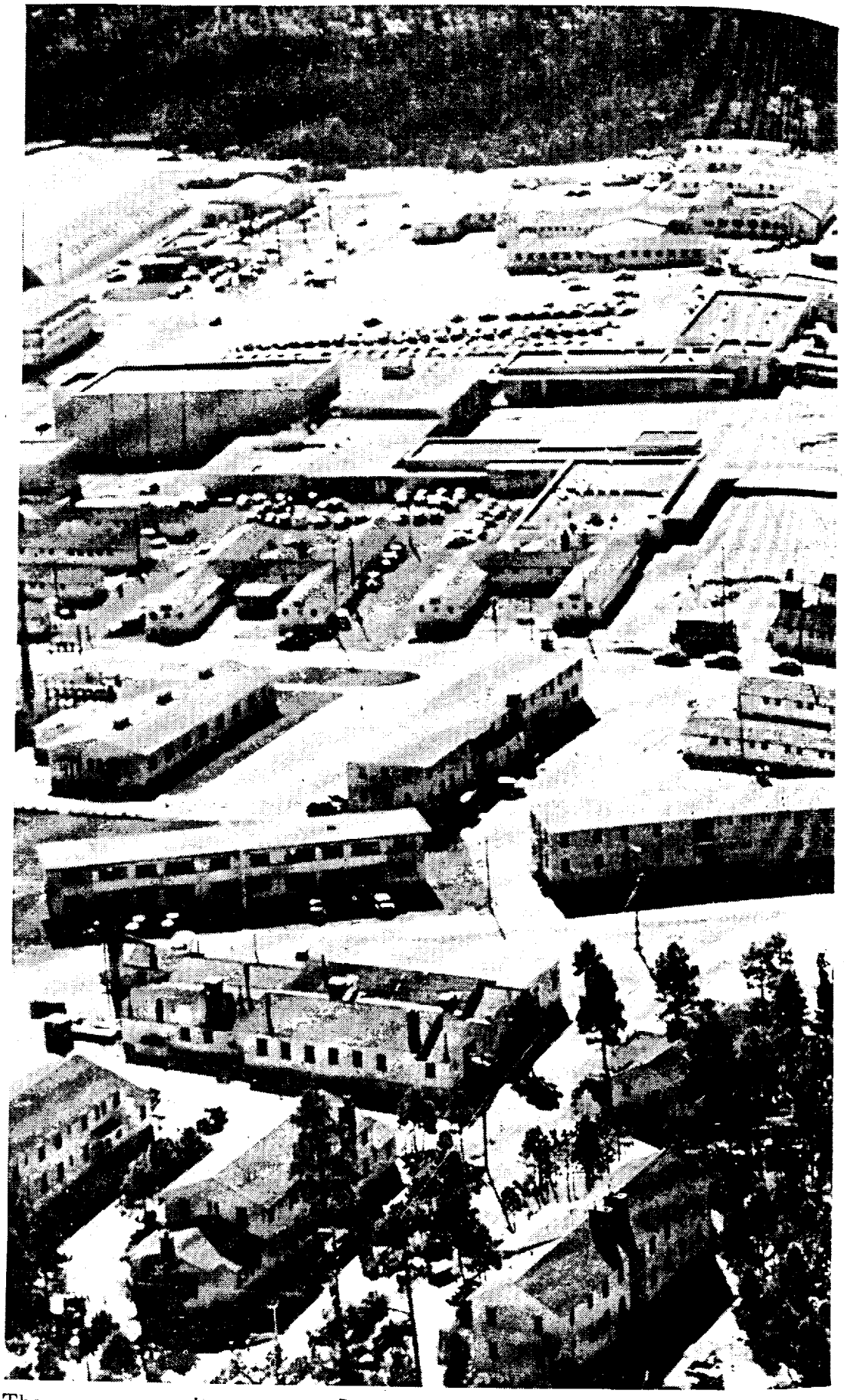
On July 24, 1948, the President affirmed the present custody of atomic weapons by the Atomic Energy Commission. He stated:

> As President of the United States, I regard the continued control of all aspects of the atomic energy program, including research, development and the custody of atomic weapons, as the proper functions of the civil authorities. Congress has recognized that the existence of this new weapon places a grave responsibility on the President as to its use in the event of a national emergency. There must, of course, be very close cooperation between the civilian Commission and the Military Establishment. . . .

The Commission has been cooperating fully with the National Military Establishment in taking measures to assure a maximum state of readiness in the field of atomic weapons and to assure, whenever the President so directs, the immediate transfer of atomic weapons from the Commission to the National Military Establishment.

Los Alamos Community

Because of the isolated location of Los Alamos and because of the special security precautions required, it was necessary during the war to construct living quarters on the site. The community grew rapidly into a small town requiring a hospital, a church building, schools, stores, and recreational facilities. Many of the wartime buildings were temporary and inadequate, especially the housing. Moreover, since the war, the number of residents has increased from about 7,000 to about 9,000. In order to attract and retain the personnel required for this key installation, they and their families had to be provided



The new community center at Los Alamos, N. Mex., the town created by the wartime atomic weapon project on a mesa top 7,500 feet above sea level. Barracks in foreground typify the housing provided for scientists and other workers until recently.

The new
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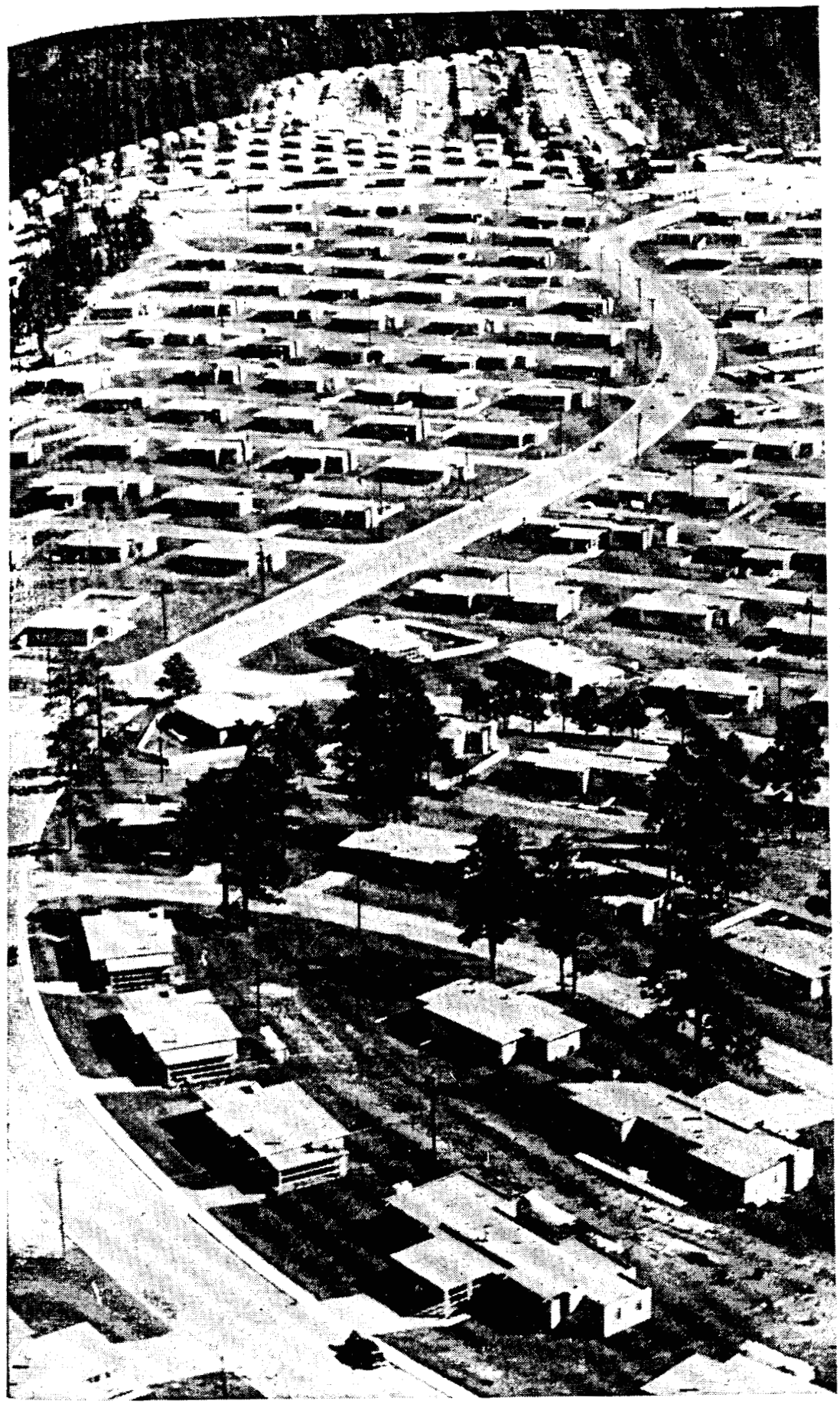

The new western housing area at Los Alamos, illustrating the permanent homes being provided for laboratory workers and their families. More than 800 houses were completed in 1948, some 330 more were under way. Population is now about 9,000.

with as nearly normal living conditions as possible. To accomplish this, it has been necessary to carry out a construction program to provide more permanent housing and a new community center. A similar problem exists at the Sandia community but is less severe because of its proximity to Albuquerque.

CONSTRUCTION IN 1948

At Los Alamos during 1948, work was completed on the construction of 826 houses, 92 2-bedroom apartments, 84 1-bedroom apartments, and a permanent trailer camp. Barracks were converted into 4 30-room dormitories. Construction is under way on 333 additional houses, 144 1-bedroom apartments, and 12 4-unit apartment houses.

The first section of the community center was occupied early in 1948. It includes a bank, theater, recreation hall, shops, offices for newspaper, radio, and welfare activities, and a central steam plant and distribution system. The second section of the community center was completed late in 1948 and is now occupied. It includes a number of stores, a restaurant, and a post office.

The Los Alamos high school was started in October 1948 and is to be completed in August 1949. Additions to other schools are being made. Work has proceeded on an addition to the power plant, a new water supply line, additional water wells, a propane-air gas plant, a steam-generating plant to serve the new high school and other structures in the same area, new warehouses, the construction and improvement of roads and streets, landscaping, and alterations or additions to the present housing, the transient quarters, the hospital, the medical supply building, the administration building, the fuel tank farm, and the landing strip for airplanes.

TOWN MANAGEMENT

The management of the Los Alamos community was undertaken by the Manhattan project during the war and became the responsibility of the Commission in 1947. Changes have been made in the administrative organization and in the operating procedures, with the result that maintenance of structures and utilities has been steadily improving and operating economies have been effected.

On December 13, 14, 15, and 16, 1948, a subcommittee of the House Committee on Expenditures in the Executive Departments held public hearings at Los Alamos. The hearings related to administrative problems at Los Alamos and did not concern the secret activities conducted there. On January 3, 1949, the Expenditures Committee submitted a report (H. Rep. No. 2478, 80th Cong., 2d sess.) on the Los Alamos investigation and set forth the subcommittee's findings and recommen-

dations. It is the view of the Commission that, in general, the tenor of this report is helpful and constructive. Most of the items criticized have already been corrected or are in the process of correction. The recommendations of the Committee will be given serious consideration in the plans for Los Alamos.

COMMUNITY AFFAIRS

The problem of self-government of Los Alamos has been manifest from the time the community was first established. A town council representing the residents was initially set up to act as an advisory body on community affairs and has continued to function in this way. It has appointed a hospital board and a library board and has formed a dormitory planning committee to study the problems of the 1,700 persons living in the 1,300 dormitory rooms at Los Alamos. An elected board of education has given the residents a voice in the curriculum and conduct of the schools, which have an enrollment of about 1,300. The town council appointed a charter commission which has made recommendations on a form of city government. It was planned to submit these recommendations to a referendum, but action has been postponed until the question of jurisdiction discussed below has been settled.

JURISDICTION

The Los Alamos area consists of approximately 69,000 acres, of which some 65,000 acres were transferred from the United States Forest Service either directly or through the Manhattan project to the Commission. This land has remained under the jurisdiction of the State of New Mexico. About 3,600 acres, consisting of small parcels of land scattered throughout the area, were bought in fee by the Manhattan project from private owners and were later transferred

jurisdiction land were not residents of New Mexico for the purpose of voting.

It is the desire of the Commission that the Congress consider as soon as possible a bill to retrocede to the State of New Mexico exclusive jurisdiction held by the Federal Government of land within the boundaries of the Los Alamos area. The whole area would then be considered as part of the State of New Mexico and uniform jurisdiction would be achieved. This retrocession would place the Los Alamos project on the same basis as the Commission's projects at Oak Ridge, Tenn., and Hanford, Wash., where State laws apply. Experience at Oak Ridge and Hanford has demonstrated that the performance, protection, and security of the Commission's functions can be adequately safeguarded under State jurisdiction.

III

RESEARCH IN THE PHYSICAL SCIENCES

Introduction

Scientific research can be described in terms of quality and quantity, but while it is possible to give a numerical measure of quantity, for instance, by listing the numbers of technical reports written during a period of time, quality is not so readily described. Outstanding events such as the discovery of nuclear fission or the invention of the cyclotron are easily recognized. What is perhaps not so clear is the fact that these discoveries, while they are outstanding, are not isolated from the vast body of scientific knowledge which is being continually developed in laboratories around the world.

The United States until about 1930 was never an outstanding source of fundamental knowledge. After that, American science developed rapidly until World War II, and yet by far the greater share of effort was aimed at solving immediate practical problems. Industry paid for about two-thirds of all United States research in the late 1930's, Government for a sixth, and universities and institutions —where basic research was paramount—for only about a sixth. During the war, as scientists left the campus for Government or industrial projects, the flow of new fundamental knowledge dwindled to a trickle. Scientists voluntarily narrowed their horizons and concentrated on getting specific jobs done.

The national development of atomic energy will always demand this kind of work; the programs of all of the plants and major laboratories of the Atomic Energy Commission could not advance at all without teams of scientists and technicians concentrating on the solution of particular problems. But, as the Congress recognized, atomic energy development would be stunted and shriveled without a long-term program of basic research—without the continuing performance of thousands of exploratory and confirming experiments to add to our store of fundamental knowledge in the sciences related to atomic energy.

Growth of Atomic Energy Research in 1948

During 1948, the Commission has strengthened the organization through which it coordinates a Nation-wide research effort, both in its own and in contractors' laboratories. The AEC statutory General

Advisory Committee of distinguished American scientists, industrialists, and authorities in other fields has been a mainstay to the Commission in its job of shaping the broad outlines of the work.

The physical research program—the work in nuclear science and its many related fields, such as chemistry, metallurgy, physics, and mathematics—is carried on for the most part at the large AEC laboratories: Argonne National Laboratory, Brookhaven National Laboratory, Oak Ridge National Laboratory, Los Alamos Scientific Laboratory, the Ames Laboratory, the Radiation Laboratory of the University of California, and the laboratories connected with major production plants, such as the Hanford Plutonium Works, the K–25 gaseous diffusion plant, and the Y–12 Laboratory at Oak Ridge. Other centers of research—institutional and industrial—which during 1948 worked on one or more aspects of the national atomic energy physical research program include the National Bureau of Standards, Columbia University, the University of Wisconsin, the Batelle Memorial Institute, the Massachusetts Institute of Technology, the Carnegie Institute of Technology, the Illinois Institute of Technology, the Sylvania Electric Company, and the Institute for Advanced Study, Princeton, N. J.

During the year, the Commission and the Office of Naval Research agreed upon a program of joint support of fundamental research in which the two agencies have a common interest. A total of 45 contracts in physical research were selected for support in whole or in part by the Commission. The research involves unclassified projects in which many nongovernmental laboratories, universities, and other research institutions participate. Projects that cover a wide range of investigations in nuclear and general physics, chemistry, metallurgy, ceramics, mathematics, and geophysics are administered by the Office of Naval Research in order to take advantage at this time of the existing administrative organization maintained by that agency. The cooperative program provides a measure of coordination for research in fields in which there is a serious shortage of qualified scientific personnel.

Providing the Men and Machines

A good share of the year's effort went into the job of providing the men and machines without which the Nation's atomic energy enterprise would be crippled in the years ahead. The National Research Council undertook a large AEC-supported fellowship program in the sciences related to nuclear energy; all of the Commission's major laboratories moved toward making themselves into regional training centers, in more or less degree, and 58 universities worked with them toward this end (see Appendix 3). At all AEC work centers, research

buildings, laboratories, and the tremendously expensive equipment of nuclear science—nuclear reactors, particle accelerators, radiation laboratories, and the like—were either being built already or well advanced in plans.

Radioisotope Training Courses

The radioisotope training program conducted by the Oak Ridge Institute of Nuclear Studies was one of the outstanding programs of the year. During the first 6 months of its operation 128 scientists from 99 institutions in 32 States attended its 4-week, intensive courses in the use of tracer isotopes for research in such widely diversified fields as blood circulation and oil cracking. The fourth of these courses, open to industrial scientists, was attended by 32 research workers from industry and Government. Three courses are scheduled for the first quarter of 1949.

Reducing Restrictions on Information

The free publication and interchange of scientific information has been well called the lifeblood of science. This the Congress recognized in the Atomic Energy Act, in providing as one of the guiding principles for the Commission's action—

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

Late in 1948, the Commission issued a general list of unclassified areas of research related to atomic energy. Based on extensive study by Commission staff, the laboratory directors, and the Committee of Senior Responsible Reviewers (who consulted their Canadian and British counterparts), this list of unclassified areas defined a number of fields of research which, while related to the "manufacture or utilization" of fissionable materials, do not require security safeguards. The availability of such a list will go far toward encouraging wider dissemination of information of general scientific interest.

In general, the nonclassified areas of research include basic chemistry, physics, and mathematics, except for weapons physics and the nuclear and chemical properties of specific elements of special interest to the national atomic energy program; medical and biological research, and health studies, except for work with elements of atomic number 90 and above; instruments, including counters, and accelerators, with minor exceptions; and the chemistry and technology of fluorine compounds, except their specific applications in Commission installations.

Publications—the Tangible Product

Between November 1947 and November 1948 close to 2,000 research reports (including 210 concerning biology and medicine)

were produced in the laboratories of the Commission and its contractors. Of these, about 1,500 are "classified"; that is, they contain information that the United States must keep from public disclosure for the time being and are therefore available today only to selected workers on the AEC projects. Appendix 6 lists the numbers of these reports—classified and unclassified—and the laboratories that produced them. The reader will see that the degree of secrecy of research work varies widely from laboratory to laboratory. In the laboratory of the Hanford works, for example, only 2 out of 158 reports were of the publishable kind, and at Argonne laboratory, only 11 out of 132; whereas, at Brookhaven laboratory, which the Commission now plans to keep as free as possible of security restrictions so that wide academic participation will be possible, 40 out of 46 reports were publishable. All in all, however, more than three-quarters of the reports produced were of the nonpublishable kind.

There are therefore two large obstacles to the nontechnical reporting of research progress in atomic energy: The secrecy of the work, and—no less hampering—the abstruse science of studies connected with nuclear energy. Nevertheless, the interested layman can get a very good idea of what is happening on the frontiers of atomic energy if he is willing to leave the technical details to the scientist.

Progress in Basic Research

Today's nuclear science and the atomic energy industry, which is growing out of this science, rest upon the fundamental experiments and deductions of early twentieth century physicists. Niels Bohr, Ernest Rutherford, R. A. Millikan, and others of that distinguished company worked out fundamental principles. A more numerous company experimented and observed, gathered data, and developed the detailed theory. All together their research rounded out a working base for the engineers who built the machines of the wartime atomic industry.

For further advance in the pure sciences, which must precede industrial application, it is necessary in these postwar years to keep a large and growing crew of physicists and chemists experimenting, gathering more data, and reflecting on the facts observed and recorded in order to secure new understanding of nuclear forces. It is this fundamental endeavor in the field of physical research that the Atomic Energy Commission is helping to support, in accordance with objectives and plans for the development of which the law holds the Commission responsible to the Congress and the President.

Why is it that Government today assumes such a prominent part in providing the facilities for physical research? The men of the

first four decades of the twentieth century whose genius made possible the progress of the 1940's did not do their work in Government laboratories, with Government-provided equipment.

The reason for such large-scale Government aid is that the gathering of the data on the problems before the nuclear physicists and chemists of today requires the work of men in teams of large size and the use of very expensive instruments.

Though the main supports of research in the past continue to play a strong part, it is necessary for progress, at the speed required, to draw upon the resources of the Nation through the public treasury. To get further into the mysteries of nuclear structure and nuclear forces, the physicist requires not, as in the 1930's, laboratory equipment in $10,000 lots, but single machines of great cost, machines such as the multibillion volt particle accelerators the AEC is building at the Radiation Laboratory of the University of California ($9,000,000) and at Brookhaven National Laboratory ($3,475,000); machines such as the nuclear reactors nearly finished at Brookhaven ($21,600,000).

These facilities and their operating groups are at the disposal of university and industrial scientists. The Commission also finances a wide range of studies on campuses and in industrial laboratories using privately-owned facilities. Research work done on two-thirds of the forty-odd particle accelerators in the United States is financed in whole or in part by the Commission.

The reason for this widespread and costly scientific fact-hunt basically is that our understanding of the atomic nucleus is today all too inadequate. Though we have learned how to obtain energy in quantity from the nucleus of the atom of uranium and plutonium, we do not know the origin of the forces which hold the atomic nucleus together and hence govern the release of energy. Scientists today can offer no completely satisfactory explanation of most of the properties they have found the atomic nuclei to possess—such properties as the spin of nuclei, or the strength of the magnetism that atomic nuclei have been shown to have.

New and better instruments are an indispensable key to progress in atomic and nuclear research. The nuclear scientists cannot directly observe what takes place in the atom or in its nucleus. From hundreds and thousands of individual clues, they must piece together a solution to the mystery of what goes on in the nucleus. They work by indirection, using ingenious methods and machines. For example, present knowledge of atomic structure stemmed from intensive work late in the 19th century with the optical spectroscope, an

instrument which arranges the component parts of a beam of light in a rainbow-like pattern according to their energies.

Present nuclear theory is probably at about the same stage as was the theory of atomic properties and structure 70 years ago when the experimenters of the day had begun to gather facts about atomic energies by tabulating spectral lines. In another 20 to 35 years, the genius of Rutherford, Max Planck, and Bohr set up theories about the structure of the atom and fixed energy levels which were found to give meaning to the observed facts.

It is the hope that the data now being gathered will in the same way relate in the not too distant future to a fruitful theory of the atomic nucleus by the new interpreters who will come along.

The path to knowledge is not a superhighway. It is full of turns and switch-backs. Promising leads become dead ends. In the face of road blocks scientists search for byways, never knowing which valley—which new fact—will lead to the truth ahead. Always there is pressure for greater precision of measurement, more sensitive instruments, improved techniques. Most important of all is the scientist himself. From his vision and curiosity will spring the great technological advances of the future.

PHYSICS

In 1948, the major part of the Commission's physical research funds was used to support work in physics, particularly nuclear physics, the design and construction of particle accelerators, design of research reactors, design and construction of radiation detection instruments, and the improvement of isotope separation methods by means of the mass spectroscope. The Commission has made adequate amounts of fissionable material available for nonweapon research and development work.

Nuclear Reaction Studies

In each phase of these research projects, scientists taking part aim at solving practical immediate problems and at accumulating data which are helping the scientists of the future to reach new conceptions of the nature of the atom and the nucleus.

The most extensive field of data accumulation comprises the studies of what happens when the fundamental particles of the atom (see the list below) collide with one another or with the nuclei of varying forms (or isotopes) of the atoms of the 96 elements so far identified. Finding these facts is the purpose of the research work done with particle accelerators—synchrotrons, cyclotrons, betatrons, Van de Graaff

generators, and linear accelerators—and with nuclear reactors, or piles.

There is much immediate purpose to these studies. Through them the scientists are building the complete record of the nuclear reaction cross sections* of more than 700 isotopes of the elements when each is struck by nuclear particles of varying energies: a description of great importance to the physicist and the engineer. For these technicians, the facts about nuclear reaction cross sections tell how and what materials to choose for the structural frame, the control rods, the cooling gases or liquids, and the shields of the nuclear reactors which we hope one day will light our homes, power our industry, and possibly drive ships and airplanes.

Of course, back of this and other immediate practical applications for nuclear reaction cross sections lies the use of data of this fundamental sort for the development of new theory of the structure and the behavior of atomic nuclei and their particles.

But for whatever purpose the scientists and engineers wish these data, the scientists must first collect them. The collection starts through the process of bombarding the nuclei of a target material with a beam of particles coming from one of the small or great machines of present-day nuclear research.

At present, the entities most useful for bombarding nuclei are protons, deuterons (hydrogen 2), tritium (hydrogen 3), helium 3, alpha particles (helium 4), gamma rays, mesons of several varieties, neutrons, and electrons. Since the type of nuclear reaction that occurs and the probability of its occurrence vary considerably with the energy of the bombarding particle, it is necessary to work over a great range of energies, say from one thousandth of an electron volt to several billion electron volts. Moreover, it is desirable for the energies of the bombarding particles in a given beam to be precisely known and to be monochromatic; i. e., all of the same energy. If the bombarding particle has a charge, the velocity or energy of the beam may be raised to any desired level by one of the various types of

*The term "cross section" is a very common one in nuclear science and engineering. It indicates to the physicist, chemist, metallurgist, or engineer working with nuclear reactors, the probability that a given nuclear reaction will take place. The cross section measures the size of the "bull's-eye" or nuclear target, which is an important factor in whether a "hit" or reaction occurs. But this is not the only factor; under similar conditions any one of several types of nuclear reactions may occur, each a definite percentage of the time. Scientists take care of this situation by assigning a cross-section value to each reaction. These values, which are determined experimentally, enable him to calculate the probable number of hits.

There are many types of nuclear reactions, such as an alpha-neutron reaction, a proton-neutron reaction, or a deuteron-neutron reaction. The symbol for an alpha particle is a; for a neutron n; for a proton p; and for deuteron d. Thus, the three reactions mentioned would be written (a, n), (p, n), and (d, n). The first symbol represents the bombarding particle, the second, the emitted particle after the reaction has occurred.

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particle accelerators.† The neutron is chargeless so that it cannot be accelerated by a particle accelerator.

However, high energy neutrons are most readily obtained by using a particle accelerator to bombard a suitable target material with a charged particle such as the proton, deuteron, or alpha particle. The neutrons are emitted from the reaction between the bombarding particles and the target.

The nuclear reactor provides an abundant source of low energy neutrons for neutron bombardment. This very important tool for modern physical research is available only at the research establishments of the national atomic energy program. No universities or industries possess such machines.

The Commission has reactors now available for general research at the Oak Ridge National Laboratory and the Argonne National Laboratory. These facilities are open to men and women of industries and colleges and universities from any part of the country. Of course, much classified research of use in the development of the phases of the atomic energy program having to do with weapons and power production is carried on at these and at other reactors owned by the Commission as trustee for the American people.

Measurement of Neutron Cross Sections

Scientists need to measure various cross sections of neutron-bombarded nuclei, since neutrons are released in nuclear reactors

†Cyclotrons, synchrotrons, and betatrons are particle accelerators employing large electromagnets to hold the paths of the charged particles being accelerated in closed or spiral orbits. These machines contrast with linear accelerators and Van de Graaff generators which do not employ electromagnets. In the latter the paths of the particles are straight lines.

A brief tabulation of the various types of machines in operation or in construction follows:

Type of machine	Maximum energy (million electron volts)	Precision of energy determination	Number of particles
ELECTRON ACCELERATORS			
Betatron	300	Fair	Plentiful.
Synchrotron	300	Fair	Plentiful.
PROTON, DEUTERON, TRITIUM, HELIUM-3, ALPHA ACCELERATOR			
Van de Graaff	12	Excellent	Plentiful.
Cyclotron	20	Fair	Plentiful.
Linear accelerator	32	Fair	Few.
Synchrocyclotron	350	Fair	Few.
PROTON ACCELERATOR			
Proton synchrotron	10,000	Fair	Few.

and by atomic bombs and are necessary agents in bringing about the great output of energy in these machines. To make possible these fundamental measurements, a variety of instruments have been developed or improved by the men of the atomic energy project during and since the wartime days:

A mechanical velocity selector or "neutron chopper" in use before the war was improved and used at the Argonne National Laboratory for making these cross-section measurements.

A second instrument in use at Cornell University before the war was used and developed further by scientists at Los Alamos and Columbia University. In this instrument, a burst of neutrons produced by a cyclotron is detected in such a way that the effect of neutrons of a particular energy range can be measured and studied.

A third instrument, called a crystal spectrometer, based on the property of certain crystals to reflect neutrons of specific velocities at specific angles, was developed for use with the research reactors at Argonne and Oak Ridge.

Still a fourth type of instrument sometimes called a "pile oscillator" and based on the change in the operating characteristics of a reactor when a sample of material is periodically inserted into and withdrawn from the nuclear reactor, is in use at Argonne and Oak Ridge.

A problem common to all these instruments is that of getting neutrons of nearly the same velocity to use as bombarding particles.

By the use of these four types of instruments and others, a whole new range of data bearing on nuclear cross sections is being accumulated. Development of these instruments and the technique for their use represents one of the solid advances of the past 2 years in nuclear physics.

In addition to the measurement of neutron cross sections at Argonne, Oak Ridge, and Columbia University, investigations of neutron reactions are being carried on at Los Alamos, the University of California at Berkeley, and other institutions under contract with the Commission.

Research directly connected with the development of the atomic energy industry has been the investigation of what the scientists describe as the complete neutron properties of all the uranium isotopes and other fissionable isotopes as a function of neutron energy. Most of this work, having to do with the production of fissionable materials, is classified.

Nuclei Under Bombardment

During the past year data on behavior of nuclei under bombardment continued to pile up at the Radiation Laboratory of the University of California. There the 184-inch cyclotron, the most powerful in the world, used in bombardment of a variety of target materials, produced reactions not before observed by nuclear physicists. The meaning of many of these newly found phenomena is not yet clear to the physicists, but they mark further progress in accumulating detailed knowledge of the forces which hold the nucleus together and which may in time be released and controlled for man's purposes. In two fields, important new phenomena were recorded:

1. New examples of an unusual reaction in which target material bombarded by protons gave off deuterons.
2. The production of nitrogen 17, by bombardment of heavier elements with deuterons; and the measurement of its rate of decay to a new neutron-emitting isotope, oxygen 17.

At the Los Alamos Scientific Laboratory, fission and various other nuclear reactions have been studied. For example, a search was made for cases of triple fission, where the atomic nucleus splits into three comparable masses instead of two as in the usual binary fission. Triple fission of uranium 238 by fast neutrons was found to take place less frequently than once in every 4,000 binary fissions. Triple fission of uranium 235 by slow neutrons was found only about once in every 300,000 binary fissions.

Investigation of Nuclear Forces and the Meson

It is widely believed that particles known as mesons have an intimate connection with nuclear forces, but no satisfactory theory of the meson has yet been established. Physicists first observed mesons about 12 years ago on photographs taken of the interaction of cosmic rays with various types of nuclei. The mesons discovered then had a mass approximately 200 times that of the electron and about one-ninth that of the proton. Since then, researchers have found heavier mesons and have determined that mesons apparently may have a positive charge, a negative charge or in some cases none at all.

The Commission and the Office of Naval Research are supporting jointly a number of cosmic ray studies devoted to finding more about the behavior of these strange particles. For example, at the University of Minnesota scientists have sent cloud chambers attached to balloons up to altitudes of 100,000 feet. In addition to data on mesons, photographs taken at such heights reveal many types of particles

approaching the earth from outer space, including atomic nuclei of middleweight elements such as copper.

Artificial Production of Mesons

Early in 1948 scientists reported the first artificial production of mesons in the giant 184-inch cyclotron at the Radiation Laboratory of the University of California, Berkeley. Hitherto, physicists had encountered these particles only in cosmic ray processes. Thus they could observe mesons only in haphazard and more or less accidental fashion. The California physicists produced these mysterious particles artificially by bombarding various targets with 400-million electron-volt alpha particles.

Now with hundreds of millions of times more mesons available than occur in cosmic ray observations—and available under controlled laboratory conditions—scientists are on the track of understanding the formerly mysterious processes by which mesons are formed and disappear and the make-up and behavior of the particles themselves.

For example, scientists of the Radiation Laboratory in 1948 measured at 1.22-hundred-millionths of a second, the mean lifetime of the heavy meson against its decay into the lighter meson. They also measured the masses of these two particles with far greater precision than ever before. They found the heavy meson to have a mass 284 times that of the electron while the light meson is 215 times heavier than the electron.

Scintillation Counters

Simpler instruments of measurement, easier to handle and cheaper to build, are continually sought by the scientists working in the nuclear physics field. Their work is done entirely by indirect means, and measurement is at the heart of it. The most important advance in radiation-measuring instruments for nuclear research made during the year was the improvement and development of "solid scintillation counters," which detect gamma rays, fast neutrons, and alpha particles. Because the neutron has no charge the ordinary Geiger-Mueller counter will not detect it effectively.

The operation of the scintillation counter is based upon the fact that certain crystals, notably stilbene and anthracene, made from coal-tar chemicals will detect gamma rays, fast neutrons, and alpha particles. When a particle impinges upon the crystal, a flash of light of short duration and relatively high intensity results. This flash can be picked up and amplified by a special photomultiplier tube, and translated into a pulse of electric current which can be registered upon earphones or upon a mechanical counter.

Although much research remains to be done to perfect this type of instrument, it is expected that it can be developed into a radiation counter of extreme lightness and compactness as compared to existing radiation detection instruments for similar purposes. Scientists now have under investigation such problems as methods of producing pure crystals, comparison of one crystalline material with another, and study of the effect of temperature on the size of pulses.

Work on the solid scintillation counter is going on at the University of California at Berkeley, at the Argonne National Laboratory, at the Los Alamos Scientific Laboratory, at Brookhaven National Laboratory, and at the Oak Ridge National Laboratory.

Magnetic Properties of Particles

In many respects protons and neutrons behave like small magnets; they possess a property known as the magnetic moment, which has been determined with great accuracy for many particles and nuclei. Under normal conditions, the total magnetic moment of a system should be equal to the sum of the moments of the individual parts of the system. However, Argonne National Laboratory scientists in 1947–48 found by very precise measurements that tritium (hydrogen 3) which has one proton and two neutrons, and helium 3 which has one neutron and two protons, have magnetic moments about 10 percent higher than the expected values.

This discovery indicates that there must be some additional magnetic forces in the system. Magnetism is associated with a flow of current, and since an additional magnetic moment was measured it seems probable that the additional magnetic forces may arise from an electric current flowing around the nucleus. Since the protons and neutrons are believed to exchange their identities as the current flows past, the current is called an exchange current. At present scientists believe the exchange current is associated with the meson in the nucleus and that both play important parts in holding the nucleus together. There are many gaps, however, in present knowledge.

Other types of research on the nature of magnetism and the magnetic properties of various materials have been conducted at Argonne. When a beam of neutrons is sent through a piece of magnetized iron, the neutrons become polarized, i.e., they become reoriented so that the magnetic poles of some of the neutrons tend to line up in the same direction; the production of polarized neutrons by magnetized iron has been investigated during the year, and a relation between the extent of neutron polarization to the magnetic saturation of iron magnets has been worked out.

Spectroscopy, Neutron Effects, and Stable Isotopes

In the past year, the Commission has expanded the program of both classified and unclassified research in optical spectroscopy, X-ray spectroscopy, and mass spectroscopy. There are many active programs under way to develop new information about the structure of atomic nuclei. One large project using the X-ray spectrograph has developed to the point where the spectrum lines of heavy atoms approaching the atomic weight of fissionable elements can be studied to a degree far greater than was formerly possible.

Considerable work has been done at Argonne and Oak Ridge to discover the changes in physical properties of materials that follow intense neutron radiation. The men there have found that neutron bombardment causes disordering of the arrangements of atoms in crystals of various alloys. Further experiments will be made to determine what effect such changes have on the strength, resistance to heat, and other physical properties of metals.

The electromagnetic separation plant (Y–12), at Oak Ridge, has not been in operation for the production of uranium 235 since shortly after the end of the war; however, a vigorous development and research program has been carried on at this plant utilizing the great magnetic machines which separated the first production quantities of U 235.

The equipment at Y–12 can separate isotopes of almost any element. By the close of 1948, the naturally occurring isotopes of 35 nonfissionable elements had been concentrated electromagnetically at Y–12‡. Work is proceeding on the remaining elements of the periodic table. Many of these pose problems of great magnitude and complexity. One group of researchers at Y–12 is surveying the physical and chemical properties of stable isotopes. The aim is to determine the differences in properties of the various isotopes of each element. The contribution to fundamental knowledge already is great and it is growing steadily.

New Standard of Length

The electromagnetic separation process assumes importance in connection with the proposal that the wave length of the light emitted by mercury 198 be used as a standard of length. This is one of the seven stable isotopes of mercury. It may be made in an impure form in small quantities by neutron bombardment of gold in the atomic pile at Oak Ridge. Now the Y–12 research group is attempting to separate this isotope in larger quantities. The National

‡Stable isotopes of the elements separated at Y–12 are now in use in laboratories throughout the country for many types of tracer and other work.

Bureau of Standards has measured the wave length of the green light from this isotope with an accuracy of 1 part in 100,000,000, higher than any other measurement known. Because of this great precision, and because it appears that the isotope may be produced in quantity, the Bureau of Standards has suggested to the International Conference of Weights and Measures that the wave length of mercury 198 be used as the world's primary standard of length.

Physical Properties of Helium 3

A considerable advance in study of the behavior of atoms and molecules at very low temperatures was achieved by the physical chemists at Los Alamos laboratory. This was the liquefying for the first time of helium 3. This substance occurs in very small amounts in natural helium, the great bulk of which is helium 4. It is also obtained by the radioactive decay of hydrogen 3, which can be produced by the bombardment of lithium in a nuclear reactor. Both types of stable helium are of unusual scientific interest because of their remarkable low-temperature properties in the neighborhood of absolute zero, −459.6° Fahrenheit.

Helium 4 is the only substance that has no normal freezing point. When liquid helium 4 is cooled, instead of freezing to a solid, it converts to a unique liquid, called Helium II, which has a viscosity of zero. In this Helium II stage the liquid becomes "superfluid," creeping up the sides of its vessel, literally flowing uphill. As a "superfluid," Helium II is very difficult to contain. It will "leak" through the cracks and minute holes in the walls of a container which will hold any other liquid absolutely tight. Its heat conductivity is nearly a million times higher than normal liquids. Scientists expect that helium 3 will have none of these esoteric properties, and they believe that comparison of the differences in physical behavior of the two helium isotopes will give new insight into the relation of nuclear structure to physical behavior.

The Los Alamos group, upon liquefying helium 3, observed its boiling point to be 5.7° Fahrenheit above absolute zero compared to 7.7° F. for helium 4, and its vapor pressure at low temperatures is much greater than that observed for helium 4. At 2.2° F. above absolute zero, for example, the vapor pressure of helium 3 is 35 times that observed for normal helium.

CHEMISTRY

Much research in chemistry financed with funds of the Atomic Energy Commission has to do with the chemistry of the heavy elements—lead and above. More knowledge of the chemistry of these

elements is needed in order to solve the problems of production and handling of fissionable materials—the basis for the atomic energy industry.

At the Radiation Laboratory, Berkeley, work continued during 1948 with the large cyclotron on extending knowledge of the identification and properties of the new man-made elements above plutonium in the atomic scale. Similar work on isotopes of the heavy elements produced by neutron bombardment in reactors was carried on at the Argonne National Laboratory and the Oak Ridge National Laboratory.

Basic chemical properties of certain other elements are also under investigation because of their potential usefulness in power reactors as moderator materials, coolants, or structural materials.

Practically all Commission laboratories have participated in radiochemical studies, which includes the study and use of radioisotopes. Considerable success has been reported in the preparation of complex organic compounds containing carbon 14 as a tracer isotope.

"Hot Atom" Chemistry

Chemists in many Commission-supported laboratories are investigating a new field, the so-called "hot atom" chemistry, of great interest and importance. Many nuclear reactions change one element into another having entirely different chemical properties, and scientists have observed some remarkable results. For example, by means of the neutron-proton reaction they are able to change chlorine 35 into sulfur 35. Strangely enough, scientists find that when the chlorine in potassium chloride is converted to sulfur, the product actually isolated is potassium sulfate. The sulfur has been oxidized to sulfate under conditions which would normally be impossible. Chemists believe that such behavior is possible only because of the large amount of energy evolved in the nuclear reaction, but they will continue such investigations until they know what happens.

Men are working on various "hot atom" chemistry problems in laboratories at Argonne, Brookhaven, and Oak Ridge, at Massachusetts Institute of Technology, at the Los Alamos Scientific Laboratory, and at Knolls Atomic Power Laboratory, Schenectady, N. Y.

Biochemistry

An interesting example of research in the field of chemistry is being carried on by the bio-organic chemistry group at the University of California, Berkeley. The work here has been mainly directed toward extending the usefulness of the radioactive isotope carbon 14 in studies of chemistry, animal biochemistry, and plant biochemistry. The men doing this work have made over 30 new compounds containing this isotope in specified positions in the molecule. By the use of

molecules containing the "labeled" carbon atom, researchers can follow the course of many chemical reactions in man, animals, and plants.**

Men in many laboratories have made exciting progress with studies of photosynthesis and phytosynthesis. These are the processes by which green leaves convert carbon dioxide and water into sugar, fat, and carbohydrate by means of energy provided by the sun. Much has already been learned about a number of the intermediate steps in the conversion of carbon dioxide into sugar. Furthermore, it has been demonstrated that it is possible to influence to some extent the products which are formed by one-celled green organisms; that is, to control the proportions of sugar, fat, and carbohydrate, produced by some types of algae.

Chemistry and Metallurgy of Reactor Materials

Studies of the characteristics of metals which might serve as reactor structural materials, moderators, and coolants were actively pursued during the past year. Metallurgists are particularly interested in such characteristics as the way in which metallic structure develops under various casting and forging processes and patterns of flow and fracture.

For a long time engineers have known that the properties of zirconium make its use as a reactor construction material a possibility, but they have not considered the metal seriously because of some fundamental drawbacks. In 1948, however, scientists at Argonne, Ames, Oak Ridge, the Radiation Laboratory, the National Bureau of Standards, and others have developed new methods of purification and analysis in order to determine whether or not zirconium can be made into useful material for reactor construction. If this can be accomplished, we will have added one more to the growing list of substances of value in the reactor program.

Chemical Separation Processes

The Ames Laboratory is continuing fundamental studies on certain types of chemical separation processes in which the chemicals to be separated stick to organic resins or transfer from one liquid to another as the liquids flow past each other through a column. Pilot plants have been set up using such processes, and the basic principles involved are being intensively studied.

Problems encountered in the recovery of thorium and uranium from waste slag and other waste products are also under examination at Ames Laboratory as well as at Argonne and Oak Ridge. The possibilities of obtaining thorium and the pure rare earths from monazite ores by new processes are under investigation.

** See Fourth Semiannual Report.

The Chemistry Division of the Argonne National Laboratory also is working on the development of separation techniques for pile-irradiation processes and the development of satisfactory pile materials.

In the field of nuclear chemistry and radiochemistry, scientists have obtained during 1948 more accurate values of neutron capture cross sections for plutonium 238, protoactinium 231, and thorium 230. Half-lives of numerous radioactive elements have been measured or redetermined. Radioactivity decay schemes have been intensively studied, and preliminary measurements of the energy of the beta particles from tritium have been made.

MATHEMATICS AND COMPUTATIONS

During the year, scientists using the Eniac, the high-speed electronic calculator, at the Aberdeen Proving Ground, solved several nuclear physics problems of enormous complexity, including neutron-diffusion problems. They used the so-called Monte Carlo method developed at Los Alamos, in which the fate of the neutron is determined statistically, by means mathematically related to roulette as played in the famous gambling casino. Mathematicians at the Institute for Advanced Study, Princeton, have reported progress in design of special types of high-speed computing machines for the Commission.

TRAINING PROGRAM

The war produced a sharp cut in the number of students normally graduated with degrees in the physical sciences and in the number of postgraduate students who would in the usual course of events have secured their doctorates in those sciences. Approximately 40,000 students will not receive their bachelors of science degrees; 7,600 will not complete their studies for their doctor's degree. The Nation has lost a reservoir of scientific manpower that will have to be slowly replenished by determined effort.

ATOMIC ENERGY FELLOWSHIPS

To select qualified students in the physical sciences, the Commission turned to the National Research Council of the National Academy of Science, and with its help established a fellowship program for both predoctoral and postdoctoral students. The National Research Council, which has had 25 years of experience in administering a Nation-wide system of fellowships, assumes for the Commission the responsibility for examination of candidates, selection and placement of fellows, and continued check on their progress.

By June of 1948, the Commission through the Council had awarded 44 fellowships to applicants from 20 States and 24 different institu-

tions. By mid-December, it had granted 162 fellowships in the physical sciences assigned to 40 different educational and research institutions in 21 States. (See Appendix 7.) The stipends of these fellowships vary between $1,600 to $2,400 per year for predoctoral, and between $3,000 and $4,000 per year for postdoctoral students.

TRAINING AT THE AEC LABORATORIES

The Commission's three national laboratories—Argonne, Brookhaven, and Oak Ridge—with their 58 cooperating universities and research institutions, offer exceptional opportunities for special research and advanced study by university staff members, by students who have completed their doctorate training, and by industrial research workers. Training programs at these laboratories, described below, including that of the Oak Ridge Institute of Nuclear Studies, instruct the student in new research techniques, familiarize him with problems of research of interest to the Commission, and provide centers for dissemination of recent findings.

AEC Laboratories and Contractors for Research

The Commission maintains independent research establishments and uses the established university, industrial, and Government laboratories of the Nation. In its 2 years of operation, the Commission has provided by contract for a great deal of research outside its own facilities. At the same time, it has built up the strength of its own regional laboratories in all parts of the country.

There are several reasons why Government-owned regional research centers are essential to the national atomic energy program. In the first place, many of the devices used in modern nuclear research—the nuclear reactors, the large particle accelerators ("atom smashers"), the radiation chemical laboratories ("hot labs")—are so very expensive that they cannot be built at most universities or industrial laboratories or even by the Government itself in more than a few places. In the second place, the Nation is short of scientific manpower, and the atomic energy project must find ways of getting a lot of scientific work done without taking teachers away, very far or for very long, from the classrooms and laboratories where they are training tomorrow's scientists. And in the third place, roughly three-quarters of the research done in the program is classified: it must be done under security restrictions.

THE COMMISSION'S LABORATORIES

The Commission's three national laboratories—Argonne at Chicago, Brookhaven on Long Island, and Oak Ridge—and its other centers

of research—the Los Alamos Scientific Laboratory; the Radiation Laboratory at the University of California, Berkeley; the Knolls Laboratory at Schenectady, N. Y.; the Ames Laboratory at Iowa State College; and, to some extent also, the laboratories connected with its Hanford and Oak Ridge production plants—are the answer to the problem of how to get the men and the machines together in places where atomic energy work can be done in security.

The three AEC National Laboratories are being equipped with the machines of nuclear research. Located as they are in the Northeast, Southeast, and Midwest, they have enlisted the active participation of 58 universities and research institutions. In them the university scientists—physicists, chemists, metallurgists, mathematicians, biologists, medical men—can work full time or part time, or as advisers or consultants, and can attend meetings and keep in touch with developments. Also, selected students from the universities can get first-hand experience and training in atomic energy.

Argonne National Laboratory.

In the earliest stages of the atomic bomb project, a group of scientists were brought together at the University of Chicago to form the "Metallurgical Laboratory". The low-power, chain-reacting pile which they first set up at Stagg Field was later moved to an isolated site in the Argonne Forest section of the Cook County Forest preserve, from which the Argonne National Laboratory takes its name. A heavy-water reactor was also built there, and the Argonne site became the center of much of the Chicago research.

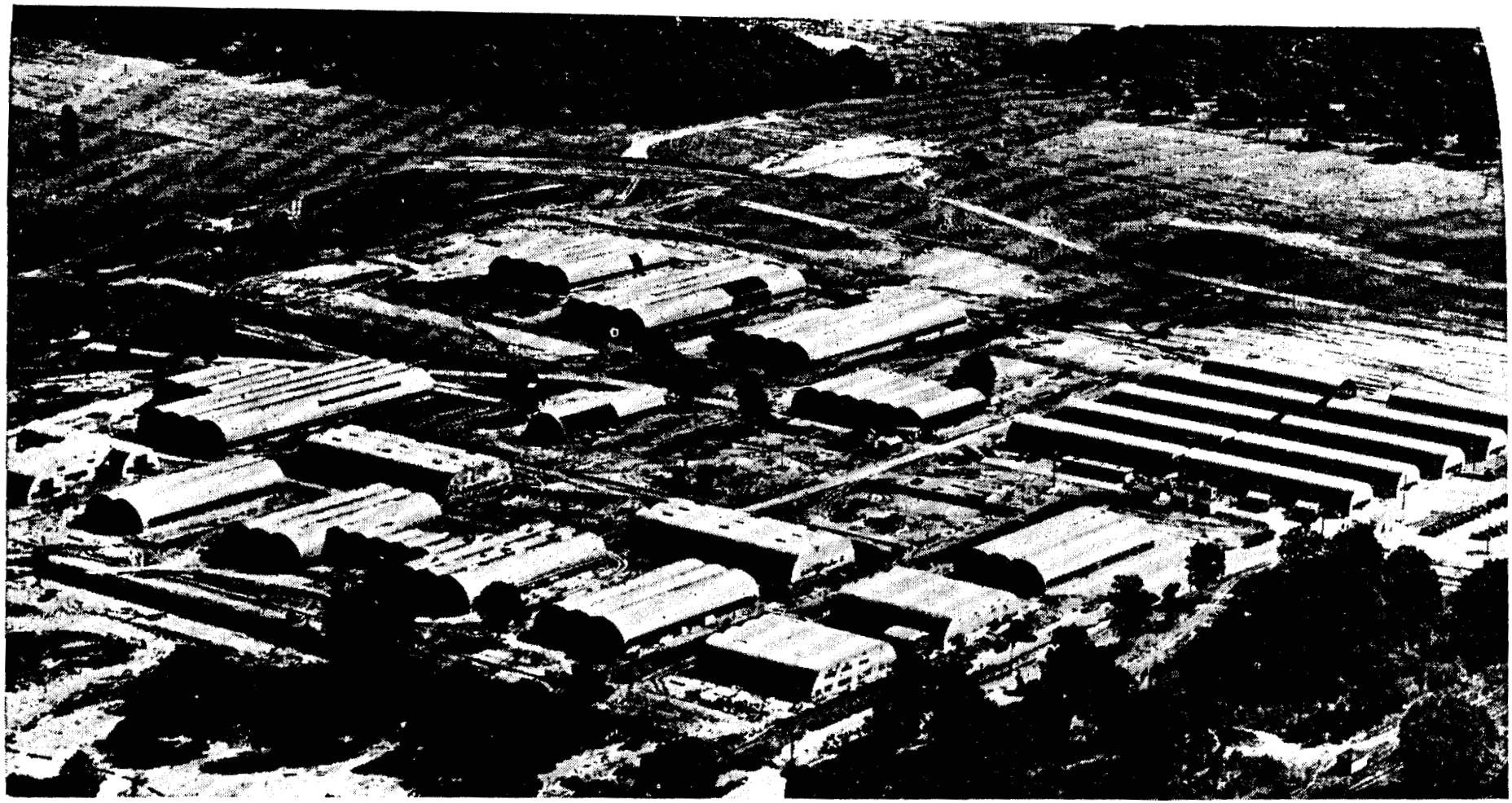
Soon after the war, a group of representatives from 29 midwestern universities and research institutions met at Chicago under sponsorship of the Manhattan Engineer District and arranged to participate in the research made possible by the Argonne facilities. The University of Chicago operated the project, under contract first with the Manhattan Engineer District and after January 1947 with the Commission. A list of the participating institutions, now 30 in number, may be found in Appendix 3.

During 2 years, the Commission has continued to build up the organization and staff of the laboratory. Today it has fully rounded research programs in biology and medicine, and all the physical sciences. It has 418 scientists on its staff. During 1948, its workers produced more than 130 reports on research and development in the atomic sciences. Numerous scientific meetings and seminars were held, including one at which 145 papers were presented.

Argonne's training program is an integral part of its research. During 1948, several universities have made it possible for workers at the laboratory to gain academic credit toward advanced degrees

Architect's drawing showing the proposed lay-out of the Argonne National Laboratory at its new site in Du Page County, Ill., 25 miles from Chicago. Permanent construction began in September 1948. The laboratory, operated for AEC by the University of Chicago, is now scattered at many locations in and around the city.

Architect's drawing showing the proposed lay-out of the Argonne National Laboratory at its new site in Du Page County, Ill., 25 miles from Chicago. Permanent construction began in September 1948. The laboratory, operated for AEC by the University of Chicago, is now scattered at many locations in and around the city.



Temporary construction on Argonne National Laboratory's new site (see opposite page), showing Quonset huts adapted to laboratory use. This construction was started in the spring of 1948, and many scientists are already at work here.

and even to submit theses based upon work done while conducting investigations under the supervision of Argonne staff members. The Illinois Institute of Technology, Michigan College of Mining and Technology, Northwestern University, the University of Chicago, the University of Michigan, and the University of Missouri have already completed such arrangements; and several other institutions are planning to give credit for Argonne training courses.

Along with its two reactors, Argonne has fully equipped laboratories for all kinds of atomic energy research. It will also have a 4,000,000-electron-volt Van de Graaff generator, now being constructed.

The laboratory's quarters are scattered in and around Chicago, wherever space is available, some in Quonset huts. During 1947, the Commission acquired land in Du Page County, Ill., for a new permanent home for Argonne. Temporary construction at the new site began in the spring of 1948, and by the end of the year some laboratory personnel had already moved to Du Page County. Permanent construction on the chemistry buildings was started in September 1948.

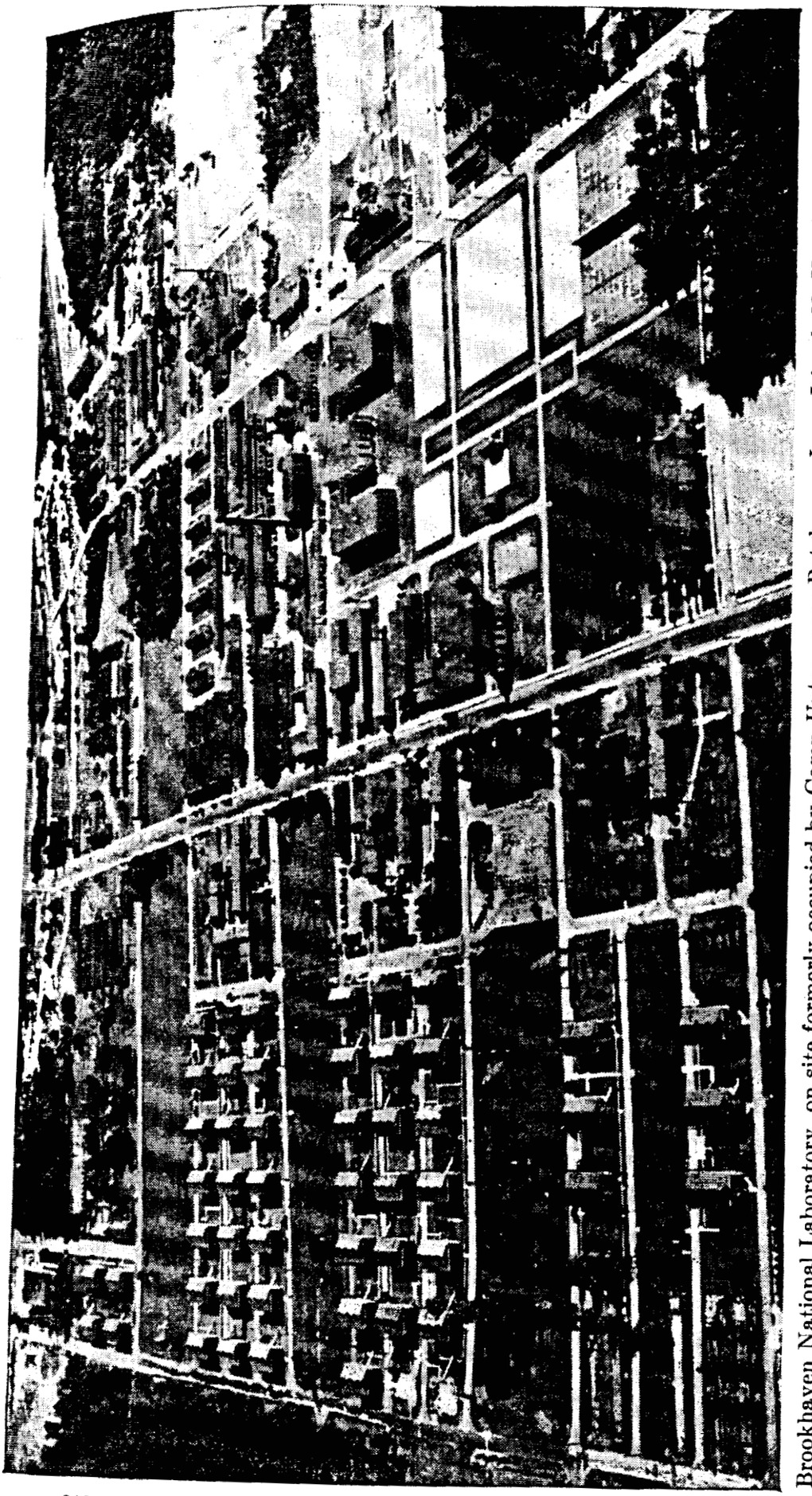
Brookhaven National Laboratory

The Brookhaven National Laboratory was established after the war to provide a center of atomic research for the educational and scientific institutions of the northeastern United States. Nine of the leading universities of the region organized Associated Universities, Inc., a nonprofit corporation which operates the laboratory for the Commission.

Since January 1948, the laboratory has had five working research departments—physics, chemistry, biology, medicine, and engineering. During the past year, its regular staff grew to almost 200, and many other scientists spent part of their time at the laboratory. A program of Brookhaven Research Fellowships for predoctoral students in the nuclear sciences was announced for the academic year of 1948–49. Ten graduate students are now pursuing their studies at the laboratory. This program will be greatly enlarged in the future.

Outstanding in Brookhaven's very complete array of scientific equipment will be two great machines: a nuclear reactor now nearing completion and a proton synchrotron. The latter is an electronuclear accelerator which will accelerate nuclear particles to energies about seven times as great as any produced in laboratories today.

The reactor will be the first ever built expressly as a tool of research, to produce radioactive materials and beams of neutrons for nuclear studies. It will be a graphite-and-uranium pile cooled by air. Its 300-foot exhaust stack was finished in September. The first of its graphite blocks was laid November 8. It will be operating in 1949.



Brookhaven National Laboratory, on site formerly occupied by Camp Upton, near Patchogue, Long Island, N. Y. Army barracks have been adapted to laboratory use. The laboratory is operated for AEC by Associated Universities, Inc., a nonprofit organization of nine eastern universities.

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Photograph on page 73, shows a scale model of the proton synchrotron and the excavation for the great oval track, 75 feet across, around which protons will race at close to the speed of light and with energies of 3-billion electron volts. So penetrating are the particles moving at these energies, that the track will be set about 10 feet below ground.

In November 1948, the foundation was completed for the magnet. This magnet, 70 feet in diameter, will contain 1,600 tons of iron. Three scaled-down models of it have already been built and tested. The magnet power supply is a major item in itself, involving a 40,000-kilovolt-ampere generator coupled to a 40-ton flywheel. The contract for this equipment has been let, and it will be delivered late in 1949.

The Brookhaven designers believe that they have solved all the fundamental problems of their trail-blazing machine. They expect to have all of its major parts in place by the end of 1949. Even then, however, they may have a year of testing and adjustments ahead of them before they get the machine into operation.

Brookhaven will have two smaller particle accelerators: a standard 60-inch cyclotron of 30-million-electron volts and a Van de Graaff generator of 3½-million electron volts. The building that will house them will be completed in March 1949. The cyclotron magnet iron was erected in October, and the wire coils are now in place; most of the power equipment has been received and is now in storage awaiting completion of the building. The Van de Graaff generator has already been assembled and is now being tested.

Two strange towers have recently been completed at Brookhaven. They are needed for study of air currents high above the laboratory so that the operators of the nuclear reactor will know where its exhaust gases are going. One of them is 420 feet tall—highest structure on Long Island—and has a pipe running all the way to the top. When weather observations are going on, the smoke from a standard Army smoke generator released through the pipe creates a small cloud, which can sometimes be seen for miles around.

Oak Ridge National Laboratory

In 1943, the Manhattan project, with the duPont Company as contractor, built at Oak Ridge the world's second nuclear reactor as a small-scale test plant and training center for the plutonium-producing reactors at Hanford. From the beginning, this reactor, with its chemical plants and many auxiliary laboratories was a center of atomic research. The project, first known as X–10 and later as Clinton Laboratory, has recently been renamed the Oak Ridge National Laboratory. The Monsanto Chemical Company, contract operator for nearly 3 years, was succeeded by the Carbide & Carbon Chemicals Corporation in March 1948.

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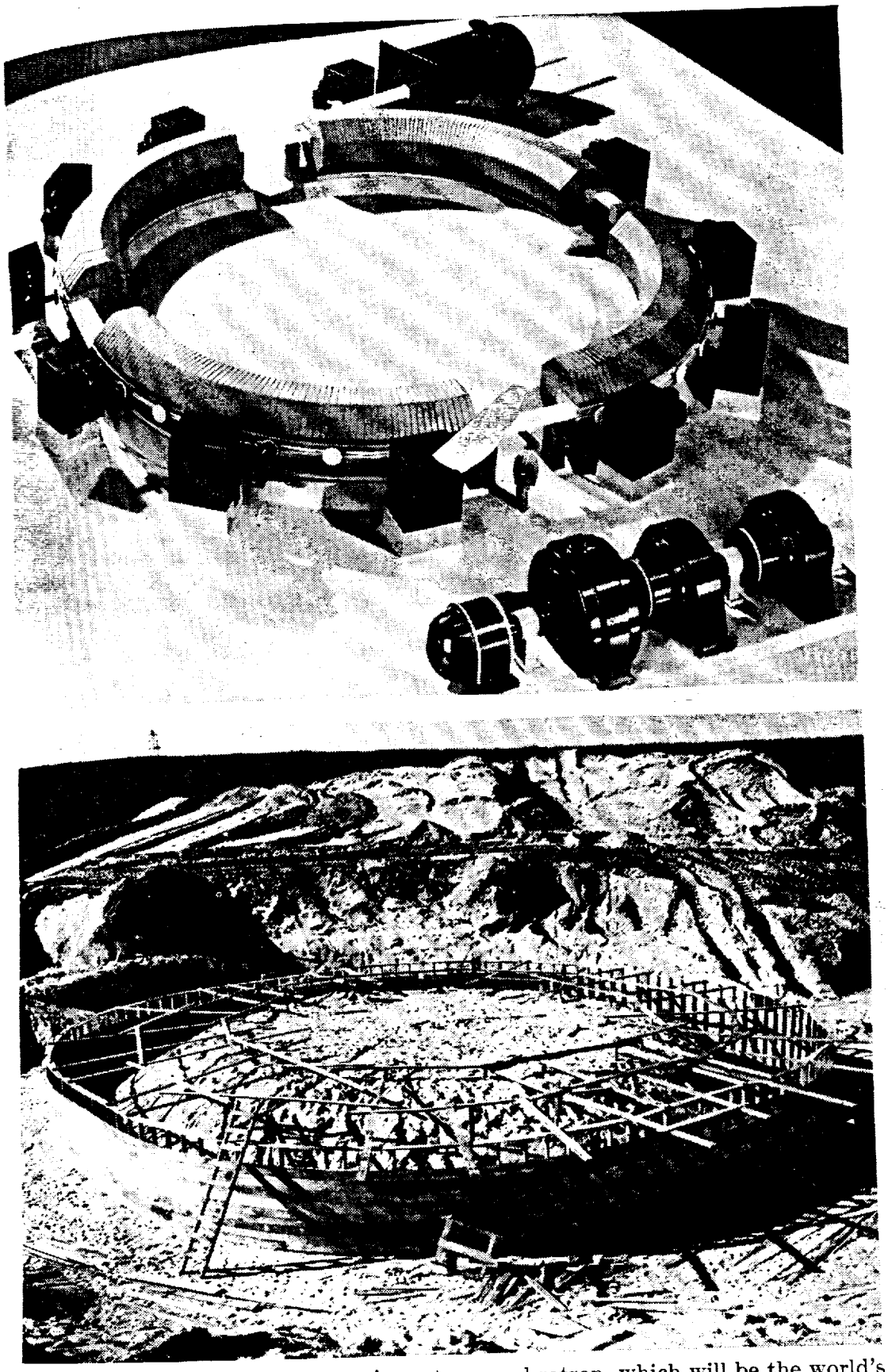
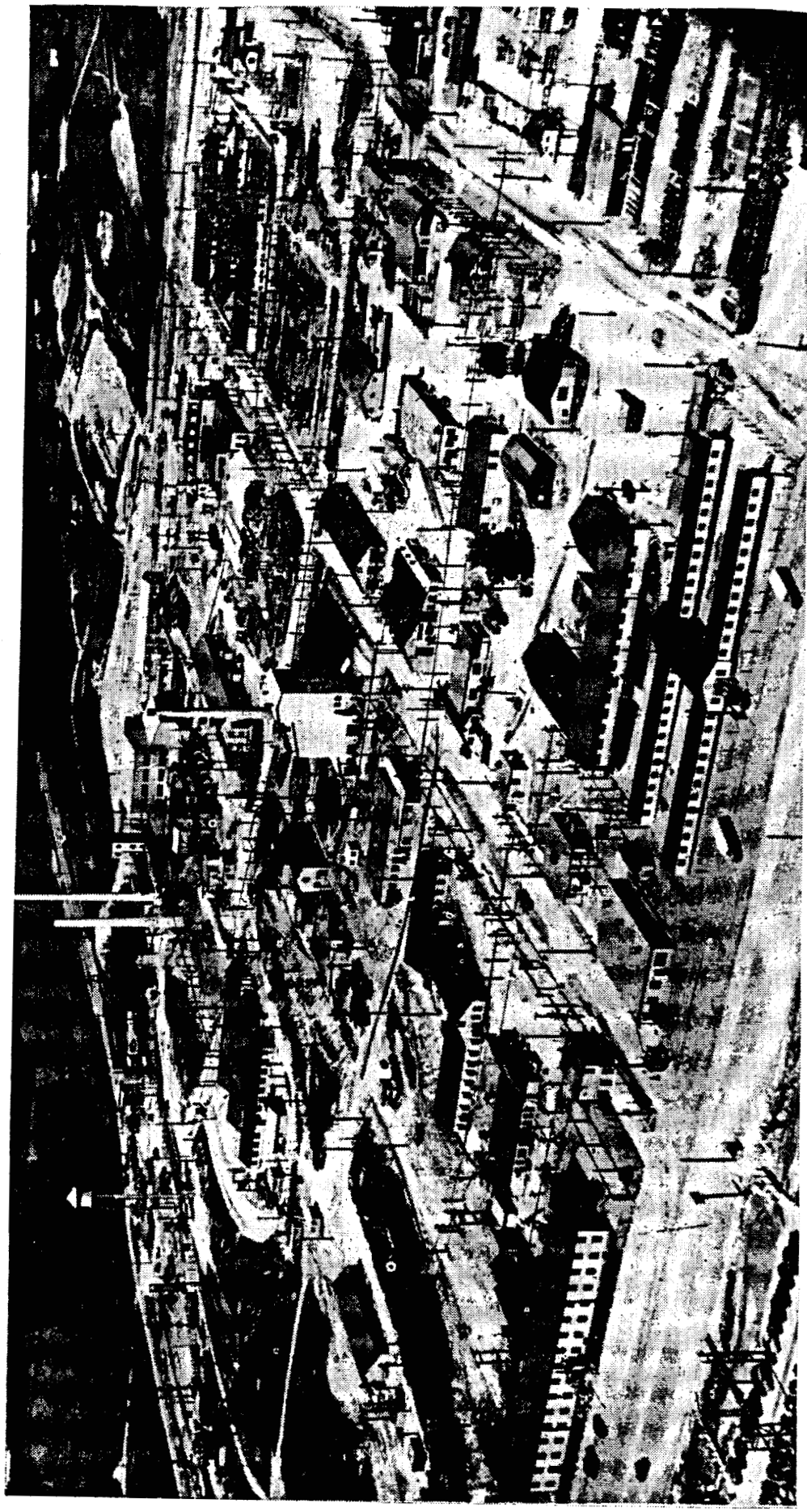


Brookhaven National Laboratory's proton synchrotron, which will be the world's greatest particle accelerator when completed. Above is scale model (notice human figure). Below is excavation for the track, 75 feet across, around which atomic particles will race at a speed of more than 180,000 miles—seven times around the earth—per second.



Oak Ridge National Laboratory, which occupies the "X–10" site, built during the war to test plutonium production by nuclear reactor. The reactor, second ever built, now produces radioisotopes for world-wide scientific use; it is housed in the large building to the right of the stacks, background. Entire project is operated for AEC by Carbide and Carbon Chemicals Corporation.

By the end of 1948, there were five research divisions at Oak Ridge: biology, chemistry, health physics, metallurgy, and physics. The scientific and technical staff numbered approximately 700, in addition to an outside consultant staff of 75 prominent scientists. These workers produced more than 275 scientific reports in 1948.

Research at Oak Ridge centers around the air-cooled, graphite-moderated reactor. Its use in the manufacture of radioactive isotopes has been described in the Commission's Fourth Report to Congress.

The preparation of materials for irradiation, the chemical changes that take place in substances exposed to the intense radiations in the reactor, the extraction and purification of radioelements from irradiated materials, the combining of radioelements into useful compounds, the use of these compounds in the tracer analysis of chemical reactions—all this work occupies the time of a large and talented group of chemists. Biologists are able to study the effects of radiation and radioactive substances on living matter. Physicists can use pile radiations as a key to unlock the further secrets of the atom. A whole host of engineering problems arise.

The Oak Ridge Institute of Nuclear Studies, attached to the laboratory, is being developed as the center of atomic energy training of the South. It is operated by 19 member universities under contract with the Commission. It offers a variety of training opportunities. Two of its programs have proved particularly valuable in 1948. One, the resident graduate-training program, operated by the University of Tennessee, has made it possible for 200 scientific workers employed at the laboratory to continue their work there while also working toward their postgraduate degrees. The institute's radioisotopes training program is described on page 51.

During 1948, the laboratory's new central steam and power plant, the new metallurgical and health physics buildings, the new radioisotope laboratories and a number of other facilities were completed.

Los Alamos Scientific Laboratory

The Los Alamos Scientific Laboratory engages both in atomic weapons development and in fundamental research. Its history, facilities, and accomplishment are discussed in the chapter on military application.

Radiation Laboratory, University of California, Berkeley.

The Radiation Laboratory of the University of California at Berkeley was from the start a pioneering workshop in the development of atomic energy. Today the laboratory, operated by the university under contract with the Commission, is a national center of atomic energy research. Berkeley is the birthplace of the cyclotron; the first one was designed and built there, and the 184-inch synchro-

Oak Ridge National Laboratory, which occupies the "X–10" site, built during the war to test plutonium production by nuclear reactor. The reactor, second ever built, now produces radioisotopes for world-wide scientific use; it is housed in the large building to the right of the stacks, background. Entire project is operated for AEC by Carbide and Carbon Chemicals Corporation.

cyclotron at the laboratory is the largest and most powerful in the world today. In addition, the laboratory has a 60-inch cyclotron, a Van de Graaff generator, a linear accelerator, and a synchrotron.

For the past 2 years and more, the Berkeley specialists have been at work designing a new super-accelerator, a proton synchrotron of 110-foot diameter and 6-billion-electron-volt output, by far the most powerful atom smasher ever planned. By early 1948, their plans had become firm enough, and promising enough, so that the Commission could take the step of authorizing the development of this machine. It will cost some $9,000,000 and be 4 or 5 years in the building. It is so entirely unprecedented that its builders will first be obliged to make and operate a quarter-scale model to help solve the problems and locate the "bugs" in the design. The Berkeley proton synchrotron will be something like 18 times as powerful as the 184-inch synchrocyclotron, the present greatest machine; it will attack the atomic nucleus with energies so far beyond today's range that even its designers are unable to predict the nature of the facts it will uncover.

In addition to the specialists in physics who design and operate the machines and those who interpret the results, Berkeley has specialists in chemistry, biology, and medicine, whose work is directly connected to the effects the machines can bring about. There are three main research groups in biology and medicine, as well as groups in nuclear and bio-organic chemistry, engineering, health physics, health chemistry, and medicine, together with technicians—nearly 600 workers in all.

Construction, expansion, and improvement of facilities have been vigorously pressed in 1948. The new central research laboratory was begun in November 1948, to provide over 40,000 square feet of badly needed space for physics, chemistry, and health physics, plus a central library, an information office, document vault, and lecture hall. A 30,000-square-foot warehouse with an additional 30,000 square feet of paved, open-storage space has been completed, along with a number of lesser construction projects.

Ames Laboratory

The scientists of Iowa State College played a leading role in the development of atomic energy, particularly in investigating the nature of uranium and other little-understood metals and in developing new processes for purifying and working these metals. The Commission has reenlisted the Ames staff in the Nation's peacetime effort and enlarged the project into a major laboratory, which will be housed in two new and well-equipped buildings now being constructed on Government-leased ground on the college campus. Construction on

the metallurgy building, begun in 1947, is now 75 percent along, and is scheduled for completion in February 1949. The plans and specifications for the general research building are virtually complete.

Research in metallurgy at Ames is aimed at finding better and cheaper ways of producing in extremely pure form such now-important materials as uranium, thorium, beryllium, and the group of elements known as the rare earths. Along with this work, the staff must tackle a great assortment of problems in chemistry, chemical engineering, analytical chemistry, physics, ceramics, and crystallography.

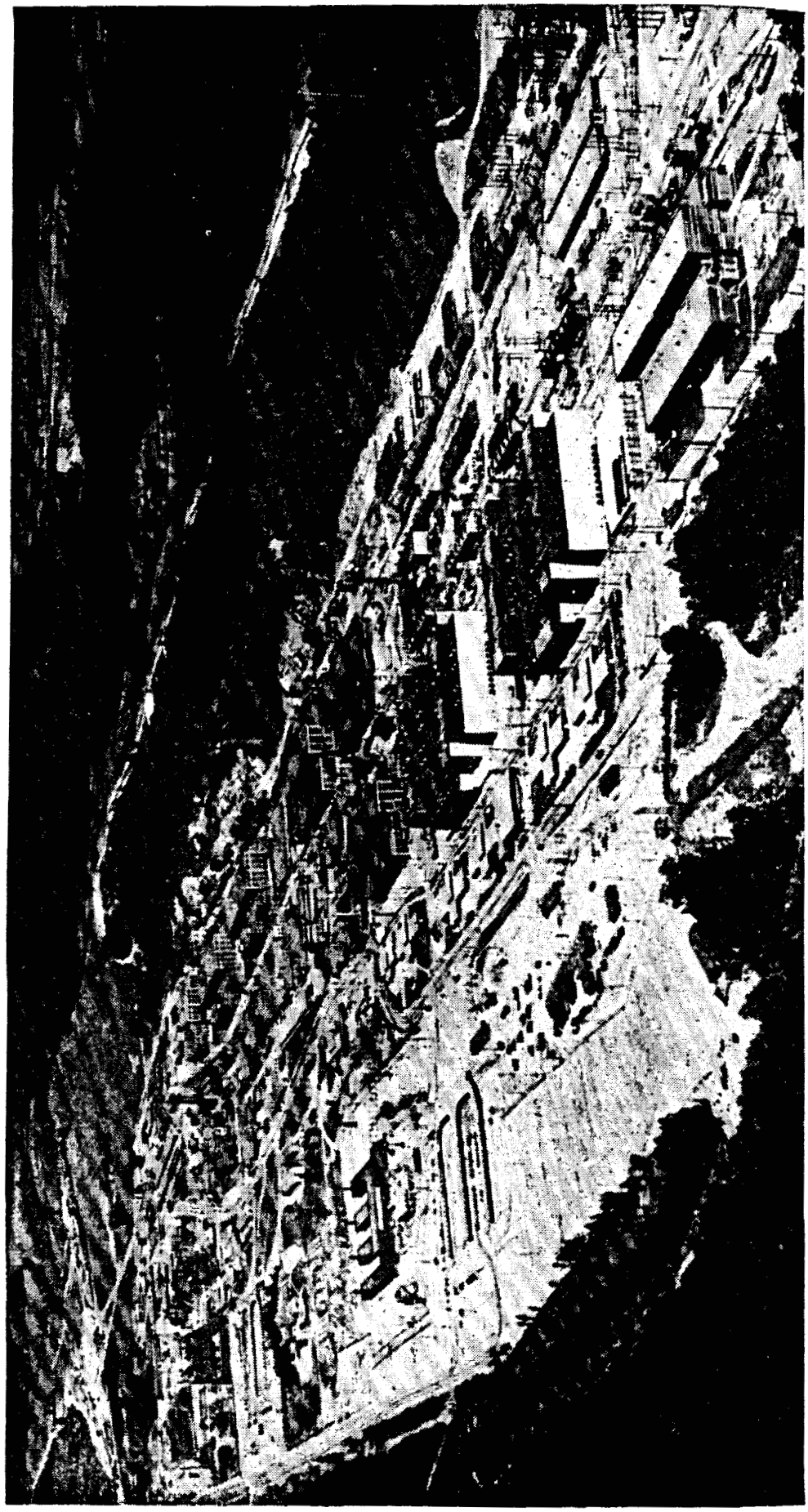
Other AEC Laboratories

Something is said in other sections of this report about the other laboratories of the Commission where the scientific work is less fundamental and long-range in its character, more closely tied up with day-to-day problems of production and development. The Hanford Plutonium Works and the Oak Ridge gaseous diffusion plant, K–25, both maintain programmatic research concerned not only with the production processes as such but also with the health of workers and the protection of adjacent areas. In addition to its Argonne center of activity, the reactor development program has an extensive project, the Knolls Atomic Power Laboratory at Schenectady, N. Y., operated for the Commission by the General Electric Company. The Monsanto Chemical Company operates the Mound Laboratory at Miamisburg, Ohio, where highly classified process, research, and development work is carried out. A new laboratory is being fitted out at New Brunswick, N. J., for analyzing the feed materials used in the production of fissionable materials. Also, the Y–12 electromagnetic separation plant at Oak Ridge constructed during the war to produce uranium 235 is today the scene of large-scale separation of the chemical elements into their various isotopes. The Carbide & Carbon Chemicals Corporation, contractor for this work, is producing stable isotopes which are distributed to institutions throughout the Nation for research in all the biological and physical sciences.

AEC CONTRACT RESEARCH

The Battelle Memorial Institute

Important contributions have been made and continue to be made to the Commission program by the Battelle Memorial Institute at Columbus, Ohio, an endowed nonprofit research foundation, with a permanent staff, equipped to conduct research for industry and Government agencies. Battelle is especially noted for its work in metallurgy and related fields. In an average month about 100 of its technical men spend some portion of their time on atomic energy



"Y-12" at Oak Ridge, the plant built during the war to produce uranium 235 by the electromagnetic method. The plant is now in stand-by, but important research and development on the process and also production of stable isotopes for Nation-wide scientific use are being carried on.

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research under Commission contract, several groups continuously dealing with a variety of problems.

The bulk of the research at the institute is in the broad fields of metallurgy and ceramics, with the basic sciences of physics and chemistry playing supporting roles. The work in general is directed toward the development of materials for reactors, and includes basic, long-range research as well as immediate developmental research on specific reactor components.

Columbia University

The Commission contract with Columbia University provides for nuclear research which is largely unclassified, and concerns neutron physics, crystal structure, fundamental particle interactions, beta ray spectroscopy, and instrument development. Thus at the university large numbers of graduate students are being trained in the particular field of interest to the Commission simultaneously with the research program.

Office of Naval Research Contracts

Late in 1947, the Commission and the Office of Naval Research arranged a program of joint support of basic scientific research. The purpose was to initiate new research and extend or intensify research already undertaken in the ONR's program, sometimes to a greater extent than that office had previously contemplated. The main points of the arrangement are as follows:

1. Projects are selected for joint support with due consideration of the availability of scientific personnel for the purpose, and of the probable extent of any disruption of other scientific activities which might result therefrom.
2. Projects are supported from funds made available by AEC and by ONR in proportions agreed upon.
3. Contracts are negotiated, executed, and administered by ONR with AEC and ONR concurrence in any changes in the form of contracts, such as clauses pertaining to patents and security which may be necessitated by AEC participation.
4. The joint program does not cover projects judged likely to involve or produce classified or restricted data. The AEC and ONR decide with the contractor what security or other measures should be taken with respect to any project showing a tendency to involve or produce classified or restricted data.

To this joint program the Commission furnished $5,550,000 during 1948. Of this amount $4,050,000 was to be allocated to the physical sciences and $1,500,000 to medical research. In carrying out this agreement the AEC now participates in support of nine contracts for research in cosmic radiation, six contracts for work with elementary

-12" at Oak Ridge, the plant built during the war to produce uranium 235 by the electromagnetic method. The plant is now in stand-by, but important research and development on the process and also production of stable isotopes for Nation-wide scientific use are being carried on.

particles and their interactions, five contracts in the field of nuclear reactions, three in the field of nuclear structure, five in particle accelerators, and four in projects which include more than one of these types of work.

Production of Isotopes and Rare Earths

ISOTOPES

The production and distribution of radioactive and stable isotopes has continued to expand during the last 6 months of 1948. For the most recent statistical report on the progress of this program see Appendix 5.

The Commission's Fourth Report to the Congress was devoted primarily to the program for production, distribution, and utilization of isotopes. This discussion, therefore, concerns only those items of special significance occurring during the past six months.

On October 27, the AEC Isotopes Division at Oak Ridge made available two more isotopes, hydrogen 3 (tritium) and helium 3, to laboratories outside AEC projects. Tritium is radioactive whereas helium 3 is stable. Both isotopes are extremely useful in physical and nuclear research. Tritium is also a valuable adjunct to carbon 14 for labeling organic tracer compounds.

Recently another radioisotope, cobalt 60, has received much attention. Several applicants have proposed the use of large quantities of cobalt 60 as external gamma ray sources in experimental radiology and radiography. The Isotopes Division has begun the production of high specific activity cobalt and is working on the problems connected with utilization.

Isotope-Labeled Compounds

The Commission's policy has encouraged participation of private industry in the field of isotope-labeled compounds. To an increasing extent private industries are extending their services to isotope users especially in the manufacture of instruments and in the production of isotope-labeled compounds. More than 40 firms manufacturing radiation detection and measuring equipment provide a wide variety of instruments in both cost and type of performance. Three commercial firms—Tracerlab, Inc., Cambridge, Mass., Abbott Laboratories, Chicago, Ill., and Texas Research Foundation, Renner, Tex.—produce and distribute various types of chemical compounds containing radioisotopes. In addition, Ayerst, McKenna & Harrison, Ltd., Montreal, Canada, is sponsoring the preparation by Tracerlab of radioisotope-labeled hormones to be distributed without charge to qualified investigators.

Among the tagged compounds and preparations made available during the past 6 months are—

Diiodofluorescein labeled with iodine 131, an iodine salt of a fluorane dye, of interest in medical research.

Sterile colloidal gold solution containing gold 198. Because of the short half-life of gold 198, this solution may be injected directly into malignant tissue, a treatment which simplifies radiation treatment techniques in some cases.

Gold sodium thiosulfate labeled with gold 198. This preparation may prove useful in treating certain types of chronic skin diseases.

Thiourea labeled with sulfur 35, of research value in studying thyroid disorders.

Phosphorus 32 in solution, most useful as a tracer in this form.

Pentothal labeled with sulfur 35, a sulfur-containing barbiturate, of interest in medical research.

Both the Argonne and Oak Ridge National Laboratories have initiated "isotope farm" programs, one function of which will be the biological synthesis of complicated organic compounds labeled with isotopes. Compounds which cannot be synthesized chemically will be given special attention.

Other Activities

The Commission continued to distribute phosphorus 32, iodine 131, and sodium 24 free of production costs to laboratories and medical institutions engaged in research on cancer and allied diseases, and is planning on enlargement of this activity as a further contribution to United States cancer research. With the assistance of the National Bureau of Standards, and a number of hospitals and clinics the Commission began studies to standardize the measurements of radioactive iodine 131. Wide variation in standards had been found to hamper establishment of uniform treatment procedures in several medical institutions administering this important radioisotope.

Over the last 6 months, the Commission increased its efforts to expand education and public information programs for the purpose of orienting technical groups in isotope applications. Staff members of the Isotopes Division answer many invitations for lectures, exhibits, and participation in scientific and educational conferences. The AEC Isotopes Branch has prepared several panel exhibits at various levels of technical complexity for exhibition at technical meetings throughout the country. This information is in great demand and is particularly helpful to members of the medical profession who hope to use these materials for therapeutic, diagnostic, and research purposes.

RARE EARTHS

From their research into chemical separations methods, Commission laboratories have developed production methods for limited amounts of rare earths of a purity and quantity previously unattained.

The rare earths comprise a group of 14 metals, ranging from cerium (atomic number 58) through lutecium (atomic number 71). Because of their unique atomic structure these metals have been extremely difficult to separate and very little is known of their chemical, physical, or metallurgical properties. A present commercial utilization of the rare earths is the use of mischmetal, a cerium master alloy from which sparking "flints" of cigarette lighters, miners' lamps and welding torches are made. Pure cerium is also utilized for certain types of radio tubes and nonferrous alloys.

The wider availability of these little known materials is of interest to scientists in many fields. Moreover, it now appears that they may have a bright commercial future as alloy metals in the manufacture of high-temperature structural materials and other specialized products. At present, the demand for separated rare earths from Commission laboratories is greater than the supply but it is hoped that separated materials can eventually be made available to interested investigators.

The following rare earth salts were prepared in Commission laboratories in purely experimental quantities:

Material	*Purity*
Lanthanum oxalate $9H_2O$	Other rare earths not determined spectrographically; probably less than 0.05 percent.
Lanthanum oxide	Do.
Lanthanum chloride anhydrous	Do.
Cerium ammonium nitrate	Do.
Cerium oxalate $9H_2O$	Do.
Cerium chloride anhydrous	Do.
Praseodymium oxide (Pr_6O_{11})	Nd_2O_3 less than 0.2 percent; CeO_2 less than 0.2 percent; La_2O_3 less than 0.2 percent.
Neodymium oxide (Nd_2O_3)	Sm_2O_3 less than 0.05 percent; Pr_6O_{11} less than 0.1 percent; other rare earths not detected.
Samarium oxide (Sm_2O_3)	Eu_2O_3 less than 0.03 percent; other rare earths not detected.
Samarium oxide (Sm_2O_3)	Less than 0.15 percent europium; other rare earths not detected.
Gadolinium oxide (white)	A few hundredths of one percent samarium present.
Ytterbium oxide	Other rare earths not detected.
Yttrium oxide	Better than 90 percent; other rare earths present.

In addition to the above, the following metals were prepared in very small quantities:

a. Pure lanthanum and cerium metal, free from other rare earths, in rod form of fixed sizes.

b. Neodymium metal, spectrographically pure; neodymium metal containing up to 2 percent samarium; other rare earths absent to spectrographic determinations.

c. Didymium metal, approximately 80 percent neodymium, 8 percent samarium, 8 percent praseodymium.

Information Exchange

In research, progress depends upon broad and effective exchange of scientific information and ideas. In the atomic energy program there is a pressing necessity for this kind of exchange among the research workers scattered in groups in laboratories throughout the country. Exchange of data is complicated by problems of security. To facilitate cross-fertilization of ideas and effective exchange of information, the Commission has developed several procedures.

UNCLASSIFIED RESEARCH

In 1948, the Commission defined certain broad fields of research related to atomic energy in which security restrictions are no longer considered necessary or desirable. (See Chapter V, page 108.) Under this authorization, each of the five AEC Managers of Operations may permit the contractors and others under his jurisdiction to conduct investigations in these fields without security restriction.

Qualified scientists may now visit the locations of unclassified work and freely obtain information about its purposes, methods, and results in the traditional scientific way. Scientists performing unclassified research may discuss it freely with nonproject personnel. Further, the results of such work may be published in accordance with the traditional pattern of review by the laboratory director or his designated board of review.

Among these unclassified fields of research are pure and applied mathematics, physical metallurgy of elements and alloys up to and including lead in the periodic table, the basic chemistry of almost all elements of atomic number below 90, most work in the field of instruments including radiation detection instruments, and fluorine and fluorocarbon chemistry.

REPORT EXCHANGE

Under the information-security principles necessary today, no person receives more classified information than that needed for the performance of the particular tasks entrusted to him. In practice, this

restriction may work against progress since often one person or group will be in possession of information of great value to others.

With the end of the war and the publication of the Smyth Report, the official report on the atomic energy project, the magnitude, scope, and over-all direction of the project was revealed. However, restrictions on the dissemination of detailed technical information must still be maintained. In 1948, a total of more than 1,600 new classified research and development reports were produced within the Commission. Distribution of so great a volume of material cannot be controlled in detail from a central information office without time-consuming effort. In order to facilitate the exchange of classified information among Commission installations, a system of standard distribution lists has been introduced. A total of 24 categories of technical information have been established, with an approved list of authorized recipients for each.

After a technical report is written, the laboratory director determines the category in which the report belongs and it is distributed automatically to other Commission installations authorized to receive the information. The Division of Research also maintains a small staff of technically trained personnel at Oak Ridge to review all new reports and authorize additional distribution where necessary.

As a further supplement to this information-exchange program, the Commission prepares two semimonthly documents, with the cooperation and authorization of the Division of Research: (1) a title-and-author list of all classified reports published during the preceding period and (2) Abstracts of Classified Documents, in which abstracts or content notes on all new reports published during the preceding period are given.

Both documents receive wide circulation to all Commission installations and contractors. The use of this reference material enables any installation to be sure it has received all the classified reports pertaining to its work. (See Chapter V., page 112.)

INFORMATION MEETINGS

Two large information meetings were held during 1948, and symposia on specialized subjects were also held from time to time. These meetings are effective instruments for the exchange of information and ideas among the scientists of the Commission. The earlier meeting was held April 26 to 28 at the Brookhaven National Laboratory, and was attended by nearly 400 visiting scientists. The second, held at the Argonne National Laboratory, October 18 to 21, included a symposium on the effects of radiation on solid materials. This meeting was attended by nearly 600 visiting scientists.

Atomic energy information meetings have the same function and are handled in the same general fashion as national meetings of the chemical, physical and mathematical societies, but only classified papers are presented and admission is restricted to "cleared" personnel. This allows discussion of topics which cannot elsewhere be presented and serves to develop interest in the subjects which are of most immediate application.

THE PROGRAM OF TECHNICAL COOPERATION

During 1948 the program of technical cooperation among the United States, Canada, and the United Kingdom has continued in such general areas as health and safety, research with low power reactors, extraction chemistry, stable isotopes, and radioisotopes.

The wartime experience shared by the three Governments provided a convincing demonstration of the mutual benefits to be derived from cooperative effort. Recognizing this, the three Governments concerned are continuing to utilize, in an expanded way, the cooperative principle in certain limited areas in which work has been proceeding separately along the same lines in two or more of the three countries. In some of these fields, all three nations are working; at other times, only two of the three are involved.

This program of technical cooperation is carried out under the general direction of the Combined Policy Committee, which also reviews those problems of raw-materials supply common to the three Governments. The Combined Policy Committee was established early in the period of wartime development, in August 1943, by the three Governments, to provide broad direction to the atomic project as between the countries. As announced by the Secretary of War August 6, 1945, the Committee provided for interchange of information on certain sections of the secret project—the interchange necessary to achieve the objective of developing atomic weapons during the war—and took action to insure supplies of the uranium ore essential to the production of the atomic weapon.

With the passage of the Atomic Energy Act of 1946, the wartime cooperation between the three Governments had to be viewed in the light of the responsibilities fixed by Congress upon the Commission as well as of considerations of foreign policy and national defense.

The general framework thus provided has been utilized to develop technical consultations on specified topics and to provide for a number of visits by scientists and technicians of each country to the other two. The health and safety factors in connection with the Canadian atomic installation at Chalk River, Ontario, for example, have been examined in the light of the technical experience of the United Kingdom and the United States.

The exchange of research experience and the mutual availability of stable and radioactive isotopes is another field in which benefits derive to each of the three nations.

In connection with the development of research reactors and fundamental knowledge about reactor materials the United States, as well as Canada and the United Kingdom, can share some degree of experience to achieve mutual benefit to all three Governments. Experience and knowledge in the important field of extraction chemistry acquired by the United States and the United Kingdom can be of mutual benefit to the activity of each nation.

IV

BIOLOGY AND MEDICINE

Introduction

Over the many decades during which physicians have used X-rays and radium for the treatment of disease, they have become familiar with the harmful effects of overdoses of radiation. Biologists have assisted by studying how radiations affect plants and animals, biophysicists by studying how they could be measured and controlled. By the time that atomic energy was developed, therefore, science was already familiar with the biological effects of most types of radiations.

What was new to the biologist and the physician in the development of atomic energy was the massive quantity of radioactive materials created and the greater potentialities of these materials for both good and ill. The Atomic Energy Commission has the obligation to investigate these potentialities and to encourage and assist others to do so. It must explore the many benefits in prospect for better health and production of food, and it must learn how to forestall the dangers to human, plant, and animal life.

In 1947, the Commission, as a first step in meeting its responsibilities, designated an Advisory Committee for Biology and Medicine, composed of a group of outstanding scientists. (See Appendix 2 for membership.) This committee subsequently assisted in the establishment of a Division of Biology and Medicine in the Washington staff of the Commission.

EXPANSION OF THE PROGRAM IN 1948

The biological and medical activities of the wartime atomic energy project had been highly compartmentalized for security reasons. During 1948, the Commission made considerable progress in coordinating the biological, medical, and biophysical activities at the various facilities. The Advisory Committee met for information and guidance as to the scope and extent of these programs. In addition, the leading representatives of the laboratories held bimonthly meetings at various laboratories or in the Washington offices for mutual exchange of information and guidance.

Commission Laboratories

During the war, the Manhattan project established a research project at the University of Chicago as a part of the Metallurgical

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Laboratory especially to determine the effects of plutonium and radiation on the body. The Commission has expanded this program at its Argonne National Laboratory to embrace a wide variety of cancer studies and the application of tracer radioisotopes to research.

All of the AEC laboratories have enlarged their research programs during 1948—at Brookhaven chiefly for the study of the uses of atomic energy products in the understanding, diagnosis, and treatment of disease; at Oak Ridge, for the investigation of the effects of radiations on plants and lower animals; at Hanford, for determination of the effects of radiation and radioisotopes on aquatic organisms; and at Los Alamos, for the solution of the biological and medical problems connected with the development and assembly of atomic weapons. Biophysics (health physics) staffs which protect working personnel at all AEC installations have been strengthened during the year.

AEC Contract Research

During 1948, also, the Commission renewed, enlarged, or initiated contracts and arrangements for projects in biology and medicine at institutions in all parts of the country, as follows:

University of Rochester, for studies of radiation and other problems associated with atomic energy work;

University of California, Western Reserve University, and Columbia University, for similar projects and for a wide range of basic studies of the effects of radiation on life processes and reproduction;

University of Washington, University of Tennessee, United States Department of the Interior, and other institutions, for investigation of the effects of radioactive materials on wildlife and livestock;

Memorial Hospital and Sloan Kettering Institute in New York, Washington University in St. Louis, Harvard University, University of Oregon, University of California, and, a number of other institutions and AEC laboratories, for cancer studies;

United States Department of Agriculture and a number of State agricultural experiment stations in all parts of the Nation, for experimentation on the effects of radiation on plant life.

The Commission, early in 1948, took over from the Office of Naval Research the financial support of some 28 projects. Since that time it has selected and furnished funds for some 70 projects in its various fields of interest. These projects cover a wide range of activity. At the Harvard Medical School and the Massachusetts Institute of Technology, for example, AEC-supported research workers have used

radioisotopes in studying the chemical constitution of the blood cells in a variety of diseases, with the twin aims of increasing understanding and discovering treatments. At Washington University, St. Louis, biologists have developed methods for preparing artificially certain fundamental substances contained in living cells and their nuclei. And at the California Institute of Technology, the University of Colorado, and Reed College, Portland, Oreg., other workers are finding the explanation of many of the previously unknown facts about the manufacture of proteins, the building blocks of the body.

Also, the Commission arranged for the creation of training centers in 13 universities in all regions of the United States and for active training programs in its own laboratories. It also took steps to provide the specialized equipment and materials needed for radiation research—the radioactive isotopes, particle accelerators, radiation detection instruments, special laboratory and clinical apparatus, and, at Brookhaven, a nuclear reactor. At its University of Rochester research center, the Commission began construction of major training and laboratory facilities; and approved for construction at Chicago a cancer hospital to be operated by Argonne Laboratory in connection with the University of Chicago's own program.

Conserving Expert Manpower

The Commission has shaped its expanding program to take into consideration today's severe shortage of scientific and medical workers trained to engage in atomic energy work. Instead of taking teachers from the universities for its laboratory staffs, it has, wherever possible, tried to strengthen university staffs through its support of independent research. The work done under the Commission's contracts has thus the important secondary benefit of training young scientists and has, very often, actually provided centers of research training to which select fellows may be assigned. Furthermore, many of the academic scientists who obtain leave of absence to work in the Commission's own laboratories will start training courses, and even entire departments in atomic energy subjects in their schools when they return.

Spreading Information

To stimulate research and education in the biological and medical aspects of atomic energy outside the areas of its own directed program, the Commission acted in 1948 to circulate information on the subject, both through meetings and through publications. Brookhaven laboratory held a conference July 12–30 on the biological applica-

at Argonne laboratory, at which radiation exposure problems were discussed.

The "Nuclear Science Abstracts" series published twice a month by the Commission also contains abstracts of articles on biophysics, biology, and medicine both from Commission laboratories and from current publications. At the end of 1948, the series was being distributed without charge to some 900 institutional libraries interested in these three subjects and by paid subscription to individuals as well.

Heightened Activity

During the year independent activity of institutions in the fields of medicine and biology related to atomic energy increased noticeably in nearly all parts of the Nation. Some universities established departments of biophysics; others incorporated such subjects into their existing structure. Hundreds of research institutions and hospitals regularly used radioactive and stable isotopes from the Commission's Oak Ridge nuclear reactor. An increasing number of papers were delivered on radiation subjects in scientific meetings.

THREE MAJOR FIELDS OF RESEARCH

The Commission's program of investigation in the life sciences falls naturally into three distinct but closely overlapping fields of effort: *biology*, *medicine*, and *biophysics*.

Biology

In the field of biology, the Commission is supporting and lending direction to a comprehensive investigational program in its various laboratories and in many private, State, and Federal research organizations. The research deals with the broad subject of the effects of radiation on plant and animal life and ranges from the long-time effects of low-level radiation to the effects of high-intensity levels that produce marked injury or death. Scientists in the program are conducting large-scale studies on the mechanics of absorption by plants from the soil of the wide variety of radioactive elements produced in nuclear fission—their localization in portions of plants and their accumulation by, and effects on, animals fed with materials that contain them. Many of the research workers are using radioactive tracer atoms to observe for the first time the intimate and detailed aspects of life processes, which range from the manufacture of food in the cells of green plants to the functions of the liver in animals.

In most of this research, the workers utilize radioactive materials in new and unique ways to aid in the solution of basic problems of plant or animal physiology. The results of their work have wide application.

DOES RADIATION STIMULATE PLANT GROWTH?

The question of whether nuclear radiations from radioactive materials stimulate the growth of plants is nearly as old as man's knowledge of radioactivity; and with the new plentifulness of such materials resulting from the development of atomic energy, the question has become a very practical one. Early in 1948, the Commission arranged for the Department of Agriculture and a number of State experiment stations to run a comprehensive series of experiments in the application of low-level radioactive materials to growing crops. The materials used to supply radioactivity were a commercial radioactive product and radium.

During the past growing season, tests were carried out in 14 states on 19 different crops:

Arkansas	Sweetpotatoes.
Georgia	Cotton.
Illinois	Corn, soybeans, oats, alfalfa.
Kentucky	Tomatoes.
Maryland	Tomatoes, turnips.
Michigan	Navy beans, table beans, spinach.
Mississippi	Corn.
Montana	Potatoes.
North Carolina	Tobacco, peanuts.
Ohio	Ladino clover.
New York	Carrots, potatoes.
North Dakota	Wheat, barley.
Washington	Sugar beets, field beans, wheat.
West Virginia	Corn.

The Maryland experiments were conducted at the Plant Industry Station, United States Department of Agriculture, Beltsville, the others at experiment stations, both State and commercial.

These widespread one-season field experiments indicate strongly that the farmer cannot expect increased yield from money invested in radioactive materials available at present. A second series of tests will be run in 1949.

These studies are quite separate and distinct from the numerous investigations which have been made and are being continued in fertilizer tracer research, where radioactive isotopes are being used to gain further understanding about the growth of plants—the rate and volume of movement of various fertilizer materials in the soil, their absorption into the plants, and their accumulation in plant parts. Such studies are expected to solve practical problems of fertilizer application which are of direct dollars-and-cents interest to farmers, fertilizer producers, and farm machinery manufacturers.

GENETIC STUDIES

A major portion of the biology research program is devoted to studies of the effects of the various radiations on living cells, with special emphasis on their effects on chromosomes and the genetical make-up or inheritance. It has long been established that nuclear radiations have the power to cause "mutations" in the offspring of plants and animals, that is, to interfere with the normal workings of heredity. This fact has tremendous implications, both good and evil, in an atomic age.

The Commission has undertaken studies which range from effects of radiation on individual cells to genetic results expressed in population numbers and mutation types. Test organisms now being studied include higher plants, animals, molds, and bacteria. Bacteriophage viruses and enzyme systems are also being studied. The experimenters use various intensities and various types of radiation. All Commission laboratories and a number of universities under contract are conducting research on these subjects, the specific studies at each location depending upon the facilities and the trained scientific personnel available.

The Oak Ridge National Laboratory has embarked on an extensive study of the genetical effects on mice of exposure to nuclear radiations. Little is known about the effects of radiation on the mutation rates in mammals even though tolerance levels are being constantly studied. But in 10 years of work with mice, biologists can observe about 50 generations—a genetical history that would require a 1,000-year span in human life.

EFFECTS OF RADIATION ON LIVESTOCK

On the morning of July 16, 1945, in New Mexico, a herd of cattle was accidentally exposed to the radiation of the first atomic bomb. Today, biologists of the University of Tennessee, in cooperation with the Commission, are studying the breeding records of some of these same cattle and their offspring and comparing them with normal animals of the same breed. Also, the Tennessee workers are preparing to feed farm animals with radioactive materials and to observe, among other things, how that part of the radioactive food not excreted is distributed among the body tissues and how long it remains. Their major object is to learn whether the milk and meat of such animals is fit for human consumption. They will feed the meat to rats through several generations and compare them with other rats that have been fed with varying doses of radiomaterials. They will then

know how the test rats have been affected, if at all, by their diet. They will observe and record such typical symptoms of low-level radiation injury as altered reproduction and progressive changes in weight, blood composition, and tissue and bone structure.

BIKINI AND NEW MEXICO SURVEYS

In test atomic bomb explosions, scientific events leading up to the explosion and the blast itself are largely of interest to physicists and chemists; the events following the test are largely of interest to the biologists. The medical and biological scientists are concerned with the immediate victims in the plant and animal kingdoms—what species are highly vulnerable and what species are more resistant. Surviving specimens may provide useful information regarding recovery phenomena, and, should any produce offspring, observations can be made on any genetic changes that appear.

Just as interesting as these immediate and striking effects, however, are the data on the lingering radioactivity after water or land explosions and the effects of such continuous radioactivity on plants and animals. The uptake of radioactivity by the land and water organisms and the accumulation of such activity in parts of the body or portions of the plant comprise an important and very extensive field of investigation.

The Commission's New Mexico survey was undertaken under a contract with the University of California at Los Angeles. The purpose of the survey was to measure the radioactivity in and near the site of the bomb explosion and to determine if external radiation hazards exist anywhere in the area. Related problems on soil radioactivity, plant uptake, and the hazards of windblown dust were also studied. Data already available indicate that there are no appreciable hazards of external radiation for men or livestock at the New Mexico bomb site outside of the fenced area of several hundred acres surrounding the actual place of explosion. With the passage of time additional information will be forthcoming.

In August, an expedition sponsored by the Commission, with the assistance of the Department of the Navy, completed a survey of the effects of the atomic explosions on marine plant and animal life at Bikini and Eniwetok Atolls in the Pacific Ocean. The survey was conducted by a party of 12 men under a contract with the School of Applied Fisheries, University of Washington, Seattle, Wash. The Navy provided forward area support, including surface craft, transportation, and housing. The results of the previous survey of Bikini in the summer of 1947 will be correlated and combined with the results of this summer's survey to provide a continuing picture of the effects

of the 1946 Bikini atomic bomb tests on plant and animal life in the lagoon. In various areas of the lagoon, aquatic fauna and flora samples were gathered for preservation by drying, ashing, quick freezing, and by chemical means for laboratory analyses. It is too early to present any conclusive data on the aftereffects of such atomic explosions on plant and animal life. Further studies are being planned for the future.

BIOLOGICAL SYNTHESIS OF RADIOACTIVE SUBSTANCES

Before artificial radioactive elements are used to trace life processes in biological experiments on animals or human beings, they must generally be built into one or another of the chemical compounds which the body typically uses. Therefore, an important step in preparing isotopes for laboratory use in biology is this preparation of biochemical compounds. For many months, AEC scientists at Argonne and Oak Ridge laboratories and elsewhere have been developing the interesting method of administering radioisotopes to plants and animals and allowing the living organisms to synthesize them into natural body compounds which then may be extracted and prepared for tracer laboratory use.

Several Commission laboratories have under way studies designed to test this method thoroughly. Compounds produced include radioactive sugars, starches, amino acids, drugs, and cellulose, all potentially important materials for understanding of the action of foods, drugs, and other substances in biology.

Jerusalem artichokes or sugar beets, for example, growing in an atmosphere containing radioactive carbon dioxide gas develop radioactive sugar in the tubers or roots. In a similar manner, the foxglove plant is made to produce radioactive digitalis; and through biological synthesis, radioactive casein has been produced by cows.

MEDICINE

Within the broad field of radiobiology, the medical program of the atomic energy enterprise concentrates its attention upon the effects of radiation, and also of new elements and various unfamiliar substances, upon human health. Seeking to understand and prevent the harmful effects of radiation is only part of the Commission's task in medicine; equally important are the potentialities for good—for better understanding of diseases, for more accurate diagnosis, and even, in a few cases, for cure. By the end of 1948, an extensive AEC medical program was under way.

RADIATION INJURY

One of the Commission's most pressing responsibilities, of course, is to find out as much as possible, as rapidly as possible, about the injuries that radiation inflicts upon the human body—about precisely how the injuries take place, what parts of the body are affected, what functions are disturbed, how to diagnose the injuries as early as possible, and how to treat them.

All AEC laboratories are conducting studies of these phenomena. At the Los Alamos laboratory, biologists and medical men are searching for the subtle changes in cell multiplication that are characteristic of the effects of low-level radiation. Among other things, they look for alterations in the composition of the blood of workers who may have been slightly exposed, with the object of building up a useful index of degrees of radiation effect. Argonne laboratory is presently concentrating upon the chemical effects, observing the characteristic lowering of blood pressure and changes in the nitrogen content of the blood. Oak Ridge laboratory and Argonne are both studying alterations in the bodily enzyme systems now believed to be affected by radiation injury. It is hoped that through these studies one or more tests may be developed for detecting early radiation injury.

At the AEC laboratory at the University of Rochester a number of drugs and hormones are being tested for their effect in ameliorating the changes characteristic of radiation injury.

OTHER HEALTH PROBLEMS

Radiation is not the only health problem involved in atomic energy work. In any industry undertaking activities with diverse newly important materials there are bound to be certain elements and compounds that are potentially dangerous to the worker. Thus the element beryllium which may be used as a "moderator" to slow down neutrons in nuclear reactions has been of considerable concern. It is now well recognized that beryllium may cause acute and chronic lung disease of a serious nature, and cases have developed in employees of private companies from whom the AEC purchases beryllium. In 1948, accordingly, the Commission initiated extensive studies regarding permissible concentration of beryllium, prevention of injury, diagnosis, and treatment. As a result of these studies, reliable authorities now predict that over 90 percent of the hazard can be removed.

The Commission has such work in progress at Argonne laboratory, the AEC laboratory at the University of Rochester, the Kettering Institute at the University of Cincinnati, and the Saranac Laboratories at Saranac Lake, N. Y.

The University of Rochester laboratory has developed a strong program in industrial toxicology where important information has been collected regarding a number of elements encountered in the atomic energy project. Studies are in progress on the effects of inhaled dusts with particular attention to particle size.

The element plutonium, the product of the Hanford works, may cause serious damage to the liver, kidney, and bone marrow if enough of it gets into the blood stream. Scientists at the Los Alamos laboratory have developed an accurate test to detect and measure plutonium excreted from the body and thus to keep a clinical watch over personnel whose work puts them in danger of overexposure. Argonne laboratory has developed another attack upon this problem by demonstrating that the relatively harmless element zirconium will displace large amounts of plutonium in the body and thus eliminate it.

CANCER PROGRAM

The Commission's cancer program deals with all of the relationships between nuclear radiations and the disease. There are three of these relationships generally recognized. In the first place, overexposure to radiation may induce cancer; radiologists in the past have contracted leukemia, a cancerous abnormality of the blood, and research workers are now regularly inducing cancer in experimental animals with radioisotopes. In the second place, radioisotopes used to trace materials in the body are teaching biologists new facts about the nutrition of cancers—about what materials nourish them and make them grow. And, in the third place, medical men today regularly use radioisotopes to diagnose the existence of cancer in patients and, to a limited extent, to treat the disease in some of its forms.

In the fission of uranium atoms a variety of radioactive elements are set free. Studies on these materials as well as on such elements as radioactive strontium and plutonium have revealed that several of these substances localize in bone and may thereby produce bone tumors. Through these studies, information may be obtained about the development of cancer and those factors which inhibit or stimulate such developments.

The Commission has developed its program along four major lines:

(1) *The distribution without charge of radioactive phosphorus, iodine, and sodium for cancer research.*—One of the deterrents to cancer research has been the cost of these materials. To date, under this phase of the program, radioisotopes have been distributed to over a hundred hospitals, medical schools, and clinics in the United States.

(2) *Financial and scientific support for selected research projects in the cancer field.*—By supporting the cancer research of many physicians and scientists through institutional contracts, the Commission directs the talents of skilled investigators toward the applications of atomic energy to the problem. For example, AEC-sponsored research at the Memorial Hospital, New York City, has made an advance in the treatment of thyroid cancers with radioiodine. Metastatic thyroid cancers, i. e., cancers that spread through the body, may pick up radioiodine in amounts sufficient to destroy the tumor partially or perhaps completely. Administration of thyroid-stimulating hormone or removal of the thyroid gland may increase by one-third the number of tumors absorbing radioiodine and thus the number destroyed.

One of the most interesting applications in the cancer field lies in the use of radioactive compounds in the detection of cancer. With the support of the Commission, various fundamental bodily compounds are being labeled with radioisotopes and their uptake by various tumors studied with the anticipation that a compound will be found that will be of diagnostic assistance.

(3) *Clinical cancer research facilities at the installations of the AEC.*—In the chain-reacting uranium pile a number of radioisotopes may be prepared which are so short-lived that it is impossible to distribute them through the country and evaluate their application to cancer research. Therefore, the AEC is establishing facilities at several of its laboratories where these short-lived radioisotopes may be studied. At the Oak Ridge National Laboratory a clinical cancer research facility is being established under the direction of southern medical schools through the Oak Ridge Institute of Nuclear Studies. In May 1948, representatives of these institutions met with AEC staff members in Washington in preliminary discussions. In November 1948, a clinical director of the program was designated. This clinic will receive full financial support from the AEC and will utilize already existing Oak Ridge facilities. The participating medical schools will refer here cancer cases for research, diagnosis, and treatment. A similar facility is planned at the Brookhaven laboratory. At the Argonne laboratory a cancer research hospital is presently under construction.

Further work is needed not only with short-lived radioisotopes but also with the various accelerating devices now available at several AEC facilities. The betatron in which electrons are accelerated at high speed, the high voltage cyclotrons now being developed, and the various modifications of these instruments require intensive study in their relation to cancer. Workers in

the clinical cancer research facilities of the AEC will carry out such studies along with a number of medical schools affiliated with the regional laboratories.

(4) *The work of the Atomic Casualty Commission*, which includes extensive studies on the incidence and types of cancer in the survivors at Hiroshima and Nagasaki.

THE ATOMIC CASUALTY COMMISSION

On May 15, 1946, the Armed Forces Joint Commission for Investigating the Effects of the Atomic Bomb in Japan reported that the medical surveys performed on atomic bomb casualties indicated that a program of investigation should be continued for a long time to come. It was recommended that this program proceed along the following lines:

1. Registry of exposed persons.
2. Establishment of a permanent American Control Commission to pursue further studies which would include—
   a. Hematologic studies.
   b. Studies in the sexual sphere, including sperm counts and genetic aberrations, and sterility.
   c. Studies of possible carcinogenic (cancer-producing) effects.

In November 1946, after the National Research Council and the Surgeon Generals of the Army and Navy had concurred in the proposal, the Secretary of the Navy recommended that the President—

> instruct the National Academy of Sciences, National Research Council, to undertake a long-range, continuing study of the biological and medical effects of the atomic bomb on man and authorize the council to enlist the aid of Governmental agencies and personnel, and such civilian agencies and personnel as might be needed.

Meanwhile the Atomic Casualty Commission held frequent meetings on the scope and development of the program. Information was cataloged regarding the exposure and condition of those individuals exposed and the harmful effects of the atomic bomb. The remaining building sites were surveyed for possible utilization as laboratory facilities. Several scientific groups visited Japan to insure a continuing activity.

AEC and the National Academy of Sciences signed a 2-year contract in May 1948 covering—

> studies and conduct of research and experimental investigations, primarily in Japan, in accordance with general programs approved from time to time by the Commission. This shall include investigations of physiological and biological effects of radiation and such work as may be necessary or proper to the carrying out of such studies, research, and investigation, and also the compilation and dissemination of reports relating thereto.

Progress of the Survey in Japan

Since May 1948 there has been considerable activity in this field: in establishing facilities and in accumulating scientific data. Complete laboratory facilities in these studies were planned for Hiroshima and Nagasaki, and Kure. At present laboratories at Hiroshima and Kure are active, and the Nagasaki unit is developing rapidly. Personnel for these laboratories are drawn from the United States and Japan. There are 41 Americans working in Japan, including 16 professional personnel, 15 technical, and 10 clerical. There are approximately 140 Japanese personnel engaged in the units, including physicians, technical assistants, and laborers.

The laboratory at Hiroshima has examined a large number of survivors and has accumulated a considerable amount of data which will serve as a base line in follow-up studies through the years. These data include physical examinations, blood studies, X-ray examinations, and a variety of other studies. Practically all births and all deaths which occur are studied for any evidence of changes that might be induced by overexposure to radiation. A fairly complete list of exposed personnel has been accumulated, and in many instances it is possible to determine the approximate amount of radiation that they received at the time of the explosion. X-ray and detailed measurement (anthropometric) studies are being conducted on the bones of exposed children.

Preliminary Results

These studies reveal in many instances lines of so-called "growth arrest" which could be due to nutritional deficiences or could be related to the atomic explosions. These cases will be followed closely.

Thus far there has been no evidence of any alteration in the offspring of exposed individuals; nor has there been any demonstrable increased incidence of still births or miscarriages. In view of the fact that the gene injured by radiation is a recessive characteristic which can be carried but is not necessarily manifested in the next or many generations, it will be many years before a final statement can be developed on this problem.

There has been a high incidence of keloids, i. e., overgrowth in the scars resulting from thermal burns. Studies on the Japanese exposed to the fire bombings at Tokyo also reveal a higher incidence of these keloids which are apparently a racial trait rather than an atomic sequel. During the summer two American specialists studied this and related problems and were impressed with the incidence and extent of the thermal burns as evidenced by the scarring.

A long-term study on the effects of the atomic explosion on fertility is being undertaken. Survivors are also being studied for signs of cancer.

Agencies Work Together

The development of this project has benefited measurably from the wholehearted cooperation of several agencies. The United States Army has three medical officers on loan to the Atomic Casualty Commission; the Public Health and Welfare Section, General Headquarters of Supreme Commander Allied Powers, has given wholehearted cooperation; all charts and specimens are filed by the Army Institute of Pathology; and the United States Navy has actively assisted in the work of the Casualty Commission.

Biophysics

In nearly all Commission work, both research and production, potentially hazardous radiations are a major problem. Although the biological effects of these radiations have been studied intensively for only a relatively short time, there is good reason to believe that they are entirely controllable hazards. During the entire period of operation of both the Manhattan project and Atomic Energy Commission there have been a total of 13 injuries, with only 2 deaths due to radiation, and in each instance known safety devices were not fully utilized.

The Applied Biophysics Branch was established in Washington with the major objective of constantly studying such radiations to learn how to minimize their effect on operations. First is the problem of detecting the presence of such radiations; second, the problem of shielding the operators; third, the problem of determining safe permissible radiation to which operating personnel may be continually exposed; and fourth, the problem of adequate safeguards to protect the surrounding environment against radiation from atomic energy establishments. While the day-to-day concern is for the individual worker, and the protection of environment adjacent to atomic energy installations, the results carry much further by providing a substantial amount of information which can be applied in such directions as civilian defense.

THE BIOPHYSICS PROGRAM

All AEC installations conduct extensive biophysics projects—"health physics studies"—which vary from project to project to conform to many different radiation problems. Thus, separate research organizations are required at each establishment, to insure (1) that the programs at the various installations are adequate for their own purposes and (2) that the programs are sufficiently coordinated to prevent any unnecessary duplication.

Potential radiation problems which must be controlled come from two major sources: (1) Reactor and particle-accelerator operations

including isotope production and the chemical treatment of radioactive isotopes and (2) the handling and disposal of waste containing substantial amounts of radioactive material.

At many of the AEC projects there is a unique industrial waste, radioactive materials. While these are somewhat similar to ordinary industrial wastes, they always present the possibility of radioactive contamination. The great majority of waste disposal problems are engineering in nature. However, the setting up of maximum permissible levels of radiation and the measuring of radioactivity in the waste are biophysics functions.

Surveys at AEC Installations

The Commission has surveys under way at all of its major installations to determine precisely the steps that need to be taken to safeguard the surrounding areas—to determine, for example, to what extent conventional waste disposal plants and water treatment plants are effective in removing radioactive materials. The Oak Ridge National Laboratory, the Tennessee Valley Authority, United States Public Health Service, and the Geology Department of the University of Tennessee undertook such a survey of the surrounding area in 1948. At Los Alamos, the United States Public Health Service and the University of California are assisting in similar work. Other universities are cooperating in these surveys at Hanford and other installations.

Control of Radioactive Wastes at Brookhaven

At the Brookhaven laboratory an extensive program is under way to study the general environment of the area adjacent to the laboratory—the geological formations, water tables, meteorology, and adjacent animal life. The laboratory is developing and putting into effect methods of control to insure the safe operation of the nuclear reactor now under construction. The Weather Bureau and the

utilized with cobalt. As soon as these problems are solved, it is reasonable to expect that cobalt 60 will be available for therapeutic purposes to a much larger number of medical centers than are now in a position to afford radium for the same purposes. Consequently, considerable effort is being put in this direction.

In general, the Commission is making a careful, Nation-wide study of the biophysics programs relating to the utilization of penetrating radiations. It reviews requests for grants made for such projects and at the same time is endeavoring to initiate projects in especially suitable institutions to fill in the gaps of our scientific knowledge.

Training Program

The critical shortage of scientific personnel qualified to work on atomic energy problems in biology, medicine, and biophysics made it necessary for the Commission to take the initiative in the development and support of a comprehensive training program. The objectives of this program are to train new personnel for the Commission's programmatic research at AEC installations; to increase the national pool of trained personnel in these fields for work in industry, universities, hospitals, and other institutions; to increase the efficiency of personnel now active in these fields in the Commission's program, and outside it, by providing on-the-job training programs for Commission personnel and cooperative training programs for other personnel, including members of the armed services.

TRAINING AND FELLOWSHIP ACTIVITIES

Fellowship Program

During 1948 a total of 98 fellowships were awarded in the field of biology and medicine under the AEC fellowship program described on page 65. All told, 350 annual fellowships were established for postdoctoral study and research in the medical, biological, and agricultural sciences, for predoctoral study in the biological sciences, including health physics, and for training in health physics at the technical level. The Commission intends to make annual awards as follows: 100 postdoctorals in medicine; 50 postdoctorals in biology; 175 predoctorals in biology and health physics; and 25 technical fellowships in health physics. By November 1948, the following awards had been made: 27 medical postdoctoral; 5 biology postdoctoral; 48 predoctorals in biology and health physics; and 18 technical fellowships. With an increasing number of applications from well-qualified applicants it is expected that the program in 1949 will be operating at its maximum proposed level.

University Training Centers

The Commission has given support during 1948 to two or more universities in each of four broad geographical areas for the development of cooperative training centers. These programs are uniquely suited to offer indoctrinal training to AEC fellows in the first semester in each academic year. (Under the fellowship program fellows are not confined to these training centers; they are allowed to pursue their study and research in universities or other nonprofit institutions of their choice as approved by the NRC boards.)

The joint participation by the universities allows for the utilization of key personnel and resources at each university. It also makes it possible to integrate medical and biological training with basic courses in physics, mathematics, and chemistry and to develop well-rounded indoctrinal training in the techniques of radioisotope research applicable to medical and biological problems. Each of the universities, as an integral part of its training program, is conducting research which is also important to the Commission for increasing knowledge in the fields of biology and medicine. The cooperating universities are as follows:

I

Duke University, Durham, N. C.
University of North Carolina, Chapel Hill, N. C.
North Carolina State College of Agriculture and Engineering of University of North Carolina, Raleigh, N. C.
Bowman Gray School of Medicine, Wake Forest College, Winston Salem, N. C.

II

Baylor University College of Medicine, Houston, Tex.
Rice Institute, Houston, Tex.

III

Oregon State College, Corvallis, Oreg.
University of Oregon Medical School, Portland, Oreg.
College of Liberal Arts, University of Oregon, Eugene, Oreg.
Reed College, Portland, Oreg.

IV

University of Denver, Denver, Colo.
University of Colorado, Denver, Colo.
University of Colorado, Boulder, Colo.

COOPERATING WITH THE ARMED SERVICES IN TRAINING

Eleven officers of the National Military Establishment are taking courses established at the AEC training centers. The Commission will also provide a 6-month supplementary training course for this group at one of its national laboratories. The training is being given to prepare these men for their work in radiological safety with the armed forces.

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TECHNICAL FELLOWSHIPS

The Commission is supporting special training programs for technical fellows at University of Rochester Radiological Laboratories and the Oak Ridge National Laboratory. The teaching program will consist of courses in biology, chemistry, mathematics, applied biophysics, industrial hygiene, and sanitary engineering. This portion of the work will be carried out over an 8- or 9-month period, corresponding approximately to a school year, and will be supplemented by practical laboratory experience in the use of radiological instruments. Following the teaching program will be a 3- or 4-month work program, where the fellows will be assigned to plant operations at Commission installations. In this phase they will be given practical training experience in radiation monitoring and health-physics techniques such as are required in the AEC plant. At the moment it is estimated that there is a critical need within the AEC alone for approximately 250 people having sufficient training. It is accordingly planned to step up the technical fellowship training program next year in order more nearly to fulfill the demand.

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PUBLIC AND TECHNICAL INFORMATION SERVICE

Introduction

One of the five major programs which the Atomic Energy Act of 1946 directs the Commission to carry on is "a program for the control of scientific and technical information which will permit the dissemination of such information to encourage scientific progress . . ."

The Congress in imposing this duty recognized that under the system of atomic energy development set up by the act the Commission is the main source of most newly developed technical information about atomic energy. It carries the responsibility for determining what categories of information may be generally published and what categories must be limited in circulation in the interest both of control of information to safeguard the national defense and security and of dissemination to bring about scientific advance.

On undertaking in 1947 the development of the information program prescribed by the act, the Commission took into account the needs of various groups for information. The scientific and technical workers in the employ of the Commission or of contractors require technical information in order to perform their work most quickly and surely. Some of this information under the terms of the Atomic Energy Act of 1946 is restricted data. This must be classified and distributed only to those requiring it in their duties. Some, after examination, may be declassified. Some is clearly unclassified from the beginning.

Scientists and technicians and business executives not directly associated with the Commission or its contractors increasingly require information not only for their part in research and in development of atomic energy but also for general advance in research and industrial technology.

The American people need information on atomic energy and the developments in the program. Facts are the only sound basis for citizens' decisions on national policies to guide the control and development of these primal forces.

Measurable progress toward meeting these needs has been made in the past 2 years. Much yet remains to be done before there is a satisfactory service of information—a service that conforms to requirements of the act prescribing both secrecy respecting some phases of the program, and the issuance of all information which can be released without harm to the common defense and security.

Operations of the Declassification System

At the root of this matter are the policy and the operations for defining what information must be classified and held out of general circulation and providing for declassification of information which does not contain restricted data. The Commission took over from the Manhattan project a system established in 1946 pursuant to the report of a committee headed by the late Dr. Richard C. Tolman, of the California Institute of Technology. The Tolman committee defined the principles for determining what matter must be classified and what may be generally issued. Under this system, an official of the laboratory or plant where information originates makes the first determination as to its suitability for declassification. If this first determination is favorable, the paper is then referred to a Responsible Reviewer qualified in the field of science with which the information deals. This reviewer makes an analysis based on the Declassification Guide. This analysis may result in declassification of the document, or item of information, or it may mean denial of clearance. In case of doubt, the question is referred to one of four senior scientists designated as Senior Responsible Reviewers.

In addition to emphasizing control of the dissemination of scientific and technical information in such manner as to encourage scientific progress, the act declares the policy of the Commission to be to "control the dissemination of restricted data in such manner as to assure the common defense and security." In section 10 (b) (1), restricted data is defined as follows:

> "The term 'restricted data' as used in this section means all data concerning the manufacture or utilization of atomic weapons, the production of fissionable material, or the use of fissionable material in the production of power, but shall not include any data which the Commission from time to time determines may be published without adversely affecting the common defense and security."

Four Major Steps in Information Policy

The Commission, starting in 1947, has taken a number of steps to clarify policies and guide information operations in accordance with the act. These include:

1. Designation of unclassified fields of research related to atomic energy. These fields are generally free of any security restriction.

2. Two over-all revisions of the Declassification Guide originally prepared under the Manhattan Engineer District. These revisions were made jointly with the declassification authorities

of the United Kingdom and Canada. These nations were joined with the United States in the wartime atomic energy program, and in peacetime are following identical declassification policies with respect to information jointly held. The Declassification Guide states for each nation the general topics of data which may be made public without adversely affecting the common defense and security.

3. Adoption, with the National Military Establishment, of a joint classification guide for the military application of atomic energy, with special provision for the handling of data primarily of a military operational nature.

4. Action to develop more precise and more flexible methods of determining what information must be withheld from general publication and what may be publicly issued.

The Commission has undertaken to designate unclassified areas of research and development work related to atomic energy as a means of aiding the progress of atomic energy research and development in several ways.

The Commission recognizes that advance depends in part upon a wide range of research work done without stimulation or assistance by government.

Likewise, staffing of atomic energy projects is hampered so long as there is feeling on the part of many scientists that employment in the atomic energy program precludes their working on any but "classified" research projects with consequent denial of general publication.

Finally, sharper definition of unclassified areas makes clearer what must be held restricted, and reduces the number of documents unnecessarily classified. Thus confusion is cut down, the will to protect classified information is strengthened, and security is enhanced.

It is the Commission's intention to define and announce further unclassified areas.

BASES OF THE CLASSIFICATION-DECLASSIFICATION SYSTEM

The AEC Declassification Guide at present lists some 60 categories of scientific and technical data under which information must remain classified; the guide also lists an equal number of fields or topics under which information can be released. Scientists and laboratory directors, applying the guide, have cleared for release more than 2,600 scientific and technical papers on atomic energy work.

For the greatest value to scientists, the declassification program needs to be clearly understood. The present Declassification Guide, however, must itself be classified because it specifically indicates the importance in the national atomic energy program of a wide range of

data having to do with production of fissionable materials or production and use of weapons.

The following lists of topics* indicate generally the present content of:

(*a*) Unclassified areas—the types of work that can be conducted and reported on an unclassified basis in the atomic energy program in AEC or non-Governmental facilities;

(*b*) Declassifiable information—that which may be published for general use after being officially declassified; and

(*c*) Clearly classified information—that currently held as restricted data under the Atomic Energy Act.

Unclassified Areas

In general, item (a), the unclassified areas, covers the pure science related to atomic energy but not plant processes or specific experimental data of vital project importance. It includes:

(1) Pure and applied mathematics, except that applying to specific classified projects.

(2) Theoretical physics (except the theory of fission, of reactors, and of neutron diffusion, and weapon physics).

(3) All physical (except nuclear) properties of all elements of atomic number less than 90. Nuclear properties of most isotopes.

(4) The basic chemistry of all elements (except for the analytical procedures and technology of the production of fissionable materials) and the physical metallurgy of all elements of atomic number less than 83.

(5) Instrumentation, including circuits, counters, ionization and cloud chambers, neutron detectors (excluding fission chambers), electronuclear accelerators, such as cyclotrons, betatrons, Van de Graaff generators, etc.

(6) Medical and biological research and health studies (excluding work with elements of atomic number 90 and above).

(7) Chemistry and technology of fluorine compounds (except the specific applications in AEC installations).

Declassifiable Information

Item (b), the declassifiable information which may be expected to be found in the general literature after official declassification,includes:

(1) Most reactor and neutron diffusion theory, except for those parts involving semiempirical methods or related to specific assemblies.

*The reader of this report cannot take these lists of topics as an exact statement of types of data which are unclassified, classified, or declassifiable. The lists are indicative only. The complete lists, as stated earlier, are themselves classified. Writers, editors, publishers, or speakers intending to make public matter related to atomic energy, who are uncertain about classification status, should query the Declassification Branch, United States Atomic Energy Commission, Washington, D. C. They should not try to make their own evaluation on the basis of these partial listings.

(2) Certain physical properties of isotopes of elements of atomic number greater than 90, and the nuclear properties (except for certain neutron and fission characteristics) of isotopes of elements greater than 90.

(3) Analytical procedures (except for production applications); most physical and process metallurgy of elements of atomic number greater than 90.

(4) Medical and biological research and health studies with elements of atomic number 90 and above.

(5) Certain properties of experimental reactors, such as: fluxes, neutron distribution not revealing lattices and information regarding thermal columns, and the velocity spectrum in the thermal column.

Classified Information

The types of information covered by item (c) are clearly classified information:

(1) Information on the production of fissionable material—equipment used, technology, handling, and disposition—including the technology of production of feed materials—and specifically all quantitative and qualitative output data.

(2) The technology of production and power reactors, including design, operating characteristics, and working materials.

(3) Information dealing with nuclear weapons and their components, including production technology, handling, disposition, testing, and technical data relating to military employment.

(4) Certain information relating to the operations and facilities of the United States atomic energy program which may be of value to an enemy in sabotage planning, or in studies of the strategic vulnerability of the United States or defense potential of the United States with respect to atomic weapons.

Upon inspection of these lists it will be seen that much scientific and technical information in the field of atomic energy is now open to those who wish to use it. There is, however, much to be done before all the requirements for the atomic energy information program are met. The Commission has directed that there be a continued vigorous effort to define precisely the standards for release and for classification, and to issue information that may be released, in accordance with the requirement of promoting the national interest by both protecting security and speeding technical advance.

More than 100 scientists and technicians working in the declassification program as Responsible Reviewers and four as Senior Responsible Reviewers are in the main responsible for the progress made so far. Their work is an important service to the Nation and the Commission counts on their continued cooperation for further advance.

PROVISION OF INFORMATION TO ARMED FORCES

A special problem in classification of information has been largely solved within the past year. This is the problem of providing to the armed services, in a manner consistent with the objectives of the security provisions of the Atomic Energy Act, certain types of information required in the conduct of military training operations.

A great deal of information which concerns the use of atomic weapons has to do solely with the military employment of atomic energy and not with the development or manufacture of fissionable materials and weapons. For example, information as to certain special equipment used on drone planes taking samples at bomb tests is information "concerning the utilization of atomic energy," but it is information of slight importance in the actual development or manufacture of a weapon. The importance of such information to a foreign rival can be readily evaluated. Such evaluation indicates that while full control of dissemination of the data is desirable, it is not possible to require FBI investigation of every person having access to such data. For instance, it would not be feasible to have FBI investigation of all the service and maintenance personnel at every airport where any drone or other specially equipped aircraft may be landed.

The Commission, at the request of the National Military Establishment, approved a plan for distribution within the NME of certain topics of information having to do principally with the handling of the weapon by military contingents—as opposed to development and production of weapons. Restricted data of this category may be distributed within the armed forces and in their contractors' organizations where needed under the degree of control necessary to assure the common defense and security by using a grade of security classification agreed upon by the Commission and the National Military Establishment. For this purpose, the Commission employs the same classification grading system used by the National Military Establishment.

This action followed extensive discussion between the National Military Establishment and the Commission concerning the operational necessities for a broader dissemination of certain types of restricted data. The Military Liaison Committee informed the Commission that the three departments of the National Military Establishment were severely handicapped by current clearance requirements for dissemination of those items of restricted data which relate directly to the military employment of the weapons, as opposed to the development and manufacture of weapons.

It was their view that the military operational phases of the atomic energy program required wide dissemination of these types of re-

stricted data, and that such necessary dissemination was a practical impossibility when subjected to current clearance requirements. (See Chapter VI, footnote page 121 on military clearance.) Accordingly, they proposed for the Commission's consideration the adoption of a "Classification Guide for the Military Application of Atomic Energy." This Classification Guide differentiated between two categories of restricted data: (1) Those to which an individual under the jurisdiction of the National Military Establishment might not have access until he had a specific "restricted data clearance," and (2) those which the national defense requires be made available under military safeguards without specific restricted data clearance to persons under jurisdiction of the National Military Establishment. The latter category was referred to as "Type B" restricted data.

Weapons Effects Classification Board

In order to have the benefit of expert judgments on this important subject, the Commission, with the advice of the Committee of Senior Responsible Reviewers, convened as a Weapons Effects Classification Board a panel of experts on weapons-effects data to recommend the proper handling of a wide range of such data (see Appendix 2). The information considered by the board is that which the NME and the AEC believe should be distributed under special conditions to support the national defense in both military and civilian activities. These special conditions contemplate the dissemination of Type B restricted data to NME personnel who do not have specific restricted data clearance, provided that the dissemination is in accordance with normal military safeguards.

The report of the Weapons Effects Classification Board was carefully analyzed by the three Services, by staffs of the AEC Declassification Branch, the Division of Security, and the Division of Military Application. The Commission approved the board's recommendations on classification with minor changes. Accordingly, the Commission and the National Military Establishment have adopted an interpretive guide in accordance with the amended report of the board.

The Weapons Effects Classification Board urged that a considerable amount of weapons-effects data be determined to be unclassified, and distributed for use in training of military personnel, and made publicly available. Members of the board agreed to aid in the preparation of such data for publication and to enlist the aid of a number of other qualified military and civilian specialists. The Los Alamos Scientific Laboratory, in cooperation with the board and the authors, has responsibility for recommending to the Commission the contents of such a weapons-effects handbook.

THREE-NATION DECLASSIFICATION POLICY

As a continuation of the policy of cooperation with respect to information shared by the United Kingdom, Canada, and the United States, as a result of their combined wartime efforts, the second International Conference on Declassification was held on September 6–9, 1948, at Harwell, England. This conference was concerned with a discussion of the interpretations to be placed on certain topics of the Declassification Guide, in the light of technical developments and of the experiences gained during the months in which the Declassification Guide, drawn up at the first international meeting, had been in use in the three countries. As before, discussions at this conference were limited to technical knowledge held jointly by the participating nations as a result of their cooperation during the war.

Issuance of Technical Information

While progress was being made in classification and declassification policies and operations, a parallel advance took place in the development of the Commission's organization and program for handling and distributing technical information to scientists and technicians inside and outside the national atomic energy program.

By the end of 1948, the technical information staffs of the Commission and the contractors had sorted, indexed, published, and distributed within the atomic energy enterprise most of the large backlog of informational papers built up during the war. During 1948, the results of current research were handled for both on-project and off-project distribution as they were received. The first physical task of catching up on distribution of technical information had been nearly completed by the end of the year.

CLASSIFIED REPORTS

Of continuing high importance is the distribution of restricted data to all those working in the project who need it and are authorized to have it. During 1948, over 3,000 individual classified reports were distributed. An average of 50 copies of each report went out. Each laboratory and plant received those categories of information required for its programs. Besides this routine distribution, 50,000 individual copies of classified reports went on specific order to various laboratories.

To improve the usefulness of classified research reports in a field of great activity and many workers, the Commission established in 1948 a classified "Journal of Metallurgy and Ceramics of the Atomic Energy Project." This is issued three times each year. More such

journals are planned to insure that the scientific worker on the atomic energy project may study classified project results in a form as convenient and useful as possible.

Other technical information services supplying classified information to scientists and technicians on the project were expanded throughout 1947 and 1948. This special group of services includes a classified abstract journal which carried 2,400 abstracts of classified reports in 1948 and a classified title list which last year carried 5,500 titles of papers.

OPEN ABSTRACT SERVICE

Scientists and technicians in the atomic energy program need more than classified material alone. They also require quick access to a wide range of declassified and unclassified papers originating either inside or outside the program. To provide them with this service, the Commission in 1948 established a semimonthly publication "Nuclear Science Abstracts." In its first 12 issues, to the end of 1948, it carried a total of 1,800 abstracts. It is in wide demand from Government agencies, cooperating universities and research laboratories, depository libraries of the Library of Congress and other institutions of service to scientists outside the atomic energy project. The demand from hospitals, medical schools, and medical research institutes during the year reached such a point that a special distribution to 1,200 such institutions was undertaken as a permanent part of the circulation. The publication is available for sale to the technical public on subscription basis.

A very detailed index of current material in "Nuclear Science Abstracts" and semiannual cumulative indexes of abstracts to serve as a key to the unclassified literature of nuclear science, are produced quickly and economically through the machine records system. This system is also used to maintain permanent inventories of the nearly 25,000 classified documents now registered.

The abstracting of the backlog of declassified documents which appeared before 1948 was completed during 1948. A total of 2,023 abstracts was made and a cumulative index of them issued.

NATIONAL NUCLEAR ENERGY SERIES

A major event of the past year in the technical information program was publication of the first volume of the National Nuclear Energy Series (formerly Manhattan Project Technical Series), a 110-volume compilation of scientific treatises based primarily on research started and carried out for the most part under the Manhattan project. Columbia University, representing the Atomic Energy Commission

and its research contractors, executed a contract with the McGraw-Hill Book Company to publish the declassified volumes of this series, which are expected to number about sixty 500-page volumes. During 1948, 14 volumes were declassified. The first of these volumes, "The Histopathology of Irradiation from External and Internal Sources," was put on sale late in December 1948.

Classified volumes to be reproduced and distributed to project personnel in accordance with security requirements also number approximately 60 volumes. Of these 24 are now at hand in the process of editing and reproduction.

PROGRESS IN RELEASING INFORMATION

Although the Commission is not satisfied that the rate of progress in declassification is rapid enough, declassification of atomic energy project information did continue at a steady pace during 1948. About one-third of the 900 documents declassified were for inclusion in the NNES. In addition, 870 documents were published in edited form in various scientific and engineering journals. The Commission reproduced and distributed to project libraries, Government agencies, the Library of Congress, and the depository libraries authorized by the Congress nearly 800,000 copies of more than 1,000 separate documents during 1948. These figures include a large number of documents declassified before 1948.

The Commission also reproduced a number of pertinent declassified reports in the field of nuclear science originating outside the project. Among these were 96 reports from the British and Canadian atomic energy research establishments. By agreement with the British and Canadians these were declassified in accordance with the same policies used in the United States and 19,200 copies were made available throughout the project.

Many declassified documents were made available for sale by the Commission under an agreement with the Superintendent of Documents. In keeping with the Commission's policy of encouraging the use of normal channels for the release of scientific and technical information, only documents not intended for publication in the NNES, or in technical journals, were sold by the Commission for the Superintendent of Documents. The Commission sold, in all, 42,000 documents during the year.

Late in 1948, a procedure was approved for the issuance by contractors of unclassified research reports in certain scientific fields, where it was agreed that the laboratory directors concerned would determine that these contain no restricted data.

REPORT INDEX

All Commission reports, classified, declassified, and unclassified, were carefully indexed during the year, to facilitate the location by project scientists and librarians of information on special subjects contained in them. An average of six index cards was prepared for each document issued. This indexing operation was on a current basis during 1948 and progress was made in eliminating the backlog of unindexed reports accumulated during the war years. During the year, 5,700 reports were indexed and 1,712,000 index cards were distributed to laboratories of the atomic energy project. It is planned to make the declassified and unclassified cards available for sale outside the project as soon as reproduction facilities are available.

INTERCHANGE OF INFORMATION WITH THE ARMED FORCES

Liaison between the Atomic Energy Commission and the National Military Establishment with respect to interchange of scientific and technical information was improved during the year. The Research and Development Board established a Special Committee on Technical Information with an AEC representative as an associate member. The committee established a panel to study the interchange of information between the National Military Establishment and the Commission, and this panel accomplished a great deal in promoting such interchange. Informal contacts between AEC and NME representatives were also fruitful. In particular, arrangements were made for abstracts originating in the Commission's abstract publications, the Navy's "Technical Information Pilot," and the Army's "National Defense Review," to be used in the others. Much information in pertinent fields now appears in all three of these abstract publications.

EXHIBIT

To acquaint the world of science and technology with the resources of technical information in nuclear science fields available through the Atomic Energy Commission, a technical information exhibit was prepared and shown at key scientific meetings during 1948. This exhibit brought to the attention of a large number of scientists the resources of nuclear science information available.

Public Information and Education Service

Upon assumption of responsibility by the Commission, the public information service had to be developed from the beginning made in the postwar period by the Manhattan project. The Commission has set up a small staff to provide such service, which is increasingly in demand.

In order to provide a basis for the determination of public policy on atomic energy, there is a need for information on the operations and the plans and prospects for the national atomic energy program insofar as these matters can be publicly reported. The Commission's public information program is based on the provision of such facts to the existing agencies of public communication—the press, the radio, schools, organized groups, and others.

Citizens also seek help in learning about the basic physical phenomena involved in the release and control of atomic energy. This information is available from many sources other than the Commission. Organizing it and putting it into form for use in the schools and organized groups is not a prime function of the Commission. In the American tradition, this function, along with the function of presenting and discussing the issues of public policy that rise in this field belongs to the educational and information institutions of a free people.

WORK WITH EDUCATIONAL ORGANIZATIONS

With limited information staff and funds for educational and informational materials, the Commission has given as much aid as possible to educational agencies and services.

Educational Institutions

The Commission consults with the Interdivisional Committee of the United States Office of Education, which is developing a program of interchange of information on programs and methods used in teaching atomic energy in schools and colleges, and of stimulating the spread of good teaching in this field throughout the educational system.

The Association of Secondary School Principals and the North Central Association of Secondary Schools and Colleges have issued guides for organization of study within the secondary schools on atomic energy and its implications. Commission representatives have assisted, but the guides for use in the schools have been issued on the responsibility of these groups and the entire projects have been financed by the groups. The Commission is cooperating with the National University Extension Association, the Commission for Adult Education, American Council on Education, and many others.

At the request of the American Textbook Publishers Institute, the Commission in 1948 undertook the preparation of a Source Book on Atomic Energy. This is intended to be an authoritative treatment of the basic science and technology of atomic energy for use by authors of textbooks and educators generally in all scientific fields to enable them to incorporate in their texts and course work such changes as have been made necessary by recent advances in nuclear science.

Also under preparation in 1948 was a handbook or guide for the use of employees of the Commission and contractors. This guide will appear in three parts. The first will consist of a primer of the atomic energy facts needed for understanding the operation of the national atomic energy program. The second part will be a glossary of terms used in atomic energy and on the atomic energy project. The third will consist of a description of the purposes, the facilities, and the potentialities of atomic energy development in the United States.

In the field of research into the social, economic and political implications of atomic energy, and the development of teaching programs on these matters, the Social Science Research Council is becoming active in the field of atomic energy. Commission representatives are cooperating with the Council's Committee on the Social Implications of Technological Change by providing factual information.

Civic Organizations

The educational work of civic bodies has tended to center on the organization of atomic energy weeks or similar occasions, or the introduction into the programs of other larger civic occasions of an element of instruction in atomic energy. For this purpose, there has been a persistent demand from all quarters for the provision of educational exhibits showing the organization, and operation of various phases of the national atomic energy program, prospects for peacetime uses of atomic energy, and fundamental physical and biological fact about atomic energy. The Commission has authorized its contractors, where they desire, to provide exhibit material for educational purposes.

The Brookhaven National Laboratory has two special exhibits of this type which have been widely shown in eastern cities. The Ames Laboratory provided such an exhibit to the Iowa State Fair in the summer of 1948. Various of the industrial contractors constructed units portraying atomic energy program details and prospects which were assembled for the New York City Golden Jubilee Exposition under the auspices of an Advisory Committee on Atomic Energy appointed by the mayor of New York City. Later these units were shown in Cincinnati under the auspices of a Mayor's Advisory Committee on Atomic Energy. These exhibit materials have been requested for an Oak Ridge educational center to be operated by the University of Tennessee Extension Service to provide educational materials for the visitors expected at Oak Ridge when the town is opened and to be used also as a facility in a South-wide public educational program to be carried on in cooperation with the Oak Ridge Institute of Nuclear Studies.

Special exhibits have been constructed for use at scientific meetings portraying the biological and medical phases of the national atomic

energy program, as a means of speeding the fellowship training effort, and for use at technical meetings showing the new developments in instrumentation related to atomic energy.

In all, attendance during the past 18 months at exhibits for which the contractors or the Commission provided units is estimated at more than 4,000,000.

Program for Films

The educational film makers have been brought together by the American Council on Education to develop a program for production of teaching films on the fundamentals of atomic energy which will be available for purchase by school systems and groups. The commercial motion-picture industry is considering films on the Nation's atomic energy industry and the prospects for application of atomic energy. Documentary film makers are interested in the field and projects are under formulation.

COOPERATION WITH PRESS AND RADIO

The function of the press in informing the public about atomic energy is threefold—(1) in its feature services, the press (including periodicals) carries a considerable volume of explanation of the fundamental physics, chemistry, and biology of atomic energy put in lay terms; (2) in its news reporting the press chronicles the developments in the atomic energy program and outside it which have public importance; (3) in its editorial comment the press presents views to aid citizens in making up their own minds on what public policies should be.

The press calls upon the Commission organization for assistance in the first and second function. The assistance desired is of two forms—first, facts; second, security guidance as to what may be reported and what should be withheld in the interest of national security.

For the provision of facts to the daily and periodical press and to the other media of public information—radio, picture services, etc.—the Commission's small public information branch in Washington and one- or two-man staffs at each of the five offices of operations in the United States are responsible. These men all have additional duties besides servicing the public media. However, their first responsibility is giving that service. The demands have grown steadily.

Besides reporting current developments in the atomic energy program, the public information officers give special service to writers and editors who wish to check the accuracy of unclassified but scientifically and technically complex facts on atomic energy to be used in news stories, feature articles, broadcasts, talks, etc.

Use of Commission's review service is not compulsory. Newsmen, broadcasters, or speakers anxious, however, to be accurate and to protect the national security, are availing themselves of the service in increasing numbers.

PRESS SEMINARS FOR REPORTERS, EDITORS

The press is making a special effort to develop a body of newsmen trained and qualified in the facts of atomic energy so that they may do an accurate and serviceable job of reporting and interpreting. The American Society of Newspaper Editors at its annual meeting in April 1948 authorized a special committee to work out ways and means of holding training courses for press men in the fundamentals of atomic energy and its implications. The first of these courses is scheduled for January 1949 in Minneapolis. The Commission is cooperating with the Society of Newspaper Editors and is ready to cooperate similarly with other organizations of the public communications media.

The technical and business periodicals as a group perform a tremendously important service in the atomic energy program, keeping the industrial groups whose participation in the program is essential to its success informed of new developments, their meaning, and the possibilities they offer for cooperation of industry. The Commission has made a special effort to serve this group. Important during 1948 was the organization of a visit to the Oak Ridge installations and the Commission offices in New York and Washington by a group of 25 editors of the leading periodicals in the metallurgical and chemical fields.

For the use of all media as well as of individual readers, the Commission sees a need for the development of special reports stating all that can be revealed about various phases of the atomic energy program. The statutory semiannual reports to the Congress are of basic importance, but there is a continuing requirement for much more frequent and detailed reporting. The Commission has instructed the General Manager to prepare special reports at periodic intervals throughout the year dealing with topics of special interest or for which there is a need for more detailed information.

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VI

SECURITY

Introduction

The objectives of security in the Atomic Energy Commission are to assure the safekeeping of information which the Commission has decided cannot be released without endangering the common defense and the safety of the Nation and to protect the plants and installations of the Commission and its contractors in order that research and production programs may not be interfered with or valuable materials lost.

To achieve these objectives, the Commission has built up three interdependent programs: One, *personnel security*, to determine the eligibility for security clearance of all employees of the Commission, and of those employees of its contractors or licensees who are to have access to restricted data; a second, *physical security*, to prevent unauthorized access to installations, materials, and information, and to protect such property against sabotage, espionage, and theft; and a third, *document and information control*, to systematize and enforce procedures by which classified information—whether in documentary or spoken form—is withheld from unauthorized persons.

Personnel Security Program

To protect the vital scientific information and the physical facilities essential to the Nation's preeminence in postwar atomic energy development, the Congress established, in the Atomic Energy Act of 1946, a strict procedure for determination of the eligibility of all workers in the program. The act provides that no individual shall be employed by the Commission, except in emergency situations, until the Federal Bureau of Investigation has made an investigation and report to the Commission on his character, associations, and loyalty. It also provides for such investigations and reports in the case of those employees of contractors or licensees who are to receive access to restricted data. The Commission is then responsible for determining, on the basis of this report, that "permitting such person to have access to restricted data will not endanger the common defense or security." The Commission's determination must be made not only for new applicants for employment but also for the many thousands of workers who had been given access to atomic energy

information during their wartime and postwar employment in the Manhattan project.*

During the first 2 years of the Commission's operation, the FBI has investigated, and the Commission has taken subsequent action on, more than 100,000 candidates for clearance. The number of people employed by the Commission itself is small and the turn-over among them relatively low. Also, employment among the operating contractors is relatively stable. But construction workers are being replaced continuously, and some of these must also be cleared. The record of the building of the K–25 plant at Oak Ridge is an indication of these conditions: Maximum total of construction workers at any time was 25,000, but more than 125,000 were actually hired while the job was going on.

DEVELOPMENT OF CRITERIA

Out of the more than a hundred thousand decisions made on employee clearance since January 1947, fewer than 2,000 have involved serious questions concerning eligibility; but the administrative burden of these decisions has been very great. Definitive criteria for the purpose—standards of judgment which would at the same time be safe for the Nation and fair to the applicant—had to grow out of experience in handling individual cases. It was therefore necessary to prepare a detailed analysis of every case that raised a new problem, in order that the decision might serve as a basis for Commission policy on later cases of the same type.

Responsibility for decisions is peculiarly grave. The Commission must determine from the reported information on character, associations, and loyalty whether the applicant or employee would be a risk to the national safety if permitted access to restricted data. In the great majority of decisions, loyalty—allegiance to the United States and belief in its form of government—is not in question. Associations have a bearing on eligibility for clearance, but the Commission must

*The Atomic Energy Act provides for the security investigation and clearance of employees of the Commission. The act further provides that Commission contractors shall agree in writing not to permit any individual to have access to restricted data prior to investigation and clearance of such individuals. However, the act contains no specific provisions regarding investigations and clearance of National Military Establishment personnel who gain such access by means other than through contractors or employment in the Commission and need the knowledge in the course of their duties. For investigation and clearance of these personnel, the Commission and the National Military Establishment have agreed on procedures which, in general, provide that the National Military Establishment will conduct the investigation and rule on clearance; the Commission reserves the right of review and audit. Furthermore, in the exercise of its general authority to control the dissemination of restricted data in such manner as to assure the common defense and security, the Commission has approved the dissemination of certain limited categories of restricted data within the National Military Establishment without requiring specific restricted data clearance for persons having access to this data. (See ch. V, p. 111, for further information on the dissemination of restricted data within the National Military Establishment.)

consider them only as a significant part of the information on the candidate's character. Since the candidate's character as a whole must be considered, each case presents a separate problem.

To make these analyses, the Commission employed and consulted experts with experience in investigating espionage, sabotage, and subversion, who had demonstrated their knowledge of the principles of fair procedures. Decisions made over a period of months gradually built up and refined a systematic catalog of the kinds of information which serve to warn that a person under investigation might be a risk to the common defense and security. In 1948, it became possible to delegate to the regional managers of operations the responsibility for screening cases—to grant clearances where no doubt existed, to refer others to Washington.

During the latter half of 1948, the Commission codified and simplified the results of its experience and, with the assistance of its distinguished Personnel Security Review Board under the chairmanship of the Honorable Owen J. Roberts, developed a set of definitive criteria to serve as guides for determination. The new "Criteria for Determination of Eligibility for Security Clearance" were published in the Federal Register on January 5, 1949. They are not exhaustive, but they contain the principal types of derogatory information that indicate security risk. Category (A) includes those classes of derogatory information that establish a presumption of security risk. A candidate for clearance, for example, who has publicly or privately advocated revolution by force or violence to alter the constitutional form of the government of the United States is presumed to be a security risk if the evidence is sufficient to establish reasonable belief. Category (B) includes those classes of derogatory information where the extent of activities—the attitude or convictions of—the individual must be weighed in determining whether a presumption of risk exists. If, for example, there is substantial evidence to prove that the individual has maintained sympathetic association with members of the Communist Party, the evidence must be carefully evaluated to determine the extent of that association and its importance. (See Appendix 8 for text of criteria.)

GAIN IN EFFICIENCY

As of the end of 1948, the Commission is called upon to handle between 5,000 and 6,000 personnel clearance cases per month. The existence of the new criteria will increase the efficiency and speed of this operation and reduce the administrative burden, although it will necessarily continue to be great. For example, it is now possible to extend to managers of operations the authority to make decisions on clearance in the great majority of cases. Progress is being made, also,

in the elimination of unnecessary requests for security clearance by resurveying and further delimiting those areas which will require security clearance.

ELIGIBILITY HEARINGS

The new criteria will also assist the Commission in dealing with the cases in which doubt as to eligibility for security clearance has been indicated by analysis of the investigative reports. The Commission's Interim Procedure for Administrative Review established April 15, 1948, provides for the notification to the individual of the basis for the question concerning his eligibility for security clearance, and outlines the opportunities provided him for reply and formal hearing, as well as the procedure to be followed by the AEC in finally deciding the case. As the Fourth Semiannual Report states, the Commission is studying the desirability of granting hearings to applicants for employment who have been denied clearance.

Authority to initiate the Interim Procedure for Administrative Review, without reference of individual cases to Washington headquarters, is being granted to managers of operations. The headquarters office will provide staff assistance and will make surveys to assure that the personnel security program is fairly and consistently administered.

PERSONNEL SECURITY REVIEW BOARD

During 1948, the Commission has received much valuable assistance and advice from the AEC Personnel Security Review Board under Chairman Roberts. (See Appendix 2 for membership.) The board has not only served as a board of appeal for cases acted on under the Interim Procedure for Administrative Review; it has also made general recommendations on formulating standards for personnel clearance and the procedures of analysis and review. Now that it has discharged its responsibility for counsel on standards and practice, the members of the board have tendered their resignations to the Commission. It is apparent that another board of similar stature is essential to carry on the work so well begun.

Physical Security

At the close of 1948, there are 1,270 separate plants, laboratories, offices, storage facilities, test areas, and other installations where the Commission must protect restricted information and strategically important facilities and materials. These installations, located in 41 states, Canada, and the Marshall Islands, represent a wide range of diverse security problems, for they include, among other things, laboratories devoted to secret research and development in new fields of atomic energy, offices of scientists containing classified documents

of varying degrees of secrecy, costly giant factories for the production of fissionable materials, and testing areas in the far Pacific. The functions and whereabouts of some are publicly known; the very existence of others is secret. All must be protected against unauthorized intrusion, espionage, theft, and sabotage. Another day-in, day-out security necessity is the safeguarding and protection of routine several-thousand-mile shipments of materials and components of great value and importance.

BUILDING A PHYSICAL SECURITY SYSTEM

When the war ended, the job of physical protection changed radically. While the Nation was still fighting, the very existence of the atomic energy project had been an official secret. The postwar project, however, is permanent, and its protection must be planned for years of safety rather than for months.

This responsibility meant replacement of some wartime buildings and plants, additional construction, and a thorough check of all existing protective measures.

In 1947, the Commission's physical security officers were chiefly occupied with surveying installations, taking quick emergency steps to protect those that had serious weaknesses, and planning the full-scale, long-term protection required by the national atomic energy program. They examined identification procedures, studied guarding systems, picked flaws in shipment and storage methods, recommended hundreds of improvements, and set about ordering necessary equipment and construction. The close of 1948 saw most of the needed changes in effect, including the construction of many miles of chain-link fencing set in concrete and topped with barbed wire; the installation of protective automatic alarms using infrared, photoelectric, temperature, proximity, sonic or circuit disturbance detectors; establishment of tamper-proof identification systems; installation of standby communications systems, and improvement in the quality, training, and arming of guards.

EXCLUSION OF AIRCRAFT

Despite the "danger areas" established over Oak Ridge, Hanford, and Los Alamos during the war, many aircraft continued to fly over these locations, endangering critical installations and constituting security risks. On January 17, 1948, upon the Commission's recommendation, the President issued Executive Order 9925 (see Appendix 11) establishing areas over these three major sites where flights are prohibited unless specifically approved by the Commission. The reflection of this order in official aeronautical charts, widespread dissemination of its provisions, and the cooperation of the Civil

Aeronautics Administration and the armed services in assisting the Commission in taking necessary measures for its enforcement, have materially reduced this security hazard.

ANTICIPATING SABOTAGE

During 1948, as additional insurance, AEC security and technical staffs conducted a comprehensive analysis of the sabotage vulnerability of major plants. They covered all sensitive points in key operations at which serious damage could be effected by determined subversive individuals who might gain access to such areas. As the result of such studies, a number of additional mechanical, electrical, and other protective devices as well as other safeguards have been installed to control and limit possible sabotage damage. Moreover, the Commission familiarized FBI liaison agents with technical aspects of vital materials, components, and activities to assist them in their evaluation and investigation of any information they might receive or develop with respect to subversive activity affecting the Commission's program. Antisabotage emergency plans have been formulated at all important sites, and may be promptly placed in operation in the event of an emergency.

STANDARDS AND THEIR ENFORCEMENT

The kinds of protection given to the multitude of different atomic energy activities cannot be uniform in degree; a cyclotron does not have to be guarded in the same way as equipment used in atomic weapons production. Specific standards have been established to match different degrees of critical importance and vulnerability of various AEC operations. The system of standards serves as a uniform guide for determining the degree of security safeguards needed at a research laboratory; for the storage of fissionable material; at a laboratory studying power reactors; and, in general, what specific special protection meets the requirements of each installation.

The Commission has established a system for evaluating the status of security which incorporates the principle of independent audit to insure that adequate safeguards are maintained at all plants, laboratories, and other activities. Separate inspection units inspect and survey each installation and activity. The only function of these units is to analyze and evaluate the adequacy of security provisions at the facilities and to do so as often as the rated importance of each separate facility requires.

Some 2,500 formal security inspections and surveys were made during 1948.

PREPARATIONS FOR DEFENSE

During 1948, also, the Commission has taken steps for the emergency defense of its vital facilities against attack. To this end the Commission collaborated with the National Military Establishment in the development of plans for the emergency military protection of its key installations, plans which involve close coordination with the armed services. In carrying out its phase of these plans, the Commission has obtained from the Department of the Army weapons, armored vehicles, and communication and other equipment. Guard forces at major installations have been trained in the use of military equipment and in other tactical defense measures in cooperation with the armed services. Tactical maneuvers and practice alerts in which both Army and Air Force combat units and Commission protective forces have participated, have been conducted at principal sites. Periodic joint inspections and further studies by Commission and military personnel have been, and will continue to be, made to assess the problem and to be certain that all phases of alert and emergency plans are currently effective.

Document and Information Control

The Atomic Energy Act states that the term "restricted data" means all data "concerning the manufacture or utilization of atomic weapons, the production of fissionable material, or the use of fissionable material in the production of power, but shall not include any data which the Commission from time to time determines may be published without adversely affecting the common defense and security." The Commission, in meeting its obligation to protect and control such data, took steps early in 1947 to establish a specific means of control of restricted data and maintain, through constant inspection and supervision, uniform procedures among the thousands of persons employed in its programs. To control classified information properly the Commission had to devise means to prevent disclosure to unauthorized persons and at the same time permit free circulation of such information among all those employees of the Commission and its contractors who need it in daily research or operation.

Specifically, this responsibility meant that the Commission had to classify large numbers of documents—Top Secret, Secret, Confidential, or Restricted—according to their importance to the national safety; devise ways of protecting them when they were transmitted, stored, reproduced, and destroyed; and maintain a system to account for their disposition and for the movement of highly classified documents. The Commission also was responsible for instructing all

employees within its programs and those of associated agencies in the proper protection of classified information or restricted data and for providing cryptographic communications systems for rapid and safe transmission of messages that contained restricted data.

It is a task of some magnitude. Blueprints on construction that would fill trains of freight cars, miles of photographic film of the Pacific experiments, hundreds of thousands of documents recording research and development work or precise directions for operations—these are the classified data on atomic energy laboriously achieved in 6 years of national endeavor. They are not inert materials that can be locked away in safe storage. To maintain the forward movement of the atomic energy project new information must be circulated through installations to all those who need it. Each month approximately 10,000 documents move from one installation to another. And every month about the same number of classified documents is originated.

REVISION OF SECURITY MEASURES

The Commission inherited from the Manhattan Engineer District a set of documentary and information controls and kept them in force as interim measures. The problems of a peacetime agency with widened scope of responsibility—such as that for basic research and the production of atomic power—were quite different, however, from those of an establishment working toward a single military goal. While the Commission continued its day-to-day operations it had, first, to take an inventory of all the Top Secret documents it had received from MED and all Research and Development Reports; next, to revise MED regulations to fit new circumstances and add to them wherever necessary; and finally, to work out broad new policies that would be the basis for required protective measures in a permanent peacetime agency.

In 1948, the Commission issued a "Compilation of Security Instructions," which contained in loose-leaf form the working instructions on security: Original MED regulations that had been retained, revisions to them, and additions that the Commission had made.

The Commission meanwhile revised and simplified security instructions on document control. It also put into use two systems of cryptographic communications and devised adequate security precautions for them—one by which the flow of highly classified information between the Task Force at Eniwetok and continental installations could be handled, and one for quick, safe communication between offices of the Commission.

PROGRESS OF THE INVENTORY OF RESEARCH AND DEVELOPMENT REPORTS

The inventory of Research and Development Reports is continuing. Only after the inventory was well along was the size of the task realized. It is now estimated that the number of such classified documents—and the copies of them—will be approximately 450,000. As the inventory progressed, however, it became clear that large numbers of these documents no longer needed the original classification and that the information in them could either be down-graded—that is, from Top Secret to Secret, from Secret to Confidential, and so on—or declassified entirely, or unwanted copies of the document destroyed. The scope of the inventory was broadened to include review of contents in order to remove as many of the documents as possible from accountability rolls and reduce the administrative burden of such accounting.

ACCOUNTING FOR TOP SECRET DOCUMENTS

To maintain continuous watch over the number of Top Secret documents and all copies of them, Washington headquarters now receives (1) a monthly report of all Top Secret documents originated, transferred, or destroyed; and (2) a semiannual inventory from each installation by the possessors of Top Secret documents to provide a necessary check on the accuracy of the reports. The Commission plans to reduce the clerical burden of the monthly reports, however, by having sent to headquarters a daily record of Top Secret documents originated or officially destroyed from every official authorized to classify, and by using a special form of receipt with every transfer of a Top Secret document. The sender and the recipient of every such document mail copies of this receipt form to headquarters at the time of transfer. This method provides an automatic check on the completion of the transfer and thus minimizes the possibility of error. This new procedure goes into operation January 1, 1949.

SECURITY EDUCATION OF EMPLOYEES

Proper observance of security regulations depends upon the understanding and cooperation of all employees. To impress upon every employee his responsibility for security, each installation, in an indoctrination course, explains to all employees the reasons behind security regulations and the way in which they operate. By later talks and conferences the local security officers keep alive a regard for security. They interview and explain to every employee who terminates his service with the Commission his responsibilities. During the past

year the Commission has taken steps to systematize its security education. It has made clear to management and supervisory officials that the success of such a program depends upon their conscientious interest in promoting common understanding of security. All field offices have received guides and sample talks to assist supervisors in indoctrinating employees in security principles. The Washington Office of the Commission through security news letters, through posters, and through a series of pamphlets, the first two of which were issued in November, has the means for reaching employees informally and providing them with a medium for wide informal discussion of security problems.

VII

FINANCE

Introduction

The Atomic Energy Commission has developed and put into effect several finance policies and methods designed to suit its industrial and research operations and to meet peacetime standards. Under the pressures of war and extensive security requirements not much could be accomplished in the way of analytical accounting. It has now been possible to analyze and to take steps to untangle the complex finance problems inherited by the Commission. All changes in financial arrangements with contractors and in other business operations have been based upon careful review of the going operations taken over by the Commission. Since all such operations have had to be maintained currently while being overhauled and put on an adequate long-term basis, changes have been introduced only gradually and after consultation with the Commission's contractors and others concerned.

The Commission operates the atomic energy program, both the production and the research and development functions, largely through private industrial firms and educational and scientific institutions whose activities the Commission directs and for whose results it is responsible. A number of Government agencies also take part. Several hundred contractors, not counting public schools, suppliers of services, consultants, and other agencies, are engaged in carrying on the Commission's operations. Some of these prime contractors have many subcontractors. For instance, the General Electric Company at Hanford, holding the largest prime contract, has approximately 50 subcontractors. Some of the subcontractors themselves have subcontractors conducting special parts of the operations.

Since the atomic energy project is essentially an industrial undertaking, the Commission decided very early to fit the accounting methods found most practicable and effective in industry and commerce to its operations. This decision required some departures from the conventional Government methods which are designed for non-industrial operations. Before making such departures, the Commission discussed them with the General Accounting Office and obtained the approval of the Comptroller General and his concurrence that the proposed methods would provide a basis for improved administration and would also provide adequate audit facilities for his office to protect the interests of the United States.

Accounting and Auditing Methods

In wartime, in the field of atomic energy, many unusual arrangements were utilized. One of the most difficult tasks facing the Commission was to obtain a clear picture of those arrangements in order to have the background necessary for sound decisions on accounting and methods of handling funds. In the fall of 1947, the Commission decided to employ public accounting firms, under contract, to review and evaluate accounting practices under typical contracts taken over from the Manhattan project.

Review of Accounting and Auditing Methods

After consultation with the Comptroller General, the Commission contracted with the following public accounting firms for the review:

Haskins & Sells.
Lybrand, Ross Bros. & Montgomery.
Scovell, Wellington & Company.
Arthur Andersen & Company.
Touche, Niven, Bailey & Smart.

Each firm was assigned one of the five typical contracts selected for review. These contracts represented a cross section of Commission activity, covering town management, research, plant construction, and production. The public accountants reviewed the accounts and records of both the contractor and the Government under the selected contracts. Each firm worked independently of the others, and each made a separate report of its findings.

Extensive Revisions Necessary

Before the end of January 1948, the Commission had received the reports of the accounting firms, covering the accounting policies, standards, and procedures prevailing under the various contractual arrangements reviewed. The accounting firms had worked on different types of contracts, yet their findings had a similarity that left no doubt that extensive revisions were necessary before the accounting records and procedures and the methods of internal control instituted in wartime could be considered adequate for the Commission's long-term peacetime conditions of operation.

The record-keeping practices and audit procedures that the contractors had previously followed were primarily designed to justify their expenditures to the Government, item by item. But these methods did not serve the functions so essential in the industrial and commercial world, of providing up-to-date meaningful records of costs and controls of property. Changes were needed to eliminate duplica-

tion of audit work and records, to speed up reimbursement of contractors, and to arrive at complete and realistic operating statements.

The accountants' reports confirmed rather completely the opinions developed by the Commission's staff, that the only practical solution to the accounting problems lay in a fundamental departure from the conventional Government accounting concepts and practices.

REVISION OF ACCOUNTING AND AUDITING METHODS

Government agencies generally have considered that the Government's accounting begins when the Government disburses funds. Their general practice when operating through private contractors on a reimbursable-cost basis, has been to record the initial sums paid such contractors as advances and to reflect costs in the Government's accounts only when contractors' expenditures have been audited and reimbursed by the Government. This practice has two basic weaknesses in the accounting for contract activities of the nature of the atomic energy program:

(1) A considerable lag in time exists between the dates when the contractor incurs costs and when the Government accounts record the expenditures.

(2) It is extremely difficult for the Government to break down the records of these expenditures so as to obtain a useful costs analysis—how much has been spent for any particular purpose at any particular time.

Much time and effort has been spent in the past in auditing the details of these reimbursements and attempting to analyze them in terms of intelligible costs.

Contractors' Relation to Government

In studying this matter, the Commission's accounting staff realized that for accounting purposes the major cost type contracts should be considered as though they were—to use a business concept—affiliated corporations as far as their contracts with the Commission were concerned. Costs would thus be considered as incurred by the Government at the moment the contractors incurred them, and the movement of cash between the Government and its contractors should have no more cost-accounting significance than the transfer of funds from one bank account to another.

Auditing and Financing

If Commission contractors established separate sets of accounts for their operations under the contracts, kept Commission funds separate from their own, and maintained adequate systems of internal control and pre-audit on the expenditure of these funds, under Commission

direction, it would become unnecessary for the Commission to subject such contractors' expenditures to the detailed item-by-item examination of the conventional Government type. For this examination, the Commission could substitute a comprehensive field audit—such as would be performed by a public accounting firm in the examination of the accounts of any business.

By eliminating the cumbersome reimbursement procedure under which all the detailed transactions are individually audited before reimbursement, the Commission could furnish funds to the contractor as promptly as required. Contractors could then operate with a smaller working-fund advance.

Comprehensive Accounting

By treating cost-type contractors as operating affiliates for accounting purposes and subjecting their contracts, accounts, and statements to periodic commercial-type audits, it becomes possible, under the new system, to adopt the accounting techniques of intercompany accounts and consolidated statements. The Commission establishes "intercompany" accounts on its books for cost-type contractors to charge them with all funds, facilities, and material provided them. The contractors keep similar accounts to credit the Commission with these items. Customary asset, liability, and operating accounts are maintained by contractors. From these accounts they prepare monthly financial and cost statements, which the Commission uses in preparing consolidated statements for the entire program. This makes unnecessary all attempts to obtain costs by analyzing contractor's reimbursements.

INSTALLATION OF NEW ACCOUNTING METHODS

Simple and almost obvious as these concepts may appear, the practical application of them to a going concern of the magnitude of the Commission's extensive and diversified operations has added up to a considerable task. The Commission has enjoyed the wholehearted support and assistance of the Comptroller General of the United States and his staff in instituting the new accounting policies. Adopting the commercial-type audit at the contractor's site in lieu of the voucher-type audit of reimbursements has posed some technical difficulties which have temporarily delayed realization of the full benefit to be derived from the new approach. Here again, Comptroller General Warren has shown great interest and helpfulness in working out these problems.

Contractors, for the most part, have received these new procedures with approval. The procedures made sense to industrial contractors, as well as to the public accountants consulted, because they are pat-

terned after those generally used in industry. University contractors have experienced some difficulty in adopting them because their background and usual requirements are different; but rapid strides are now being made in introducing the procedure among the institutional contractors. Carbide & Carbon Chemicals Corporation and the University of California are two major contractors among the first to adopt the new procedures and have taken an active part in developing them.

Approximately 60 percent of the Commission's prime cost-type contractors have already set up accounts for their contracts integrated with the new accounting system, as will most of the others before next July. Where the system is in operation, it is improving control of Commission property, as financial records integrated with the other accounts are set up to replace the separate nonfinancial records of property. One of the important jobs still to be done is to bring into the accounts the cost of physical facilities taken over from the Manhattan project or otherwise acquired by the Commission and provide for writing them off as they wear out or become obsolete. A preliminary survey just completed with the help of independent engineering and accounting firms indicates that this job is feasible.

Development of Consistent Cost-Payment Policies

One of the early tasks facing the Commission was to correct inconsistencies and inadequacies in the cost-reimbursement provisions of its contracts. As in all cost contracts, the provisions for paying overhead costs have called for particular attention to insure that such payments are fair and on a factual basis. Some of the important principles followed in new contracts are that all elements of overhead cost shall be identifiable, payments of such costs must contain no element of profit or fee, and all such charges must be subject to audit by the Commission. Also the contractor must be paid for all items of cost and expense actually incurred by him in good faith for carrying forward the provisions of the contract. Since January 1948, the application of these principles has improved Commission-contractor relations as well as cost control.

Budget

Expenditures on the atomic energy program during the fiscal year 1948 (July 1947–June 1948) under appropriations made available by the Congress amounted to $462,000,000. For the fiscal year 1949, ending next June 30, expenditures are estimated at $632,000,000. The major activities covered by these amounts are the operations in the various production plants and laboratories connected with the

program and the construction of new and replacement facilities. The expenditure side of the Commission's activities, expressed in millions, may be summarized as follows:

	Fiscal year 1948 (actual)	Fiscal year 1949 (estimated)
Operating expenditures	$257	$353
Construction expenditures	205	279
Total expenditures	462	632

In the submission of the budget estimates for the fiscal year 1949, the figures were prepared on the basis of major functions, such as construction, production, research, town operations, and AEC administration. Within this framework the data were broken down by areas of responsibility in the five major operating offices. Under the recent reorganization, the activities of the Commission were being administered by five headquarters program divisions. The budget estimates for the fiscal year 1950, therefore, were prepared on the basis of the major programs in which the Commission is engaged. They are set forth under the following general program headings:

Source and Fissionable Materials.
Weapons.
Reactor Development.
Physical Research.
Biology and Medicine.
Town Operation.
Administration.

Under these, appropriate subprograms have been established. This presentation of the budget estimates has proved useful to the Bureau of the Budget. The staff of the Commission is now working on the coordination of the budget classification with the financial and cost accounts. The full integration of the budget-fiscal accounts with the general accounts poses technical and administrative problems made particularly complex by the financing of long-term commitments through annual appropriations.

Business Operations

Responsibility for the Commission's business activities such as transportation, communications, procurement, and disposal of real estate and other property, and the custody of records was combined with the accounting, auditing, insurance, and budget functions into a Division of Finance in September 1948. The bringing together

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of these activities is resulting in better coordination and the elimination of duplication. For instance, the integration of property controls with accounting and auditing is making for more efficient operation of these functions.

Substantial progress has been made in the development of uniform methods for organizing and storing Commission and contractor records. Forward steps were also taken toward solving the intricate problems inherent in such activities as traffic management, operating a communications network made complex by security requirements, maintaining and operating pools of motorized equipment, and handling the holdings of real estate and other property.

Insurance and Benefit Plans

INSURANCE

Some of the Commission's principal contractors have encountered difficulty in finding insurance companies willing to insure and administer workmen's compensation and general liability claims. This difficulty has arisen in part from insufficient knowledge and experience concerning the nature of some operations to meet insurance company requirements, and in part from the security necessity of restricting access by the insurance companies to certain Commission facilities for purposes of safety inspections and the investigation of claims. In these cases, the Commission and its predecessor have approved special insurance arrangements. Most of the workmen's compensation and general liability policies carried by the Commission's cost-type contractors were issued under the War Department Insurance Rating Plan—a plan under which, in effect, tentative monthly premiums paid by the contractor to the insurance company are periodically adjusted so as to reimburse the insurance company for claims paid and for its charges in connection with the administration and settlement of claims. Normally, policies issued under this plan carry an upper limit on the amount of premiums payable, so that the risk of severe losses is borne by the insurance company. Where special arrangements have been necessitated by the nature of the operations, however, this upper limit on premiums has been removed. Thus the contractor has become obligated to reimburse the insurance company (and the Commission in turn to reimburse the contractor) for all claims payments, without limit, in addition to the charge for the services of the insurance company in the administration and settlement of claims.

In some instances, at the outset of the atomic energy program, it was necessary for contractors to establish with their insurance companies substantial amounts of collateral from funds advanced by the Government as security for the liability to claimants imposed by law

and by the terms of the insurance policies directly upon the insurance companies. The sums thus established aggregate $25,750,000. The Commission's contractors have not had to advance similar collateral during the period of the Commission's operations, although the Commission has in a few instances agreed with the insurance companies to act as surety for the contractor's financial obligations under the insurance policy.

The cost experience of Commission contractors under the War Department Insurance Rating Plan and modifications described above has actually been very good. Adjusted premiums under this rating plan from the beginning of the atomic energy program through 1948 aggregate approximately $6,300,000 for workmen's compensation and general liability, which is very substantially less than the cost of comparable coverage under normal commercial rating plans.

The Commission has made some progress in its efforts to reduce the area in which special insurance arrangements are required by providing information to insurance companies on the nature of the risks they are requested to insure. Representatives of insurance companies have in some cases been cleared for access to facilities and information that would enable them to determine the insurability of the operation in question. The Commission has also encouraged the casualty insurance companies to establish a formal committee, composed of representatives of both mutual and stock companies, through which the Commission and its contractors can communicate with the industry. It is hoped that through this committee the casualty insurance companies may become familiar with the nature of certain risks that they will confront in the field of atomic energy, not only in respect to the Commission's operations but in respect to the increasing use in industry at large of radioactive products.

BENEFIT PLANS

Certain of the contractors conducting atomic energy operations have also been authorized by the Commission and its predecessor to establish employee-benefit plans, making special provisions for injuries or death to employees as a result of exposure to hazards peculiar to the atomic energy program. The plans differ somewhat in detail, but generally provide for a gratuitous payment by the contractor of up to $10,000, in addition to workmen's compensation payments, to an employee or his beneficiaries where disability or death is suffered as a result of specified causes such as radiation or toxic materials. The plans are effective throughout the life of the contract and for 10 years after the termination of the contract in order that they may cover delayed disabilities. The determination to make benefit payments is

made by the contractor with the approval of the Atomic Energy Commission. To date payments have been made under the terms of the plans to five individuals and not more than 14 additional potential claims are known to exist.

Funds aggregating $16,500,000 were established by the Commission's predecessor with contractors to cover benefits that might be paid by the contractor during the period of the contract or in the ensuing 10 years. Since January 1, 1947, the Commission has extended benefit plans to the Brookhaven laboratory and to the separation plant at Oak Ridge, but has not funded either of these plans.

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VIII

ORGANIZATION AND PERSONNEL

Organization

During the latter half of 1948, the Commission reorganized its Washington office. The Atomic Energy Act specifies four of the operating, or program, divisions of the Commission's organization—Research, Engineering, Production, and Military Application—and specifies that the principal offices of the Commission shall be in Washington. Because of the geographic spread of the atomic energy program and the need for close association between responsible representatives of the Government and the management of the contractors carrying on the work, the Commission was organized originally and continues with five operating managers—at New York, Oak Ridge, Chicago, Los Alamos, and Hanford—each having primary responsibility for major phases of the program.

The reorganization left unchanged the relationship of the principal office in Washington to the field operating offices. Within the Washington office, however, certain division directors who had served in a staff capacity were given direct responsibility under the General Manager for the major programs of the Commission—research, production, engineering, military application, biology and medicine, and the development of reactors. Because of the demands on the General Manager's time, the Deputy General Manager was appointed to give full time to the daily operating problems of the Commission.

Under the modified plan, the Director of Production is responsible for the Hanford, Oak Ridge, and allied operations, including raw materials and feed-material processing under the New York office. The Director of Research and the Director of Biology and Medicine are responsible for the research programs in the physical and life sciences respectively at the national laboratories and in contract research institutions. The Director of Reactor Development heads a newly created division to take over all phases of reactor development and is responsible for the Chicago office. The Division of Engineering is a part of the Division of Reactor Development. The reorganization plan gave the Director of Military Application responsibility for the Los Alamos operations and allied weapon development and production activities, subject to the General Manager and the Commission.

With realinement of both the program and management divisions, the total number of persons reporting to the General Manager was reduced from 19 to 12. (See page 152 for the current organization chart.)

CONTRACTUAL ARRANGEMENTS

The Commission carries on its actual operations largely through contractual arrangements with industrial firms, colleges and universities, and Government agencies. Of a total of approximately 70,000 persons engaged on the atomic energy program, about 5,000 are direct employees of the Federal Government and about 700 of these are in Washington. The Managers of Operations at Oak Ridge, Hanford, New York, Chicago, and Santa Fe all have authority to enter into contracts on behalf of the Commission, where such contracts are within the program authorized by the Commission. Through the central authority of the Commission, the efforts of many thousands of people are coordinated, even though they are geographically dispersed and under many different types of organizations.

Development of Labor Policy

The broad objectives of the labor policy in the atomic energy program are—

1. Wholehearted acceptance by contractors and by labor and its representatives of the responsibility to the Nation inherent in participation in the atomic energy program;
2. Development of procedures to assure that all participants in the program are loyal to the United States, including those whose participation involves the exercise of negotiating and disciplinary authority over bargaining units, and of assurance that determination of unit, jurisdiction, and similar questions will not breach security;
3. Continuity of production at vital AEC installations;
4. Consistent with the Commission's responsibility under the law, the least possible interference with the efficient management expected from AEC contractors; and
5. Minimum interference with traditional rights and privileges of American labor.

The major developments in the field of labor relations should be viewed in the light of these objectives.

During the early months of 1948 and continuing into the summer, a series of conferences was held with the Commission's principal contractors and the principal leaders of the AFL and CIO in the program. These discussions were undertaken in the belief that a workable labor-

relations policy must be a product of voluntary cooperation and mutual understanding on the part of the contractors and their employees. While no over-all agreement emerged from these meetings, valuable information was developed and problems were more clearly defined.

LABOR DISPUTES

The labor dispute at the Oak Ridge National Laboratory (X–10) in early 1948, following shortly upon a settlement of a dispute in late 1947 at the Oak Ridge gaseous diffusion plant (K–25), underscored the problem of continuity of operation. Public hearings were held by the Joint Committee on Atomic Energy on March 9, 10, 12, 15, and 16, for the purpose of developing information which might be helpful to the Committee and the Commission in considering a labor-management program which would give maximum assurance of continuity of production at vital atomic energy installations. (See Hearings before Joint Committee on Atomic Energy, 80th Cong., 2d sess., on Labor Policies in Atomic Energy Plants.)

As recounted in the Fourth Semiannual Report, the dispute at the Oak Ridge National Laboratory (X–10) was settled June 15, 1948, without any stoppage of work, following utilization of the National Emergency Provisions of the Labor Management Relations Act, 1947. As a part of these procedures, the President, on June 18, 1948, transmitted a report to the Congress in which he announced his intention to establish a Commission to study labor relations in the atomic energy program. Thereafter, on September 3, he appointed the following members to this Commission: William H. Davis, Aaron Horvitz, and Edwin E. Witte, well-known experts in the field of labor relations. In the course of its study the group has conferred with the Atomic Energy Commission, Commission officials in Washington and at field installations, principal contractors, and labor representatives.

Consistent with the objective of minimum interference with the traditional rights and privileges of American management and labor, the Commission, on September 27, announced that, subject to proper security safeguards, the procedures of the Labor Management Relations Act were being made available to labor and management at all Government-owned, contractor-operated AEC installations. (See Appendix 9, items 1, 2, and 3, for text of the Commission's letters to National Labor Relations Board, General Electric Company, and the University of Chicago.) At the request first of the Manhattan Engineer District, and then of the Commission, procedures of the National Labor Relations Act, and later the Labor Management Relations Act, had been withheld at installations other than Oak Ridge. Experience at Oak Ridge indicated the feasibility from a security

standpoint, and the desirability from an operating standpoint, of giving full effect to the labor policy of the Nation throughout the atomic energy program. Elections conducted by the National Labor Relations Board since September 27 have resulted in the certification of the International Guards Union of America to represent the guards at the Argonne National Laboratory, Chicago, and the Federal Labor Union (AFL) to represent the maintenance and shop employees at the Brookhaven National Laboratory, Long Island, N. Y.

In a review of the current status of labor organization at AEC facilities preparatory to extending Labor Management Relations Act procedures to installations other than Oak Ridge, a serious question arose with respect to alleged communist association and affiliation of certain officers of the United Electrical Workers (CIO) and the United Public Workers of America (CIO). A collective-bargaining agreement between General Electric Company and the United Electrical Workers covering most of General Electric's private plants had in its administration by the parties been applied to employees engaged on classified atomic energy work in Schenectady. This work was soon to be expanded and transferred to the Commission's new Knolls II Atomic Power Laboratory in the Schenectady area. The United Public Workers of America was conducting an organizing campaign at the Argonne National Laboratory, which is operated under contract by the University of Chicago.

The General Electric Company was directed on September 27 not to recognize the UE as the collective-bargaining representative of workers to be employed at the new Knolls Atomic Power Laboratory. On the same day the University of Chicago was directed to continue to refrain from recognizing the UPWA as the representative of employees at the Argonne National Laboratory. The Commission stated in part:

> Consistent with the national policy as stated in the Atomic Energy Act of 1946 and the Labor Management Relations Act, 1947, it is the settled policy of the Atomic Energy Commission that the atomic energy facilities be operated in a manner best calculated to assure that those who participate in the program are loyal to the United States. This includes those who, though themselves not employees of contractors, do exercise administrative, negotiating and disciplinary authority over such employees of contractors as are members of union bargaining units. . . . Employees working on atomic energy projects, with access to restricted data are . . . all fully investigated by the Federal Bureau of Investigation with respect to character, associations and loyalty, and such individuals have been subject to the usual security clearance by Commission representatives.

(See Appendix 9, items 3 through 13, for Commission letters announcing the security policy and resulting correspondence.)

The Commission on two separate occasions invited the union officials concerned to participate in a fuller exploration of the question of their loyalty. These letters made it clear that failure to cooperate in this further exploration would result in the withdrawal and withholding of recognition from the UE as the representative of employees then engaged on classified atomic energy work in Schenectady.

On October 26, the UE initiated legal action for damages and to restrain the Commission and the General Electric Company from interfering with their collective-bargaining status. On November 1, the Commission directed the General Electric Company to withdraw and withhold recognition from the UE as representative of employees engaged in AEC work anywhere in the Schenectady area—in addition to Knolls. The Department of Justice, representing the AEC, filed a motion for dismissal of the complaint November 26. The UE has been granted an extension of time in which to prepare a response to the motion, and the case remains pending in the United States District Court for the District of Columbia.

Work Stoppages

On July 29 and 30, 1948, a total of 110 electricians and linemen employed directly by the Roane-Anderson Company, the Commission's maintenance and service contractor at Oak Ridge, resigned their employment in protest against the awarding of a contract to an "open shop" contractor. Charges of unfair labor practices were filed by Roane-Anderson Company with the National Labor Relations Board against the local union involved and on August 31 the United States District Court for Eastern Tennessee issued a preliminary injunction restraining the union from engaging in further specified activities pending disposition of the charges by the National Labor Relations Board. An NLRB trial examiner has sustained the unfair labor practice charge, which now awaits final action by the National Labor Relations Board.

In August, a similar work stoppage occurred in Los Alamos, where the Commission's award of a construction contract to an "open shop" contractor provoked a 7-day work stoppage of approximately 3,000 workers employed by several other construction and maintenance contractors on the site.

Personnel Policy

During the calendar year 1948, substantial progress was made in the formulation and development of a body of personnel policies and procedures designed to meet the specific needs of the atomic energy program.

In September 1948, to assist in the development of these policies and procedures the Commission appointed an Advisory Committee on Personnel Management. (See Appendix 2 for membership.) This committee is a permanent body which meets monthly and provides guidance and assistance to the Commission, the General Manager, and the Commission's personnel staff in laying the basis for an effective system of personnel management throughout the atomic energy program.

FEDERAL EMPLOYEE PERSONNEL POLICY

On November 30, the Commission announced the establishment of a merit personnel program, designed to meet the special needs of the atomic energy project. An essential part of this action was the Commission's decision to exempt positions in the agency from the competitive Civil Service, which was announced at the same time. Section 12 (a) (4) of the Atomic Energy Act authorized such a decision.* This step was taken after thorough examination of both atomic energy personnel operating requirements and Civil Service regulations and procedures, after nearly 2 years of operating experience under various applications of these regulations. This experience included several months of personnel operations early in 1947 under the post-war "transitional" Civil Service regulations, a brief period of operation under the new peacetime regulations which were published in May 1947, and a year or more of operation under various emergency exemptions from regulations granted by the Civil Service Commission.

These exemptions enabled AEC to meet its operating requirements during its initial organization period when prompt recruitment of specialized staff and the rapid adjustment of former MED staff into the new pattern of operation were necessary. This adjustment involved the transfer and reassignment of large numbers of personnel, including a high percentage of "war service" and "temporary indefinite" (nonstatus) employees who could not have been reassigned under normal Civil Service eligibility requirements. The exemption of nonstatus employees from mandatory displacement requirements permitted the Commission to retain in their jobs large numbers of experienced nonstatus employees who would otherwise have been lost to the program.

While these temporary emergency exemptions were effective as an interim measure, they did not solve the problems arising out of the

* Sec. 12 (a) (4) of the Atomic Energy Act of 1946 authorizes the Commission to "appoint and fix the compensation of such officers and employees as may be necessary to carry out the functions of the Commission. Such officers and employees shall be appointed in accordance with the civil-service laws and their compensation fixed in accordance with the Classification Act of 1923, as amended, except that to the extent the Commission deems such action necessary to the discharge of its responsibilities, personnel may be employed and their compensation fixed without regard to such laws * * *."

fact that 40 percent of Commission employees still lacked Civil Service status and therefore could have no certainty of tenure in the atomic energy program. Nor were these exemptions satisfactory as a foundation for a permanent personnel program.

Publication by the Commission of "AEC Federal Employee Personnel Policy" on November 23 was the first step in the installation of such a merit program. (See Appendix 10 for copy of this publication.) Detailed operating policies and procedures under this comprehensive statement of personnel policy are now in process of development and will ultimately be incorporated into a manual of basic personnel policies and procedures.

The system of personnel management which is being developed with the advice of expert consultants drawn from industry, Government, and higher education extends the authority for personnel management to the Commission field offices. Each of the five major field offices has its own Division of Organization and Personnel operating under a Director of Organization and Personnel who reports directly to the Manager of the Operations Office. Each Operations Office has full authority to receive applications and carry on its own recruitment and selection, subject to review in Washington of a small number of key positions only.

Pursuant to Executive Order 9980, issued by the President on July 26, 1948, the Director of Organization and Personnel has been designated as the Fair Employment Officer for the Atomic Energy Commission. Appropriate procedures for insuring compliance with this order are now in process of development. These procedures are in support of that portion of the AEC Federal Employee Personnel Policy which states that—

> there will be no discrimination in favor of or against an employee or applicant because of race, color, sex, religion, physical handicap, or national origin.

Relationships With Contractors on Personnel Policy Matters

Faced with similar operating problems arising out of their management responsibilities in the atomic energy program, a number of the major AEC contractors have expressed an interest in learning more about the methods used by other contractors' organizations in solving them. The Commission has encouraged this interest by arranging for a series of voluntary meetings on the subject of personnel policies among AEC contractors. The first of these meetings was held at Los Alamos in July, the second at the Brookhaven National Laboratory in September, and others will be held periodically in the future.

Each of the principal AEC contractors is invited to be represented at these meetings and to suggest subjects for consideration and discussion by the group. During the course of the two meetings

to date, however, voluntary agreements have been reached concerning a number of items of personnel policy on atomic energy projects, including matters of wage and salary policy, job-evaluation plans, leave privileges, retirement plans, group insurance, exchange of personnel information, and the like. The objective of these meetings is not to achieve identical personnel practices among AEC contractors, since it is recognized that there is great variation among the contractors as to operating conditions, types of contracts, nature of production processes, and so forth. Rather the effort has been, by the exchange of information concerning common problems, to bring about a broader understanding of the management of the atomic energy program as a whole, and enable each of the participants to benefit from the experience of all of the others.

SELECTIVE SERVICE AND MANPOWER

Calls to military service under the Selective Service Act of 1948 pose problems for the atomic energy program, particularly in view of the relative youthfulness of many persons working on the program. Atomic energy is a "young man's field," and many important contributions to the field have been and are continuing to be made by persons still in their twenties. To draw any substantial number of these persons away from their atomic energy work for military service at the present time would put the program under a handicap. During World War II, the Manhattan Engineer District was keenly aware of this problem and requested the deferment for continued civilian duty of numbers of young engineers and scientists. The Commission is currently conducting a comprehensive manpower survey covering both AEC employees and employees of the principal AEC contractors and subcontractors in order to provide a sound factual basis for the best allocation and utilization of atomic energy manpower in any possible future emergency.

Safety and Accident Prevention

SAFETY AND FIRE PROTECTION

The report of the Safety and Industrial Health Advisory Board, appointment of which was described in the Third Semiannual Report, was submitted to the Commission April 2, 1948. This report contained a number of basic recommendations designed to improve the health, safety, and fire protection activities of the Commission and its contractors. The majority of these recommendations were accepted as feasible and action is being taken to put them into operation.

ACCIDENT PREVENTION

In general, the Commission's accident and fire records show improvement over the year 1947. Despite the manifold increase of man-hours devoted to construction, which has proved to be the most hazardous of Commission activities, the 1948 injury rate on December 1 for all Commission and contractors' employees was reduced 14 percent from the 1947 rate of 5.04 employees injured per million man-hours of work, and is 67 percent below the 1947 national average of 13.26 persons injured per million man-hours of industrial employment.

The frequency of accidents in Commission and contractor operation of Government-owned motor vehicles in 1948 increased slightly over the previous year, but still was 35 percent lower than the 2.69 accidents that occurred nationally for every 100,000 miles of commercial operation. Despite a $65,000 school fire in one of the AEC communities, fire loss of 1948 was less than that of 1947. The ratio of the Commission's fire losses for 1948 was 10 mills per $100 estimated evaluation of Government property, compared to 150 mills for national industrial properties. Average per capita fire loss for the three Commission-administered communities was $1.68, compared to $4.41 for the Nation.

FIRE PREVENTION

In recognition of excellent fire-prevention work during 1948, the community of Oak Ridge, Tenn., received first-place award, duplicating its 1947 achievement, in competition with 2,927 American and Canadian municipalities in the National Fire Prevention Week contest. Los Alamos, N. Mex., and North Richland, Wash., were ranked eighth and thirteenth in the 1948 contest. In the industrial division of the 1948 contest, two Oak Ridge work locations tied for first place and another contractor placed fourth, compared to a 1947 record of first, second, seventh, and ninth positions for Oak Ridge contractors. The community of Oak Ridge was also awarded prominent recognition by the National Safety Council for its traffic safety record of 1947. On December 31, 1948, this town had accounted for 1,002 days without a traffic fatality.

Increased fire prevention and protection have been obtained in part by strengthening Commission and contractor field staffs with fire protection engineers upon recommendations by the Safety and Industrial Health Advisory Board. The influence of these fire protection engineers is reflected in better safety and fire protection in the design of new facilities.

IX

PATENTS AND INVENTIONS

In keeping with the controls which the Congress established over fissionable materials and atomic weapons, the Atomic Energy Act includes special provisions relating to patents and inventions in the field of atomic energy. These provisions are necessarily cast in somewhat technical language. In brief, section 11 of the act specifies that patents shall not be issued for any invention "useful solely in the production of fissionable material or in the utilization of fissionable material or atomic energy for a military weapon," and that patents shall not confer any rights to the extent that the invention "is used" for such purposes. Just compensation is assured to the owners of any already-existing patent rights revoked by the act; and insofar as these provisions prevent future inventions from coming within the regular patent system the Commission is empowered to make awards after hearings held before its Patent Compensation Board. In addition, future patents shall not confer any rights to the extent that the invention "is used in the conduct of research or development activities" in the five fields specified in section 3 of the act.

In order to make the peacetime benefits of atomic energy widely available, the Congress also authorized the Commission to declare a patent to be "affected with the public interest" if the licensing of the invention is necessary to effectuate the policies and purposes of the act and if the invention utilizes or is essential in the utilization of fissionable material or atomic energy. This is a reserve power of the Commission which would permit it to authorize the use of a patent on a reasonable royalty basis under certain rather exceptional circumstances. There has been no occasion thus far for the Commission to exercise this power.

PATENT ADVISORY PANEL

Shortly after the transfer of the atomic energy program from the Manhattan Engineer District, the Commission recognized that the patent provisions of the Atomic Energy Act presented novel and complex problems, on which it would be desirable to obtain the expert advice and judgment of men experienced in patents and patent administration. Accordingly, in January 1947, a Patent Advisory Panel of three members was appointed to make a general review and appraisal

of these problems. The membership of this panel later was increased to five. (See Appendix 2.)

On September 17, 1947, the panel submitted an initial report, issued publicly by the Commission, surveying the problems arising under the patent provisions of the act. High lights of the report were as follows:

a. The impact of the Atomic Energy Act upon the patent system, and upon normal process of industry, is as small as possible consistent with the needs of the common defense and security and the other purposes of the act. Because of the special conditions existing in the field of atomic energy, indemnification by way of just compensation, reasonable royalty fee, or award has been substituted for the usual right of a patentee to exclude.

b. The types of patent clauses used in Commission contracts were generally satisfactory.

c. The practice of the Commission in administering patents is to disturb the normal conduct of business as little as possible; and the panel found evidence of general satisfaction among the Commission's contractors with the fairness with which contracts have been negotiated and administered.

d. The Commission's authority to declare patents "affected with the public interest" should be exercised sparingly.

The Patent Advisory Panel has continued to meet from time to time, and to advise the Commission and its staff on various questions of policy and procedure. The panel rendered invaluable assistance in the preparation of regulations to govern proceedings before the Patent Compensation Board. These regulations (see Appendix 4) were issued in final form in June 1948, and are aimed at providing a reasonably simple procedure for the fair and impartial adjudication of applications filed before the Patent Compensation Board, which will take final action on behalf of the Commission. To date there have been three applications filed under the Commission's regulations.

Persons dissatisfied with whatever award, just compensation, or reasonable royalty fee is fixed by the Commission through the Patent Compensation Board are entitled to judicial review in the courts.

The Commission's Patent Branch is under the supervision of the Office of the General Counsel, and the bulk of its work arises out of the negotiation and administration of patent clauses in Commission contracts, the identification of inventions occurring in the course of the work, and the prosecution of patent applications where appropriate. At present the Patent Branch is filing new patent applications in the United States Patent Office at the rate of about 17 per month.

THREE TYPES OF CLAUSES

In implementing its patent policies the Commission has used three general types of clauses (designated "type A," "type B," and "type C") to meet the varying situations which arise in connection with the research, development, and operations contracts it supports with Government funds. The present text of the clauses embodies revisions suggested by the Patent Advisory Panel. In all three types of clauses the Commission reserves the right to take title to any inventions arising in the course of the work. The differences between them may be indicated as follows: Under type A clause, which is used in the absence of special factors of the character noted below, no rights are reserved to the contractor by the contract although rights may be given to him later by administrative determination in any instance where the circumstances warrant it. Under type B clause, which is used when the work relates not only to atomic energy but also to a field in which the contractor has an established industrial and patent position, the contractor obtains a nonexclusive license in the fields other than atomic energy. Under type C clause, which is used when the work relates only incidentally to atomic energy but directly to the field of the contractor's established industrial and patent position, the contractor obtains a sole license (with the right to grant sublicenses) in the fields other than atomic energy. In applying these clauses each case is examined on its merits, so that there will be general uniformity of treatment of similarly-situated contractors.

FURTHER REVIEW

Since its initial report to the Commission in September 1947, the Patent Advisory Panel has made a second review of the manner in which the contract clauses are negotiated and administered by the Commission's staff. The panel concluded that the Commission's contractors have continued to be generally satisfied with the fairness with which such negotiation and administration have been conducted. The Commission, however, keeps this matter under periodic review, to assure that its contract provisions do not become a hindrance to broad industrial participation in the atomic energy program.

The recent report of the Industrial Advisory Group stressed the desirability of preparing a statement which would give businessmen who have little or no background in atomic energy an understanding of the consequences of the patent provisions of the act and of the Commission's patent policies. The Commission fully recognizes the importance of bringing about a wider public understanding of this complex subject, in a way which will provide accurate information on matters of interest to the business community.

In July 1948, pursuant to a recommendation of the Patent Advisory Panel, the Commission announced that inventions made in the course of work (not financed by Commission funds) on or with radioisotope compounds would be subject to patenting by the inventors in accordance with normal industrial practices and without any patent rights being reserved to the Commission. While the users of such radioisotopes are required to publish or report the significant results of their work, these reporting requirements are to be applied so as not to interfere with an inventor's opportunity to obtain patent protection for his discoveries. By this action, it was the Commission's intention to assure that the normal conduct of business be interfered with as little as possible and that all proper incentives are offered to private industry to enter this field.

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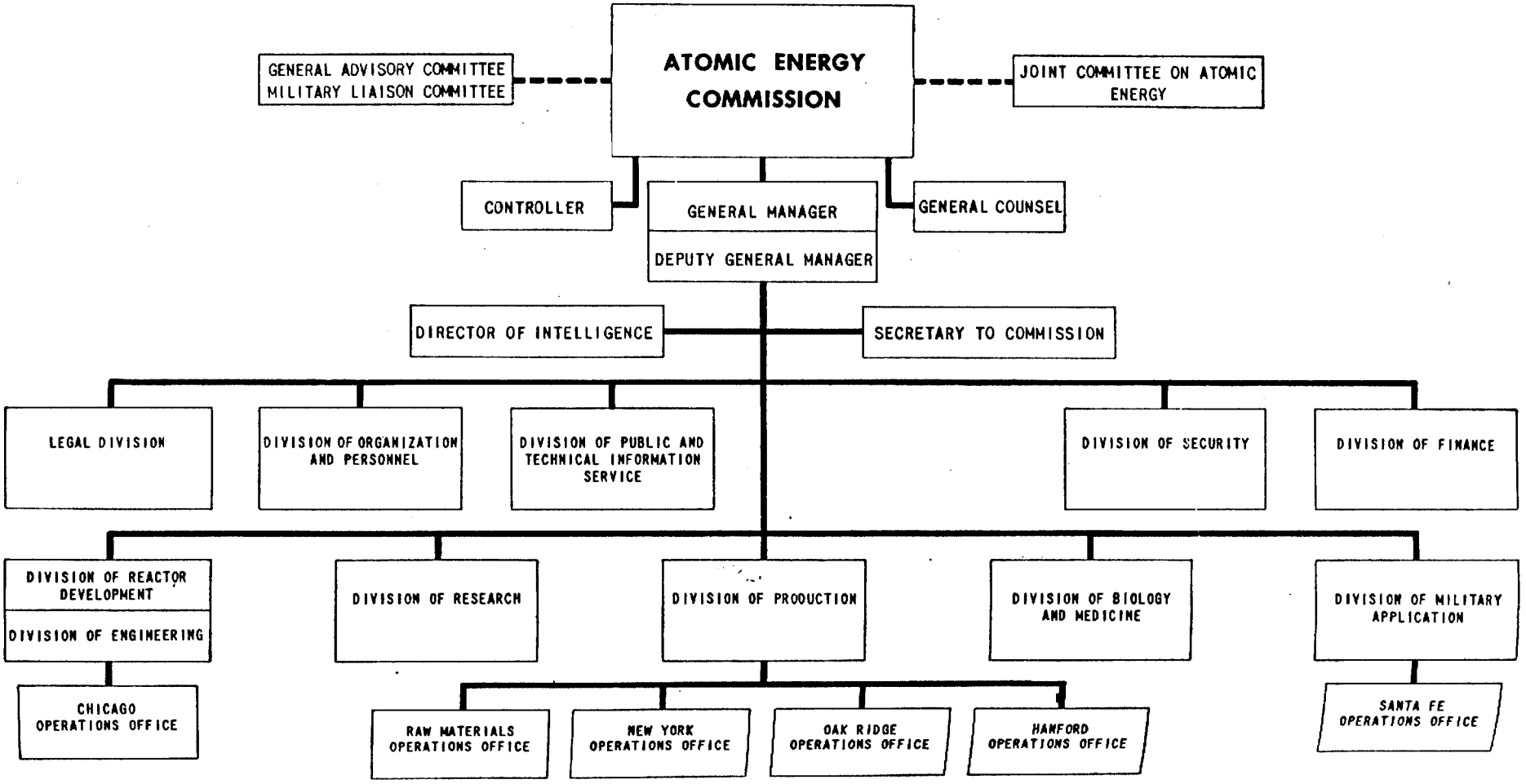
U. S. ATOMIC ENERGY COMMISSION



SANTA FE OPERATIONS OFFICE

HANFORD OPERATIONS OFFICE

OAK RIDGE OPERATIONS OFFICE

NEW YORK OPERATIONS OFFICE

RAW MATERIALS OPERATIONS OFFICE

CHICAGO OPERATIONS OFFICE

APPENDIX 1

U. S. Atomic Energy Commission, Principal Staff and Managers of Operations Offices

Atomic Energy Commission	David E. Lilienthal, *Chairman.* Robert F. Bacher. Sumner T. Pike. Lewis L. Strauss. (Vacancy).
General Manager	Carroll L. Wilson.
Deputy General Manager	Carleton Shugg.
Secretary to Commission	Roy B. Snapp.
Director of Intelligence	Walter F. Colby.
Executive Secretary, Program Council	David B. Langmuir.
General Counsel	Adrian S. Fisher.
Associate General Counsel	Joseph Volpe, Jr.
Controller	Paul M. Green.
Director, Division of Research	Kenneth S. Pitzer.
Director, Division of Engineering	Roger S. Warner, Jr.
Director, Division of Production	Walter J. Williams.
Director, Division of Military Application.	Brig. Gen. James McCormack, Jr.
Director, Division of Reactor Development.	Lawrence R. Hafstad.
Director, Division of Biology and Medicine.	Dr. Shields Warren.
Director, Division of Organization and Personnel.	Fletcher C. Waller.
Director, Division of Public and Technical Information Service.	Morse Salisbury.
Director, Division of Security	Rear Adm. John E. Gingrich, USN.
Managers of Operations Offices:	
Chicago (Illinois) Operations Office	A. Tammaro.
Hanford (Washington) Operations Office.	F. C. Schlemmer.
New York (New York) Operations Office.	W. E. Kelley.
Oak Ridge (Tennessee) Operations Office.	John C. Franklin.
Santa Fe (New Mexico) Operations Office.	Carroll L. Tyler.

Raw Materials Operations Office . . . John K. Gustafson

Advisory Committee on Personnel Management

Arthur S. Flemming, *president*, Ohio Wesleyan University, former U. S. Civil Service Commissioner, Delaware, Ohio; *chairman*.
Lawrence A. Appley, *president*, American Management Association, New York, N. Y.
L. Clayton Hill, *professor of industrial relations*, University of Michigan, Ann Arbor, Mich.
Alvin E. Dodd, *honorary president*, American Management Association, New York, N. Y.
Wallace Sayre, *professor of public administration*, School of Business and Public Administration, Cornell University, Ithaca, N. Y.
Thomas G. Spates, *vice president for personnel administration*, General Foods Corporation, New York, N. Y.

Reactor Safeguard Committee

Dr. Edward Teller, Institute of Nuclear Studies, University of Chicago, Chicago, Ill.; *chairman*.
Dr. Manson Benedict, Hydrocarbon Research, Inc., New York, N. Y.
Dr. Joseph W. Kennedy, department of chemistry, Washington University, St. Louis, Mo.
Col. Benjamin Holzman, Office of Director of Research and Development, U. S. Air Forces, Washington, D. C.
Dr. John A. Wheeler, Palmer Physical Laboratory, Princeton University, Princeton, N. J.
Dr. Abel Wolman, department of sanitary engineering, Johns Hopkins University, Baltimore, Md.

Senior Responsible Reviewers

Dr. W. C. Johnson, *chairman*, department of chemistry, University of Chicago, Chicago, Ill.
Dr. W. F. Libby, *professor of chemistry*, University of Chicago, Chicago, Ill.
Dr. J. H. Manley, *associate director*, Los Alamos Scientific Laboratory, AEC, Los Alamos, N. Mex.
Dr. R. L. Thornton, *professor of physics*, University of Calif., Berkeley, Calif.
Dr. Frederic de Hoffmann, *consultant*, U. S. AEC., Washington, D. C., *secretary*.

Temporary Advisory Bodies Appointed by the Commission

Industrial Advisory Group

James W. Parker, *president and general manager*, Detroit Edison Co., Detroit, Mich.; *chairman*.
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, *chairman of board*, Babcock & Wilcox Tube Co., Beaver Falls, Pa.
Jerome C. Hunsaker, *chairman*, National Advisory Committee for Aeronautics, Washington, D. C.

Safety and Industrial Health Advisory Board

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

William F. Brown, *safety director*, Consolidated Edison Co. of N. Y., New York, N. Y.
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*, U. S. AEC, 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.

Personnel Security Review Board

Owen J. Roberts, *former associate justice*, U. S. Supreme Court, Philadelphia, Pa.; *chairman.*
Karl T. Compton, *president*, Massachusetts Institute of Technology, Cambridge, Mass.
Hon. Joseph C. Grew, *former Undersecretary of State*, Washington, D. C.
George M. Humphrey, *president*, M. A. Hanna Co., Cleveland, Ohio.
H. W. Prentis, Jr., *president*, Armstrong Cork Co., Lancaster, Pa.

Advisory Committee for Equipment and Material Control

Hugh M. Beshers, *chief*, export control branch, Division of Production, U. S. AEC, Washington, D. C.; *chairman.*
R. W. Albright, *vice president*, Distillation Products, Inc., Rochester, N. Y.
A. O. Beckman, *president*, National Technical Laboratories, South Pasadena, Calif.
George H. Bucher, *vice chairman of board*, Westinghouse Electric Corp., Pittsburgh, Pa.
Richard S. Morse, *president*, National Research Corp., Cambridge, Mass.
H. B. Neal, *president*, Kinney Manufacturing Co., Boston, Mass.
C. S. Redding, *president*, Leeds & Northrup, Philadelphia, Pa.
John A. Victoreen, *president*, Victoreen Instrument Co., Cleveland, Ohio.

WEAPONS EFFECTS CLASSIFICATION BOARD

Dr. Norris E. Bradbury, *director*, Los Alamos Scientific Laboratory, AEC, N. Mex.; *chairman.*
Dr. Frederic de Hoffmann, *secretary*, Committee of Senior Responsible Reviewers, AEC, consultant to and formerly of the staff, Los Alamos Scientific Laboratory, AEC, N. Mex.
Dr. Joseph O. Hirschfelder, *professor of chemistry*, University of Wisconsin, consultant to and formerly of the staff, Los Alamos Scientific Laboratory, AEC, N. Mex.
Maj. Gen. Kenneth D. Nichols, *chief*, Armed Forces Special Weapons Project and member of the Military Liaison Committee; formerly district engineer, Manhattan Engineer District. Represented by alternate, Lt. Col. David Parker, Plans and Operations, Army General Staff.
Capt. James S. Russell (USN), Division of Military Application, AEC, Washington, D. C. Represented by alternate, Col. Paul Preuss, Division of Military Application, AEC.
Rear Adm. W. S. Parsons, *member*, Military Liaison Committee, Deputy Chief of Naval Research, *director*, Atomic Energy Division, U. S. Navy Department; formerly of the Los Alamos Scientific Laboratory, AEC, N. Mex.
Dr. John von Neumann, Institute for Advanced Studies, Princeton, N. J., and consultant to the Los Alamos Scientific Laboratory.
Dr. Ralph Carlisle Smith, *chief*, Documentary Division, Los Alamos Scientific Laboratory; and Mr. Arnold Kramish, *consultant*, AEC, serve as joint secretariat to the Board.

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 Institute of Technology
Illinois Institute of Technology
Indiana University
Iowa State College
Kansas State College of Agriculture and Applied Science
Loyola University of Chicago
Marquette University
Mayo Foundation
Michigan College 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. Leland Haworth

OAK RIDGE NATIONAL LABORATORY

Oak Ridge, Tenn.

Contract operator: Carbide & Carbon Chemicals Corp. Participating institutions:

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

Executive director: Dr. C. N. Rucker

OTHER AEC RESEARCH CENTERS

Ames Laboratory, Ames, Iowa (Iowa State College, contractor), Dr. F. H. Spedding, *project director*, Atomic Research Institute.

University of California Radiation Laboratory, Berkeley, Calif. (contractor), Dr. E. O. Lawrence, *director*.

Knolls Atomic Power Laboratory, Schenectady, N. Y. (General Electric Co., contractor). Dr. K. H. Kingdon, *head*, Atomic Power Division.

Los Alamos Scientific Laboratory, Los Alamos, N. Mex. (University of California, contractor), Dr. Norris E. Bradbury, *director*.

University of Rochester, Rochester, N. Y. (contractor), Dr. Henry A. Blair, *director*, Atomic Energy Project.

APPENDIX 4

Regulations of the U. S. Atomic Energy Commission

PART 60

DOMESTIC URANIUM PROGRAM

Circular No. 1—Ten Year Guaranteed Minimum Price

§ 60.1 *Ten year guaranteed minimum price*—(a) *Guarantee.* To stimulate domestic production of uranium and in the interest of the common defense and security the United States Atomic Energy Commission hereby establishes the guaranteed minimum prices specified in paragraph (b) of this section, for the delivery to the Commission, in accordance with the terms of this section during the ten calendar years following its effective date, of domestic refined uranium, high-grade uranium-bearing ores and mechanical concentrates, in not less than the quantity and grade specified in paragraph (e) of this section. This guarantee does not apply to uranium-bearing ores of the Colorado Plateau area, commonly known as carnotite-type or roscoelite-type ores, prices for which are established by § 60.3.

Note.—The term "domestic" in this section, referring to uranium, uranium-bearing ores and mechanical concentrates, means such uranium, ores, and concentrates produced from deposits within the United States, its Territories, possessions and the Canal Zone.

(b) *Guaranteed minimum prices.* The following minimum prices are established:

(1) For uranium-bearing ores and mechanical concentrates, $3.50 per pound of U_3O_8 (uranium oxide) determined by the Commission to be recoverable, less cost per pound of refining such ores or concentrates to standards of purity required for the Commission's operations, to be determined by the Commission after assay of a representative sample.

(2) For refined uranium products, $3.50 per pound contained U_3O_8 (uranium oxide).

Prices are f. o. b. railroad cars or trucks at shipping point designated by the Commission convenient to mine, mill, or refinery. Weights are avoirdupois dry weight.

(c) *Making an offer.* Anyone who has domestic refined uranium, high-grade uranium-bearing ores, or mechanical concentrates of the quantity and grade specified in paragraph (e) of this section, may offer it for delivery to the Commission by sending a letter or telegram addressed as follows:

United States Atomic Energy Commission,
Post Office Box 30, Ansonia Station,
New York 23, N. Y.
Attention: Division of Raw Materials.

With each offer there should be furnished a representative ten-pound sample and the following information:

(1) Location of property;

(2) Character of material offered for delivery (state whether refined uranium, mechanical concentrates, or uranium-bearing ores, indicating approximate composition);

(3) Amount of material offered;

(4) Location of material offered;

(5) Origin of material if offered by other than producer;

(6) If material is owned, in whole or in part, by any person other than the person making the offer, the name of each person having such ownership and nature of his rights; and

(7) Name and address of person making the offer.

Note.—The reporting requirements hereof have been approved by the Bureau of the Budget pursuant to the Federal Reports Act of 1942.

(d) *Purchase contract.* Upon receipt of an offer and sample, an analysis of the sample will be made. If the sample and the information furnished are determined by the Commission to meet the conditions of this section, the Commission will forward to the person making the offer a form of contract containing applicable terms and conditions ready for his acceptance. Prices will be not less than the applicable prices of paragraph (b) of this section.

(e) *Minimum quantity and grade.* No delivery will be accepted under this section of less than ten short tons (2,000 pounds per ton) of ores or mechanical concentrates, nor of ore or mechanical concentrates which assay less than 10 [illegible] U_3O_8 by weight. No delivery high-grade domestic uranium deposits and in the interest of the common defense and security the United States Atomic Energy Commission will pay, in addition to the guaranteed minimum price established in § 60.1, a bonus of $10,000 for delivery to the Commission,

whether for any other reason a bonus is not payable. In making this determination the Commission will be guided by the mining laws of the United States which provide, generally, that lode locations may extend in lode or vein formation up to 1,500 feet along the vein and in width 300 feet on each side of the middle of the vein, the end lines of the location being parallel to each other; and that placer locations may not be greater than 20 acres for each location or 160 acres in a single location for up to eight locators. The fact that a bonus has already been received will not prevent the payment of another bonus to the same person with respect to production from a different location.

(d) *Notice of discovery and production.* Notice of the discovery of a uranium deposit and of production therefrom believed to meet the requirements of paragraph (a) of this section should be forwarded to the Commission by letter or telegram, to the address specified in paragraph (f) of this section, together with an offer to deliver such ore to the Commission under § 60.1. In addition to the information and the 10-pound sample required under § 60.1, the following must be furnished:

(1) A brief description of the location or property indicating its size and relationship to mineral monuments or the public land surveys;

(2) Name of owner of record of property;

(3) Location of Recorder's Office where ownership is recorded.

NOTE.—The reporting requirements hereof have been approved by the Bureau of the Budget pursuant to the Federal Reports Act of 1942.

(e) *Inspection of claim.* Upon receipt of a notice of discovery and sample, forwarded as required in § 60.1, an analysis of the sample will be made. If the sample and supporting data indicate the claim is likely to meet the requirements of paragraph (a) of this section, an inspection of the property and verification of the weights and assays of material produced will be undertaken by the Commission. On the basis of a report of such inspection and verification, if favorable, the Commission will determine the quantity of ore produced. If this determination indicates that the production requirements established in paragraph (a) of this section have been met, the Commission will pay the bonus in addition to the price established under § 60.1, when delivery of such ore is completed.

(f) *Inquiries and communications.* Inquiries about this section and all other communications should be addressed as follows:

United States Atomic Energy Commission,
Post Office Box 30, Ansonia Station,
New York 23, N. Y.
Attention: Division of Raw Materials.

(g) *Licenses.* Arrangements will be made by the Commission for the issuance of licenses, pursuant to the Atomic Energy Act of 1946, covering deliveries of source material to the Commission under this section. (Sec. 5 (b), 60 Stat. 761)

Effective date. This circular will become effective at midnight, April 11, 1948.

Dated at Washington, D. C., this 9th day of April 1948.

CIRCULAR NO. 3.—GUARANTEED THREE YEAR MINIMUM PRICE FOR URANIUM-BEARING CARNOTITE-TYPE OR ROSCOELITE-TYPE ORES OF THE COLORADO PLATEAU AREA

§ 60.3 *Guaranteed three year minimum price for uranium-bearing carnotite-type or roscoelite-type ores of the Colorado Plateau area*—(a) *Guarantee.* To stimulate domestic production of uranium-bearing ores of the Colorado Plateau area, commonly known as carnotite-type or roscoelite-type ores, and in the interest of the common defense and security the United States Atomic Energy Commission hereby establishes the guaranteed minimum prices specified in Schedule I of this section, for the delivery of such ores to the Commission, at Monticello, Utah, and Durango, Colorado, in accordance with the terms of this section during the three calendar years following its effective date.

NOTE.—In §§ 60.1 and 60.2 (Domestic Uranium Program, Circulars No. 1 and 2), the Commission has established guaranteed prices for other domestic uranium-bearing ores, mechanical concentrates, and refined uranium products.

(b) *Definitions.* As used herein, the term "buyer" refers to the U. S. Atomic Energy Commission, or its authorized purchasing agent. The term "seller" refers to any person offering uranium ores for delivery to the Commission. Weights are avoidupois dry weight.

(c) *Deliveries of not to exceed 1,000 tons per year.* To aid small producers, any one seller may deliver without a written contract but otherwise in

accordance with this section up to, but not exceeding, 1,000 short tons (2,000 pounds per ton) of ores during any calendar year.

(d) *Deliveries in excess of 1,000 tons per year.* Sellers desiring to deliver in excess of 1,000 short tons (2,000 pounds per ton) of ores during any calendar year will be required to execute a contract with the Commission. Buyer is not obligated to purchase in excess of 5,000 short tons of ores from any one seller during any calendar year, although buyer may elect to do so.

(e) *Delivery.* Seller, at his own expense, shall deliver and unload all ores at the buyer's depots at Monticello, Utah, or Durango, Colorado. (Additional depots may be established at later dates.) Deliveries shall be in lots of not less than 10 short tons (2,000 pounds per ton), but such lots may be delivered in more than one load. Days and hours during which ore may be delivered to a depot will be posted at the depot. The exact date on which ore buying will commence at the two depots mentioned will be announced later; no deliveries will be accepted prior to this announced date. It is expected that the Monticello depot will be ready to receive ore during the month of July 1948, and that the Durango depot will be in operation shortly thereafter.

(f) *Weighing, sampling and assaying.* Buyer will bear the cost of weighing, sampling and assaying. The net weight of each load will be determined by the buyer's weighmaster on scales which will be provided by the buyer at or in the vicinity of the purchase depot and such weight will be accepted as final. A weight ticket will be furnished seller or his representative for each load. Each lot of ores will be sampled promptly by the buyer according to standard practice and such sampling will be accepted as final. Seller or his representative may be present at the sampling at his own expense. The absence of seller or his representative shall be deemed a waiver of this right. Buyer will make moisture determinations according to standard practices in ore sampling. All final samples will be divided into four pulps and distributed as follows: (1) the seller, or his representative, will receive one pulp; (2) the buyer will retain one pulp; (3) the other two pulps will be reserved for possible umpire analysis. The buyer's pulp will be assayed by the buyer. The seller may, if he desires, and at his own expense, have his pulp assayed by an independent assayer. In case of disagreement on assays as to any constituent of the ores, an umpire shall be selected in rotation from a list of umpires approved by the buyer whose assays shall be final if within the limits of the assays of the two parties; if not, the assay which is nearer to that of the umpire shall prevail. The party whose assay is the farther from that of the umpire will pay the cost of the umpire's assay for the constituent of the ores which is in dispute. In the event that the umpire's assay is equally distant from the assay of each party, costs will be split equally. In case of seller's failure to make or submit assays, buyer's assays shall govern. After sampling, the ores may be placed in process, commingled, or otherwise disposed of by buyer.

(g) *Payment.* Buyer will make payment promptly on payment dates to be posted at depots. Payment will not be made until an entire minimum lot of ten short tons (2,000 pounds per ton) has been delivered and accepted, unless special arrangements have been agreed upon by buyer, in which case there may be an extra charge for assaying and sampling. The analysis of any one lot consisting of more than one load will be based on a composite of the samples tak n. Moisture determinations, analyses and settlement sheets, together with the check in payment, will be mailed to seller.

(h) *Inquiries.* All inquiries concerning the provisions of this section, offers to deliver ores, or questions about the Commission's uranium program in the Colorado Plateau area should be addressed to:

United States Atomic Energy Commission,
Post Office Box 270,
Grand Junction, Colorado.
Telephone: Grand Junction 3000.

(i) *Licenses.* Arrangements will be made by the Commission for the issuance of licenses, pursuant to the Atomic Energy Act of 1946, covering deliveries of source material to the Commission under this section.

SCHEDULE I—MINIMUM PRICES, SPECIFICATIONS, AND CONDITIONS

1. *Quality and size.* Ores will not be accepted by buyer under this section which, in buyer's judgment at time of acceptance:

(a) Contain less than 0.10% U_3O_8;

(b) Contain more than three parts of lime ($CaCO_3$) to one part of V_2O_5, or a total of more than 6% lime in the ore;

(c) Contain other impurities deleterious to buyer's extraction process:

(d) Contain lumps in excess of 12 inches in size.

2. *Prices.* Payment for delivery of the ores will be computed on the following basis:

(a) *Vanadium.* V_2O_5 at $0.31 per pound up to, but not exceeding, ten pounds of V_2O_5 for each pound of U_3O_8 contained in ores. No factor will be included for V_2O_5 in excess of ten pounds for each pound of U_3O_8. (Example: For an ore containing two pounds of U_3O_8 and twenty-five pounds of V_2O_5, payment would be made for twenty pounds of V_2O_5 at $0.31 per pound, but no payment would be made for the additional five pounds.) Such excess V_2O_5 shall be deemed to be buyer's property.

(b) *Uranium.* (1) Ores assaying less than 0.10% U_3O_8: no payment. Any such ores which are delivered to the purchase depot shall become the property of the buyer as liquidated damages for buyer's expense of weighing, sampling and assaying, and after sampling may be placed in process, commingled, or otherwise disposed of by buyer. If seller has any question as to the quality of his ore, it is suggested that before shipment and delivery to the purchase depot a representative sample be submitted to the buyer or to one of the umpires for assay at seller's expense. The buyer at his discretion may assay a limited number of samples without charge.

(2) Ores assaying 0.10% U_3O_8 up to 0.15%: price of $0.30 per pound of contained U_3O_8 for 0.10% ore, plus $0.30 per pound for each 0.01% above 0.10% U_3O_8 up to (but not including) 0.15%. (Example: The contained U_3O_8 in an ore assaying 0.13% U_3O_8 per ton would be paid for at $\$0.30+(3\times 0.30)=$ $1.20 per pound.)

(3) Ores assaying 0.15% U_3O_8 and more: base price of $1.50 per pound U_3O_8 content, plus a "development allowance" (at seller's option) of $0.50 per pound, or a total of $2.00 per pound U_3O_8 content.

(4) Premiums: $0.25 per pound for each pound of U_3O_8 in excess of 4 pounds U_3O_8 per short ton (2,000 pounds per ton) and an additional premium of $0.25 per pound for each pound in excess of ten pounds U_3O_8 per ton of ore.

(Example: U_3O_8 payments for a short ton of ores assaying 0.6% U_3O_8 would be as follows:

Base price 12 lbs. @ $1.50	$18.00
Development allowance 12 lbs. @ $0.50	6.00
Premium 8 lbs. (12–4) @ $0.25	2.00
Additional Premium 2 lbs. (12–10) @ $0.25	.50
Total U_3O_8 Payments	$20.50)

(c) Assays shall be adjusted to the nearest 0.01% for purposes of payment.

NOTES.— 1. The "development allowance" of $0.50 per pound of U_3O_8 contained in ores assaying 0.15% U_3O_8 or more, is offered by buyer in recognition of the expenditures necessary for maintaining and increasing the developed reserves of uranium ores. Sellers accepting this allowance are deemed to agree to spend such funds for the development or exploration of their properties. Sellers delivering less than 1,000 short tons per calendar year will not be required to submit an accounting record of expenditures for development or exploration pursuant to this agreement but sellers delivering in excess of 1,000 short tons per calendar year will be required, under the terms of their contracts, to submit proof satisfactory to the Commission that funds equivalent to the amount received as development allowance have been spent for development or exploration during the contract period or within six months thereafter.

2. Commitments by the Commission to accept delivery of ores are limited to the provisions of this section, as amended from time to time, or to written contracts between the Commission and sellers. Other commitments purporting to be made by the Commission's field personnel or other agents of the Commission will not bind the Commission unless they are in accord with the provisions of this circular or other official circulars.

3. Weights are avoirdupois dry weight; tons are short tons (2,000 pounds per ton).

(Sec. 5 (b), 60 Stat. 761)

Effective date. This circular will become effective at midnight, April 11, 1948.

Dated at Washington, D. C., this 9th day of April 1948.

CIRCULAR NO. 4—TEMPORARY ADDITIONAL ALLOWANCES, COLORADO PLATEAU AREA CARNOTITE-TYPE AND ROSCOELITE-TYPE ORES

§ 60.4 *Temporary additional allowances, Colorado Plateau area carnotite-type and roscoelite-type ores*—(a) *Additional allowances.* In addition to the guaranteed minimum prices specified in § 60.3 (Circular No. 3) issued April 9, 1948, the relevant terms and conditions of which are hereby incorporated in this section by reference, the Commission will pay the allowances specified in paragraph (b) of this section in connection with the delivery of carnotite-type or roscoelite-type uranium-bearing ores at the Commission's established purchase depots in the Colorado Plateau area.

(b) *Allowances specified.* The following allowances are specified:

(1) A haulage allowance of 6¢ per ton mile for transportation of ore from the mine where produced to the purchase depot specified by the Commission, up to a maximum of 100 miles. The haulage distance from the mine to the purchase depot will be determined by the Commission and its decision will be final.

(2) An allowance of 50¢ per pound for uranium oxide (U_3O_8) contained in ores assaying 0.20% or more U_3O_8., in addition to the development allowance provided for in Schedule I of § 60.3.

(c) *Inquiries.* All inquiries concerning the provisions of this section, offers to deliver ores, or questions about the Commission's uranium program in the Colorado Plateau area should be addressed to:

United States Atomic Energy Commission,
Post Office Box 270,
Grand Junction, Colorado,
Telephone: Grand Junction 3000.

(d) *Effective date.* The allowances provided for in this section will become effective June 1, 1948 and will be in effect until July 1, 1949, and shall, during this period, constitute guaranteed minimum prices in addition to those specified in § 60.3. (Sec. 5 (b), 60 Stat. 761.)

Dated at Washington, D. C., this 15th day of June 1948.

PART 40

CONTROL OF SOURCE MATERIAL

GENERAL PROVISIONS

AUTHORITY: § § 40.1 to 40.70, inclusive, issued under Pub. Law 585, 79th Cong., 60 Stat. 755 et seq.

GENERAL PROVISIONS

§ 40.1 *Basis and purpose.* The regulations in this part, for the control of source material essential to the production of fissionable material, are promulgated by the United States Atomic Energy Commission pursuant to the Atomic Energy Act of 1946 (60 Stat. 755) in order to assure adequate source material for production, research, and development activities and to prevent the use of such material in a manner inconsistent with the national welfare.

§ 40.2 *Definitions.* (a) As used in this part, the term "source material" means any material, except fissionable material, which contains by weight one-twentieth of one percent (0.05%) or more of (1) uranium, (2) thorium, or (3) any combination thereof.

(b) "Fissionable material" means fissionable material as defined in section 5 of the Atomic Energy Act of 1946 and regulations which may be issued pursuant to that act by the Commission.

(c) "Raw source material" means (1) source material which has not been chemically processed in any manner and (2) source material in the form of residues or tailings.

(d) "Refined source material" means source material other than raw source material.

(e) "Person" means any individual, corporation, partnership firm, association, trust, estate, public or private institution, group, the United States or

(a) During any single calendar month a quantity of raw source material after removal from its place of deposit in nature which contains less than 10 pounds of uranium or thorium or any combination thereof, or

(b) Products listed in Schedule I (§ 40.60).

LICENSES

§ 40.20 *Applications for licenses.* Applications for licenses to transfer or deliver, receive possession of or title to, or export source material shall be filed with the United States Atomic Energy Commission, P. O. Box 42, Station F, New York 16, New York. Applications should be filed on Form AEC–2, copies of which are available at the above address. When it is impracticable to use this form, applications may be made by letter or telegram, giving the information required by Form AEC–2.

§ 40.21 *Issuance of licenses.* Upon

to applications filed with the Commission. Specific licenses may authorize a continuing activity or, as in the case of exports, may be limited to an individual transaction. So far as consistent with the purposes of the Atomic Energy Act of 1946, licenses will be tailored to fit the normal business requirements of the licensee.

§ 40.24 *Conditions of licenses.* Each license will require the licensee to comply with certain conditions, including the filing of reports with the Commission and restrictions upon the use of source material. Willful failure of a licensee to file any such report which truthfully sets forth all information required, or willful failure to comply with any other condition of the license, shall constitute a violation of the regulations in this part.

§ 40.25 *Revocation, suspension, modification of licenses.* Any license may be modified, withdrawn, suspended, revoke, or annulled at any time in the discretion of the Commission upon a determination by the Commission that the public health interest or safety requires such action or that the licensee has willfully failed to comply with any condition of the license. In the absence of such a determination, no modification, withdrawal, suspension, revocation, or annulment of any license will be made except upon application therefor by the licensee or unless, prior thereto, facts or conduct warranting such action have been called to the attention of the licensee in writing and the licensee has been accorded opportunity to demonstrate or achieve compliance with all lawful requirements. Nothing in this part shall limit the authority of the Commission to issue or amend its regulations in accordance with law.

§ 40.26 *Renewal of licenses.* In any case in which a licensee has filed an application in proper form for a renewal or a new license not less than 30 days prior to expiration of his existing license, such existing license, to the extent that it has reference to any activity of a continuing nature, shall not expire until the application for a renewal or a new license has been finally determined by the Commission.

§ 40.27 *Transfer of licenses.* Licenses shall be non-transferable.

§ 40.28 *Licenses to transfer uranium for certain uses.* Unless justified by exceptional circumstances licenses will not be issued for transfers of source material which contains by weight uranium in excess of one-twentieth of one percent (0.05%) for use in the manufacture of or for incorporation in any of the products listed in Schedule II (§ 40.61).

§ 40.29 *Control or possession of source material by persons who do not hold specific or general licenses.* (a) Any person who has, or who hereafter obtains, possession of or title to (1) a quantity of raw source material after removal from its place of deposit in nature which contains 10 pounds or more of uranium, thorium, or any combination thereof, or (2) a quantity of refined source material which contains 1 pound or more of uranium, thorium, or any combination thereof (except refined source material incorporated in products listed in Schedule I (§ 40.60)) shall, not later than 30 days after the effective date of the regulations in this part or after the date of obtaining such possession or title, whichever is later, file with the Commission a reasonably detailed statement of:

(i) The nature of the material,
(ii) Its quantity,
(iii) Its uranium and thorium content,
(iv) Its location, and
(v) Its ownership.

(b) The requirement in paragraph (a) of this section does not apply to any person who holds a specific or general license from the Commission.

REPORTS

§ 40.30 *Reports.* Reports, in addition to those called for in licenses, may be required by the Commission from time to time, subject to approval by the Bureau of the Budget in certain cases, with respect to the ownership, possession, extraction, refining, shipment, or other handling of source material after removal from its place of deposit in nature, as the Commission may deem necessary.

NOTE.—The reporting requirements hereof have been approved by the Bureau of the Budget pursuant to the Federal Reports Act of 1942.

VIOLATIONS

§ 40.40 *Penalties for violations.* A violation of the regulations in this part shall be deemed to be a violation of the Atomic Energy Act of 1946 and shall subject the violator to the penalties therein prescribed. In addition, the Commission may take such action with respect to source material involved in any violation as it deems appropriate and in accordance with law.

INTERPRETATIONS, PETITIONS, AND COMMUNICATIONS

§ 40.50 *Valid interpretations.* Except as specifically authorized by the Com-

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mission, no interpretation or explanation of the meaning of the regulations in this part issued by any officer or employee of the Commission other than one issued by the General Counsel in writing will be recognized to be valid and binding upon the Commission.

§ 40.51 *Petitions.* Petitions for relief from any restriction imposed under the regulations in this part may be made by filing a letter, in duplicate, with the United States Atomic Energy Commission, Post Office Box 42, Station F, New York 16, New York, stating the reasons why the petition should be granted.

§ 40.52 *Communications.* All communications concerning the regulations of this part or any license issued under them should be addressed to the United States Atomic Energy Commission, P. O. Box 42, Station F, New York 16, New York.

SCHEDULES

§ 40.60 *Schedule I: Exempted products* (see § 40.10 and § 40.29).

(a) Incandescent mantles.
(b) Ceramic products.
(c) Refractories.
(d) Glass products.
(e) Photographic film, negatives and prints.
(f) Rare earth metals and compounds, mixtures and products containing not more than 0.25% by weight thorium, uranium, or any combination of these.
(g) Vacuum tubes.

§ 40.61 *Schedule II: Prohibited uses of uranium* (see § 40.28).

(a) Ceramic products.
(b) Glass products.
(c) Photographic film, negatives and prints.

§ 40.62 *Schedule III: General licenses* (see § 40.23). Transfers, deliveries and receipts of possession of or title to source material, except where export is intended or where export occurs, which are within any one or more of the following categories, are hereby generally licensed:

(a) Transfers, deliveries and receipts of possession of (but not of title to) source material by contractors and agents of the Commission in the authorized course of their business for the Commission:

NOTE.—The term "person" as defined in section 18 (c) of the Atomic Energy Act of 1946 and in § 40.2 does not include the Commission or officers or employees of the Commission in the exercise of duly authorized functions. Consequently, the restriction on transfers in § 40.10 does not apply in such cases.

(b) Transfers, deliveries and receipts of possession of (but not of title to) source material by common or contract carriers for transportation purposes only in the regular course of business.

(c) Transfers, deliveries and receipts of possession of and title to a quantity of refined source material which contains less than one pound of uranium, thorium, or any combination thereof, from or to any one person during any single calendar month, to the extent that the transaction consists of either:

(1) Transfer to or receipt of possession or title by a licensed dispensing pharmacist solely for the compounding of medicinals for delivery to consumers, or

(2) Transfer to or receipt of possession or title by a physician or consumer for medicinal purposes only, and not for resale, or

(3) Transfer to or receipt of possession or title by an educational institution or hospital for educational or medical purposes only, and not for resale.

§ 40.70 *Effective date.* The regulations in this part shall become effective at midnight, March 31, 1947. This effective date, which is less than thirty days subsequent to publication, is found necessary and appropriate by the Commission in view of the fact that controls on transfers of source material exercised by the Civilian Production Administration under the Second War Powers Act will lapse at midnight, March 31, 1947.

Dated at Washington, D. C., this 17th day of March 1947.

PART 50

CONTROL OF FACILITIES FOR THE PRODUCTION OF FISSIONABLE MATERIAL

GENERAL PROVISIONS

GENERAL RESTRICTIONS

APPLICATIONS FOR AND ISSUANCE OF LICENSES

TYPES AND CONDITIONS OF LICENSES

REPORTS

VIOLATIONS

INTERPRETATIONS, PETITIONS, COMMUNICATIONS

SCHEDULES

EFFECTIVE DATE

AUTHORITY: §§ 40.1 to 40.80, inclusive, issued pursuant to the Atomic Energy Act of 1946 (Pub. Law 585, 79th Cong.; 60 Stat. 755–ff).

GENERAL PROVISIONS

§ 50.1 *Basis and purpose.* The regulations in this part, for the control of facilities for the production of fissionable material, are promulgated by the United States Atomic Energy Commission pursuant to the Atomic Energy Act of 1946 (60 Stat. 755, 42 U. S. C. 1801 *et seq.*) to effectuate the policies and purposes of the Act.

§ 50.2 *Definitions.* (a) As used in this part, the term "facilities for the production of fissionable material," means (1) any equipment or device capable of such production and (2) any important component part especially designed for such equipment or devices as determined by the Commission. All such facilities are, for the purposes of the regulations in this part, classified as follows:

(1) Class I: Any facility (other than a Class II facility) capable of producing any fissionable material, including items listed in Schedule A (§ 50.70);

(2) Class II: Any item listed in Schedule B (§ 50.71). The Commission has determined that such items are important component parts especially designed for equipment or devices capable of the production of fissionable material.

(b) The term "person" means any individual, corporation, partnership, firm, association, trust, estate, public or private institution, group, the United States or any agency thereof, any government other than the United States, any political subdivision of any such government, and any legal successor, representative, agent, or agency of the foregoing, or other entity, but shall not include the Commission, or officers or employees of the Commission in the exercise of duly authorized functions.

(c) The term "Commission" means the Atomic Energy Commission created by the Atomic Energy Act of 1946, or its duly authorized representative.

(d) The term "United States", when used in a geographical sense, includes all Territories and possessions of the United States and the Canal Zone.

(e) The term "fissionable material" means plutonium, uranium enriched in the isotope 235, any other material which the Commission determines to be capable of releasing substantial quantities of energy through nuclear chain reaction of the material, or any material artificially enriched by any of the foregoing, but does not include source materials, as defined in the Atomic Energy Act of 1946.

GENERAL RESTRICTION

§ 50.10 *License required.* Unless authorized by a license issued by the Commission, no person shall manufacture, produce, transfer, or acquire facilities for the production of fissionable material. Licenses issued by the Commission are of two basic types, general and specific (see § 50.33), depending on the nature of the activity to be authorized.

§ 50.11 *Activities incident to export.* A specific license must be obtained to authorize export from the United States of facilities for the production of fissionable material, or to authorize the manufacture, production, transfer, or acquisition of such facilities for export.

§ 50.12 *Domestic activities.* (a) A specific license must be obtained (except as indicated in paragraph (c) below) to authorize manufacture, production, transfer, or acquisition of Class I facilities.

(b) A general license is hereby issued for manufacture, production, transfer, and acquisition of Class II facilities which takes place within the United States and is not for export. This general license shall be deemed to include manufacture, production, transfer, and acquisition of Class II facilities for incorporation into other Class II facilities prior to export of the latter. Each per-

son acting under authority of this general license remains subject to the reporting requirements of §§ 50.40 and 50.41 below.

(c) No license is required for activities expressly excepted from the licensing requirements of the Atomic Energy Act of 1946; that is, for manufacture, production, transfer, or acquisition of Class I or Class II facilities incident to or for the conduct of research or development activities in the United States of the types specified in section 3 of the Act.

§ 50.13 *Other activities.* A specific license must be obtained to authorize manufacture, production, transfer, or acquisition of facilities for the production of fissionable material in cases other than those specified in §§ 50.11 and 50.12 above.

APPLICATIONS FOR AND ISSUANCE OF LICENSES

§ 50.20 *Applications for licenses.* License applications for the activities covered by § 50.11 above shall be filed in duplicate with the United States Atomic Energy Commission, on Form AEC–17, copies of which may be obtained from the Commission. License applications for all other activities shall be filed by letter. In accordance with instructions given in Form AEC–17, applicants using that form shall also file with the Commission five copies of Shipper's Export Declaration (Department of Commerce Form 7525–V).

§ 50.21 *Issuance of licenses.* Upon a determination that an application meets the requirements of the Atomic Energy Act of 1946 and of the regulations of the Commission, the Commission will issue a license by approving, upon such conditions as it deems appropriate and in accordance with law, the application filed, forwarding a copy of the license to the applicant. Confirmation of such approval in appropriate cases will be stamped on all copies of the Shipper's Export Declaration which, with the exception of one copy retained for the Commission's files, will be returned to the applicant for use in complying with Customs procedures at the time of export.

§ 50.22 *Standards for issuance of licenses.* In making the determination mentioned in the preceding section, the Commission will be guided by the following standards:

(a) Assuring the common defense and security;

(b) Assuring an adequate supply of facilities for the production of fissionable material;

(c) Preventing the use of such facilities in a manner inconsistent with the national welfare;

(d) Effectuating the policies and purposes of the Atomic Energy Act of 1946.

So far as consistent with these standards, licenses will be granted for the conduct of normal business activities.

TYPES AND CONDITIONS OF LICENSES

§ 50.30 *Types of licenses.* A general license has been issued in the cases specified in § 50.12 (b) above and in such cases the filing of an application with the Commission is not necessary. Specific licenses are issued to named persons in response to applications filed with the Commission. So far as consistent with the Atomic Energy Act of 1946, licenses will be designed to fit the normal business requirements of the licensee.

§ 50.31. *Conditions of licenses.* Each license will require the licensee to comply with certain conditions, including the filing of reports with the Commission. Willful failure of a licensee to file any such report which truthfully sets forth all information required, or willful failure to comply with any other condition of the license, shall constitute a violation of the regulations in this part.

§ 50.32 *Revocation, suspension, modification of licenses.* Any license may be modified, withdrawn, suspended, revoked, or annulled at any time in the discretion of the Commission upon a determination by the Commission that the public health, interest, or safety requires such action, or that the licensee has willfully failed to comply with any condition of the license. In the absence of such a determination, no modification, withdrawal, suspension, revocation or annulment of any license will be made except upon application therefor by the licensee or unless, prior thereto, facts or conduct warranting such action have been called to the attention of the licensee in writing and the licensee has been accorded opportunity to demonstrate or achieve compliance with all lawful requirements. Nothing in this part shall limit the authority of the Commission to issue or amend its regulations in accordance with law.

§ 50.33 *Transfer of licenses.* Licenses shall be non-transferable.

REPORTS

§ 50.40 *Reporting possession or title.* (a) Any person (whether or not a licensee) who, on the effective date of the regulations of this part, has possession of or title to any Class I facility for the production of fissionable material (including those listed specifically in Schedule A, § 50.70) shall, not later than 60 days after such date, file with the Commission a reasonably detailed statement of:

(i) The location of the facility;
(ii) Its present use;
(iii) Its proposed use;
(iv) Its engineering specifications, including capacity;
(v) The name, title, and address of the persons having control of the facility.

(b) The requirement of this section does not apply to any facility held under authority of a contract for an arrangement with the Commission.

NOTE.—The term "person" as defined in section 18 (c) of the Atomic Energy Act of 1946 and in § 50.2 does not include the Commission or officers or employees of the Commission in the exercise of duly authorized functions. Consequently, the requirement of this § 50.40 does not apply in such cases.

§ 50.41 *Reports.* Reports in addition to those called for in licenses may be required by the Commission from time to time, subject to approval by the Bureau of the Budget in certain cases, with respect to the ownership, possession, manufacture, production, export, shipment, transfer, acquisition or other handling of facilities for the production of fissionable material, as the Commission may deem necessary.

VIOLATIONS

§ 50.50 *Penalties for violations.* A violation of the regulations in this part shall be deemed to be a violation of the Atomic Energy Act of 1946, and shall subject the violator to the penalties therein prescribed. In addition, the Commission may take such action with respect to the facilities involved in any violation as it deems appropriate and in accordance with law.

INTERPRETATIONS, PETITIONS, COMMUNICATIONS

§ 50.60 *Valid interpretations.* Except as specifically authorized by the Commission, no interpretation or explanation of the meaning of the regulations in this part issued by any officer or employee of the Commission other than one issued by the General Counsel in writing will be recognized to be valid and binding upon the Commission.

§ 50.61 *Petitions.* Petitions for relief from any restrictions imposed under the regulations in this part may be made by filing a letter, in duplicate, with the Commission, stating the reasons why the petitions should be granted.

§ 50.62. *Communications.* All communications concerning the regulations of this part or any license issued under them should be addressed to the United States Atomic Energy Commission, Washington 25, D. C., Attention: Director of Engineering.

SCHEDULES

§ 50.70 *Schedule A: Class I facilities* (see §§ 50.2, 50.20, and 50.40). As defined in § 50.2 above, a Class I facility is any facility (other than a Class II facility) capable of producing any fissionable material, such as (a) nuclear reactors or piles, (b) facilities capable of the separation of isotopes of uranium, and (c) electronuclear machines (*e. g.*, cyclotrons, synchrocyclotrons and linear ion accelerators) capable of imparting energies in excess of 1 Mev each to positively charged nuclear particles or ions.

NOTE.—Under section 4 (c) (1) of the Atomic Energy Act of 1946 the Commission, as agent of and on behalf of the United States is made the exclusive owner of all facilities for the production of fissionable material *other than* facilities which (a) are useful in the conduct of research and development activities in the fields specified in section 3 of the Act, and (b) do not, in the opinion of the Commission, have a potential production rate adequate to enable the operator of such facilities to produce within a reasonable period of time a sufficient quantity of fissionable material to produce an atomic bomb or any other atomic weapon. The listing of a facility for the purposes of the regulations in this part shall not be deemed to be an expression of the opinion of the Commission as to ownership of any such facility for the purposes of section 4 (c) (1) of the Act.

§ 50.71 *Schedule B: Class II facilities* (see §§ 50.2 and 50.20). A Class II facility is any item listed in this Schedule B. The Commission has determined that the following items are important component parts especially designed for

equipment or devices capable of the production of fissionable material:

(a) Radiation detection instruments, and their major components, designed, or capable of being adapted, for detection or measurement of nuclear radiations, such as alpha and beta particles, gamma radiation, neutrons and protons, including the following:

(i) Geiger Mueller, proportional, or parallel plate counter scalers.

(ii) Geiger Mueller or proportional counter rate meters.

(iii) Scalers (adaptable to radiation detection).

(iv) Geiger Mueller, proportional audio, or mechanical detectors.

(v) Integrating ionization chamber meters and ionization chamber rate meters.

(vi) Geiger Mueller, proportional, or parallel plate counter detector components.

(vii) Micromicroammeters capable of measuring currents of less than 1 micromicroampere.

(viii) Counter pulse rate meters.

(ix) High gain high impedance linear pulse amplifiers.

(x) Geiger Mueller quenching units.

(xi) Geiger Mueller or proportional coincidence units.

(xii) Electroscopes and electrometers, pocket and survey types, including dosimeters.

(xiii) Chambers, pocket type, with electrometer charger-reader.

(xiv) Electrometer - type electronic tubes with input grid currents of less than 1.0 micromicroamperes, such as FP–54, RH–507, Ck–570AX, VX–32, and VX–41, and equivalent.

(xv) Resistors, values above 1,000 megohms.

(b) Mass spectrometers and mass spectographs, of all mass ranges, and their major components, including the following:

(i) Leak detectors, mass spectrometer, light gas type.

(ii) Mass spectrometers or mass spectrographs.

(iii) Ion sources, mass spectrometer or spectrograph type.

(iv) Acceleration and focussing tubes, mass spectrometer and spectrograph types.

(v) Ionization chambers, mass spectrometer detector types.

(vi) Micromicroammeters capable of measuring current of less than 1.0 microampere.

(vii) Electrometer tubes (as listed in (a) (xiv) above).

(viii) Resistors, values above 1,000 megohms.

(c) Vacuum diffusion pumps 12 inches diameter and larger (diameter measured inside the barrel at the inlet jet).

(d) Electronuclear machines, and their basic component parts, capable, with or without modification, of sustaining potential differences in excess of 100,000 volts against the discharging action of positive ion currents in excess of 10^{-7} amperes, such as belt type electrostatic generators (Van de Graaff machines).

§ 50.80 *Effective date.* The regulations in this part shall become effective at midnight, November 20, 1947, this effective date, which is less than 30 days subsequent to publication, is found necessary and appropriate by the Commission for assuring the common defense and security.

Dated at Washington, D. C., this 18th day of November 1947.

PART 70

DEFINITION OF FISSIONABLE MATERIAL

URANIUM 233

§ 70.1 *Uranium 233.* The Commission has determined (13 F. R. 1955) pursuant to section 5 (a) (1) of the Atomic Energy Act of 1946 that the isotope Uranium 233 is a material capable of releasing substantial quantities of energy through nuclear chain reaction of the material. Accordingly, the isotope Uranium 233, and any material artificially enriched thereby, constitutes a "fissionable material" within the meaning of the Atomic Energy Act of 1946.

Effective date. In the interest of the common defense and security, the determination set forth in § 60.1 shall become effective immediately upon publication in the FEDERAL REGISTER.

(60 Stat. 755)

Dated at Washington, D. C., this 20th day of April 1948.

PART 80

GENERAL RULES OF PROCEDURE ON APPLICATIONS FOR DETERMINATION OF REASONABLE ROYALTY FEE, JUST COMPENSATION, OR GRANT OF AWARD FOR PATENTS, INVENTIONS, OR DISCOVERIES

GENERAL PROVISIONS

APPLICATIONS

EXAMINATION AND RESPONSE

PREHEARING CONFERENCE

HEARING

PROPOSED FINDINGS AND DETERMINATION

ADJUDICATION

AUTHORITY: §§ 80.1 to 80.60, inclusive, issued under 60 Stat. 755; 42 U. S. C. 1811.

NOTE.—The regulations in this part appeared in proposed form at 13 F. R. 2487.

GENERAL PROVISIONS

§ 80.1 *Scope of the regulations.* The regulations in this part provide the rules of procedure to be followed by any person making application to the Atomic Energy Commission for the determination of a reasonable royalty fee, just compensation, or the grant of an award, and for the consideration of such applications pursuant to subsection (e) of section 11 of the Atomic Energy Act of 1946 (60 Stat. 755, 768; 42 U. S. C. 1811).

§ 80.2 *Definitions.* (a) All terms used in the regulations in this part which are defined in the Atomic Energy Act shall have the defined meaning.

(b) "Board" shall mean the Patent Compensation Board designated by the Commission pursuant to subsection (e) (1) of section 11 of the act.

(c) "Application" shall mean the application provided for in §§ 80.10 to 80.12, inclusive.

(d) "Response" shall mean the document, to be filed by the Office of the General Counsel of the Commission, provided for in § 80.22.

(e) "Party" shall mean the applicant (personally or through his counsel) and the Office of the General Counsel of the Commission, as the text may indicate. Each applicant shall be entitled to be represented by counsel.

§ 80.3 *Notices.* All notices required by this part and the service of all documents will be by registered mail and will be effective as of the time received.

§ 80.4 *Security.* In any proceeding under the regulations in this part, the Commission may issue any general or specific order, directive, or further regulation which it determines to be appropriate pursuant to section 10 of the act to assure the common defense and security.

§ 80.5 *Amendment.* Nothing in this part shall limit the authority of the Commission to issue or amend its regulations in accordance with law.

APPLICATION

§ 80.10 *Applicants.* (a) Any person claiming just compensation for any patent revoked in whole or in part by paragraph (1) and (2) of subsection (a) or by subsection (b) of section 11 of the act may file an application for just compensation.

(b) Any person claiming just compensation for any invention or discovery, or for any patent or patent application covering such invention or discovery, taken, requisitioned, or condemned by the Commission pursuant to subsection (d) of section 11 of the act may file an application for just compensation.

(c) Any person claiming a reasonable royalty fee for the use of an invention or discovery covered by any patent declared to be affected with a public interest pursuant to paragraph (1) of subsection (c) of section 11 of the act, or any person who has been licensed pursuant to section 11 (c) (2) of the act to utilize the invention or discovery covered by such patent and is unable to reach an agreement with the owner thereof, may file an application for the determination of a reasonable royalty fee.

(d) Any person who has made any invention or discovery covered by paragraph (3) of subsection (a) of section 11 of the act, who is not entitled to compensation therefor under subsection (a) of section 11, and who has complied with the provisions of paragraph (3) of subsection (a), may file an application for an award.

§ 80.11 *Form and content.* (a) Each application shall be signed by the applicant and shall state his name and post office address. Where the applicant elects to be represented by counsel, a request for entry of counsel's appearance shall be filed with or after the application, on a form obtainable from the Clerk of the Board.

(b) Each application shall contain a statement of the applicant's interest in the patent, patent application, invention or discovery, identifying any other claimants of whom the applicant has knowledge.

(c) Each application must contain a concise statement of all of the essential facts upon which it is based. No particular form of statement is required, but it will facilitate consideration of the application if the following specific data accompany the application:

(1) In the case of an issued patent, a copy of the patent;

(2) In the case of a patent application, a copy of the application and of all Patent Office actions and responses thereto;

(3) In the case of an invention or discovery as to which a report has been filed with the Commission pursuant to paragraph (3) of subsection (a) of section 11 of the act, a copy of such report.

(4) The date relied upon as the date of invention.

(5) In all cases, a statement of the extent to which, if any, the invention or discovery was developed through federally financed research; the degree of its utility, novelty, and importance.

(6) In the case of an application for just compensation or an award, a statement of the actual use of such invention or discovery, to the extent known to the applicant.

(7) In all cases, the cost of developing the invention or discovery or acquiring the patent or patent application.

(8) The reasonable royalty fee proposed, or the amount sought as just compensation or award; the basis used in calculating it; and whether lump sum or periodic payments are sought.

(d) Each connected series of statements shall be set forth in separately numbered paragraphs in the application. Any exhibits or documents which accompany the application may be incorporated by reference.

(e) All applications shall be verified by the applicant or by the person having the best knowledge of such facts. In the case of facts stated on information and belief the source of such information and grounds of belief shall be given.

§ 80.12 *Filing of applications.* (a) Five copies of each application shall be filed with the Clerk of the Board. At the applicant's election, only one copy of the accompanying exhibits need be filed.

(b) The Clerk of the Board will acknowledge the receipt of the application in writing and advise the applicant of the docket number assigned to the application.

(c) All communications concerning the application and all documents thereafter filed in the proceeding shall bear the docket number of the application.

EXAMINATION AND RESPONSE

§ 80.20 *Examination.* Upon receipt of the application, a preliminary examination will be made by the Commission staff.

§ 80.21 *Recommendation for acquisition by purchase.* At any time following the filing of an application and prior to final determination, the applicant may be requested in writing to meet with one or more members of the Commission staff to discuss the possibility of acquisition by purchase of the invention or discovery or patent or patent application, as the case may be, pursuant to subsection (d) of section 11 of the act. The time prescribed in § 80.22 for the filing of the response shall be extended by a time equivalent to any period in which negotiations are being conducted (beginning with the initial communication to the applicant and ending either with acceptance or rejection of a proposal or with a written communication by the applicant stating that negotiations are to be terminated).

§ 80.22 *Response.* Within a reasonable time and in no event more than four (4) months after receipt of the application, unless such time shall have been extended by special order of the Board for cause or pursuant to § 80.21, the Office of the General Counsel shall file with the Clerk of the Board a response containing a concise statement of the facts or law constituting a defense or any other relevant matter which it believes should be considered by the Board.

PREHEARING CONFERENCE

§ 80.30 *Designation.* In any proceeding in which the Board in its discretion determines that a prehearing conference would be desirable, the Board may designate one of its members to preside at a prehearing conference to which the parties shall, upon reasonable notice, be invited to appear.

§ 80.31 *Conference procedure.* (a) The prehearing conference shall be conducted in an informal manner and shall be devoted to a consideration of

(1) The simplification of the issues;

(2) The necessity or desirability of amendment or amplification of the application or the response;

(3) The possibility of obtaining agreement as to facts and documents which will avoid unnecessary proof;

(4) Such other matters as may facilitate the consideration by the Board.

(b) The Board member presiding at such conference shall prepare, with the assistance of the parties, a memorandum of matters upon which agreement has been reached, and such memorandum shall, when signed by the parties, become a part of the record.

HEARING

§ 80.40 *Notice.* The Board shall in each case afford an opportunity for a hearing for the receipt of relevant evidence. At least thirty (30) days notice shall be given of the time and place of such hearing.

§ 80.41 *Order of procedure.* Ordinarily evidence in support of the application shall be received first and thereafter evidence in reply. Thereafter rebuttal and any necessary additional evidence shall be received.

§ 80.42 *Submission and receipt of evidence.* (a) Each witness shall, before proceeding to testify, be sworn or make affirmation.

(b) When necessary in order to prevent undue prolongation of the hearing, the Board may limit the amount of corroborative or cumulative evidence, may restrict the repetitious examination or cross-examination of witnesses, and shall otherwise control the conduct of the proceeding.

(c) The Board shall admit only relevant and material evidence.

(d) Opinion evidence shall be admitted when the Board is satisfied that the witness is properly qualified.

(e) Evidence may be received in affidavit form in the discretion of the Board. All affidavits shall be submitted not later than the opening of the hearing unless the Board for cause shown shall receive them at a later time. Each party shall be permitted to examine all affidavits received in evidence, and to file counter affidavits within such period as the Board shall fix. In determining the weight to be attached to testimony contained in affidavits, the Board shall consider the lack of opportunity for cross-examination.

(f) Opportunity shall be afforded for the cross-examination of witnesses. Objections to the admission or rejection of any evidence or to any limitation of the scope of examination or cross-examination shall state briefly the grounds of such objection and the transcript shall not include argument on such objection except as ordered by the Board. No objection may subsequently be relied upon unless timely made, and the ruling on each objection shall be made part of the transcript, together with any offer of proof which may be made.

(g) In the conduct of the hearing the Board shall ensure compliance with the security regulations and requirements of the Commission and take whatever steps it may deem appropriate to assure the common defense and security pursuant to the provisions of the act.

§ 80.43 *Transcript of the testimony.* Testimony given at a hearing shall be reported verbatim. All written statements, charts, tabulations, and similar data offered in evidence at the hearing shall be marked for identification and, upon a showing satisfactory to the Board of their authenticity, relevance, and materiality, shall be received and marked as exhibits in evidence. Such exhibits (including affidavits) shall, if practicable, be submitted in quintuplicate. Where the required number of copies are not made available, the Board may in its discretion order the exhibit read in evidence or require additional copies to be submitted within a specified time.

§ 80.44 *Oral arguments; proposed findings; written arguments.* (a) In its

discretion the Board may authorize oral argument at the close of the hearing.

(b) The Board shall announce at the hearing a reasonable period within which either party may submit to the Board proposed findings and a proposed recommendation. Such proposals shall be in writing in quintuplicate, and copies shall be served on the opposing party.

(c) At the time fixed for the submission of proposed findings, either party may file written arguments in support based upon the evidence received at the hearing, citing the page or pages of the transcript of the testimony where such evidence may be found.

§ 80.45 *Copies of the record of the hearing.* The Board shall make provision for a stenographic record of the testimony and for furnishing it to the applicant upon payment of the cost. Suggested corrections to the transcript of the testimony shall be considered only if filed within a period to be fixed by the Board. Upon receipt of such suggested corrections, the Board in its discretion shall correct the transcript.

PROPOSED FINDINGS AND DETERMINATION

§ 80.50 *Formulation.* (a) Within a reasonable time after the close of the hearing the Board shall prepare and serve upon the parties its proposed findings and proposed determination and a statement of the reasons or basis therefor. The proposed findings and proposed determination shall be based upon the entire record and supported by reliable, probative and substantial evidence. On issues of fact, no finding shall be proposed except when deemed by the Board to be supported by the greater weight of the evidence. The proposed findings and proposed determination, together with the statement of the reasons or basis therefor, shall become part of the record.

(b) The Board shall further make a ruling upon each proposed finding and proposed recommendation presented by either party pursuant to § 80.44 (b). Such rulings shall be served upon each party and shall become part of the record.

§ 80.51 *Exceptions.* Either party may, within twenty (20) days after receipt of a copy of the proposed findings and proposed determination of the Board, unless such time shall have been extended by special order of the Board for cause, file with the Clerk of the Board exceptions to any part thereof or to the failure of the Board to include proposed findings requested under § 80.44. The exceptions may be accompanied by briefs in support. Five (5) copies of the exceptions and the supporting briefs shall be filed, and a copy served upon the other party. The exceptions but not the supporting briefs shall become part of the record.

ADJUDICATION

§ 80.60 *Final action.* (a) Upon the expiration of the period prescribed in § 80.51, the Board shall proceed to a final consideration of the application on the basis of the entire record, including any exceptions, and the briefs in support filed by either party. The Board shall resolve questions of fact by what it deems to be the greater weight of the evidence and shall make its decision on the entire record. Its findings as to the facts shall be supported by reliable, probative and substantial evidence. The Board shall enter an appropriate order, together with a statement of its reasons or basis, determining a reasonable royalty fee, the amount of just compensation, or the amount of an award as the case may be.

(b) The Board shall further make a ruling upon each exception presented by either party pursuant to § 80.51.

(c) The order of the Board shall constitute the final action of the Commission.

Dated at Washington, D. C., this 18th day of June 1948.

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APPENDIX 5

Isotopes and Isotope-Labeled Compounds Available for Distribution Through Commission Facilities

DISTRIBUTION OF ISOTOPES FROM ISOTOPES DIVISION—OAK RIDGE, TENN.

Domestic	Number of shipments					
	July 1 to Dec. 31, 1946	Jan. 1 to June 30, 1947	July 1 to Dec. 31, 1947	Jan. 1 to June 30, 1948	July 1 to Dec 31, 1948	Total to Dec. 31, 1948
SHIPMENTS CLASSIFIED BY BROAD FIELD OF UTILIZATION						
Radioactive isotopes:						
Medical therapy	88	319	397	487	655	1,946
Animal physiology	78	202	306	406	371	1,363
Chemistry	27	47	91	97	128	390
Physics	17	65	69	106	96	353
Plant physiology	16	33	29	78	38	194
Industrial research	14	18	33	25	60	150
Bacteriology	4	7	26	27	26	90
Metallurgy	2	8	2	8	3	23
Other				4	29	33
Total	246	699	953	1,238	1,406	4,542
Stable isotopes:						
Physics		27	77	98	107	309
Chemistry		12	45	24	26	107
Animal physiology		16	19	16	19	70
Industrial research			7	14	2	23
Plant physiology			5		6	11
Bacteriology			1	1	2	4
Total		55	154	153	162	524
SHIPMENTS CLASSIFIED BY KIND OF ISOTOPE						
Radioactive isotopes:						
Phosphorus 32	48	212	325	422	479	1,486
Iodine 131	68	208	287	454	524	1,541
Carbon 14	47	41	67	67	57	279
Sodium 24	1	31	49	64	55	200
Gold 198, 199	17	46	6	17	12	98
Sulfur 35	12	19	20	15	26	92
Calcium 45	5	17	25	15	18	80
Iron 55, 59	5	21	20	14	19	79
Potassium 42	6	17	14	10	14	61
Cobalt 60	4	20	12	10	20	66
Strontium 89, 90	3	4	5	10	8	30
Others (50)	30	63	123	140	174	530
Total	246	699	953	1,238	1,406	4,542
Stable isotopes:						
Deuterium oxide (heavy water)		31	60	55	58	204
Deuterium (hydrogen 2)		22	58	39	30	149
Boron 10		2	22	13	10	47
Oxygen 18			14	9	3	26
Electromagnetic concentrated isotopes				37	61	98
Total		55	154	153	162	524

Domestic	Total number of shipments to Dec. 31, 1948	
	Radioactive	Stable
SHIPMENTS CLASSIFIED BY STATE AND TERRITORY		
Alabama	8	
Arkansas	3	
California	403	40
Colorado	1	1
Connecticut	103	26
Delaware	22	4
Florida	45	
Georgia	64	2
Illinois	298	60
Indiana	79	20
Iowa	11	1
Kansas	3	1
Kentucky	14	
Louisiana	84	3
Maine	1	
Maryland	169	15
Massachusetts	568	51
Michigan	197	15
Minnesota	206	15
Missouri	185	8
Montana		2
Nebraska	42	
New Jersey	49	19
New Mexico	1	
New York	645	64
North Carolina	27	3
Ohio	390	60
Oklahoma	2	5
Oregon	41	
Pennsylvania	263	41
South Carolina	4	
Tennessee	123	2
Texas	171	18
Utah	15	2
Virginia	19	1
Washington	43	
West Virginia	1	1
Wisconsin	144	30
District of Columbia	93	14
Hawaii	5	
Total	4,542	524

Foreign	Total number of shipments to Dec. 31, 1948	
	Radioactive	Stable
SHIPMENTS CLASSIFIED BY COUNTRY		
Argentina	21	
Australia	60	
Belgium	35	
Brazil	1	
Canada	14	
Denmark	24	
France	8	
Iceland	1	
Italy	1	
Netherlands	25	
New Zealand	2	
Norway	10	
Peru	4	
Spain	1	
Sweden	62	
Switzerland	8	
Turkey	1	
Union of South Africa	9	
United Kingdom:		
England	57	
Bermuda	10	
British West Africa	1	
Total	355	
SHIPMENTS CLASSIFIED BY KIND OF ISOTOPES		
Phosphorus 32	178	
Iodine 131	77	
Carbon 14	29	
Sulfur 35	18	
Calcium 45	8	
Iron 55, 59	17	
Cobalt 60	14	
Strontium 89, 90	4	
Other	10	
Total	355	

Isotope-Labeled Compounds

Since the submission of the Fourth Semiannual Report to the Congress in July 1948, additions to the list of private organizations preparing isotope-labeled compounds, and schedule changes in other preparation laboratories have caused appreciable changes in the list of labeled compounds available for distribution. Following is a revised list of those compounds, now available, or soon to be available, through AEC facilities:

CARBON 14 COMPOUNDS

1. Barium carbide.
2. Acetylene.
3. Sodium cyanide.
4. Methanol.
5. Methyl iodide.
6. Sodium acetate (carboxyl labeled).
7. Sodium acetate (methyl labeled).
8. Ethyl acetate (carboxyl labeled).
9. Ethyl acetate (methyl labeled).
10. Ethanol (methylene labeled).
11. Ethanol (methyl labeled).
12. Ethyl iodide (methylene labeled).

Total number of shipments to Dec. 31, 1948	
Radioactive	Stable
21	
60	
35	
1	
14	
24	
8	
1	
1	
25	
2	
10	
4	
1	
62	
8	
1	
9	
57	
10	
1	
355	
178	
77	
29	
18	
8	
17	
14	
4	
10	
355	

13. Ethyl iodide (methyl labeled).
14. Toluene (ring labeled in the one position).
15. Benzoic acid (ring labeled in the one position).
16. Benzene (single label per ring).
17. Tyrosine (beta carbon in side chain labeled).
18. Butyric acid (carboxyl labeled).
19. Propionic acid (carboxyl labeled).
20. Stearic acid (carboxyl labeled).
21. Glutamic acid (carboxyl labeled).
22. Miscellaneous fatty acids (carboxyl labeled).
23. Ethylene cyanohydrin (labeled in CN).
24. Beta-bromopropionic acid (carboxyl labeled).
25. Valine (carboxyl labeled).
26. Norvaline (carboxyl labeled).
27. Leucine (carboxyl labeled).
28. Norleucine (carboxyl labeled).
29. Homoaspartic acid (carboxyl labeled).
30. Phenylalanine (carboxyl labeled).
31. Formalin.

SULFUR 35 COMPOUNDS

1. Cystine.
2. Cysteine.
3. Benzyl homocysteine.
4. Methionine.
5. Radioactive sulfur.
6. Benzyl mercaptan.
7. Beta-chlorethylbenzylthioether.
8. Chlormethylbenzylthioether.
9. Thiourea.
10. Pentothal.

IODINE 131 COMPOUNDS

1. Diiodofluorescein.
2. Diiodo trypan blue.
3. Diiodoorthotolidine.
4. Diiodo Evan's blue.

GOLD 198 COMPOUNDS

1. Colloidal gold.
2. Sodium aurothiosulphate.

ZINC 65 AND COBALT 60 COMPOUNDS

1. Porphyrins.

DEUTERATED COMPOUNDS

1. Lithium deuteride.
2. Lithium aluminum deuteride.
3. Ammonia.
4. Acetylene.
5. Methane.

CARBON 14 COMPOUNDS EXPECTED TO BE AVAILABLE FOR DISTRIBUTION WITHIN THE NEXT 6 MONTHS

1. Ethyl bromacetate (carboxyl labeled).
2. Ethyl bromacetate (methylene labeled).
3. Bromobenzene.
4. Alanine (carboxyl labeled).
5. Benzoic acid (carboxyl labeled).
6. Benzyl alcohol (methylene labeled).
7. Benzyl bromide (methylene labeled).
8. Methylamine hydrochloride.
9. Formic acid.
10. Synthetic vitamin K–2-methyl-1, 4-naphthoquinone (labeled in the eight position).
11. Styrene ($C_6H_5C^{14}H=CH_2$).
12. Naphthalene (labeled in the one position).
13. Malonic ester ($C_2H_5OOC—C^{14}H_2—COOC_2H_5$).
14. Succinic acid ($HOOC—CH_2—C^{14}H_2—COOH$).
15. Glycine (methylene labeled).
16. Glycine (carboxyl labeled).
17. Sodium propionate (labeled in the two position).
18. Sodium propionate (labeled in the three position).
19. Sodium valerate (carboxyl labeled).
20. Sodium caproate (carboxyl labeled).
21. Sodium heptoate (carboxyl labeled).
22. Alanine (alpha labeled).
23. Alanine (beta labeled).
24. Calcium glycollate (carboxyl labeled).
25. Calcium glycollate (methylene labeled).
26. Propyl alcohol (labeled in the one position).
27. Propyl alcohol (labeled in the two position).
28. Propyl bromide (labeled in the one position).
29. Propyl bromide (labeled in the two position).
30. p-Aminobenzoic acid (carboxyl labeled).
31. Nicotinic acid (carboxyl labeled).
32. Nicotinamide (acid amide labeled).
33. Anthranilic acid (carboxyl labeled).
34. Urea.

APPENDIX 6

Research and Development Reports Issued

Nov. 1, 1947 to Nov. 1, 1948

	Physical sciences			Health and biology			Grand total
	Classified	Unclassified	Total	Classified	Unclassified	Total	
Argonne National Laboratory	100	8	108	21	3	24	132
Brookhaven National Laboratory	4	37	41	2	3	5	46
University of California Radiation Laboratory	147	12	159	17	2	19	178
K-25 Laboratory	127	14	141	1	1	2	143
Oak Ridge National Laboratory	200	43	243	22	12	34	277
Y-12 Laboratory	83	14	97	2	0	2	99
Los Alamos Scientific Laboratory	43	3	46	4	0	4	50
Ames Laboratory	23	4	27	0	0	0	27
Atomic Energy Project, University of Rochester	8	1	9	62	9	71	80
Hanford Plutonium Works	143	2	145	13	0	13	158
Massachusetts Institute of Technology	24	0	24	0	0	0	24
Battelle Memorial Institute	32	0	32	0	0	0	32
Knolls Atomic Power Laboratory	81	1	82	0	0	0	82
Electro Technical Laboratory, Norris, Tenn	11	0	11	0	0	0	11
New York Operations Office [1]	90	3	93	2	1	3	96
Other	375	93	468	30	3	33	501
Total	1,491	235	1,726	176	34	210	1,936

[1] Includes subcontractors.

y	
Total	Grand total
24	
5	132
	46
19	
2	178
34	143
2	277
4	99
0	50
	27
71	
13	80
	158
0	
0	24
0	32
	82
0	
3	11
33	96
	501
210	1,936

APPENDIX 7

Fellowship Boards and AEC Fellowships for 1948–1949

FELLOWSHIP BOARDS

Postdoctoral Research in Medical Sciences

Dr. Homer W. Smith, *director*, Physiological Laboratories, New York University College of Medicine, New York, N. Y.; *chairman.*

Dr. Austin M. Brues, *director*, Biology Division, Argonne National Laboratory, Chicago, Ill.

Dr. Sam L. Clark, *associate dean*, Vanderbilt University School of Medicine, Nashville, Tenn.

Dr. Hymer Louis Friedell, *professor of radiology*, Western Reserve University, Cleveland, Ohio.

Dr. Joseph G. Hamilton, *associate professor of experimental medicine and radiology, associate professor of medical physics*, Crocker Laboratory, University of California, Berkeley, Calif.

Dr. Roy R. Kracke, *dean and professor of clinical medicine*, Medical College of Alabama, Birmingham, Ala.

Postdoctoral Research in Physical Sciences

Dr. Roger Adams, *professor and head*, Department of Chemistry, University of Illinois, Urbana, Ill.; *chairman.*

Dr. Carl D. Anderson, *professor of physics*, California Institute of Technology, Pasadena, Calif.

Dr. Kenneth T. Bainbridge, *professor of physics*, Harvard University, Cambridge, Mass.

Dr. George Glockler, *professor of physical chemistry and head*, Department of Chemistry and Chemical Engineering, The State University of Iowa, Iowa City, Iowa.

Dr. William W. Rubey, *principal geologist*, United States Geological Survey, Washington, D. C.

Dr. Marshall H. Stone, Andrew MacLeish Distinguished Service Professor of Mathematics, and *chairman*, Department of Mathematics, University of Chicago, Chicago, Ill.

Postdoctoral Research in Biological and Agricultural Sciences

Dr. R. G. Gustavson, *chancellor*, University of Nebraska, Lincoln, Nebr.; *chairman.*

Dr. H. K. Hartline, *professor of biophysics*, Johnson Research Foundation, University of Pennsylvania, Philadelphia, Pa.

Dr. G. Evelyn Hutchinson, *professor of zoology*, Yale University, New Haven, Conn.

Dr. W. J. Robbins, *professor of botany*, Columbia University, *director*, New York Botanical Gardens, New York, N. Y.

Dr. L. J. Stadler, *professor of field crops*, University of Missouri, Columbia, Mo.

Predoctoral Research in Biological Sciences

Dr. Douglas Whitaker, *professor of biology, dean*, School of Biological Sciences, Stanford University, Calif.; *chairman.*
Dr. Eric G. Ball, *professor of biochemistry*, Harvard Medical School, Boston, Mass.
Dr. J. H. Bodine, *professor of zoology*, The State University of Iowa, Iowa City, Iowa.
Dr. Howard B. Lewis, *professor of biological chemistry*, University of Michigan, Ann Arbor, Mich.
Dr. Raymond E. Zirkle, *professor of radiology*, Institute of Radiobiology and Biophysics, University of Chicago, Chicago, Ill.

Predoctoral Research in Physical Sciences

Dr. Henry A. Barton, *director*, American Institute of Physics, New York, N. Y., *chairman.*
Dr. John C. Bailar, Jr., *professor of chemistry*, University of Illinois, Urbana, Ill.
Dr. Tom W. Bonner, *professor of physics*, Rice Institute, Houston, Tex.
Dr. J. William Buchta, *professor of physics and chairman*, Department of Physics, University of Minnesota, Minneapolis, Minn.
Dr. G. A. Hedlund, *professor of mathematics*, Yale University, New Haven, Conn.
Dr. Charles C. Price, *professor of chemistry and head*, Department of Chemistry, University of Notre Dame, Notre Dame, Ind.

AEC Fellowships in Biological, Physical, and Medical Sciences

DISTRIBUTION BY STATE AND INSTITUTION

Postdoctoral (Biological and Physical)

	Biological		Physical	
	Name	Field	Name	Field
CALIFORNIA				
University of California, Berkeley.	McBee, R. H.	Biophysics.	Gluckstern, R. L.	Theoretical physics.
	Rosenfeld, I.	Pathology.	Sinclair, W. R.	Physical chemistry.
	Radin, N. S.	Microbiology.		
ILLINOIS				
University of Chicago, Chicago.			Kierstead, H. A.	Do.
			Rosenberg, J. L.	Do.
			Wilson, E. A.	Do.
University of Illinois, Urbana.			Hunsberger, I. M.	Organic chemistry.
MASSACHUSETTS				
Massachusetts Institute of Technology, Boston.			Spruch, L.	Experimental physics.
New England Deaconess Hospital, Boston.	Holt, M. W.	Biophysics.		
NEW JERSEY				
Institute for Advanced Study, Princeton.			Akutowicz, E. J.	Mathematics.
			Feldman, D.	Theoretical physics.
			Lepore, J. V.	Do.
Princeton University, Princeton.			Fireman, E. L.	Experimental physics.
			Hill, D. L.	Theoretical physics.

Postdoctoral (Medical)[1]

	Name	Field
CALIFORNIA		
University of California, Berkeley	Huff, R. L	Radiology.
	Lamson, B. G	Malignancy.
	Marks, S	Radiology.
	Masouredis, S. P	Metabolism.
	Smith, A. H	Do.
ILLINOIS		
University of Chicago	Jennings, F. L	Do.
	Johnson, F. B	Do.
	Redfield, R. R	Protein synthesis.
MASSACHUSETTS		
Harvard University	Edelman, I. S	Metabolism.
	Schloerb, P. R	Do.
Massachusetts Institute of Technology	Quinby, W. C., Jr	Wound healing.
Pratt, Joseph H., Diagnostic Hospital	Raben, M. S	Physiology.
MICHIGAN		
Harper Hospital, Detroit	Reed, J. O., Jr	Do.
NEW YORK		
Columbia University	Geary, J. R., Jr	Biophysics.
University of Rochester	Bly, C. G	Pathology.
Sloan-Kettering Institute	Hellman, L. D	Metabolism.
NORTH CAROLINA		
North Carolina Center (Duke University)	Aikawa, J. K	Infectious diseases.
	Arons, W. L.[2]	Physiology.
	Stevens, K. M	Protein synthesis.
OHIO		
Ohio State University	Keller, E. B	Biochemistry.
OREGON		
Oregon Center (Reed College)	Hutchens, T. T	Physiology.
TEXAS		
Texas Center (Rice Institute)	Colgan, J. W	Radiology.
	Hoeprich, P. D	Pharmaco-therapeutics.
	Mellins, H. Z	Radiology.
	Neil, C. M	Do.
	Palmer, R. F	Pathology.

[1] Includes appointments made in 1948 for work to begin in 1949.
[2] Texas Center an alternate possibility.

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Predoctoral

	Biological		Physical	
	Name	Field	Name	Field
CALIFORNIA				
University of California, Berkeley.	Baer, B. S.	Microbiology.	Danskin, J. M.	Mathematics.
	Burdick, A. B.	Genetics.	Hayward, R. W.	Experimental physics.
	Falkenheim, M.	Biophysics.	Levinthal, C.	Do.
	Forker, L. L.	do.	Markhart, A. H.	Organic chemistry.
	Geschwind, I. I.	Biology.	Mastick, D. F.	Physical chemistry.
	Goldberg, R. C.	Physiology.	Temmer, G. M.	Experimental physics.
	Levine, R. P.	Botany.		
	Lipetz, L. E.	Biophysics.		
	Peterson, B. S.	Biochemistry.		
University of California, Los Angeles.	Duffy, F. A.	Endocrinology.	Sachs, D. C.	Do.
			Walters, S. S.	Mathematics.
California Institute of Technology, Pasadena.	Altenberg, L. S.	Biophysics.	Douglas, D. L.	Physical chemistry.
	Clayton, R. K.	do.	Scibor-Marchocki, R.	Theoretical physics.
Stanford University, Palo Alto.	Backmann, B. J.	Biochemistry.	Locke, G. L.	Mechanical engineering.
			Novikoff, A. B.	Mathematics.
			Wangsness, R. K.	Theoretical physics.
COLORADO				
University of Colorado, Boulder.	Heaney, R. J.	do.	Griffin, D. M.	Organic chemistry.
CONNECTICUT				
Yale University, New Haven.	Scher, A. M.	Physiology.	Boyd, E.	Mathematics.
			Rich, J. A.	Experimental physics.
			Schenkman, E. V.	Mathematics.
			Worth, D. C.	Experimental physics.
ILLINOIS				
University of Chicago, Chicago.	Bryant, S. H.	Biophysics.	Bartle, R. G.	Mathematics.
	Ferguson, M.	Biology.	Bishop, E. A.	Do.
	Sacher, G. A.	Physiology.	Colton, F. B.	Organic chemistry.
	Spiroff, B. E. N.	Zoology.	Flanders, H.	Mathematics.
			Garwin, R. L.	Experimental physics.
			Greenman, N. N.	Geology.
			Griffel, M.	Physical chemistry.
			Haas, C. G.	Do.
			Hall, T. A.	Experimental physics.
			Halperin, J.	Physical chemistry.
			Hartzler, A.	Experimental physics.
			Hunt, J. P.	Physical chemistry.
			Johnston, W. H.	Do.
			Kadison, R. V.	Mathematics.
			Kidwell, A. L.	Geology.
			Klapproth, W. J.	Organic chemistry.
			Martin, R. L.	Experimental physics.
			Smith, H. M.	Physical chemistry.
			Stehney, A. F.	Do.
			Steinberg, M.	Do.
			Walter, R. I.	Do.
			Williams, E. S.	Mathematics.
			Weiner, L. M.	Do.
University of Illinois, Urbana.	Grant, N. H.	Biochemistry.	Bess, L.	Experimental physics.
			Katz, R.	Do.
			Klema, E. D.	Do.
			Kubitschek, H. E.	Do.
			Zimmerman, E. J.	Do.
Illinois Institute of Technology, Chicago.	----------	----------	Podolsky, H.	Physical chemistry.
Northwestern University, Evanston,	----------	----------	Wethington, J. A.	Do.

Predoctoral—Continued

	Biological		Physical	
	Name	Field	Name	Field
INDIANA				
University of Indiana, Bloomington.	White, L. A.	Bacteriology	Beiduk, F. M.	Theoretical physics.
			Kern, B. D.	Experimental physics.
			Fatora, F. C.	Organic chemistry.
University of Notre Dame, Notre Dame.			Marshall, J. F.	Theoretical physics.
			Mertz, E. C.	Physical chemistry.
			Schillinger, E. J.	Experimental physics.
			Struble, R. A.	Mathematics.
			Voiland, E. E.	Physical chemistry.
			Wolicki, E. J.	Experimental physics.
Purdue University, Lafayette.			Alpert, N.	Organic chemistry.
			Gunberg, P. F.	Do.
			Harris, R. H.	Inorganic chemistry.
			Rulfs, C. L.	Physical chemistry.
IOWA				
University of Iowa, Iowa City.	Kent, R. C.	Biophysics	Holland, R. E.	Experimental physics.
			Malmberg, P. R.	Do.
Iowa State College, Ames.			Macy, S.	Mathematics.
MARYLAND				
Johns Hopkins University Medical School, Baltimore.	Nisonoff, A.	Biochemistry.		
MASSACHUSETTS				
Boston University School of Medicine.	Wilson, M. E.	Bacteriology.		
Harvard University, Cambridge.	Dietlein, L. F.	Biology	Bodansky, D.	Experimental physics.
	Davison, C.	Biochemistry	Brachman, M. K.	Theoretical physics.
			Brown, R. M.	Experimental physics.
			Clapp, R. E.	Theoretical physics.
			Corley, R. S.	Organic chemistry.
			Donn, B. D.	Astronomy.
			Klein, A.	Theoretical physics.
			Kolsky, H. G.	Experimental physics.
			Lazarus, R. B.	Theoretical physics.
			Linnell, A. P.	Astronomy.
			Mottelson, B. R.	Theoretical physics.
			Okrent, D.	Experimental physics.
			Sirvetz, M. H.	Do.
			Wright, A.	Theoretical physics.
Harvard University Medical School, Boston.	Crane, R. K.	Do.		
Massachusetts Institute of Technology, Boston.	McCulloch, D.	Biology	Cooley, W. C.	Mechanical engineering.
			Devaney, J. J.	Theoretical physics.
			Kraichnan, R. H.	Do.
			Meckler, A.	Do.
			Schweinler, H. C.	Experimental physics.
			Shapiro, M. M.	Do.
			Stelson, P. H.	Do.
MICHIGAN				
University of Michigan, Ann Arbor.			Dasher, G. F.	Physical chemistry.
			Fowler, C. M.	Experimental physics.
			Nemerever, W. J.	Mathematics.
			Perry, C. L.	Do.
			Sangren, W. C.	Do.
			Shreffler, R. G.	Experimental physics.
MINNESOTA				
University of Minnesota, Minneapolis.			Drukey, D. L.	Theoretical physics.
			Leland, W. T.	Experimental physics.
			Robbins, H. M.	Theoretical physics.
MISSOURI				
University of Missouri, Columbia.	Lefevre, G.	Genetics.		
	MacEwan, A. M.	Botany.		
	Zarudnaya, K. I.	Do.		
Washington University, St. Louis.			Miskel, J. A.	Physical chemistry.
			Townsend, J.	Experimental physics.

Predoctoral—Continued

	Biological		Physical	
	Name	Field	Name	Field
NEBRASKA				
University of Nebraska, College of Medicine, Omaha.	Pittinger, T. H. Rosenlof, R. C. Schmidt, J. W.	Genetics. Radiology. Genetics.		
NEW JERSEY				
Princeton University, Princeton.	----------	----------	Brownell, F. H. Gross, L. Harrison, F. B. Hawley, N. S. Landis, J. W. Peisakoff, M. P.	Mathematics. Experimental physics. Do. Mathematics. Experimental physics. Mathematics.
NEW YORK				
Brooklyn Polytechnic Institute, Brooklyn.	----------	----------	Held, K. M.	Physical chemistry.
Columbia University, New York.	McClement, P. Norman, A.	Radiology Radiology	Heller, A. Lepson, B. Lohwater, A. J. Rosen, J. B. Slotnick, M. Steinhardt, F.	Mathematics. Do. Do. Chemical engineering. Theoretical physics. Mathematics.
Cornell University, Ithaca.	Kulwich, R.	Animal Nutrition.	Goldberg, S. Gray, E. P. Peshkin, M. Shapiro, A. M. Wing, G. M.	Do. Theoretical physics. Do. Experimental physics. Mathematics.
New York University, New York.	Schiffman, G.	Biochemistry	Berezin, E. Russek, A.	Experimental physics. Do.
University of Rochester, Rochester.	Millar, F. K.	Botany	Auerbach, T. Rouvina, J. Swartz, C. E.	Do. Do. Do.
NORTH CAROLINA				
Duke University, Durham.	Cohn, D.-V. Watt, T. B.	Biochemistry. Biophysics.		
North Carolina State College of Agriculture and Engineering, Raleigh.	Cain, S. H.	Genetics.		
North Carolina University, Raleigh.	----------	----------	Hayes, R. L. Moseley, H. M.	Organic chemistry. Theoretical physics.
OHIO				
CaseInstitute of Technology, Cleveland.	----------	----------	Fawcett, S. L.	Experimental physics.
Ohio State University, Columbus.	Garvey, J. S. Madison, M. C. R. Wood, D. L.	Bacteriology Genetics Biophysics	Dubowski, K. M. Grove, G. R. Hochwalt, C. A. Hunter, J. A.	Organic chemistry. Experimental physics. Organic chemistry. Experimental physics.
PENNSYLVANIA				
Carnegie Institute of Technology, Pittsburgh.	----------	----------	Achter, M. R. Blewitt, T. H. Falk, C. E. Hinman, G. W. Klahr, C. N. Opinsky, A. J.	Metallurgy. Experimental physics. Do. Do. Theoretical physics. Metallurgy.
University of Pennsylvania, Philadelphia.	----------	----------	Cranberg, L. Ferguson, G. A. Riebman, L. Sherard, G. W. Trees, R. E.	Experimental physics. Do. Electrical engineering. Experimental physics. Do.
State College of Pennsylvania, State College.	----------	----------	Lowrie, R. E.	Metallurgy.
University of Pittsburgh, Pittsburgh.	----------	----------	Mechlin, G. F.	Experimental physics.

Predoctoral—Continued

	Biological		Physical	
	Name	Field	Name	Field
RHODE ISLAND				
Brown University, Providence.	----------	----------	Brown, N. L. Schwartz, B. L.	Physical chemistry. Mathematics.
TENNESSEE				
Vanderbilt University, Nashville.	Coniglio, J. G. Rouser, G. L.	Biochemistry. Physiology.	Thomas, D. A.	Experimental physics.
TEXAS				
Rice Institute, Houston.	Read, C. P.	Zoology.	Terrell, N. J. Whaling, W.	Do. Do.
UTAH				
University of Utah, Salt Lake City.	Levedahl, B. H.	Biochemistry.		
VIRGINIA				
University of Virginia, Charlottesville.	----------	----------	Klee, V. L. Whitehead, W. D.	Mathematics. Experimental physics.
WASHINGTON				
Washington State College, Pullman.	Nelson, W. L.	Agronomy.		
University of Washington, Seattle.	Goheen, D. W.	Biochemistry.	Ringold, H.	Organic chemistry.
WISCONSIN				
University of Wisconsin, Madison.	Snyder, R. H. Yates, R. C.	Biochemistry. Botany.	Adams, E. N. Rice, W. E. Sturm, W. J.	Theoretical physics. Physical chemistry. Experimental physics.

APPENDIX 8

Criteria for Determining Eligibility for Personnel Security Clearance

The United States Atomic Energy Commission has adopted basic criteria for the guidance of the responsible officers of the Commission in determining eligibility for personnel security clearance. These criteria are subject to continuing review, and may be revised from time to time in order to insure the most effective application of policies designed to maintain the security of the project in a manner consistent with traditional American concepts of justice and rights of citizenship.

The Commission is revising its hearing procedure entitled "Interim Procedure" for the review of cases of denial of security clearance and for the conduct of hearings for employees desiring such review. The Interim Procedure announced April 15, 1948, places considerable responsibility on the managers of operations and it is to provide uniform standards for their use that the Commission has adopted the criteria described herein.

Under the Atomic Energy Act of 1946, it is the responsibility of the Atomic Energy Commission to determine whether the common defense and security will be endangered by granting security clearance to individuals either employed by the Commission or permitted access to restricted data. As an administrative precaution, the Commission also requires that at certain locations there be a local investigation, or check on individuals employed by contractors on work not involving access to restricted data (Commission authorization to be so employed is termed "security approval").

Under the act the Federal Bureau of Investigation has the responsibility for making an investigation and report to the Commission on the character, associations, and loyalty of such individuals. In determining any individual's eligibility for security clearance other information available to the Commission should also be considered, such as whether the individual will have direct access to restricted data, or work in proximity to exclusion areas, his past association with the atomic energy program, and the nature of the job he is expected to perform. The facts of each case must be carefully weighed and determination made in the light of all the information presented whether favorable or unfavorable. The judgment of responsible persons as to the integrity of the individuals should be considered. The decision as to security clearance is an over-all, common-sense judgment, made after consideration of all the relevant information, as to whether or not there is risk that the granting of security clearance would endanger the national defense or security. If it is determined that the common defense and national security will not be endangered, security clearance will be granted; otherwise, security clearance will be denied.

Cases must be carefully weighed in the light of all the information, and a determination must be reached which gives due recognition to the favorable as well as unfavorable information concerning the individual and which balances the cost to the program of not having his services against any possible risks involved. In making such practical determination, the mature viewpoint and responsible judgment of Commission staff members, and of the contractor concerned are available for consideration by the manager of operations.

To assist in making these determinations, on the basis of all the information in a particular case, there are set forth below a number of specific types of derogatory information. The list is not exhaustive, but it contains the principal types of derogatory information which indicate a security risk. It will be observed that the criteria are divided into two groups, category (A) and category (B).

Category (A) includes those classes of derogatory information which establish a presumption of security risk. In cases falling under this category, the

manager of operations has the alternative of denying clearance or referring the case to the director of security in Washington.

Category (B) includes those classes of derogatory information where the extent of activities, the attitudes or convictions of the individual must be weighed in determining whether a presumption of risk exists. In these cases the manager of operations may grant or deny clearances; or he may refer such cases to the director of security in Washington.

CATEGORY (A)

Category (A) includes those cases in which there are grounds sufficient to establish a reasonable belief that the individual or his spouse has:

1. Committed or attempted to commit, or aided or abetted another who committed or attempted to commit any act of sabotage, espionage, treason, or sedition;

2. Established an association with espionage agents of a foreign nation; with individuals reliably reported as suspected of espionage; with representatives of foreign nations whose interests may be inimical to the interests of the United States. (Ordinarily this would not include chance or casual meetings; nor contacts limited to normal business or official relations.)

3. Held membership in or joined any organization which has been declared to be subversive by the Attorney General, provided the individual did not withdraw from such membership when the organization was so identified, or otherwise establish his rejection of its subversive aims; or, prior to the declaration by the Attorney General, participated in the activities of such an organization in a capacity where he should reasonably have had knowledge as to the subversive aims or purposes of the organization;

4. Publicly or privately advocated revolution by force or violence to alter the constitutional form of government of the United States.

Category (A) also includes those cases in which there are grounds sufficient to establish a reasonable belief that the individual has:

5. Deliberately omitted significant information from or falsified a Personnel Security Questionnaire or Personal History Statement. In many cases, it may be fair to conclude that such omission or falsification was deliberate if the information omitted or misrepresented is unfavorable to the individual;

6. Violated or disregarded security regulations to a degree which would endanger the common defense or national security;

7. Been adjudged insane, been legally committed to an insane asylum, or treated for serious mental or neurological disorder, without evidence of cure;

8. Been convicted of felonies indicating habitual criminal tendencies;

9. Been or who is addicted to the use of alcohol or drugs habitually and to excess, without adequate evidence of rehabilitation.

CATEGORY (B)

Category (B) includes those cases in which there are grounds sufficient to establish a reasonable belief that with respect to the individual or his spouse there is:

1. Sympathetic interest in totalitarian, fascist, communist, or other subversive political ideologies;

2. A sympathetic association established with members of the Communist Party; or with leading members of any organization which has been declared to be subversive by the Attorney General. (Ordinarily this would not include chance or casual meetings, nor contacts limited to normal business or official relations.)

3. Identification with an organization established as a front for otherwise subversive groups or interests when the personal views of the individual are sympathetic to or coincide with subversive "lines";

4. Identification with an organization known to be infiltrated with members of subversive groups when there is also information as to other activities of the individual which establishes the probability that he may be a part of or sympathetic to the infiltrating element, or when he has personal views which are sympathetic to or coincide with subversive "lines";

5. Residence of the individual's spouse, parent(s), brother(s), sister(s), or offspring in a nation whose interests may be inimical to the interests of the United States, or in satellites or occupied areas thereof, when the personal views or activities of the individual subject of investigation are sympathetic to or coincide with subversive "lines" (to be evaluated in the light of the risk that pressure applied through such close relatives could force the individual to reveal sensitive information or perform an act of sabotage);

6. Close continuing association with individuals (friends, relatives, or other

associates) who have subversive interests and associations as defined in any of the foregoing types of derogatory information. A close continuing association may be deemed to exist if:

(1) Subject lives at the same premises with such individual;
(2) Subject visits such individual frequently;
(3) Subject communicates frequently with such individual by any means.

7. Association where the individuals have enjoyed a very close, continuing association such as is described above for some period of time, and then have been separated by distance; provided the circumstances indicate that a renewal of contact is probable;

Category (B) also includes those cases in which there are grounds sufficient to establish a reasonable belief that with respect to the individual there is;

8. Conscientious objection to service in the armed forces during time of war, when such objections cannot be clearly shown to be due to religious convictions;

9. Manifest tendencies demonstrating unreliability or inability to keep important matters confidential; willful or gross carelessness in revealing or disclosing to any unauthorized person restricted data or other classified matter pertaining either to projects of the Atomic Energy Commission or of any other governmental agency; abuse of trust, dishonesty; or homosexuality.

While security clearance would ordinarily be denied in each of the foregoing categories (A), and (B), security approval, as distinguished from security clearance, might be warranted in those types of derogatory information mentioned under category (B) above.

The categories outlined hereinabove contain the criteria which will be applied in determining whether information disclosed in investigation reports shall be regarded as substantially derogatory. Determination that there is such information in the case of an individual establishes doubt as to his eligibility for security clearance.

The criteria outlined hereinabove are intended to serve as aids to the manager of operations in resolving his responsibility in the determination of an individual's eligibility for security clearance. While there must necessarily be an adherence to such criteria, the manager of operations is not limited thereto, nor precluded in exercising his judgment that information or facts in a case under his cognizance are derogatory although at variance with, or outside the scope of the stated categories. The manager of operations upon whom the responsibility rests for the granting or denial of security clearance, and for recommendation in cases referred to the director of security, should bear in mind at all times, that his action must be consistent with the common defense and national security.

APPENDIX 9

CORRESPONDENCE CONCERNING AEC LABOR POLICY

ITEM 1

UNITED STATES ATOMIC ENERGY COMMISSION

Washington 25, D. C.

SEPTEMBER 27, 1948.

PAUL M. HERZOG,
Chairman, National Labor Relations Board,
Washington, D. C.

DEAR CHAIRMAN HERZOG: This letter is in connection with labor relations in the atomic energy program which have been discussed in earlier exchanges of letters between the National Labor Relations Board on one hand and the Secretary of War and the Atomic Energy Commission on the other. You will recall that originally Secretary of War Patterson requested that you withhold action in any case involving the Manhattan Engineer District. Later you were informed that the War Department believed it possible, consistent with the requirements of national security, to work out procedures under which National Labor Relations Board cases involving the project at Oak Ridge might be handled. Secretary Patterson asked, however, that that Board refrain from affirmative action in cases affecting other units of the atomic energy project and this request has been continued by the Commission. Later, a special exception to this request was made with respect to certain employees of the Zia Company at Los Alamos.

From the experience with your representatives at the Commission's Oak Ridge project, it appears that safeguards for protecting the national security can be devised in most cases involving National Labor Relations Board proceedings. On the other hand, while the experience at Oak Ridge was satisfactory from this point of view, it may be that many new problems will arise at other Commission installations where novel conditions and new unions may be involved.

Under the circumstances, the Commission has decided to withdraw the request that your Board refrain from affirmative action in cases involving other atomic energy projects. While the Commission now fully approves the principle of Board proceedings at atomic energy projects in cases falling within the scope of the Labor Management Relations Act, for the present the Commission requests that National Labor Relations Board representatives clear each case as it arises with local Atomic Energy Commission representatives, in order that security considerations may be carefully reviewed. It is our judgment that under this arrangement it should be possible to process many, if not all, of the hearings and elections which have been postponed at the request of the Manhattan Engineer District and the Atomic Energy Commission.

Consistent with the national policy as stated in the Atomic Energy Act of 1946 and the Labor Management Relations Act, 1947, it is the settled policy of the Atomic Energy Commission that the atomic energy facilities be operated in a manner best calculated to assure that those who participate in the program are loyal to the United States, including those who, though not employees of contractors, exercise administrative, negotiating and disciplinary authority over such employees of contractors as are members of union bargaining units.

The Commission greatly appreciates the helpful cooperation your Board has extended in the past and trusts that the further request herein can be accepted as a basis for continued cooperation in the future. The Commission will, in turn, reappraise the situation from time to time in the hope that conditions will eventually allow the same freedom of procedures that exists in other industries.

Sincerely yours,

UNITED STATES ATOMIC ENERGY COMMISSION,
DAVID E. LILIENTHAL, *Chairman.*

ITEM 2

UNITED STATES ATOMIC ENERGY COMMISSION
Washington 25, D. C.

SEPTEMBER 27, 1948.

CHARLES E. WILSON,
President, General Electric Company,
570 Lexington Avenue at Fifty-first Street,
New York 22, N. Y.

DEAR MR. WILSON: You have previously been advised of the policy of the Manhattan Engineer District, as continued by the Atomic Energy Commission, to request the postponement of public hearings and elections under the National Labor Relations Act and the Labor Management Relations Act in respect to the atomic energy facilities at Richland, Washington.

On the basis of a full examination of present conditions the Commission has concluded that proceedings under the Labor Management Relations Act may be conducted at this facility, provided safeguards in respect to security of information which have been developed elsewhere are applied. A copy of a letter advising the National Labor Relations Board to this effect is enclosed.

The Atomic Energy Commission will expect, of course, that any labor organization which may be recognized will have met such Atomic Energy Commission security requirements as will assure the loyalty to the United States of those persons who exercise administrative, negotiating or disciplinary authority over bargaining units of atomic energy workers. The nature of these security requirements is well established as a result of the experience at Oak Ridge during the past two years. The Commission's Manager of Operations at Richland will be glad to discuss them with you in detail and assist in working out any specific problems that may arise.

In this connection, attention is invited to the Commission's January 16, 1948 labor report to the Joint Committee on Atomic Energy. This report defined certain objectives in respect to management-labor relations within the atomic energy program which the Commission would like to see all participants strive to attain. These objectives are—

(*a*) Wholehearted acceptance by contractors and by labor and its representatives of the moral responsibility inherent in participation in the atomic energy program;

(*b*) Development of procedures to assure (1) that all participants in the program are loyal to the United States, including those whose participation involves the exercise of administrative, negotiating and disciplinary authority over bargaining units, and (2) that determination of unit, jurisdiction, and similar questions will not breach security;

(*c*) Continuity of production at vital AEC installations;

(*d*) Consistent with the Commission's responsibility under the law, the least possible governmental interference with the efficient management expected from the AEC contractors;

(*e*) Minimum governmental interference with the traditional rights and privileges of American labor.

Sincerely yours,

UNITED STATES ATOMIC ENERGY COMMISSION,
DAVID E. LILIENTHAL, *Chairman.*

ITEM 3

UNITED STATES ATOMIC ENERGY COMMISSION

Washington 25, D. C.

SEPTEMBER 27, 1948.

WILLIAM B. HARRELL,
Business Manager, University of Chicago,
Chicago, Ill.

DEAR MR. HARRELL: You have previously been advised of the policy of the Manhattan Engineer District as continued by the Atomic Energy Commission to request the postponement of public hearings and elections under the National Labor Relations Act and the Labor Management Relations Act in respect to the Argonne National Laboratory at Chicago, Illinois.

On the basis of a full examination of present conditions the Commission has concluded that proceedings under the Labor Management Relations Act may be conducted at this facility, provided safeguards in respect to security of information which have been developed elsewhere are applied. A copy of a letter advising the National Labor Relations Board to this effect is enclosed.

The Atomic Energy Commission will expect, of course, that any labor organization which may be recognized will have met Atomic Energy Commission security requirements calculated to assure the loyalty to the United States of those who though not employees of contractors exercise administrative, negotiating or disciplinary authority over such employees of contractors as are members of union bargaining units of atomic energy workers. The nature of these security requirements is well established as a result of the experience at Oak Ridge during the past two years. The Commission's Manager of Operations at Chicago will be glad to discuss them with you in detail and to assist in working out any specific problems that may arise.

Your representatives have advised that a number of labor organizations have been active in organizational activities at Argonne. It is noted that the offices of one of the organizations involved, the United Public Workers of America, CIO, have failed to comply with the section of the Labor Management Relations Act which provides for filing of affidavits that they are not members of the Communist Party or affiliated with such party. In addition, information is available concerning alleged communist affiliation or association of certain officers of this union. It appears that some of these officers are in a position where they exercise administrative, negotiating or disciplinary authority over the local of this union that has been active among employees at Argonne. The failure to file noncommunist affidavits and the information concerning alleged communist affiliation of certain officers of the United Public Workers when taken together present a very serious question as to whether representation of atomic energy workers at Argonne by a union in which such officers occupy important positions would be consistent with that full and unqualified adherence and loyalty to the interests of the United States that the security of the Nation and the policy of the Atomic Energy Act of 1946 require.

The Commission's policy, as you know, is that questions relating to a contractor's labor policy should be resolved and handled directly by the contractor. However, in view of the above circumstances and of the obligation of the Commission in matters pertaining to national security, the Atomic Energy Commission directs the University of Chicago to continue to refrain from recognition of the United Public Workers of America, CIO, at Argonne National Laboratory, Chicago, Illinois.

Attention is invited to the Commission's January 16, 1948 labor report to the Joint Committee on Atomic Energy. This report defined certain objectives in respect to management-labor relations within the atomic energy program which the Commission would like to see all participants strive to attain. These objectives are—

(*a*) Wholehearted acceptance by contractors and by labor and its representatives of the moral responsibility inherent in participation in the atomic energy program;

(*b*) Development of procedures to assure (1) that all participants in the program are loyal to the United States, including those whose participation involves the excercise of administrative, negotiating and disciplinary authority over bargaining units, and (2) that determination of unit, jurisdiction, and similar questions will not breach security;

(c) Continuity of production at vital AEC installations;
(d) Consistent with the Commission's responsibility under the law, the least possible governmental interference with the efficient management expected from the AEC contractors;
(e) Minimum governmental interference with the traditional rights and privileges of American labor.

Sincerely yours,

UNITED STATES ATOMIC ENERGY COMMISSION,
DAVID E. LILIENTHAL, *Chairman.*

ITEM 4

UNITED STATES ATOMIC ENERGY COMMISSION

Washington 25, D. C.

SEPTEMBER 27, 1948.

CHARLES E. WILSON,
President, General Electric Company,
570 Lexington Avenue at Fifty-first Street,
New York 22, N. Y.

DEAR MR. WILSON: Consistent with the national policy as stated in the Atomic Energy Act of 1946 and the Labor Management Relations Act, 1947, it is the settled policy of the Atomic Energy Commission that the atomic energy facilities be operated in a manner best calculated to assure that those who participate in the program are loyal to the United States. This includes those who, though themselves not employees of contractors, do exercise administrative, negotiating, and disciplinary authority over such employees of contractors as are members of union bargaining units. General Electric employees working on atomic energy projects, with access to restricted data are, as you know, all fully investigated by the Federal Bureau of Investigation with respect to character, association and loyalty, and such individuals have been subject to the usual security clearance by Commission representatives.

Over a period of time, consideration has been given by representatives of the Commission and representatives of the General Electric Company as to whether there is such assurance of loyalty within that portion of the atomic energy program at Schenectady for which General Electric is the operating contractor. Your representatives have advised that some years ago the United Electrical, Radio and Machine Workers of America, CIO (UE), was designated through a National Labor Relations Board proceeding as the bargaining agent for the production and maintenance workers in the Company's private plants in Schenectady. Your representatives have also advised that this recognition of UE as a bargaining agent extends to certain employees performing work at Government-owned, General Electric-operated atomic energy facilities in Schenectady.

It is noted that UE officers have failed to comply with the section of the Labor Management Relations Act, 1947, which provides for filing of affidavits that they are not members of the Communist Party or affiliated with such Party. In addition, information is available, much of it a matter of open public record, of alleged Communist affiliation or association of various officers of UE. It appears that some of these UE officers are in a position within this union whereby they exercise administrative, negotiating, or disciplinary authority over General Electric Company employees engaged in atomic energy work at Schenectady. The failure to file non-Communist affidavits and the information concerning alleged Communist affiliation of these officers of UE, when taken together, present a very serious question as to whether representation of atomic energy workers at Schenectady by a union in which such officers occupy important positions is consistent with that full and unqualified adherence and loyalty to the interests of the United States that the security of the Nation and the policy of the Atomic Energy Act of 1946 require.

In the discussions with representatives of General Electric, the Commission has been advised that the Company views its over-all contract with UE, covering plants all over the country and which continues until 1950, as precluding the Company from refusing to recognize the UE as bargaining representative for any

employees covered by such contract unless the Commission so directs pursuant to its authority under the Atomic Energy Act of 1946. This conclusion prevents the Company from taking the necessary steps, on its own initiative, to improve this situation. While I am unable to follow the reasoning behind such a conclusion, we are compelled to accept it as the Company's final position.

The Commission's policy, as you know, is that questions relating to a contractor's labor policy should be resolved and handled directly by the contractor. However, in view of the Company's position respecting UE, as stated above, and of the obligation of the Commission in matters pertaining to national security, the Atomic Energy Commission as a first step toward improving the situation directs as follows: The General Electric Company not recognize United Electrical, Radio and Machine Workers of America, CIO, at the new Knolls II Atomic Power Laboratory, Schenectady, New York. The Commission will communicate with you with respect to other steps that may need to be taken.

In this connection, the Commission wishes to reemphasize that this direction, on this particular set of facts, does not mean that there is Commission objection to recognition by General Electric of any organization of employees which has met or can meet AEC security requirements as to loyalty to the United States of those nonemployees who exercise administrative, negotiating and disciplinary authority over bargaining units of atomic energy workers. This is made clear by our letter to you, of this date, concerning labor organization at the Hanford, Washington facilities of the Commission operated by you as the contractor.

Sincerely yours,

UNITED STATES ATOMIC ENERGY COMMISSION,
DAVID E. LILIENTHAL, *Chairman.*

ITEM 5

CONGRESS OF INDUSTRIAL ORGANIZATIONS
CIO
718 Jackson Place, NW., Washington 6, D. C.

OFFICE OF THE PRESIDENT,
October 1, 1948.

MR. DAVID E. LILIENTHAL,
Chairman, United States Atomic Energy Commission,
Washington 25, D. C.

DEAR MR. LILIENTHAL: I have just received this morning, through the kindness of Mr. Oscar S. Smith, Director of Labor Relations of the Commission, copies of the recent letters that went forward from the Commission under date of September 27 to the National Labor Relations Board, the General Electric Company, and the University of Chicago.

I regret very much that the Atomic Energy Commission saw fit to send these letters blacklisting two international unions affiliated with the CIO without prior consultation either with the interested parties or with responsible officials of the CIO.

The CIO cannot accept the principle that it is either within the power of the Commission or the public interest for the Commission to deny unions bargaining rights on the basis of a unilateral determination by the Commission of the loyalty of union officers. This unprecedented action on the part of the Commission is particularly objectionable in view of the fact that the Commission's decision is apparently made without according to the interested parties an opportunity to be heard and without any of the procedural safeguards which are guaranteed by the Constitution.

I am certainly not unmindful of the security considerations which must of necessity be ever present in the activities of the Commission. The letters released by the Commission, however, go far beyond the requirements of security for the operations of the Commission.

Furthermore, the Commission bases its action in large measure upon the failure of the unions involved to comply with the section of the Labor Management Relations Act which provides for filing of non-communist affidavits. The constitutionality of this section of the Taft-Hartley Law is now being litigated and

will probably be passed on by the Supreme Court of the United States at its October Term. It would seem to me that the Commission is usurping its functions in pre-judging the merits of this case particularly since one of the Justices of the Supreme Court, in passing on a preliminary aspect of this problem stated: "The case raises a serious question and one which probably will require a decision by this Court."

In view of these circumstances, I wish to record my strong objection to the action taken by the Commission and urge that the Commission reconsider the determination which it has made in connection with this matter.

Yours very truly,

PHILIP MURRAY,
President.

ITEM 6

UNITED STATES ATOMIC ENERGY COMMISSION

Washington 25, D. C.

OCTOBER 6, 1948.

Mr. PHILIP MURRAY,
President, Congress of Industrial Organizations,
718 Jackson Place NW., Washington 6, D. C.

DEAR Mr. MURRAY: Acknowledgment is made of your letter of October 1, 1948, concerning recent letters that have been forwarded from the Commission to the National Labor Relations Board, the General Electric Company, and the University of Chicago as to union recognition at atomic energy installations.

As appears in those letters the Commission has withdrawn its previous request to the National Labor Relations Board and has now expressed its agreement to the Board's processing union recognition and other cases at atomic energy facilities, subject to the security requirements of the Atomic Energy Act of 1946.

I would like to emphasize that the Commission's action with respect to United Electrical, Radio and Machine Workers of America and United Public Workers was not based solely on the failure of UE and UPW officers to comply with the non-Communist affidavit filing provisions of the Labor Management Relations Act. The action was based upon the information available—much of it of open public record—of alleged Communist affiliation or association of various officers of UE and UPW taken together with the failure of the officers of those unions to file non-Communist affidavits. The serious question concerning the adherence and loyalty of various officers of UE and UPW to the interests of the United States would remain whatever the outcome of litigation contesting the constitutionality of this provision of the Labor Management Relations Act.

An exchange of correspondence between the Commission and Mr. Fitzgerald of United Electrical, Radio and Machine Workers of America, is enclosed for your information. You will note that in this correspondence the Commission has offered the officers of United Electrical, Radio and Machine Workers of America every opportunity to participate in a fuller exploration of the serious question that has been raised concerning the absence in various of the United Electrical, Radio and Machine Workers of America officers of the requisite adherence and loyalty to the interests of the United States.

The Commission appreciates your renewed expression of the paramount importance of security to operations in the atomic energy program.

Sincerely yours,

UNITED STATES ATOMIC ENERGY COMMISSION,
DAVID E. LILIENTHAL, *Chairman.*

ITEM 7

UNITED ELECTRICAL, RADIO & MACHINE WORKERS OF AMERICA

AFFILIATED WITH THE CONGRESS OF INDUSTRIAL ORGANIZATIONS

11 East Fifty-first Street, New York 22, N. Y.

SEPTEMBER 30, 1948.

MR. DAVID E. LILIENTHAL,
United States Atomic Energy Commission,
Washington, D. C.

DEAR MR. LILIENTHAL: The newspapers of yesterday, September 29th, carried a copy of a letter from you to Charles E. Wilson, President, General Electric Company, dated September 27th, and a copy of a letter from Mr. Boulware, Vice President of the General Electric Company, dated September 28th in reply to yours. In your letter you direct the General Electric Company not to recognize the United Electrical, Radio and Machine Workers of America, CIO, at the new Knolls II Atomic Power Laboratory, Schenectady, N. Y.

There is absolutely no justifiable purpose in this flare of publicity on your part unless it was to assist the Administration in the current presidential campaign.

The Union denounces the utterly false and groundless insinuations concerning the loyalty of this union and its members in connection with atomic energy plants. The twelve-year record of the UE officers and members in service to the welfare of our country and its working people repudiates these smears. Only a combination of cheap political maneuvering and outright government-company antiunion collaboration could produce such unjustified action as you have taken.

Significantly, the Commission's action was taken without any prior notice to the Union. Even the elementary right to defend our Union and its 600,000 American workers from your slanderous imputations of disloyalty was denied. Your Commission in its unwarranted and biased procedure conferred at length with the General Electric Company without a word to the representatives of the workers.

The Federal Constitution protects the American people from such arbitrary actions by Government officials. Even the Atomic Energy Commission is not above the law of the land. This Union will take every available step to protect the constitutional and contractual rights of the members of the Union from the unwarranted and illegal action of the Commission.

Yours truly,

ALBERT J. FITZGERALD,
General President.

ITEM 8

UNITED STATES ATOMIC ENERGY COMMISSION
Washington 25, D. C.

OCTOBER 6, 1948.

Mr. ALBERT J. FITZGERALD,
General President, United Electrical, Radio & Machine Workers of America,
11 East Fifty-first Street, New York 22, N. Y.

DEAR MR. FITZGERALD: This is in reply to your letter of September 30, 1948, concerning the instructions issued by the Atomic Energy Commission to the General Electric Company as to union recognition at the Knolls Atomic Power Laboratory.

It should be borne in mind that those instructions are in no way a reflection upon the individual members of UE. The many thousands of persons, including individual members of the United Electrical Workers Union, who are employed on restricted atomic energy work are required to furnish detailed personal information including information concerning their affiliations. They are subject to investigation by the Federal Bureau of Investigation and to a determination by the Commission that their participation in the atomic energy program will not adversely affect the common defense and security.

The Commission believes that those union officers exercising administrative, negotiating, and disciplinary authority over workers employed on atomic energy projects are themselves participants in the atomic energy program and should be subject to a comparable scrutiny from the security standpoint.

As was stated in the instructions for General Electric, the Commission's action was based upon the information available—much of it of open public record—of alleged Communist affiliation or association of various officers of UE taken together with the failure of UE officers to file non-Communist affidavits under the Labor Management Relations Act, 1947. As was further stated these circumstances present a very serious question as to whether representation of the atomic energy workers at Schenectady by a union in which such officers occupy important positions is consistent with that full and unqualified adherence and loyalty to the interests of the United States that the security of the nation and the policy of the Atomic Energy Act of 1946 require.

Because of this very serious question, and because of the fact that men were soon to begin work at the newly constructed Knolls Atomic Power Laboratory, the Commission concluded that a proper discharge of its grave responsibilities to the nation required it to instruct the General Electric Company not to recognize UE as the bargaining representative of employees at this new atomic energy installation.

As was stated to the General Electric Company, the instructions already issued by the Commission are a first step in improving the situation at Schenectady. Unless the serious question concerning various of the officers of UE should be cleared up satisfactorily, the Commission intends to take such further steps as may be necessary to assure that those officers of UE shall not exercise administrative, negotiating and disciplinary authority over General Electric Company employees engaged in atomic energy work at Schenectady.

The assertions in your letter do not even begin to answer the serious question that has been raised concerning the absence in various of the UE officers of the requisite adherence and loyalty to the interests of the United States. If the officers of UE desire, the Commission will afford them every opportunity to participate in a fuller exploration of this issue. It should be understood, however, that the AEC would expect the UE officers to be prepared to give full and candid statements concerning present or past affiliations of any kind with the Communist Party or Communist-dominated organizations. In addition, the same personnel data will be requested of the UE officers as has been furnished by employees and by various officers of other unions who represent employees in the atomic energy program.

Sincerely yours,

UNITED STATES ATOMIC ENERGY COMMISSION,
DAVID E. LILIENTHAL, *Chairman.*

ITEM 9

UNITED STATES ATOMIC ENERGY COMMISSION

Washington 25, D. C.

OCTOBER 22, 1948

ALBERT J. FITZGERALD,
General President, United Electrical, Radio & Machine Workers of America, 11 East Fifty-first Street, New York 22, N. Y.

DEAR MR. FITZGERALD: This is in further reference to the Commission's letter to you of October 6, 1948, to which no reply has thus far been received. To insure that there is no misunderstanding of the issues involved in this case, we are reviewing herein the facts underlying the Commission's action.

The wartime atomic enery program was carried forward under an agreement between the War Department and the labor unions which held in abeyance the organization by unions of the employees of atomic energy operating contractors. In March 1946, the War Department relaxed the ban on union organization at Oak Ridge, Tennessee, but not at the other atomic energy installations. The organization of unions in Oak Ridge was in the nature of an experiment which would later be extended to other areas if it was decided that the activities of unions

were not inconsistent with the needs of security and uninterrupted production in these plants.

The voluntary action on the part of various unions who agreed with and participated in this policy was a most significant factor in protecting security at these projects.

Over a year ago the Commission, in letters to the Congress of Industrial Organizations, the American Federation of Labor and atomic energy contractors, expressed its own conviction that there is "a need for organized labor in the atomic energy program." We invited these organizations to join with us in appraising the Oak Ridge experience and in considering any problems relating to the extension of National Labor Relations Board proceedings to installations other than Oak Ridge.

While, as expected, the Oak Ridge experience included difficult problems, at no time was there any lack of recognition and agreement in respect to security requirements and procedures. Out of this experience and out of discussions with the above organizations the Commission concluded on September 27 that the time was now appropriate to withdraw the former request for postponement of NLRB proceedings and to release from their pledges these unions who had agreed to such postponement and who had voluntarily withheld any demands for recognition.

In making this decision the Commission decided it should no longer withhold the fullest application of the labor policy of the Nation from the major portion of the 60,000 workers employed in the atomic energy program. The NLRB was advised accordingly.

Certain procedures developed at Oak Ridge are premised on the Commission's belief that union officials exercising administrative, negotiating and disciplinary authority over workers employed on atomic energy projects, are themselves participants in the atomic energy program. These procedures therefore contemplate that such union officials be subjected to a scrutiny from a security standpoint comparable to that given to the individual union members and the employees. Such procedures were accepted by both the Atomic Trades and Labor Council (AFL) and the United Gas, Coke and Chemical Workers (CIO), the recognized unions at Oak Ridge, and participating officers complied with the same requirements applied to their members.

In the review of the situation at AEC installations other than Oak Ridge however, a serious question was found to exist in respect to alleged communist affiliation or association of various officers of the United Electrical, Radio and Machine Workers of America. This union, under its overall contract with General Electric, has acted as representative of certain atomic energy workers in Schenectady and its officers, therefore, have been in a position to exercise administrative, negotiating and disciplinary authority over such workers.

Because of the existence of this serious question, we directed the General Electric Company not to extend recognition to UE for any employees at the new Knolls Atomic Power Laboratory which is about to be put into operation.

The Commission took the position that if the officers of UE are to exercise administrative, negotiating and disciplinary authority over workers employed on the atomic energy work at Schenectady, these officers should be subject to the same scrutiny as other union officers who are participating in the program.

In my letter of October 6, the Commission proffered to the officers of UE an opportunity to participate in a resolution of this matter. Such participation, as indicated in that letter, would necessitate the furnishing by the officers of UE of the same personal data as has been furnished by all employees engaged in atomic energy work and by various officers of other union, including full and complete statements as to their associations and affiliations.

The Commission requests that it be informed by you whether in view of the lapse of time (about two weeks) since the Commission's letter of October 6, it should be assumed that the officers of UE do not desire to avail themselves of the offer proffered to them in that letter.

The Commission wishes to emphasize that it intends to move promptly on this matter. In the event that the serious question that exists is not satisfactorily answered in the manner indicated above, the Atomic Energy Commission intends to direct the General Electric Company to withdraw and withhold recognition from the United Electrical, Radio and Machine Workers of America as the bargaining representative of any employees engaged on work at AEC-owned or AEC-leased installations in the Schenectady area or engaged on atomic work which is defined as classified by the AEC and being performed by the General Electric Company.

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This action would be in effect unless and until the union's officers did submit personal data, as has been done by other union officers at other establishments, and the questions concerning such officers had been resolved.

The Commission's action is in furtherance of its clear duty to the country, imposed by law, to safeguard the Nation's atomic energy undertaking. In this we have heretofore received the full cooperation of the officers of other unions under similar circumstances. We shall either receive cooperation from the present officers of UE, in the manner indicated in this letter and our previous letter of October 6, or we shall very promptly take action in the absence of that cooperation.

In order that the employees who will be affected by this action may be fully advised of the facts and of the consideration given to this matter by the Commission, we are directing the General Electric Company to place a copy of this letter in the hands of every employee engaged in classified atomic energy work at Schenectady.

Sincerely yours,

UNITED STATES ATOMIC ENERGY COMMISSION,
DAVID E. LILIENTHAL, *Chairman.*

ITEM 10

UNITED ELECTRICAL, RADIO & MACHINE WORKERS OF AMERICA
11 East Fifty-first Street, New York 22, N. Y.

OCTOBER 26, 1948.

Mr. DAVID E. LILIENTHAL,
Chairman, United States Atomic Energy Commission,
Washington 25, D. C.

DEAR SIR: This is in reply to your communication of October 22.

We wish to point out with respect to your complaint that approximately two weeks have passed since your first letter to this Union, that the question you have raised is of such consequence that we have felt it proper to give the most careful consideration to our reply. You must recall that while you and the officials of the General Electric Company have been in consultation for months on how to use the Atomic Energy Commission to violate a legally constituted, long-established collective bargaining contract, you raised the question with us for the first time in your letter dated October 6, and then only after this Union had challenged the basis of the publicity attack upon the UE made jointly by you and the General Electric Company under date of September 27 and released for the use of the radio and newspapers on September 29.

Stripped of their camouflage, the claims that you and the General Electric Company make on behalf of the Atomic Energy Commission are as follows:

1. That the AEC shall now extend its privilege of passing upon workers directly employed on atomic energy projects—a privilege on which this Union has raised no question—to the right to exercise political control over the Union of which such employees may be members.

2. That as a means of establishing such political control, the Atomic Energy Commission may arbitrarily and unlawfully set aside established collective bargaining contracts, *without regard for the actual record of operation of such union and such contract on atomic energy and other classified work over a period of several years.*

These two claims of GE and the AEC, comprise the substance of your letter of October 22. The position of this Union on your claimed right to exercise political control can be stated briefly as follows:

1. Our membership has built our Union since its beginning upon democratic, rank and file principles which are embodied in our Constitution and which guarantee to all of our members without exception equal rights and privileges of membership. By barring discrimination against any UE member regardless of skill, age, sex, nationality, color, religious or political belief or affiliation, we have built a Union which cannot be taken out of the hands of the membership and which has achieved an outstanding record of service to its members and to its country. We do not intend to alter our principles upon your demand or the demand of the General Electric Company.

With respect to your threat to our contract we say:

2. This Union has always abided by its contractual obligations, and has always insisted upon maintaining the contract rights that our members have won. We will take all steps that appear necessary and advisable to protect our members' rights under the national contract with the General Electric Company.

In seeking to justify your claim to exercise political control over the UE and to help the General Electric Company escape its contract obligations you offer in your letter dated October 22 what purports to be a review of the facts in the case. Your review evades most of the facts pertinent to the issues between us and to the situation as it exists. Permit us to recall some of these facts to your mind.

The Atomic Energy Commission and the War Department before it, have always barred bona fide collective bargaining in new atomic plants, with the partial exception which you have noted at Oak Ridge and with the new, partial, qualified exception that you announced for the first time in your letter of October 22.

In the summer of 1946, when the Hanford, Washington, atomic plant was turned over to GE from du Pont, this Union upon its own initiative consulted directly with Secretary of War Patterson to determine whether or not any union would be permitted to give real grievance service and collective bargaining protection to workers in Hanford. We learned directly from Secretary Patterson that real union service to membership would not be permitted and we therefore decided against attempting any organization of the Hanford plant, and so advised the War Department.

When atomic work was introduced in the General Electric plant at Schenectady, whose employees have been under the protection of a UE contract for more than 10 years, members of this Union were employed on atomic work. As you know, this work has been carried on at GE for a period of years under the terms of the National UE-GE contract, both at the Schenectady GE laboratory and in the Peek Street plant.

You have now raised with us the question of the "administrative, negotiating and disciplinary authority" which you conceive that the officers of this Union exercise over its membership, and pretend to see some vague menace to the national security in that pretended relationship. Leaving aside the fact that in the UE authority lies in the hands of the membership and not in the hands of the officers, what is there in the record of this Union, in its actual relationship to atomic work, a record now covering a number of years, which could give the slightest shadow of justification for your pretended fears. You know that there is nothing. You know that the actual record of this Union on atomic work gives the lie to your insinuations.

More than that, you know, or should know, that for the major period of its existence this Union's membership has been engaged in classified armaments work, including the most secret, before the war, during the war and since the war, continuously, over a period of some 10 years. You know that in contrast to the two or three hundred UE members employed on atomic work, hundreds of thousands of members under UE contract have been engaged on classified work over a period of many years. You also know that in this entire period not one instance can be cited from the actual record of the work of this Union and its membership that could provide the slightest basis for your pretended worries. This is a record, remember, which covers hundreds of thousands of workers in plants throughout the country over a 10-year period.

You know that, far from being a menace to the security of this country, our Union has established a record of loyalty and service to this country that certainly cannot be matched by the General Electric Company, or by the majority of your associates within the Atomic Energy Commission.

It is because you know this that you seek to obscure the actual record, and seek to excuse the program you have evolved, in collaboration with GE upon the basis of newspaper gossip, the lies of self-seekers and degenerate professional witnessess and the politically motivated antics of a pair of Taft-Hartley Congressmen.

You have yielded to the solicitations of GE, ignored the clear record of facts and joined in an attack against this Union far more cowardly, false and malignant than the one that was made in similar terms against yourself in the U. S. Senate when you were appointed to your present position. You should have no hope that you will be able to appease the ill will of your political enemies by demonstrating your ability to use against others the same smear technique that they have used against you.

These are the facts you would like to hide, but which we shall not allow to be hidden.

You are also fully aware of the fact, which we quote from your letter of September 27, to C. E. Wilson, president of the General Electric Company, that "General Electric employees working on atomic energy projects, with access to restricted data are, as you know, all fully investigated by the Federal Bureau of Investigation with respect to character, association and loyalty, and such individuals have been subject to the usual security clearances by Commission representatives."

Yet you are now parrotting to us the "security" arguments of the General Electric Company as an excuse for your obvious desire to help the company break its union contract.

If security were your concern, you come to us under strange auspices and in strange company. You have turned over the secrets of the atom developed at a cost of billions of the people's money to a corporation whose record of convictions, civil and criminal, under the anti-trust laws of the U. S. can hardly be matched in our country—a corporation which has no loyalty save to its own private profit—a corporation whose latest criminal conviction under federal law has been for conspiracy with Krupp, the Nazi armaments firm, to the detriment of the defense and security of the United States.

This corporation, the General Electric Company which is now engaged in a merciless, company-wide speedup campaign against its employees, which is seeking on every hand to violate contract seniority provisions, which discriminates with respect to pay and jobs against women and Negroes, which systematically seeks to evade its contract responsibility to settle grievances—this company has just one purpose in using you to help it violate its contract with this Union. That purpose is to squeeze more profit out of the work of its employees, wherever they are employed.

You are now presenting as your own the demand of this corporation to pass upon the qualifications of this Union's leadership, with a threat to sponsor wholesale contract violation if the demand is resisted.

Your letter of October 22 bases itself in part upon the incredibly flimsy pretext that the employment of a few hundred union members on atomic work constitutes "participation" in the atomic energy program by national union leadership. You are well aware that no such participation exists or would be permitted. However, to bolster a specious argument, you have seen fit to cite to us the example of a few union leaders who have consented to place themselves under your sponsorship as to their fitness for union office. If they have done so under the delusion that they have thereby become fuller "participants" in the atomic energy program, they and their members will soon learn that they will be permitted participation only in the role of policemen to enforce the greater exploitation of their membership by the private corporations which you have placed in charge of atomic work.

We of the UE have never regarded this as a proper role of union leadership and certainly do not intend to enter it on behalf of the General Electric Company.

You have seen fit to raise with us the question of our associations as leaders of the UE. Our principal association, of course, is with our own members, with whom we deal and who deal with us, as we have informed you, without difference or distinction as to skill, age, sex, nationality, color, religious or political belief or affiliation. In our union, we follow the American principle of judging each other upon our work, our deeds, and our records and upon no other basis. We associate, where in our judgment the interests of the Union require it, with people in every walk in life, regardless of their various shades of political opinion, in the labor movement and out of it, in industry and outside it, in Government and outside of it. We deny to you and to the General Electric Company any right to meddle in this or in any other aspect of the Union's work.

You come to us in strange company to raise with us a question of politics or association. Your chief associate in this attempt to violate a union contract is the many-times-convicted General Electric Company. Your associates within the apparatus of the Atomic Energy Commission are no more savory.

To illustrate: The Personnel Security Review Board of the AEC, which you desire to establish as supreme judge over the qualifications of UE members for leadership, contains among its five members the former president of the National Association of Manufacturers, H. W. Prentiss, notorious for his connections with the fascist Franco dictatorship in Spain and noted for his hatred of the American labor movement.

During the last war your associate Prentiss told the National Industrial Conference Board that employers should work for "legislation to remove the wage-hour law, the Wagner Act, the Norris-LaGuardia Act, the Sherman Antitrust Act, and other laws affecting labor-management relations."

In 1938 this same member of your Personnel Security Review Board expressed these same motives in political terms, declaring, "American business might be forced to turn to some form of disguised fascistic dictatorship."

It was on the basis of this record that Supreme Court Justice Robert L. Jackson, when Attorney General, listed your associate Prentiss in an address before the Massachusetts Law Society as one of the "leading enemies of democracy," "underminers of morale," and "economic exploiters," classing him with such individuals and groups as General Van Horne Moseley, Merwin K. Hart, and Frank Gannett's League for Constitutional Government.

It is perfectly clear to us, and should be to you, why the General Electric Company hopes to force this Union to submit to the dictates of such men. If we were to receive the approval of such men as proper leaders of the UE we should rightly lose the trust of our membership.

The UE has been built, and its rank and file control maintained, upon the principle that no one but the membership has any right to determine what the leadership of the Union shall be. Your demand, on behalf of GE, that the leaders of this Union submit themselves to the approval of corporation officials disguised as servants of Government is subversive of the American principle of free and independent trade unionism. To agree to such a course would mean that American unions must submit to the censorship and regulation of officials acting on behalf of the corporations. It would take from the hands of the membership the right to choose their own leadership, to adopt their own Constitution, to decide how that Constitution should be applied and interpreted, and as a final consequence would take away from them the right to decide what activity their own Union should undertake.

We will fight this attempt to establish in the United States government-dominated company unionism modeled after the Nazi labor front.

While it is obvious that you and your associates have already formed a prejudgment of our case, and are proceeding according to a plan you have worked out in collaboration with the General Electric Company, we nevertheless call upon you to rescind your previous order to the General Electric Company and restrain yourself from further unwarranted interference in our affairs at the company's behest.

We regard this case as so flagrant an example of government-corporation conspiracy for the unlawful violation of a contract, and so serious an attempt to destroy the independence of our Union that we are taking the case to the courts of the United States. There we shall attempt to apply the standards of justice and rules of evidence which you profess to admire, but fail to practice, in an effort to substitute consideration of the actual and incontrovertible record of this Union for the hearsay trash upon which you have based your present course of action. We shall also attempt under the same rules and procedures to expose your conspiracy with the General Electric Company against this Union. We hope also that out of this action the people of the United States may come to learn how it has happened that the secrets of atomic power have been turned over to a corporation with the record of the General Electric Company.

Very truly yours,

ALBERT J. FITZGERALD,
General President.

ITEM 11

UNITED STATES ATOMIC ENERGY COMMISSION
Washington 25, D. C.

NOVEMBER 1, 1948.

Mr. ALBERT J. FITZGERALD,
General President,
United Electrical, Radio & Machine Workers of America,
11 East Fifty-first Street, New York 22, N. Y.

DEAR MR. FITZGERALD: This is in further reference to the Commission's letters to you dated October 6 and October 22, 1948, and your reply dated October 26, 1948.

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Attached is a copy of a letter which the Commission is today sending to Mr. Charles E. Wilson, President of the General Electric Company.

Sincerely yours,

UNITED STATES ATOMIC ENERGY COMMISSION,
DAVID E. LILIENTHAL, *Chairman.*

ITEM 12

UNITED STATES ATOMIC ENERGY COMMISSION

Washington 25, D. C.

NOVEMBER 1, 1948

Mr. CHARLES E. WILSON,
President, General Electric Company,
570 Lexington Avenue at Fifty-first Street, New York 22, N. Y.

DEAR MR. WILSON: Under date of September 27, 1948, the Atomic Energy Commission directed that the General Electric Company not recognize the United Electrical, Radio and Machine Workers of America, CIO (UE), as the bargaining representative of any persons to be employed by it at the new Knolls Atomic Power Laboratory, Schenectady, New York. This direction was based upon information concerning alleged Communist affiliation or association of various officers of UE. The positions occupied within UE by these officers are such that they exercise administrative, negotiating, or disciplinary authority within the Union over General Electric Company employees engaged at other atomic energy facilities at Schenectady where UE is the recognized bargaining agent.

This information when taken together with the failure of these officers to file non-Communist affidavits under the Labor Management Relations Act, led the Commission to conclude that there is a very serious question as to whether representation of atomic energy workers at Schenectady by a union in which such officers occupied important positions is consistent with that full and unqualified adherence and loyalty to the interests of the United States that the security of the nation and the policy of the Atomic Energy Act of 1946 require.

Under dates of October 6 and October 22, 1948, the Atomic Energy Commission wrote Mr. Albert J. Fitzgerald, General President of the UE, in connection with the Commission's direction to the General Electric Company. The Commission concluded, however, that unless this very serious question should be cleared up satisfactorily the Commission intended to take such further steps as may be necessary to assure that these officers do not exercise administrative, negotiating or disciplinary authority over General Electric Company employees engaged in atomic energy work, at Schenectady. The Commission offered the officers of UE every opportunity to participate in a fuller exploration of this issue.

On October 26, 1948, Mr. Fitzgerald replied to the Commission's letters of October 6 and October 22, 1948. From this reply it appears that the officers of UE do not intend to avail themselves of this proffered opportunity to participate in a fuller exploration of this question. In particular it appears that the officers do not intend to answer questions or submit facts concerning their loyalty and their associations with Communist party organizations, as in our view they must do, in their capacity of officers of unions who have wide authority over atomic energy activity personnel.

Accordingly the Atomic Energy Commission now directs that General Electric Company withdraw and withhold recognition from the United Electrical, Radio and Machine Workers of America, CIO, in respect to any employees of General Electric Company engaged on work at AEC-owned or AEC-leased installations in the Schenectady area or engaged on atomic work which is defined as classified by the Atomic Energy Commission and being performed by the General Electric Company.

A reappraisal of the situation will be made within a reasonable period of time after you have taken the necessary action to comply with this directive. You will thereafter be advised as to any further steps that may be necessary.

We wish to emphasize that this action, while made necessary by this refusal of these particular union officers to accept obligations as to loyalty investigations (which their own members engaged in classified atomic energy work have all accepted), is in no wise a reflection on the membership of this union, employees

of your company, who have been investigated and cleared. Further, we take this opportunity again to make it clear that the Commission does not object to General Electric Company extending recognition as bargaining agent for atomic energy workers to any labor organization whose officers have met the requisite standards in respect to full and unqualified adherence and loyalty to the interests of the United States.

Sincerely yours,

UNITED STATES ATOMIC ENERGY COMMISSION,
DAVID E. LILIENTHAL, *Chairman.*

ITEM 13

GENERAL ELECTRIC COMPANY

General Electric Building, 570 Lexington Avenue at Fifty-first Street,
New York 22, N. Y.

NOVEMBER 3, 1948.

MR. DAVID E. LILIENTHAL,
Chairman, Atomic Energy Commission,
1901 Constitution Avenue, Washington 25, D. C.

DEAR MR. LILIENTHAL: This will acknowledge receipt of your letter dated November 1, 1948, directing the General Electric Company to withdraw and withhold recognition from the UER & MWA as the bargaining representative of any employees engaged on work at AEC-owned or AEC-leased installations in the Schenectady area or engaged on atomic energy work which is defined as classified by the AEC and being performed by the General Electric Company.

Accordingly, we are today issuing the following notice to all our employees affected by your directive, and we will immediately take the action indicated therein:

"*To All Employees Engaged on Work at AEC-Owned or AEC-Leased Installations in the Schenectady Area, or Engaged on Classified Atomic Energy Work:*

"The General Electric Company has received the following directive from the Atomic Energy Commission:

[Text of letter dated November 1, 1948, from AEC to General Electric]

"Pursuant to this directive from the Atomic Energy Commission, you are hereby notified that effective immediately the General Electric Company will withdraw and withhold recognition from the UER & MWA as the bargaining representative of any employees engaged on work at AEC-owned or AEC-leased installations in the Schenectady area or engaged on atomic energy work which is defined as classified by the Atomic Energy Commission and being performed by the General Electric Company. Accordingly, the Company will discontinue check-off arrangements with respect to, and will refuse to meet with or otherwise recognize representatives of the UER & MWA as representing, employees affected by this directive of the Commission.

"Any employee affected by this directive will, of course, continue to have the right individually to present grievances to the Company, and further, the Company stands ready and willing (subject to such further directives as may be given by the Atomic Energy Commission), in accordance with the Atomic Energy Commission's letter of November 1, 1948, to extend recognition as bargaining agent for atomic energy workers in our employ to any duly certified labor organization (including the UE) whose officers shall meet the Atomic Energy Commission's standards 'in respect to full and unqualified adherence and loyalty to the interests of the United States.'

"*There will be no changes in wages or working conditions with respect to employees because of this action.*"

Very truly yours,

C. E. WILSON.

APPENDIX 10

AEC Federal Employee Personnel Policy

FOREWORD

The people of the United States, through Congress, have entrusted to the Atomic Energy Commission the vital and urgent task of developing and utilizing atomic energy for the purpose of "improving the public welfare, increasing the standard of living, strengthening free competition in private enterprise, and promoting world peace." The achievement of these objectives requires a high order of skill, ingenuity, patience, loyalty, and perseverance in meeting and resolving many new and complex problems.

All of us selected to serve in this task should be proud to be able to contribute so directly to the welfare of the Nation. Every job is a vital part of our over-all program. Our objectives cannot be met unless each individual employee, whatever his duties or responsibilities, is pulling his full weight. Every employee of the Atomic Energy Commission can derive special satisfaction and inspiration from the knowledge that whatever his particular assignment, he is a member of a unique enterprise of the greatest importance to the national welfare.

The carrying forward of this mission is "subject at all times to the paramount objective of assuring the common defense and security." The necessary secrecy stemming from the direction of the Congress means that there must be assurance that the character, associations, and loyalty of employees and workers in atomic energy shall be of the highest order. It means that unusual standards of conduct and self-discipline, both on and off the job, must be applied. It means that the exchange of information and the handling of equipment, materials, and documents must be precise and within established procedures. In short, it means that many phases of the manager's job that are "ordinary" in most organizations become "extraordinary" in the Atomic Energy Commission.

Rapid progress in scientific achievement is the most vital factor in "assuring the common defense and security."

Such progress and the forward movement of our own responsibility necessitates a work environment in which each of us has an opportunity to put forth his best effort at the work for which he is best fitted. An essential factor in maintaining an environment that encourages each employee to work enthusiastically and willingly to the best of his ability is an organization responsive to suggestions for improving the way in which things are done.

In developing such an environment it is essential that selection of employees, work assignments, and promotions are on the basis of merit and productivity. Political tests or qualifications, family relationships, or other extraneous criteria cannot be given consideration.

After a careful study of our needs and of our experience thus far, we have adopted a set of basic personnel policies which is set forth below.

These policies will constitute the broad framework within which our management job will be performed. In their application due consideration will be given to the requirements of national security, but "secrecy" must not be allowed to become a cover for bad management practice.

Many members of the Washington and field staffs have participated in formulating the policies and have shared their experiences. An even broader participation is essential in the future.

A sound personnel job is essential to the effective and economical accomplishment of the work goals of the agency. We believe that these policies provide the basis for such a personnel job.

ORGANIZATION AND SUPERVISION

The general manager and all other employees who direct the work of others will assure that those under their supervision know their jobs, to whom each is responsible, the authority that goes with their jobs, the relationships of their jobs to other jobs in the organization, and the channels of communication. Each major geographical area will so organize its activities as to provide continuing leadership, guidance and assistance to supervisors and employees in achieving proper application of the principles set forth in this policy.

The structure of the organization will be the result of careful planning designed to meet specific program needs.

Certain sound organization practices will be obvious to all good supervisors. However, the Commission feels strongly that practices such as the following are too often forgotten and therefore they are set forth below as a part of this policy.

1. Assignment of responsibility will carry with it commensurate delegation of authority.
2. Any change in the responsibilities of a position or a group of positions will be preceded by a definite understanding on the part of all concerned.
3. An employee will not be required to report directly to more than one supervisor.
4. Instructions and directions will be given to employees only through, or with the agreement of, the immediate supervisor.
5. Changes in an employee's work assignment or employment status will be communicated to him, after proper approvals, only by his immediate supervisor.

EMPLOYEE PARTICIPATION

The widest practicable opportunity will be afforded to employees for consultation and explanation in the formulation and development of policies affecting their employment status, working conditions and productivity. This opportunity will be effected through positive encouragement of a free exchange between supervisory and supervised employees of points of view and ideas in their daily work together and in regular departmental staff meetings, supervisory conferences, conferences of management of employee representatives and other effective means.

Employees are urged to avail themselves of these opportunities for participation.

The rights of employees to join or refrain from joining employees' organizations of their own choosing without coercion or fear of discrimination is recognized.

It is also recognized that employee organizations can make a positive contribution in furthering the atomic energy program. Accordingly, the participation of employee organization in the program is welcomed. The promotion of sound employee-management relations is a mutual concern and benefits employees and the Commission alike.

NONDISCRIMINATION

There will be no discrimination in favor of or against an employee or applicant because of race, color, sex, religion, physical handicap, or national origin.

EMPLOYMENT

The far-reaching significance and scope of the atomic energy program requires high standards of employment which will attract and maintain an adequate organization of capable and well-qualified people. Accordingly:

1. Adequate sources from which employees may be recruited will be developed and maintained.
2. Each job will be filled on a merit basis by selecting the available individual best qualified in terms of the carefully determined requirements of the particular position and in accordance with the Veterans Preference Act of 1944.
3. Opportunity for transfer and promotion will be provided in order to make full use of demonstrated skills and abilities. Qualified employees will be selected to fill vacancies unless candidates who are not employees are better qualified.
4. In the appointment or promotion of individuals or any other personnel action no political test or qualification shall be permitted or given consideration.

TERMINATIONS

When it is necessary to reduce employment, the selection of employees for retention within an appropriate geographical area will be on the basis of relative qualifications for the work remaining to be done, and in accordance with the requirements of the Veterans

Preference Act of 1944 including veteran status, demonstrated performance and length of federal service. Reasonable notice will be given to employees whose services are to be terminated.

An employee will be discharged from his position or demoted for cause only after he has been given (1) a statement of the reasons for the proposed action, (2) an opportunity to reply and (3) an opportunity to appeal any determination to dismiss. An employee may be put in suspension status without pay pending final determination.

EMPLOYEE EVALUATION

Systems will be established to evaluate and record performance and capabilities of employees, to determine any need for their further development or change in job status. Each supervisor will use current information on the experience, qualifications and performance of each individual under his direction as a basis of planning for the further development of such employees. Each supervisor will discuss any evaluation and the basis for it with the employee affected to develop mutual understanding.

TRAINING

Teaching skill is a requisite of effective supervision at all levels.

Employees will be provided with opportunity to fill any gaps in their knowledge, skill or attitude in order to enable them to perform the tasks assigned to them in the best known ways. This will include programs for orientation and induction before assignment of work, daily training on the job and training in supervision.

GRIEVANCES

There will be a formal and specific grievance procedure. Supervisory and supervised employees have an obligation to make every effort to resolve employment relations problems as they arise. Failing prompt and satisfactory adjustment of any grievance, appropriate provision will be made for appeal. Employees may designate representatives of their own choosing to assist them in presentation of grievances. In presenting grievances employees will be free from any interference, restraint or reprisal.

SAFETY AND HEALTH

Each supervisor will take the initiative in the establishment and maintenance of safe and healthful practices and work places for every employee under his supervision, and in assuring that the manner of performance of all operations will minimize personal injury and disease and damage to equipment, materials, and property. Safety is an integral part of each job, and each employee is responsible for the safety phase of his work just as much as he is for any other phase.

SALARY AND WAGES

Salaries and wages will be determined as follows:

1. Certain scientific and technical positions which the Commission finds must be exempted from the salary scales of the Classification Act of 1923, as amended, will receive salaries which are arrived at after consideration of the rates paid for similar work by other Government and private organizations.
2. Wages for laborer and mechanic positions will be established after consideration of rates paid for similar work by other Government and private employers in the appropriate geographical area.
3. Salaries for positions other than those discussed above will be established in line with the pay scales of the Classification Act of 1923, as amended, in accordance with the requirements of the appropriate act for the current fiscal year.

The method by which the rate of pay for his job is determined will be explained to each employee.

BENEFIT PLANS

Employees will be granted the same benefits with respect to annual leave, sick leave, leave of absence, workmen's compensation, military leave, court leave, leave for voting purposes, holidays, and retirement as are granted to other Federal employees. Information on the details of these plans will be given to employees.

CONCLUSION

The Atomic Energy Commission looks forward to the further develop-

ment of this policy: First, through the whole-hearted and effective execution of the principles of sound employee relations by the Commission members, the General Manager, and all the employees who direct the work of others; second, through the whole-hearted acceptance by all employees of the obligations that attach to their employment in the atomic energy program; third, through the development of effective employee-management cooperation.

These policies are an integral part of the daily activities of supervisors at all levels and of all other employees. The General Manager, aided by the Director of Organization and Personnel, will take such action as is appropriate to implement these policies, to evaluate the adequacy with which the policies meet current program needs, and to assure performance in accord with established policies.

As additional experience is gained with the broad principles stated above and as the task of implementing these principles with more detailed policies and procedures goes forward, the widest opportunity will be provided employees to make known their views.

APPENDIX 11

EXECUTIVE ORDERS RELATING TO THE U. S. ATOMIC ENERGY COMMISSION

E. O. 9816—PROVIDING FOR THE TRANSFER OF PROPERTIES AND PERSONNEL TO THE ATOMIC ENERGY COMMISSION

By virtue of the authority vested in me by the Constitution and the statutes, including the Atomic Energy Act of 1946, and as President of the United States and Commander in Chief of the Army and the Navy, it is hereby ordered and directed as follows:

1. There are transferred to the Atomic Energy Commission all interests owned by the United States or any Government agency in the following property:

(a) All fissionable material; all atomic weapons and parts thereof; all facilities, equipment, and materials for the processing, production, or utilization of fissionable material or atomic energy; all processes and technical information of any kind, and the source thereof (including data, drawings, specifications, patents, patent applications, and other sources) relating to the processing, production, or utilization of fissionable material or atomic energy; and all contracts, agreements, leases, patents, applications for patents, inventions, and discoveries (whether patented or unpatented), and other rights of any kind concerning any such items.

(b) All facilities, equipment, and materials, devoted primarily to atomic energy research and development.

2. There also are transferred to the Atomic Energy Commission all property, real or personal, tangible or intangible, including records, owned by or in the possession, custody, or control of the Manhattan Engineer District, War Department, in addition to the property described in paragraph 1 above. Specific items of such property, including records, may be excepted from transfer to the Commission in the following manner:

(a) The Secretary of War shall notify the Commission in writing as to the specific items of property or records he wishes to except; and

(b) If after full examination of the facts by the Commission, it concurs in the exception, those specific items of property or records shall be excepted from transfer to the Commission; or

(c) If after full examination of the facts by the Commission, it does not concur in the exception, the matter shall be referred to the President for decision.

3. The Atomic Energy Commission shall exercise full jurisdiction over all interests and property transferred to the Commission in paragraphs 1 and 2 above, in accordance with the provisions of the Atomic Energy Act of 1946.

4. Any Government agency is authorized to transfer to the Atomic Energy Commission, at the request of the Commission, any property, real or personal, tangible or intangible, acquired or used by such Government agency in connection with any of the property or interests transferred to the Commission by paragraphs 1 and 2 above.

5. Each Government agency shall supply the Atomic Energy Commission with a report on, and an accounting and inventory of, all interests and property, described in paragraphs 1, 2, and 4 above, owned by or in the possession, custody, or control of such Government agency, the form and detail of such report, accounting, and inventory, to be determined by mutual agreement, or, in case of nonagreement, by the Director of the Bureau of the Budget.

6. (a) There also are transferred to the Atomic Energy Commission, all civilian officers and employees of the Manhattan Engineer District, War Department, except that the Commission and the Secretary of War may by mutual agreement exclude any of such personnel from transfer to the Commission.

(b) The military and naval personnel heretofore assigned or detailed to the Manhattan Engineer District, War Department, shall continue to be made available to the Commission, for military and naval duty, in similar manner, without prejudice to the military or naval status of such personnel, for such periods of time as may be agreed mutually by the Commission and the Secretary of War or the Secretary of the Navy.

7. The assistance and the services, personal or other, including the use of property, heretofore made available by any Government agency to the Manhattan Engineer District, War Department, shall be made available to the Atomic Energy Commission for the same purposes as heretofore and under the arrangements now existing until terminated after 30 days' notice given by the Commission or by the Government agency concerned in each case.

8. The Commission is authorized to exercise all of the powers and functions vested in the Secretary of War by Executive Order No. 9001, of December 27, 1941, as amended, insofar as they relate to contracts heretofore made by or hereby transferred to the Commission.

9. Such further measures and dispositions as may be determined by the Atomic Energy Commission and any Government agency concerned to be necessary to effectuate the transfers authorized or directed by this order shall be carried out in such manner as the Director of the Bureau of the Budget may direct and by such agencies as he may designate.

10. This order shall be effective as of midnight, December 31, 1946.

E. O. 9908—RESERVATION OF SOURCE MATERIAL IN CERTAIN LANDS OWNED BY THE UNITED STATES

By virtue of the authority vested in me as President of the United States, and in further effectuation of the policies declared by section 1 of the Atomic Energy Act of 1946 (60 Stat. 755), it is hereby ordered as follows:

1. So far as not in conflict with existing law, (a) all disposals of lands, other than public lands, heretofore or hereafter acquired by the United States or any instrumentality thereof, including lands in the Territories and possessions of the United States, except in conveyances where all minerals, including source material, are reserved to the United States, (b) all leases, permits, or other authorizations of whatever kind hereafter granted to remove minerals from such lands, and (c) all leases, permits, or other authorizations which otherwise would preclude the United States from exercising its right to enter upon the lands and prospect for, mine, and remove minerals, shall contain the following reservation:

> All uranium, thorium, and all other materials determined pursuant to section 5 (b) (1) of the Atomic Energy Act of 1946 (60 Stat. 761) to be peculiarly essential to the production of fissionable material, contained, in whatever concentration, in deposits in the lands covered by this instrument are hereby reserved for the use of the United States, together with the right of the United States through its authorized agents or representatives at any time to enter upon the land and prospect for, mine, and remove the same, making just compensation for any damage or injury occasioned thereby. However, such land may be used, and any rights otherwise acquired by this disposition may be exercised, as if no reservation of such materials had been made; except that when such use results in the extraction of any such material from the land in quantities which may not be transferred or delivered without a license under the Atomic Energy Act of 1946, as it now exists or may hereafter be amended, such material shall be the property of the United States Atomic Energy Commission, and the Commission may require delivery of such material to it by any possessor thereof after such material has been separated as such from the ores in which it was contained. If the Commission requires the delivery of such material to it, it shall pay to the person mining or extracting the same, or to such other person as the Commission determines to be entitled thereto, such sums, including profits, as the Commission deems fair and reasonable for the discovery, mining, development, production, extraction, and other services performed with respect to such material prior to such delivery, but such payment shall not include any amount on account of the value of such material before removal from its

place of deposit in nature. If the Commission does not require delivery of such material to it, the reservation hereby made shall be of no further force or effect.

2. The reservation required by paragraph 1 above need not be included in any disposition of land which is not in excess of one acre and which is devoted primarily to a residential use.

3. Executive Order No. 9701 of March 4, 1946, entitled "Providing for the Reservation of Rights to Fissionable Materials in Lands Owned by the United States," is hereby revoked; but such revocation shall not be construed to affect the revocation of Executive Order No. 9613 made by Executive Order No. 9701 or the provisions contained therein with respect to the lands released from withdrawal by the revocation of Executive Order No. 9613. (Effective, December 5, 1947.)

E. O. 9829—EXTENSION OF THE PROVISIONS OF EXECUTIVE ORDER NO. 9177 OF MAY 30, 1942, TO THE UNITED STATES ATOMIC ENERGY COMMISSION

By virtue of the authority vested in me by the Constitution and laws of the United States, and particularly by title I of the First War Powers Act, 1941, approved December 18, 1941 (55 Stat. 838), and in the interest of the internal management of the Government, I hereby extend the provisions of Executive Order No. 9177 of May 30, 1942 (7 F. R. 4195), to the United States Atomic Energy Commission; and, subject to the limitations contained in that order, I hereby authorize the United States Atomic Energy Commission to perform and exercise all of the functions and powers vested in and granted to the Secretary of War, the Secretary of the Treasury, the Secretary of Agriculture, and the Reconstruction Finance Corporation by that order.

This order shall be applicable to articles entered for consumption, or withdrawn from warehouse for consumption, on or after January 1, 1947. (Effective, February 21, 1947.)

E. O. 9177—DEFINING ADDITIONAL FUNCTIONS, DUTIES AND POWERS OF THE SECRETARY OF WAR, THE SECRETARY OF THE TREASURY, THE SECRETARY OF AGRICULTURE, AND THE RECONSTRUCTION FINANCE CORPORATION

By virtue of the authority vested in me by the Constitution and laws of the United States, and particularly by title I of the First War Powers Act, 1941, approved December 18, 1941 (Public Law 354, 77th Cong.), as President of the United States and Commander in Chief of the Army and Navy of the United States, it is hereby ordered as follows:

1. The Secretary of War, the Secretary of the Navy, the Secretary of the Treasury, the Secretary of Agriculture, and the Reconstruction Finance Corporation are each authorized to exercise the functions, powers and duties heretofore vested in the Secretary of the Navy by that provision of an act approved June 30, 1914 (38 Stat. 399; 34 U. S. C. 568), which reads as follows:

> *Provided*, That hereafter the Secretary of the Navy is hereby authorized to make emergency purchases of war material abroad: *And provided further*, That when such purchases are made abroad, this material shall be admitted free of duty.

2. The Commissioner of Customs, with the approval of the Secretary of the Treasury, shall issue regulations governing the entry and admission free of duty of articles as to which an officer or the agency designated in section 1 of this order shall make a certificate to him in the following form:

> The procurement of this material constituted an emergency purchase of war material abroad and it is accordingly requested that such material be admitted free of duty pursuant to the Act of June 30, 1914 (34 U. S. C. 568), and Executive Order No. 9177.

3. The authority herein conferred, including the authority to execute the certificate set forth in section 2 of this order, may be exercised by the Secretary of War, the Secretary of the Navy, the Secretary of the Treasury, and the Secretary of Agriculture, and the Board of Directors of the Reconstruction Finance Corporation, respectively, or in their discretion and by their direction, respectively,

may be exercised also by and through any officer or officers or civilian officials of their respective departments and agency designated by them for those purposes, or, in the case of the Secretary of Agriculture by and through such corporations in the Department of Agriculture as are under the direction and supervision of the Secretary of Agriculture and in the case of the Reconstruction Finance Corporation, by and through one or more of its subsidiary corporations. The Secretary of War, the Secretary of the Navy, the Secretary of the Treasury, and the Secretary of Agriculture, and the Board of Directors of the Reconstruction Finance Corporation may authorize such officer or officers or civilian officials of their respective departments or agency or such corporation or corporations subsidiary to the Reconstruction Finance Corporation or under the direction and supervision of the Secretary of Agriculture to make further delegations of such powers and authority within their respective departments and agency, and within such corporation or corporations.

4. This order shall become effective as of the date hereof, shall continue in force and effect until the termination of title I of the First War Powers Act, 1941, and shall authorize or ratify any emergency purchase of war materials abroad heretofore or hereafter made by or for the account of any of the said departments, the said agency, or such corporations, and any such war material so purchased may be entered, or withdrawn from warehouse, for consumption free of duty during the effective period of this order.

5. Any provision of any Executive order, and any provision, rule, or regulation of any officer, department, board, commission, bureau, agency or instrumentality of the Government of the United States conflicting with this order are superseded to the extent of such conflict. (Effective, May 30, 1942.)

E. O. 9925—ESTABLISHING AIRSPACE RESERVATIONS OVER CERTAIN FACILITIES OF THE UNITED STATES ATOMIC ENERGY COMMISSION

By virtue of and pursuant to the authority vested in me by section 4 of the Air Commerce Act of 1926 (44 Stat. 570), the airspace above the three following-described portions of the United States is hereby reserved and set apart for national defense and other governmental purposes as airspace reservations within which no person shall navigate an aircraft except in the interest of national defense or by authority of the United States Atomic Energy Commission:

All that area within the United States lying within each of the following-described boundaries:

1. *Clinton Engineering Works, Oak Ridge, Tenn.*—Beginning at latitude 36°00′25″ longitude 84°07′05″; thence to latitude 35°51′35″ longitude 84°16′25″; thence to latitude 35°52′10″ longitude 84°24′15″; thence to latitude 35°55′45″ longitude 84°29′30″; thence to latitude 36°05′05″ longitude 84°13′30″; thence to latitude 36°00′25″ longitude 84°07′05″, the point of beginning.

2. *Hanford Engineer Works, Richland, Wash.*—Beginning at latitude 46°33′40″ longitude 119°13′00″; thence to latitude 46°20′00″ longitude 119°13′13″; thence to latitude 46°18′06″ longitude 119°30′00″; thence to latitude 46°26′00″ longitude 119°47′25″; thence to latitude 46°40′45″ longitude 119°47′28″; thence to latitude 46°46′50″ longitude 119°33′35″; thence to latitude 46°46′50″ longitude 119°28′16″; thence to latitude 46°33′40″ longitude 119°13′00″, the point of beginning.

3. *Los Alamos Project, Santa Fe, N. Mex.*—Beginning at latitude 36°00′00″ longitude 106°04′00″; thence along the Rio Grande River to latitude 35°45′00″ longitude 106°15′00″; thence to latitude 35°45′00″ longitude 106°30′00″; thence to latitude 36°00′00″ longitude 106°30′00″; thence to latitude 36°00′00″ longitude 106°04′00″, the point of beginning.

Any person navigating an aircraft within any of these airspace reservations in violation of the provisions of this order will be subject to the penalties prescribed in the Civil Aeronautics Act of 1938 (52 Stat. 973), as amended. (Effective, January 17, 1948.)

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