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THE JOINT CHIEFS OF STAFF

JOINT INTELLIGENCE COMMITTEE

WASHINGTON 25, D. C.

15 January 1948

MEMORANDUM FOR EXECUTIVE DIRECTOR, CIA

SUBJECT: Organizational Chart
U. S. Atomic Energy Commission

1. I thought you might be interested in the attached organizational chart of the Atomic Energy Commission. Please note the lack of classification.

[redacted] STAT

Colonel, GSC
Liaison CIA

Attachment:
1 chart

STAT [redacted] ig

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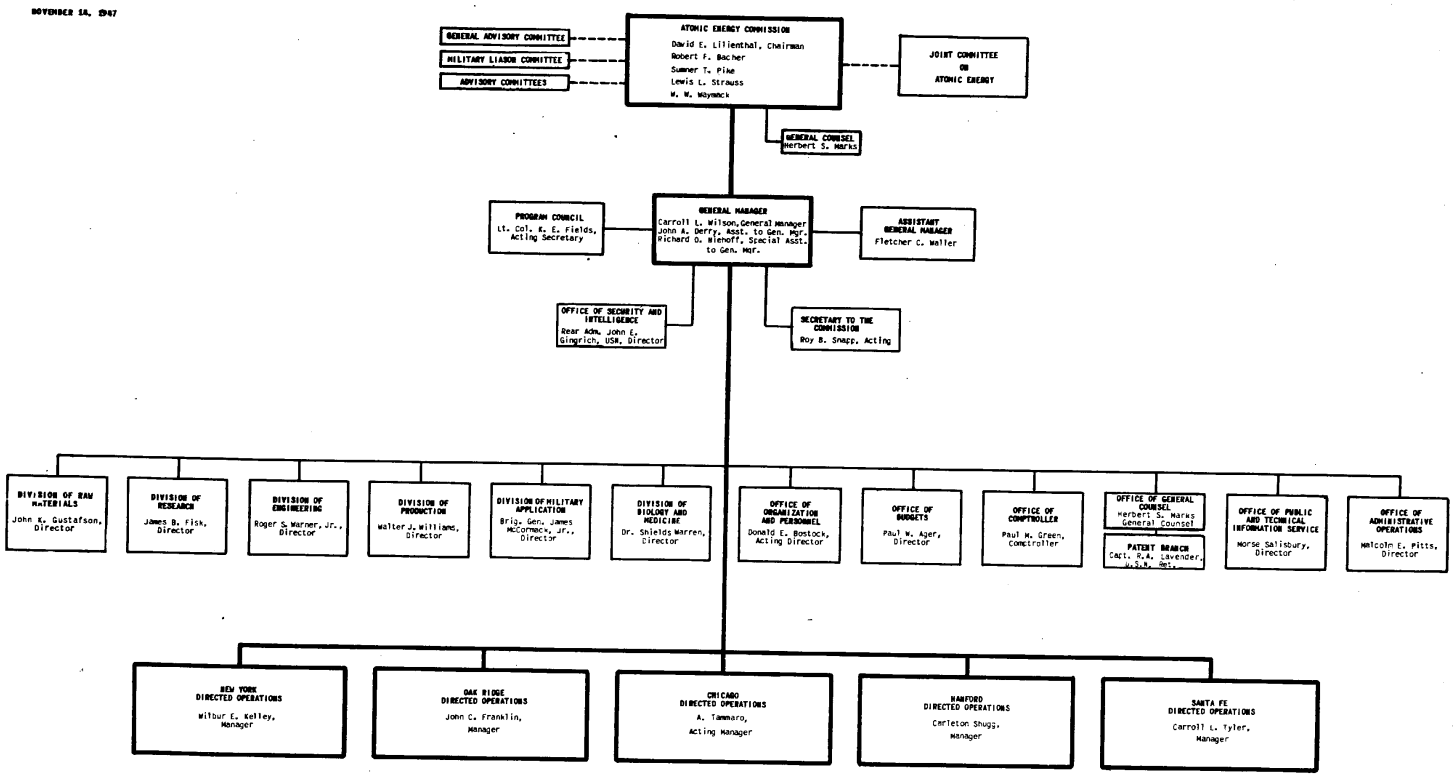
U.S. ATOMIC ENERGY COMMISSION

NOVEMBER 18, 1967



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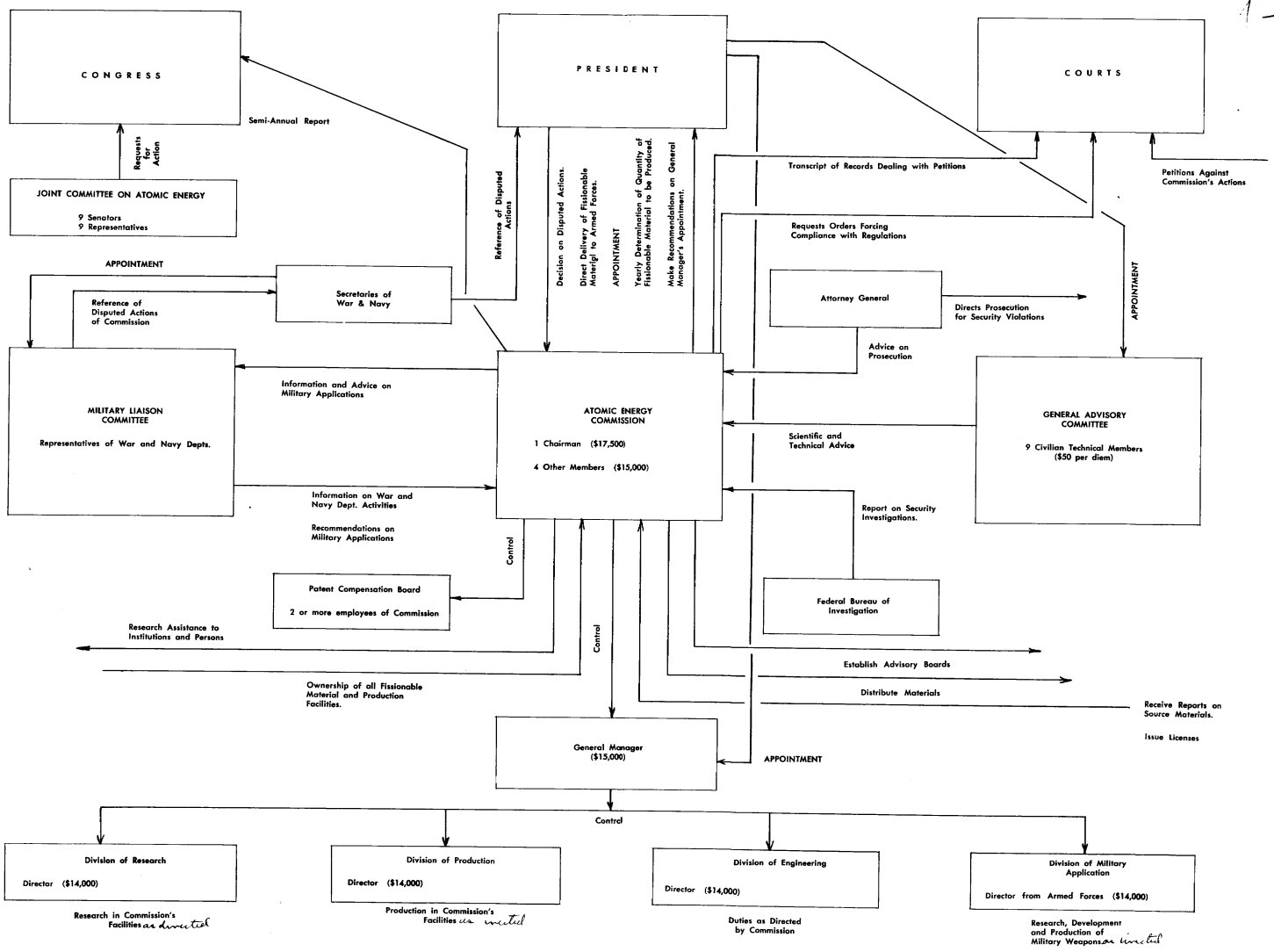

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80TH CONGRESS, 1st Session | SENATE | DOCUMENT No. 8

ATOMIC ENERGY COMMISSION

LETTER

FROM THE

MEMBERS OF THE UNITED STATES ATOMIC ENERGY COMMISSION

TRANSMITTING

THE INITIAL REPORT OF THE COMMISSION

JANUARY 31, 1947.—Referred to the Joint Committee on Atomic Energy and ordered to be printed

UNITED STATES
GOVERNMENT PRINTING OFFICE
WASHINGTON : 1947

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LETTER OF SUBMITTAL

UNITED STATES ATOMIC ENERGY COMMISSION,
Washington 25, D. C., January 30, 1947.

Hon. ARTHUR H. VANDENBURG,
President of the Senate.

DEAR MR. PRESIDENT: We have the honor to submit herewith the initial report of the Atomic Energy Commission.

Sincerely yours,

DAVID E. LILIENTHAL, *Chairman.*
ROBERT F. BACHER.
SUMNER T. PIKE.
LEWIS L. STRAUSS.
WILLIAM W. WAYMACK.

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REPORT TO THE CONGRESS BY THE UNITED STATES ATOMIC ENERGY COMMISSION

To the PRESIDENT OF THE SENATE OF THE UNITED STATES.
o the SPEAKER OF THE HOUSE OF REPRESENTATIVES OF THE UNITED STATES.

INTRODUCTION

The following report is respectfully submitted pursuant to the direction of section 17 of the Atomic Energy Act of 1946, which provides that—

> The Commission shall submit to the Congress, in January and July of each year, a report concerning the activities of the Commission * * *.

The Atomic Energy Act was approved on August 1, 1946. On October 28, 1946, while the Senate was in recess, the President named as members of the Commission the undersigned. The members of the Commission required some time to sever their existing business and employment connections in order to comply with the requirement of section 2 (a) (2) of the act that—

> No member of the Commission shall engage in any other business, vocation, or employment than that of serving as a member of the Commission.

On November 13 the Commission held its first meeting, and since that time its members have devoted their entire time to the business of the Commission. Because of the magnitude and complexity of the undertakings and responsibilities vested in the Commission by the act, and because of the necessity of uninterrupted activity, the War Department consented to continue operation of the enterprise—known as the Manhattan Engineer District of the Corps of Engineers—until a transfer to the Commission could be effected without risk of interruption consequent upon the change from military direction by the War Department to operation by the newly constituted statutory Commission. At midnight on December 31, 1946, this transfer became effective, by virtue of Executive Order 9816 (a copy of which is attached as appendix A). The Executive order was issued pursuant to the directions of the Congress contained in section 9 (a) and other provisions of the act.

The relative brevity and lack of detail in this initial report of the Commission is explained by the fact that the Commission has been in responsible control of this very large undertaking for only about 4 weeks and but 2½ months have elapsed since its first meeting. In its next semiannual report to the Congress, due in July of this year, it is the intention of the Commission to submit a comprehensive statement (within the limitations that the maintenance of secuity of information makes feasible in a public report). Prior to that time the Commission will report, orally and in writing, to the Joint Committee on Atomic Energy, in accordance with section 15 of the act, which provides that—

> The Commission shall keep the joint committee fully and currently informed with respect to the Commission's activities.

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As promptly as possible the Commission will report to the joint committee the present status of the work of the Commission, the status of properties, facilities, contracts, personnel, financial condition, and other similar facts, and plans for future development as those plans proceed. The Commission also will keep the joint committee fully and currently informed concerning the program of administration consistent with the policies of the act (sec. 1 (b) (5)) and other policy determinations, among which some of the most important relate to methods of maintaining secure the information which must be kept secret in the interest of national safety.

INSPECTION OF MANHATTAN DISTRICT

The members of the Commission determined that their first step should be a survey of the facilities of Manhattan District. Accordingly, on November 12, accompanied by Col. Kenneth D. Nichols, the district engineer, the Commission left Washington for Oak Ridge, Tenn., administrative center and principal installation of Manhattan District. In the ensuing 2 weeks the Commission visited a number of major installations, making brief inspections and holding conferences with key executive and scientific personnel of Manhattan District and its contractors.

TRANSFER OF MANHATTAN DISTRICT

On October 26, the day President Truman named the members of the Commission, all five members conferred with the Secretary of War, General Eisenhower, and General Groves. Secretary Patterson offered the full cooperation of the War Department in the Commission's work and agreed to continue the Manhattan District operations under War Department jurisdiction until the members of the Commission could organize formally and acquaint themselves with the project. At the same time Secretary Patterson urged that the properties and functions then under the jurisdiction of Manhattan District, and required by the act to be transferred, should be placed under Commission jurisdiction at the earliest possible date and that as soon as possible military personnel should be released.

As already indicated, following the first formal meeting on November 13, all the members of the Commission spent the next 2 weeks visiting major installations of Manhattan District, consulting with key personnel of the district and its contractors, and studying the work and the problems of the project. As soon as these activities had proceeded far enough to afford a general familiarity with Manhattan District, its personnel and installations, the Commission took up the problem of bringing about the transfer of the project as contemplated by section 9 (a) of the act.

The numerous details involved in the transfer of the properties, funds, personnel, and contracts were worked out during the month of December. During that month a large part of the time of the Commission was devoted to these matters.

At that time Manhattan District had more than 5,000 direct employees, military and civilian. The contractors for the district who were operating its installations had more than 50,000 employees in that work. A major problem that had to be solved related to the

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fiscal and disbursing arrangements necessary to avoid any interruption in work when the transfer occurred. In cooperation with the War Department, the Department of the Treasury, the Bureau of the Budget, and the General Accounting Office, arrangements were made for the allocation of appropriations to the Commission under Public Law 663, and fiscal and disbursing procedures were established to assure continuity in operations. Through consultation with the War Department, the Department of the Navy, and the Military Liaison Committee, arrangements were perfected to make certain that those operations and functions essentially military in character should remain under military jurisdiction.

Arrangements also had to be made for the retention of military personnel in actual Commission operations during the transition period; procedures had to be worked out in consultation with the Federal Bureau of Investigation with a view to obtaining the FBI investigations required by section 10 of the act at the earliest feasible date; and numerous other matters connected with the transfer, and in which other Government agencies were concerned in one way or another, had to be dealt with.

It is a measure of the cooperative spirit in which all these problems were approached by the various Government agencies that the Executive order and other formal documents covering the transfer were executed and the actual transfer completed on January 1, on a mutually satisfactory basis and without any interruption in continuity of operations.

GOVERNMENT-OWNED FACILITIES

The principal Government-owned atomic energy installations transferred from Manhattan District and now under the jurisdiction of the Commission are:

1. Clinton Engineer Works, Oak Ridge, Tenn., a 59,000-acre reservation, the site of the Manhattan District administrative headquarters and of the following production and research units:

(*a*) Electro-magnetic plant for the separation of U–235, operated by Tennessee Eastman Corp.

(*b*) Gaseous diffusion plant for the separation of U–235, operated by Carbide & Carbon Chemicals Corp.

(*c*) Thermal diffusion plant for the separation of U–235, not in operation.

(*d*) Clinton Laboratories for general nuclear research, operated by Monsanto Chemical Co.

2. Hanford Engineer Works, Pasco, Wash., a reservation of nearly 400,000 acres owned or controlled by the Government, site of plutonium production plants and of research and development facilities, now operated by General Electric Co.

3. Los Alamos Laboratory, at Los Alamos, N. Mex., a 45,000-acre reservation, site of a research installation principally for the military applications of atomic energy and operated under contract with the University of California.

4. Argonne National Laboratory, at Chicago, Ill., successor to the metallurgical laboratory, now housed in part on the campus of the University of Chicago, which is contractor for administration. The board of governors for this laboratory is composed of representatives of 25 midwestern universities and research institutions.

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5. Radiation Laboratory of the University of California at Berkeley (not a Government-owned facility—except for certain buildings and equipment).

6. Brookhaven National Laboratory, Patchogue, Long Island, now under construction on the site of Camp Upton, a general atomic research center to be operated by Associated Universities, Inc., representing nine major eastern universities with the collaboration of other colleges and universities in the region.

7. Knolls Atomic Power Laboratory, Schenectady, N. Y., a research center for development of useful power from atomic energy, now under construction and to be operated by General Electric Co. Under arrangements made by the Commission, provision has been made for participation of interested segments of the national economy.

The Commission plans immediately to consult with representatives of interested American industries in such fields as utilities, electrical manufacturing, chemicals, and others, in order to assure broad participation by private enterprise in its research and development program, looking toward the industrial applications of atomic energy.

8. Dayton Engineer Works near Miamisburg, Ohio, a research and development facility now under construction and to be operated by Monsanto Chemical Co.

In addition, activities contributing directly to the operations transferred to the Commission are carried on in a large number of other facilities. A partial list of the extensive research and development contracts includes those held by Battelle Memorial Institute, Columbus, Ohio; Columbia University, New York; Iowa State College, Ames, Iowa; Massachusetts Institute of Technology, Cambridge, Mass.; National Bureau of Standards, Washington, D. C.; United States Geological Survey, Washington, D. C.; University of Rochester, Rochester, N. Y.; University of Washington, Seattle, Wash.; Victoreen Instrument Co., Chicago, Ill.; and Washington University, St. Louis, Mo.

MAJOR PROGRAMS IN EFFECT

The following principal programs, which had been initiated by Manhattan District, were transferred to the Commission:

1. The production of fissionable materials.

2. The declassification of atomic energy data, to the extent consistent with security, carried out on the basis of recommendations of a committee headed by Dr. Richard C. Tolman.

3. The production and distribution of radioactive isotopes, started by Manhattan District during the summer of 1946. Upon recommendations of an advisory committee appointed by General Groves, radioactive isotopes have been distributed to qualified institutions capable of observing the necessary health and safety precautions.

4. A broad program for the production of electric power from nuclear fuels, initiated by Manhattan District, with Monsanto Chemical Co. and General Electric Co. as prime contractors. A large number of industrial and research organizations are participating in this program, and a summary review of the status of the work was recently published by Manhattan District.

5. Studies of the possibility of applying nuclear energy to aircraft propulsion, being made under contract between the Army Air Forces and Fairchild Engine & Airplane Corp. as prime contractor. Through

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arrangements made with Manhattan District, space and technical services have been made available at Oak Ridge for the staff assigned to these studies by the Air Forces and the contractors.

6. A comprehensive accident prevention and health program, in effect throughout all facilities. Care has been taken to safeguard personnel against injury from radiation exposure and other hazards, and reports indicate that the program has been effective.

7. Broad research programs in the fields of health and biology, under way at Argonne National Laboratory, Los Alamos Laboratory, and at Clinton Engineer Works, in cooperation with the United States Institute of Public Health.

8. Training programs for the instruction of personnel in the handling of radioactive materials, in effect at Argonne National Laboratory, the Radiation Laboratory, and Clinton Laboratories.

9. The compilation of scientific developments resulting from the work of Manhattan District.

10. Research programs too numerous to list, many of which are classified secret, under way in both Government and non-Government facilities. These programs include the physics of reactors, development of materials for construction of reactors, metallurgy, radioactive isotopes, production processes, fundamental nuclear physics, ceramics, radiobiology, various types of instruments, and health measures.

DEVELOPMENT OF ORGANIZATION

The Commission took steps to maintain as a going concern the organization transferred from Manhattan District. Col. K. D. Nichols, district engineer, was appointed Acting Deputy General Manager of the Commission. Colonel Nichols and all other personnel transferred from Manhattan District were instructed by the Commission to continue to perform their functions in the manner in which they had performed them under Manhattan District. The Commission thus made certain at the outset that there should be no interruption or loss of continuity in operations. At the request of the Commission, General Groves has consented to act as a consultant to the Commission.

The act provides for the appointment by the President from civilian life of nine members of a General Advisory Committee to advise the Commission on scientific and technical matters relating to materials, production, and research and development. The President had appointed the following members of the General Advisory Committee on December 12, 1946:

Dr. James B. Conant, president of Harvard University.
Dr. Lee A. DuBridge, president of California Institute of Technology.
Prof. Enrico Fermi, University of Chicago.
Dr. J. Robert Oppenheimer, University of California.
Prof. I. I. Rabi, Columbia University.
Mr. Hartley Rowe, chief engineer of United Fruit Co.
Prof. Glenn T. Seaborg, University of California.
Prof. Cyril S. Smith, University of Chicago.
Mr. Hood Worthington, chief chemist of E. I. du Pont de Nemours & Co.

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At the request of the Chairman of the Commission, the General Advisory Committee held its first meeting on January 3 and 4, 1947, for the purpose of organizing its work and determining the methods whereby it might assist and advise the Commission. The committee designated Dr. J. Robert Oppenheimer as chairman. The Commission has arranged to furnish for review by the General Advisory Committee a statement of the Commission's research and development, production, and materials programs. A report on research and development programs will be available for the next meeting of the committee, February 2 and 3, 1947. Subsequent meetings of the General Advisory Committee are now planned at 2-month intervals.

Before making a recommendation to the President, pursuant to section 2 (a) (4) (A) of the act, with respect to the appointment of a General Manager, the Commission sought the advice of the following advisory group:

Karl T. Compton (president, Massachusetts Institute of Technology).

Herbert Emmerich (director of public administration, clearing house).

Georges Doriot (professor, Harvard School of Business).

John Lord O'Brian, attorney (former general counsel, War Production Board).

After a review of the qualifications of a large number of individuals, this group submitted the names of several individuals, including Carroll L. Wilson, whom the group considered to be exceptionally qualified for this position. After careful consideration of these men, the Commission unanimously recommended to the President the appointment of Mr. Wilson. The President named Mr. Wilson as General Manager on December 30, 1946.

A great deal of careful consideration has been given to the form of organization best adapted to suit the purposes of the Commission and, in particular, to the functions of the four divisions of research, military application, production, and engineering provided for by section 2 (a) (4) (B) of the act. The Commission has concluded that these four divisions should be staff divisions responsible for planning, review, and evaluation of the work of the Commission under these broad functional categories.

Under this concept of organization, the Division of Military Application assumes a far more important position in relation to the entire program of the Commission than would be the case if it were merely a line operating division concerned with direct supervision of such portions of the Commission's operations as might be identified as primarily relating to military applications. The Division of Military Application will be concerned with the broad and complicated interrelationships between military planning and the research, development, and production programs of the Commission.

In view of the great responsibilities placed upon the Commission by the act, that its operation shall be conducted always with the paramount objective of assuring the common defense and security, the Commission has given most careful consideration to the essential qualifications for the officer who shall be the Director of the Division of Military Application. The Commission has discussed its views of the qualifications for such officer with the Secretaries of War and the Navy and have asked them to submit the names of the best-qualified

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officers in their respective services. The Commission has under consideration a small group of exceptionally qualified officers who have been so recommended and expects to make the appointment in the near future.

As Director of the Division of Research, the Commission has appointed Dr. James B. Fisk, formerly assistant director of physical research at the Bell Telephone Laboratories and recently appointed professor of applied physics at Harvard University. Dr. Fisk was recommended to the Commission by a subcommittee of the General Advisory Committee, appointed for the specific purpose of making recommendations for this position.

As Director of the Division of Production, the Commission has appointed Mr. Walter J. Williams, former Director of Operations at Oak Ridge for Manhattan District and recently appointed Manager of Field Operations of the Commission.

The appointment of the Director of the Division of Engineering will be announced later by the Commission. A five-man advisory panel, recommended by the General Advisory Committee, has been requested to make recommendations for this position.

The Commission has made appointments to some other key staff positions. These include the Director of Organization and Personnel, Mr. G. Lyle Belsley, who was formerly Assistant Administrator of the National Housing Agency and executive secretary of the War Production Board; and the general counsel, Mr. Herbert S. Marks, who was formerly special assistant to Under Secretary of State Dean Acheson.

THE MILITARY LIAISON COMMITTEE

Pursuant to section 2 (c) of the act, the Secretary of War and the Secretary of the Navy have designated the following representatives of their Departments as members of the Military Liaison Committee:

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

Informal contact between members of the Commission and the Military Liaison Committee was established prior to the Commission's first meeting. Since the Commission's inspection tour of the Manhattan District installations, the Commission has met with the Military Liaison Committee, and there have been frequent contacts between the staff of the Commission and the committee. Discussions have centered around problems of organization, procedure, the development of close liaison, and working relationships. The committee was consulted in the preparation of the various papers and in the working out of the various arrangements covering the transfer of the Manhattan District to the Commission. Matters now under joint consideration by the Commission and the Military Liaison Committee include production of fissionable materials, security problems, research programs, relations with the General Advisory Committee, and relations with the Joint Research and Development Board, which is under the chairmanship of Dr. Vannevar Bush.

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MAINTENANCE OF SECURITY

The Commission has maintained in full force the security measures of Manhattan District and has under consideration the adequacy of those measures in terms of the requirements of national defense and of the act.

The Commission has met with the Attorney General and with the Federal Bureau of Investigation for the purpose of establishing procedures for the investigation of personnel and of security violations.

The Commission has been able to obtain the services of Mr. Frank J. Wilson, Chief of Secret Service, until December 31, 1946, as consultant on security policies and problems.

The Commission also has obtained the services of Mr. Thomas O. Jones as special assistant for security to the General Manager. Mr. Jones was formerly an officer assigned to the Manhattan District. He served as security officer at the Los Alamos installation and was designated by General Groves as the security officer at the Bikini tests.

PRODUCTION OF FISSIONABLE MATERIALS AND ATOMIC WEAPONS

The production operations which Manhattan district had under way at the time of the transfer are being continued. Much of the information relating to the production of fissionable materials and atomic weapons vitally concerns the common defense and security. This information received the highest security classification by Manhattan District, and that classification has been continued by the Commission.

The primary application of atomic energy is today in the production of weapons. These weapons require fissionable material of considerable purity, and this requirement was the main reason for the construction of the installations at Oak Ridge and Hanford. Fissionable material also is necessary for the development of many of the peacetime applications of atomic energy. In addition, the basic raw material—uranium—is the same either for weapon production or for the peacetime applications. There is accordingly a very deep and basic relation between weapons and the peacetime uses of atomic energy. The long-range security of the Nation may very well depend closely upon the wise and speedy development of the applications of atomic energy. Research and development work on improved atomic weapons is in progress at installations now operated by the Commission.

In December General Groves informed the Commission that improvements in the processes for the separation of uranium 235 at Oak Ridge would permit considerable savings in operating costs and result in substantial reduction in the number of employees required at one of the Oak Ridge plants. After careful study of a report from Colonel Nichols, the district engineer, the Commission concurred in the necessary operating changes. Every effort is being made by the Commission to assure the retention of key personnel whose jobs have been discontinued as a result of the operating change.

RESEARCH AND DEVELOPMENT PROGRAMS

A comprehensive report on the status of research and development programs was initiated by the Commission. For this purpose the Commission called a meeting in January of laboratory directors,

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representing Argonne National Laboratory, Brookhaven National Laboratory, the University of California, Clinton Laboratories, General Electric Co., Iowa State University, and Los Alamos Laboratory. The reports prepared by these laboratory directors will furnish a basis for recommendations by the Director of the Division of Research and by the General Advisory Committee and will enable the Commission to plan and evaluate research and development projects. Meanwhile, a number of specific administrative decisions have been made by the Commission in order to assure continuance of programs initiated by Manhattan District pending thorough review by the Commission.

SOURCE MATERIALS

The Commission has under consideration a plan for the control of source materials, as provided by the act. Meanwhile, the wartime control over uranium exercised by the War Production Board is being continued by the Office of Temporary Controls.

An important phase of the Commission's programs will be the development of new sources of uranium and thorium. The Commission has met with Secretary Krug and other representatives of the Department of the Interior for the purpose of considering how best the services of the United States Geological Survey may continue to be employed in this field and for the purpose of discussing other ways in which the Department of the Interior and the Commission might cooperate.

HEALTH AND MEDICAL PROGRAM

A medical committee, under the chairmanship of Dr. Stafford L. Warren, was appointed by General Groves to advise Manhattan District on health and medical problems. The committee consisted of representatives of laboratories and other installations holding contracts with Manhattan District. The Commission called a meeting of this medical committee in January with a view to the preparation of a report on the status of health and medical programs. It is expected that a report will be available to the Commission shortly.

LABOR RELATIONS

During the interval between VJ-day and transfer of the activities of Manhattan District to the Commission, elections were held by the employees of the principal contractors at Oak Ridge. The employees of Carbide & Carbon Chemical Corp. are now represented by a CIO union and the employees of Monsanto Chemical Co. by an A. F. of L. affiliate. Labor contracts, negotiated by these companies and their respective unions, had been presented to Manhattan District for approval. At the request of the Commission, the contracts were examined by an advisory board consisting of David A. Morse, Assistant Secretary of Labor; George H. Taylor, former chairman of the War Labor Board and a member of the faculty of the Wharton School, University of Pennsylvania; and Lloyd K. Garrison, former general counsel and later chairman of the War Labor Board. Pursuant to the recommendations of this advisory board, the Commission approved execution of the contracts subject to further consideration of those clauses affecting security and continuity of work.

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PATENTS

The Commission has appointed Casper W. Ooms, Commissioner of Patents; William H. Davis, chairman of the Department of Commerce Patent Survey Committee; and John A. Diener, former president of American Patent Law Association, as an advisory panel to recommend to the Commission policies, procedures, and staff organization for the effectuation of the patent provisions of the act (sec. 11). Following a report and recommendations by this advisory panel, the Commission expects to appoint a Patent Compensation Board as required by the act and to institute appropriate patent regulations and procedures.

BUDGET AND FISCAL PROGRAM

The Commission has submitted to the House Appropriations Committee a full statement of the transfer to the Commission of War Department funds for the Manhattan project and a budget justification of appropriation requests for the fiscal year 1948. Pursuant to Public Law 663, the President has withdrawn $506,000,000 from the War Department accounts for the Manhattan project, of which $5,000,000 has been allocated to the Federal Bureau of Investigation and the balance to the Commission. Of the $501,000,000 allocated to the Commission, $263,991,000 was immediately obligated to cover contract and other obligations transferred to the Commission.

The President's budget for the fiscal year 1948 includes $250,000,000 for Commission expenditures and $250,000,000 for Commission contract authorizations. In estimating its requirements, the Commission has necessarily, because of the short time available, relied largely on the experience and estimates of Manhattan District. The Commission is proceeding with the development of its own financial and budgetary plans and estimates as a matter of primary importance. In its next report it will be in a position, therefore, to discuss these matters more fully.

ACCOUNTING CONTROL

One of the important problems confronting the Commission relates to the setting up of measures of accounting control that will be consistent with the requirements of a Government undertaking and at the same time adapted to the special character of the Commission's enterprises. Because of the novelty and difficulty of many of the questions involved, the Commission has sought the advice of leading experts in this field with respect to the choice of a comptroller. The following panel was established to advise the Commission in this matter:

Mr. Edward B. Wilcox, partner, Edward Gore & Co. (Chicago); president, American Institute of Accounts.

Mr. Walter L. Schaffer, partner, Lybrand, Ross Bros. & Montgomery (New York).

Mr. Paul Grady, partner, Price, Waterhouse & Co. (New York).

Mr. Donald Stone, Assistant Director in charge of Administrative Management, Bureau of the Budget.

Prof. W. Arnold Hosmer, professor of accounting, Harvard Graduate School of Business Administration.

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This group has met with the entire Commission and the General Manager and has held a number of meetings with the Commission's staff. It is expected that as a result of the work of this group the Commission will shortly be in a position to appoint a comptroller and to initiate the work that needs to be done in order to set up a constructive system of accounting controls.

RELATIONS TO WORK OF UNITED NATIONS ATOMIC ENERGY COMMISSION

On October 28, 1946, the day the President named the members of the Commission, the Commission called upon the Secretary of State, Mr. Byrnes, and Under Secretary Acheson, to discuss in a preliminary way the relations of the Commission to the responsibilities of the State Department and to establish liaison.

On October 30 the Chairman of the Commission called upon Mr. Bernard Baruch and his associates of the American delegation to the United Nations Atomic Energy Commission at their office in New York City. On behalf of the Commission Mr. Lilienthal stated the Commission's desire to cooperate with Mr. Baruch in whatever ways might appear helpful to him in his great responsibility. Informal liaison was established thorugh the services of Joseph Volpe, Jr., formerly consultant to Mr. Baruch and now a deputy general counsel of the Commission, and technical liaison was established through Dr. R. C. Tolman, head of the American delegation's Technical Advisory Committee. A number of informal communications and consultations have followed. The Commission has assured Senator Warren R. Austin, Mr. Baruch's successor as American representative, of its desire to cooperate with him in whatever ways he finds may be helpful.

LEGISLATION

Section 17 of the act, which directs the Commission to submit to the Congress, in January and July of each year, a report concerning the activities of the Commission, also provides that—

> The Commission shall include in such report, and shall at such other times as it deems desirable submit to the Congress, such recommendations for additional legislation as the Commission deems necessary or desirable.

The Manhattan district operated during its existence largely upon the wartime powers of the President. A comprehensive review of the arrangements made under these wartime powers is currently under way in order to fit them into a pattern for peacetime operation under the act. The Commission has not yet had an opportunity to determine whether additional legislation is required.

Dated January 31, 1947.

DAVID E. LILIENTHAL, *Chairman.*
ROBERT F. BACHER.
SUMNER T. PIKE.
LEWIS L. STRAUSS.
WILLIAM W. WAYMACK.

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EXHIBIT A

EXECUTIVE ORDER NO. 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,

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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 non-agreement, 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.

HARRY S. TRUMAN.

THE WHITE HOUSE, *December 31, 1946.*

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[PUBLIC LAW 898—80TH CONGRESS]

[CHAPTER 828—2D SESSION]

[H. R. 6402]

AN ACT

To provide for extension of the terms of office of the present members of the Atomic Energy Commission.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That section 2 (a) (2) of the Atomic Energy Act of 1946 is amended to read as follows:

"(2) Members of the Commission shall be appointed by the President, by and with the advice and consent of the Senate. In submitting any nomination to the Senate, the President shall set forth the experience and the qualifications of the nominee. The term of office of each member of the Commission taking office prior to June 30, 1950, shall expire at midnight on June 30, 1950. The term of office of each member of the Commission taking office after June 30, 1950, shall be five years, except that (A) the terms of office of the members first taking office after June 30, 1950, shall expire, as designated by the President at the time of the appointment, one at the end of one year, one at the end of two years, one at the end of three years, one at the end of four years, and one at the end of five years, after June 30, 1950; and (B) any member appointed to fill a vacancy, occurring prior to the expiration of the term for which his predecessor was appointed, shall be appointed for the remainder of such term. Any member of the Commission may be removed by the President for inefficiency, neglect of duty, or malfeasance in office. Each member, except the Chairman, shall receive compensation at the rate of $15,000 per annum; and the Chairman shall receive compensation at the rate of $17,500 per annum. No member of the Commission shall engage in any other business, vocation, or employment than that of serving as a member of the Commission."

Approved July 3, 1948.

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C/A, p. 6

80TH CONGRESS, 2d Session } SENATE { REPORT No. 850

DEVELOPMENT AND CONTROL OF ATOMIC ENERGY

JANUARY 30 (legislative day, JANUARY 26), 1948.—Ordered to be printed

Mr. HICKENLOOPER, from the Joint Committee on Atomic Energy, submitted the following

REPORT

[Pursuant to Public Law 585, 79th Cong.]

FIRST REPORT OF THE JOINT COMMITTEE ON ATOMIC ENERGY TO THE CONGRESS OF THE UNITED STATES

This report is submitted to the Congress by the Joint Committee on Atomic Energy in order to give the Members of Congress a brief outline of the general fields of activity of the joint committee from the time of its active organization, to date. The Atomic Energy Act of 1946 imposes strict injunctions of secrecy against revealing details or other information falling within the classification of restricted data and in order that these legal prohibitions be observed, it will be necessary to make this report in general terms.

Section 15 (b) of the Atomic Energy Act of 1946 (Public Law 585, 79th Cong.), among other provisions, states:

> The joint committee shall make continuing studies of the activities of the Atomic Energy Commission and of problems relating to the development, use, and control of atomic energy.

HISTORY OF THE ACT

Shortly after the first military use of the atomic bomb in August 1945, a number of proposals for exercise of control over the production, use, and development of atomic energy were introduced in both Houses of Congress. On October 3, 1945, the President sent a message to the Congress stressing the necessity of legislation. On October 29 the Senate adopted Senate Resolution 179 establishing the Special Committee on Atomic Energy, and all bills concerning atomic energy introduced in the Senate were referred to this committee. Bills concerning atomic energy introduced in the House were referred to the Military Affairs Committee. Both committees held open and executive hearings, receiving the testimony of a large number of witnesses in the scientific, technical, military, business, and Government fields.

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Following weeks of discussion in the Senate special committee, S. 1717, introduced by Senator McMahon, chairman, was reported back to the Senate on April 19, 1946, as amended in committee. On June 1 the bill was passed by the Senate and was referred to the House Military Affairs Committee. After a number of amendments, this committee reported H. R. 5364 (S. 1717, as amended), which passed the House of Representatives on July 20 and went to conference. Here the bill was agreed upon in its final form and the conference report was accepted by both Houses on July 26. With the affixing of the President's signature on August 1, 1946, Public Law 585 came into force and effect.

With the enactment of this law, it was declared to be the policy of the people of the United States that—

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

Following the effective date of the act, the President, on October 28, 1946, announced the recess appointments of the members of the Atomic Energy Commission as follows:

David E. Lilienthal, Chairman
Robert F. Bacher
Sumner T. Pike
Lewis L. Strauss
William W. Waymack

These appointees took their oaths of office and assumed their duties on November 1, 1946, and it was directed by the President in Executive Order 9816 that title to the properties of the Manhattan engineer district be transferred to the Atomic Energy Commission effective midnight, December 31, 1946, and this was done.

On December 12, 1946, the President appointed, as provided by the act, members of the General Advisory Committee, as follows:

Dr. James B. Conant, president of Harvard University
Dr. Lee A. DuBridge, president of California Institute of Technology
Dr. J. Robert Oppenheimer, University of California
Dr. Enrico Fermi, University of Chicago.
Dr. I. I. Rabi, Columbia University
Mr. Hartley Rowe, chief engineer of United Fruit Co.
Dr. Glenn T. Seaborg, University of California
Dr. Cyril S. Smith, University of Chicago
Mr. Hood Worthington, chief chemist of E. I. du Pont de Nemours & Co.

These appointments are not subject to Senate confirmation.

Thereafter, on January 4, 1947, Dr. J. R. Oppenheimer was named chairman of this General Advisory Committee.

On December 30, 1946, the President announced the recess appointment of Carroll L. Wilson to be general manager of the Commission, subject to Senate confirmation. The announcement of this appointment completed the Presidential appointees provided for in the act who are subject to Senate confirmation.

Pursuant to section 2 (c) of the act, the Secretary of War and the Secretary of Navy appointed, as representatives of their respective Departments, members of the Military Liaison Committee, as follows:

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Lt. Gen. Lewis H. Brereton, United States Army, Chairman
Maj. Gen. Lunsford E. Oliver, United States Army
Col. John H. Hinds, United States Army
Rear Adm. Thorvald A. Solberg, United States Navy
Rear Adm. Ralph A. Ofstie, United States Navy
Rear Adm. William S. Parsons, United States Navy

On January 31, 1947, Maj. Gen. Lunsford E. Oliver was reassigned and Lt. Gen. Leslie R. Groves was appointed to this vacancy.

On August 2, 1946, the day of adjournment of the Seventy-ninth Congress, second session, the Joint Committee on Atomic Energy, as provided by the act, was appointed as follows:

By the President pro tempore of the Senate, Mr. McKellar, on the part of the Senate:

Mr. Brien McMahon, of Connecticut
Mr. Richard B. Russell, of Georgia
Mr. Edwin C. Johnson, of Colorado
Mr. Tom Connally, of Texas
Mr. Harry F. Byrd, of Virginia
Mr. Arthur H. Vandenberg, of Michigan
Mr. Eugene D. Millikin, of Colorado
Mr. Bourke B. Hickenlooper, of Iowa
Mr. William F. Knowland, of California

By the Speaker of the House, Mr. Rayburn, on the part of the House of Representatives:

Mr. R. Ewing Thomason, of Texas
Mr. Carl T. Durham, of North Carolina
Mr. Aime J. Forand, of Rhode Island
Mr. Chet Holifield, of California
Mr. Melvin Price, of Illinois
Mr. Charles H. Elston, of Ohio
Mr. J. Parnell Thomas, of New Jersey
Mr. Carl Hinshaw, of California
Mrs. Clare Boothe Luce, of Connecticut

This joint committee organized on August 2, 1946, and Senator McMahon was elected chairman and Representative Thomason, vice chairman.

On January 20, 1947, after the commencing of the Eightieth Congress, the Joint Committee on Atomic Energy was appointed as follows:

Mr. Bourke B. Hickenlooper, of Iowa
Mr. Arthur H. Vandenberg, of Michigan
Mr. Eugene D. Millikin, of Colorado
Mr. William F. Knowland, of California
Mr. John W. Bricker, of Ohio
Mr. Brien McMahon, of Connecticut
Mr. Richard B. Russell, of Georgia
Mr. Edwin C. Johnson, of Colorado
Mr. Tom Connally, of Texas

By the Speaker of the House of Representatives, Mr. Martin, on the part of the House of Representatives:

Mr. W. Sterling Cole, of New York
Mr. Charles H. Elston, of Ohio
Mr. Carl Hinshaw, of California
Mr. James E. Van Zandt, of Pennsylvania
Mr. James T. Patterson, of Connecticut
Mr. R. Ewing Thomason, of Texas
Mr. Carl T. Durham, of North Carolina
Mr. Chet Holifield, of California
Mr. Melvin Price, of Illinois

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The first meeting of the joint committee was held on January 21, 1947, at which time Senator Hickenlooper was elected chairman and Representative Cole, vice chairman. Later, upon his appointment to the Federal district court, Representative Thomason resigned from the House of Representatives and Representative Lyndon B. Johnson, of Texas, was appointed by the Speaker to succeed him on the joint committee.

The Presidential nominations for the members of the Commission and the general manager were referred to the Senate section of the joint committee on January 20, 1947. Hearings on these nominations were conducted by the Senate section of the joint committee over the period from January 27 through March 4, 1947, and consisted of 32 public sessions and 6 executive sessions. Fifty-five witnesses were heard and interrogated, including all of the nominees, and the committee afforded full opportunity to other Members of the Senate who were not members of the committee to request witnesses, to question witnesses, and to participate in the hearings.

At the conclusion of the hearings, the committee voted to and did recommend to the Senate that the Senate advise and consent to the appointment of all of the nominees and on April 9, 1947, they were confirmed by the Senate. Under the provisions of the act, the terms of the Commissioners will expire 2 years after August 1, 1946, which was the effective date of the act. The terms of each member of the Commission will eventually be 5 years, but the terms of the members appointed in 1948, when all present terms expire, are as follows: One Commissioner to be appointed for a period of 1 year; one Commissioner for a period of 2 years; one Commissioner for a period of 3 years; one Commissioner for a period of 4 years; and one Commissioner for a period of 5 years. Each of these terms expires on August 1 of the year in which the respective term ends, and as each term expires, an appointment for that position is to be made for a period of 5 years.

ACTIVITIES OF THE JOINT COMMITTEE

Section 15 of the Atomic Energy Act of 1946, among other provisions, defines the activities of the Joint Committee as follows:

> The joint committee shall make continuing studies of the activities of the Atomic Energy Commission and of problems relating to the development, use, and control of atomic energy. The Commission shall keep the joint committee fully and currently informed with respect to the Commission's activities. All bills, resolutions, and other matters in the Senate or the House of Representatives relating primarily to the Commission or to the development, use, or control of atomic energy shall be referred to the joint committee.

It also provides:

> The committee is authorized to utilize the services, information, facilities, and personnel of the departments and establishments of the Government.

Fully aware that the field of atomic energy is of vast significance to the people of the United States and of the world, and conscious of the unprecedented problems created by this revolutionary development of science, the committee members undertook, as their first activity, the task of familiarizing themselves with the general nature of this new field. It seemed axiomatic that there must be general comprehension of the nature of this complex subject before the committee could undertake to evaluate the activities of the Commission or to make future recommendations to the Congress.

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Immediately subsequent to the confirmation of the Commissioners and the general manager, the joint committee began a program of consultations and executive hearings with the Atomic Energy Commission and with other departments and agencies of the Government that have varying degrees of responsibility in the program. These meetings have been held frequently and for the purpose of acquainting the committee with the operation of the program and policies of the Commission and to keep the committee informed with respect to the efficiency of the integration of the various activities and responsibilities of all departments and agencies of the Government in the advancement of the research and development of atomic energy in this country. These inquiries have, in general and in varying degrees of detail, covered the fields of over-all objectives, physical plant, security, production, personnel, materials, town management, labor, international objectives, health and biological programs, raw materials, weapons, industrial and agricultural prospects, military application, and other matters incident to these general fields.

Beginning with the organization of the committee, the selection of a staff was commenced. This staff now numbers 16 people and is set up under an Executive Director, a Deputy Director, and 4 sections—Information, Production, Security, and Development. Five members of the staff spend a substantial portion of their time visiting the various installations for inspection of activities coming within their particular fields, and they, together with other members of the staff, keep in constant touch with the Atomic Energy Commission through its headquarters staff. A constant liaison and flow of information from the field and the headquarters is maintained, designed to keep the joint committee "currently and fully informed." In addition, the committee maintains continuous liaison with the atomic energy representation of the United States at the United Nations headquarters, with one member of the staff in continuous assignment there.

It should be stated at this point that the joint committee does not attempt to pass judgment on specialized scientific or technical procedures involved in the program. The committee represents the legislative branch of the Government and is not equipped to be an authority in highly specialized fields of research or technology. Moreover, the committee has not assumed the responsibilities for administrative policies that are clearly vested in the Atomic Energy Commission under the act, but is attempting to gain as much information and knowledge from an over-all standpoint as will enable the committee to recommend, from time to time, any legislation that may be desirable and to keep abreast of the potentially changing needs and requirements of a tremendous program, that, without doubt, is still in its infancy.

Following numerous hearings and consultations by the committee between April and the 1st of August 1947, most of the committee members undertook inspection trips to the major physical installations of the Commission, such as those at Oak Ridge, Los Alamos, the radiation laboratory at Berkeley, the Hanford Works, the Argonne National Laboratory at Chicago, and some other installations. These inspections by committee members, based upon a background of information previously developed by studies, are invaluable in creating a more comprehensive understanding of the project and a first-hand

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view of the physical properties and the objectives and progress of this development.

The value of these inspection trips has proven itself in many ways. The sheer size and complexity of the plants and the diversity of the laboratory activities cannot be comprehended without personal observation. Information secured on these trips has helped provide the committee with factual background against which to evaluate progress. Many opportunities to acquire information and make independent appraisal of specific activities presented themselves. Such personal observation and inquiry provide an important means for independent judgment which the committee feels is essential to the fulfillment of its duties under the act.

Close liaison with key personnel of the Commission also has been maintained through continuous contact by the committee staff members with the Commission headquarters in Washington. Numerous conferences have been held with the chiefs of the statutory divisions, other division heads, and with personnel at varying levels within the organization, both in Washington and in the field. Periodic reports of these activities are made to the committee which keep the constantly developing picture available to its members.

The joint committee has also been aware of the importance of keeping fully informed of the progress of international purposes and plans for the control of atomic energy. For the achievement of this purpose, the committee maintains a staff representative at the United Nations who acts in the capacity of unofficial observer for the committee at the meetings of the United Nations Atomic Energy Commission. Studies have been made of the various proposals for international control, the working papers of the subcommittees and the progress of the negotiations. In this connection, the committee has also heard reports from the Under Secretary of State and the deputy American delegate to the United Nations Atomic Energy Commission.

Besides the information which comes to the committee directly from personal inspections and conferences, from the Commission and from its own staff, committee members have examined and considered a vast quantity of information obtained from other sources. Staff members have carried on a continuous program of research, compilation, and analysis of unclassified information relating to scientific development, practical applications, international negotiations, and activities in foreign countries. This has made it possible for the committee to continue its educative program as well as to carry out the directive of the Atomic Energy Act to—

> make continuing studies * * * of problems relating to the development, use, and control of atomic energy.

Much information of a classified nature, especially information relating to security, production, and military matters, has been presented to the committee in executive session. In addition to the Chairman and the Commissioners of the Atomic Energy Commission, witnesses appearing before the committee in executive session, have included the general manager of the Commission, and his principle technical aides; the general counsel; the Director of Security; Secretary of National Defense; Under Secretary of State Lovett; former Under Secretary of State Acheson; Dr. Frederick H. Osborn, deputy delegate to the United Nations; the Joint Chiefs of Staff; members of the Military Liaison Committee; the Director of the Central Intelli-

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gence Agency; Gen. Leslie R. Groves, Chief of the Armed Forces Special Weapons Project; Dr. Vannevar Bush, Director of the Research and Development Board; and Harry A. Winne, vice president in charge of engineering of the General Electric Co. Further meetings will be held periodically with these and other persons.

It is the considered conviction of the committee that, until such time as an effective, enforceable and reliable program for the international control of atomic energy is in successful operation, the most vital business of the Atomic Energy Commission must be the meeting of the atomic requirements of national defense. Executive and administrative responsibility for adequately meeting these requirements is combined by law in the President, the Department of National Defense, and the Atomic Energy Commission.

The joint committee has been assured that those charged with these responsibilities are keenly aware thereof. This phase of the atomic energy program is of paramount and continuing interest to the joint committee and the committee considers that continuous knowledge and reassurance of the adequate discharge of these responsibilities is fundamentally necessary to its reliable evaluation of the general success of our program.

The concern which large segments of the public, the press, and Members of Congress have shown for the security of our atomic energy program, is shared most actively by the members of the joint committee.

The joint committee is informing itself as completely as possible on all phases of the vital problem of maintaining security in the whole field of atomic energy. The scope and ramifications of the security responsibility which faces the Atomic Energy Commission are tremendous. Clearance for employment of thousands of persons, physical protection of numerous plants, adequate safeguarding of production, as well as accounting for and protection of millions of restricted documents, are major problems of the security program.

Numerous visits have been made to the various facilities of the Commission for the specific purpose of observing the status of physical security at these installations. Such matters as physical protection afforded by fences and protective lighting; the qualifications, training, and efficiency of the guard force; the visitor control system; shipment security; document control; and the storage of restricted materials have been the subjects of intensive study.

The joint committee has reviewed the investigative files of the Atomic Energy Commission relative to the employees of the Commission and its contractors. In a number of these cases reviewed, certain questions were raised by the committee and the matters were discussed in detail with the Atomic Energy Commission and its security staff. (In certain of these cases, the committee has requested that the Commission outline in detail its security policy as applied to these specific instances. In the majority of these cases, the personnel involved had been employed during the time when the project was operated by the Manhattan engineer district.) The committee feels strongly that it must continue to follow closely, as it has in the past, the type of personnel engaged in the atomic energy program. To this end the committee staff will continue to conduct these studies of the personnel investigative files of the Atomic Energy Commission. It is the opinion of the committee that the matter of security of per-

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sonnel is of extreme importance in the over-all problem of the protection of the vital aspects of this important program.

The joint committee has been assured by the Atomic Energy Commission that it is vitally concerned with the problem of personnel security and has recently established a Review Board, headed by former Associate Justice Owen J. Roberts, to assist it in establishing standards and criteria with regard to the employment of personnel in this program. In this connection, the Commission is increasing its efforts to assure itself that there will be no weak links in the chain. The Commission is mindful of the importance of guarding against losses of security through weaknesses or disloyalty of personnel. The Canadian incident involving Dr. Allen Nunn May is ample warning to all of us of the consequences of relaxed vigilance.

The intent of the Congress with regard to security is clearly indicated in the terms of the Atomic Energy Act of 1946. The joint committee is convinced that the Atomic Energy Commission is devoting continuous attention to the responsibility of carrying out this intent. It has inaugurated programs designed to strengthen security and to further protect the vital phases of the project.

While recognizing that the Atomic Energy Commission is unique among Federal agencies, the committee, nevertheless, is aware of parallels, in many of the Commission's production activities, with major American industries such as petroleum refining, heavy chemical production, construction and power equipment manufacture. It is, therefore, the policy of the committee to apply certain criteria applicable to private industry as yardsticks in studying the operations of the Commission.

To this end, the joint committee has requested from the Atomic Energy Commission a statement of its major programs in terms of present accomplishment and long-range forecasts for future activities. While the difficulties of formulating and stating such programs against a background of currently changing events are acknowledged, the committee believes it is impossible to examine current activities, expenditures, and programs intelligently without possessing a clear-cut definition of the aims of the Commission in discharging their responsibilities under the Atomic Energy Act. The first report has been received and is being studied. Subsequent reports will be received on a quarterly basis.

Inquiries are made on such matters as production; construction; contractor performance; town management; personnel policy; power development; radioisotope sales; medical, biological, agricultural, and basic research; fiscal policy; stock piling; export licensing; health and safety standards; and national research laboratories.

The relative importance of each of the above, and other subjects, to the joint committee's activities varies, but every effort is being made to integrate the total information so as to compose a relatively complete picture of atomic-energy development today and in the months and years to come.

As a result of the threatened strike at Oak Ridge in November and December 1947 the joint committee has undertaken a thorough investigation of the important problem of a formula that will assure continuity of work in the atomic-energy program. The committee is unanimous in its conviction that the national security demands uninterrupted operation of the critical facilities of the Atomic Energy

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Commission. Of the several operating production plants of the Atomic Energy Commission, Oak Ridge is the only one where labor is organized and bargains collectively for the production workers involved. The threat of a strike posed serious potential results as a consequence of interruption in the flow of materials from a possible shutdown of facilities and pointed up sharply the necessity for such an investigation. The committee expects to continue with its investigation and to recommend such action as its conclusions may justify.

LEGISLATION

The committee has heretofore requested, and the request is in continuous effect, from the Atomic Energy Commission and from the Secretary of Defense, that any problems which they believe to exist or are reasonably foreseeable in the future, and which may require legislation or alteration of the act, be suggested to the committee from time to time for study and recommendation. At the time of filing this report, no such suggestions or recommendations have been received. It is the opinion of the committee that sufficient time has not yet elapsed to warrant any conclusions as to whether or not additional or supplemental major legislation will be needed in the program but constant attention is given at all times to this subject.

SUMMARY

The joint committee is a legislative committee which was created as a special servant of the Congress to follow this vast and complex program within the terms of the act. The joint committee does not at this time recommend to the Congress any major legislation affecting the policies or the philosophy of the act. As a legislative committee, it does not feel that it should at this time draw any final conclusions respecting the operation of this program or the administrative policies in effect. Sufficient time has not elapsed to warrant conclusions of this kind. This is not to be construed either as an attitude of hostility or an attitude of approval, but on the contrary expresses an attitude on the part of the committee to objectively evaluate the various phases of the program as a result of more mature opportunity.

The Nation is presently far ahead of any other nation in the over-all knowledge and development in the atomic-energy field, and the joint committee believes that we must continue to maintain our preeminence in this field in the future.

Respectfully submitted.

The JOINT COMMITTEE ON ATOMIC ENERGY,
BOURKE B. HICKENLOOPER, *Chairman.*
W. STERLING COLE, *Vice Chairman.*

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81st Congress, 1st Session — SENATE — Report No. 1169

INVESTIGATION INTO THE UNITED STATES ATOMIC ENERGY COMMISSION

REPORT

OF THE

JOINT COMMITTEE ON ATOMIC ENERGY

CREATED PURSUANT TO

PUBLIC LAW 585

SEVENTY-NINTH CONGRESS

October 13, 1949.—Ordered to be printed

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JOINT COMMITTEE ON ATOMIC ENERGY

(Created pursuant to Public Law 585, 79th Cong.)

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CARL T. DURHAM, North Carolina, *Vice Chairman*

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EDWIN C. JOHNSON, Colorado
TOM CONNALLY, Texas
MILLARD E. TYDINGS, Maryland
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HAROLD BERGMAN, *Deputy Director and Chief of Information*

WILLIAM J. BERGIN, *Editor*

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81st Congress } SENATE { Report
1st Session } { No. 1169

INVESTIGATION INTO THE UNITED STATES ATOMIC ENERGY COMMISSION

October 13, 1949.—Ordered to be printed

Mr. McMahon, from the Joint Committee on Atomic Energy, submitted the following

REPORT

Under the law, in the public interest, the Joint Committee on Atomic Energy has the responsibility of checking and watching the operations of the Atomic Energy Commission. Since atomic energy has been made a unique Federal monopoly which is in its earliest pioneering stages of development, and since it is extremely dynamic in character, this congressional responsibility is destined to be a continuous procedure. From time to time, therefore, the committee will make reports to the people.

Some months ago specific and serious charges were made against the Commission by a member of this committee. We have explored those charges fully and are now ready to report on them. However, out of these explorations other vital questions with respect to the conduct of the Commission have arisen which the committee intends to pursue without prejudice. At a later time we will report on them.

BACKGROUND

On Sunday, May 22, 1949, Senator Bourke B. Hickenlooper, ranking minority member of the Joint Committee on Atomic Energy and formerly its chairman, issued the following statement to the press:

> In the national interest, the time seems to have come for some plain talk about the Atomic Energy Commission. The Atomic Energy Commission is now staggering under daily disclosure of evidence of incredible mismanagement. The Joint Congressional Committee on Atomic Energy is about to begin a series of public hearings [on the AEC Fellowship program and the reported loss of some uranium at Argonne National Laboratory] which could turn into a carnival of confusion, so as a Senator who has devoted most of the last 3 years to this subject, I feel it my duty to speak plainly before major damage may be done to our atomic energy establishment and to the principal of civilian control.
>
> On the matter of the missing uranium, the facts are:
>
> 1. A container of about 9 or 10 ounces of uranium oxide enriched with 32 grams of uranium 235 was discovered missing at the Argonne National Laboratory,

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Chicago, on February 8, 1949. The AEC Chairman, David E. Lilienthal, has attempted to minimize this quantity. He has sneered at the Nation's "4-gram jitters." The truth is that for research in the field of weapon development, this is a vast quantity of this precious material. Dr. Allen May, the British scientist, drew a 10-year prison sentence for stealing one-thousandth of a gram of U-233; and we began building Hanford before we had as much as is still missing.

2. The AEC, in direct violation of its duty, did not notify the FBI of this loss until March 28, 1949. Mr. Lilienthal has declared that there was no suspicion of theft or espionage. This is completely untrue. The FBI was called in only because there was suspicion of theft and espionage, and though the trail was completely cold, the FBI made its investigation on the assumption of theft and espionage.

3. The AEC did not notify the chairman of the congressional committee until April 27, 1949, though the law requires that such notification be made immediately.

4. When this loss was reported publicly on May 17, 1949, by the New York Daily News, Mr. Lilienthal replied that the loss was trivial and that it was being partially recovered, from "waste."

There is no satisfactory evidence to support this claim. It is true that some U-235 is being recovered from waste—this is a process which goes on constantly—but there is no satisfactory evidence that what is being reclaimed is indeed from this missing parcel.

We have no conclusive evidence that a theft has been committed but neither do we have conclusive evidence that a theft has not been committed.

What makes this situation deeply disturbing to me and other colleagues is this: We have learned from the records that there are numerous persons employed on our atomic projects who have strong Communist leanings. We have urged Mr. Lilienthal to adopt a realistic attitude toward these dangerous persons but he has not been responsive to our urgings. And if two-thirds of a pound of uranium compound can disappear without either the FBI or the joint committee being notified for 6 weeks, how can a responsible Member of Congress have any confidence in Mr. Lilienthal's management?

In the matter of the fellowship program, the situation is this:

Tomorrow, Dr. Isidore S. Edelman, a 29-year-old scientist, will appear before the congressional committee to try to salvage his career. He is no doubt a brilliant young man and the publicity given him is tragic to himself, perhaps even to the Nation. But this is a tragedy which must be laid at Mr. Lilienthal's door.

Dr. Edelman had earlier applied for work in the AEC laboratories but the AEC's own Security Department ruled that he could not be cleared for access to restricted atomic information. When Mr. Lilienthal insisted, in the face of this report, on awarding Dr. Edelman a fellowship, the joint committee warned him that he was being unrealistic and unfair.

A student or his wife having been Communist does not render him ineligible for public education in America. It does not render him ineligible for aid in private foundations. But because of the realities of our time, because there is a Communist conspiracy against democracy and peace in the world, it does render him ineligible for education in the atomic field at Government expense.

Because of this reality, Mr. Lilienthal was urged to approve no student for an AEC fellowship until the applicant had been given an FBI investigation. Mr. Lilienthal flatly refused to admit even the propriety of an investigation and Dr. Edelman's tragic experience is the result of this doctrinaire obstinence.

It is my hope that after Dr. Edelman's appearance, the necessity for making public spectacles of Mr. Lilienthal's mistakes will be eliminated. I hope that the AEC will now quietly cancel all fellowship students who cannot qualify as good security risks.

Public hearings should, of course, be afforded these persons involved who, themselves, insist on it.

In addition to these two highly publicized fiascos by Mr. Lilienthal and the AEC, in my opinion, there is now perhaps even more serious evidence of maladministration. Our atomic program is suffering from equivocation, misplaced emphasis, and waste. There are a number of important problems, the solution of which requires administration by the Chairman of the AEC which is competent, realistic, and courageous.

It is my considered opinion, in the light of the record of the past 2 years, that the interests of the Nation can best be served by the President requesting the resignation of Mr. Lilienthal.

The Joint Committee on Atomic Energy, which had not previously been aware of Senator Hickenlooper's views, felt that so serious a

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charge as "incredible mismanagement" left it no choice but to undertake a full-scale investigation. Also, the Commission itself, in a letter addressed to the chairman of the joint committee, asked that full inquiry be made. This letter reads as follows:

MAY 25, 1949.

DEAR SENATOR MCMAHON: A full, complete, and speedy report on the charges that the United States atomic energy program is virtually a failure is a matter urgently necessary; the investigation initiated by the McMahon committee and to be carried out by it is welcomed.

The charges by Senator Hickenlooper of "incredible mismanagement," "misplaced emphasis," and "maladministration" involve nothing less than the security of this Nation and the peace of the world.

If it is true that the atomic energy program is in an almost bankrupt condition, then this Nation, far from being the custodian and trustee of a substantial stock pile of atomic weapons, and in a favorable production situation, is in a sadly weakened condition. If this were true, it is difficult to imagine any single fact more disturbing to the peace of mind of the people of the country or to the security of the world's democracies.

The facts on this crucial test of our stewardship can be readily established.

That in an enterprise requiring the services of some 60,000 human beings there have been mistakes and errors goes without saying; this has been freely admitted. Working with the atom does not make human beings perfect and beyond error. For these errors and mistakes the Commission has and will continue to accept full responsibility. The failure to follow explicit Commission regulations in the matter of the uranium oxide at the Argonne Laboratory in Chicago is such an instance. In the handling of many thousands of tons of crucial materials, in various forms, the Commission and its contractor-employees have sought and will continue to seek to improve on methods of accountability, that will keep the element of human fallibility at a minimum; no system can eliminate the human factor entirely.

Among the hundreds of decisions of policy thus far made by the Commission, and those that will be made in the future, there are many the soundness of which is and will be subject to differences of judgment among equally sensible men. Such a case is that concerning scholarships for nonsecret study, awarded by the National Research Council of the National Academy of Sciences as contractor for the Commission. The policy of the Council and the Commission has in the past 10 days been changed to meet the objections, on public-policy grounds, strongly expressed by Members of the Congress. But the difference was one of judgment on which equally patriotic and reasonable men could have and do entertain differing views. The export to scientists abroad, of isotopes, announced by the President in September 1947, is another instance. This was done upon the unanimous recommendation of distinguished advisers to the Commission. There are bound to be cases of underestimating of construction costs by contractors of the Commission in connection with urgently needed facilities of a wholly new kind. These are properly subject to criticism. But they were common experience during the war and today in industry generally.

The Joint Committee on Atomic Energy of the House and Senate was established by the McMahon Act to review and consider, among other things, differences of judgment on policy, and to receive and consider and appraise the rate of progress, or lack of progress in the substantial work of this project—one of the largest enterprises and most complex in history. Numerous reports, largely secret or top secret, and frequent hearings, conferences, and staff liaison have made your committee essentially—and rightly so—a continuous congressional investigating committee.

The test of whether there has been and is "incredible mismanagement" and a grave situation in this country's atomic energy program can be made a quite specific test, or series of tests. The country, I suggest, is entitled to and will want to know the answers to such specific questions as the following, among others, and we welcome the decision of your committee to proceed to the making of such analysis and report:

(1) Has the Commission failed in its stewardship at a time of great tension in its obligation paramount to all others; i. e., the production and improvement of these complex scientific weapons? What is the state of our atomic weapons—the order of magnitude of the stock pile; the improvements made in the past 2½ years in new weapon design? What has been the progress in the past 2½ years of our stewardship? What is the progress today in still

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further improvements, and the quality of personnel and the morale of those engaged in this work?

(2) How about production of fissionable materials—the essential ingredients of atomic weapons? Is it on a secure basis? What situation did the project face concerning disruption of production and how successful were the steps taken to overcome them? We assert, and our reports to you have made clear, that production is now at the highest level in history, with the same facilities; that new facilities are approaching the production state.

(3) How has basic and applied research progressed since the Commission took responsibility—and where was it when the Commission took over?

(4) How about security? What was the state of physical protection of plants when the Commission took over? Has this improved, and in what ways?

What about security of secret documents? What was the situation when the Commission began, and what is it today?

What about accountability for source and fissionable materials? What was the situation in 1947? What is it today?

(5) What about the investigation and clearance of personnel? What was the situation and what is it today?

There are many other areas of inquiry that your committee will engage upon, in addition to those carried on by it continuously as a regular practice in the past.

But the chief question I believe is this: Is this country weak today in atomic weapons and materials, and in their production and improvements, as implied by the broad and grave charges leveled against the Commission?

It can be stated categorically that the record in this respect is a proud one. It is one to give great reassurance to the peoples of the world who, as of this hour, rely upon the strength of the United States of America.

In order that the fears and misapprehensions on this score may be settled beyond peradventure and as promptly as it is possible, it is urged that the joint committee call before it immediately, not only the Commission, its staff, its principal industrial and university contractors, but also other citizens of the highest renown and technical standing, including the distinguished members of the General Advisory Committee and other advisory groups for their testimony and appraisal. In this way the dangerous cloud of uneasiness resulting from these charges will be dispelled.

Sincerely yours,

DAVID E. LILIENTHAL,
Chairman.

With the issue thus joined, between Senator Hickenlooper's indictment and the Commission's answer, Chairman McMahon opened the June 1, 1949 meeting of the joint committee as follows:

Senator Hickenlooper, a member of the committee and formerly its chairman, has charged Mr. Lilienthal and the Atomic Energy Commission with incredible mismanagement.

Mr. Lilienthal, Chairman of the Atomic Energy Commission, has replied that the Nation's project is not incredibly mismanaged; that, on the contrary, the Commission's record is a proud one.

The issue is one which goes to the heart of our national defense.

The responsibility of the Joint Committee on Atomic Energy to Congress and to the people is now direct and immediate.

The purpose of the hearings which begin today is to get at the truth.

The American people can feel confident that a fair opportunity will be furnished here (within the limits of security) to throw a searchlight on the facts.

If the facts are such as to alarm our people, then they ought to be alarmed. If the facts are such as to reassure our people, let them be reassured. We must be thorough. We must be just. There must be no persecution and no whitewash.

When the hearings are completed, the joint committee will report to the American people. This committee, as the responsible representative of Congress and the people, is obligated to render its judgment.

When the joint committee first decided upon an investigation, Senator Hickenlooper agreed to document his general charges and, for this purpose, asked leave to examine witnesses himself and to present a continuous case throughout the first hour or hour and a half of successive open hearings. In accordance with his request, therefore,

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the early portion of each meeting was turned over to Senator Hickenlooper, and he directed the course of the discussion. Later in each meeting the other committee members became free to comment and to pose questions; and, in addition, representatives of the Commission were permitted to volunteer testimony. The investigation proceeded substantially along these lines, with one or two interruptions, for about 5 weeks, whereupon Senator Hickenlooper elected to discontinue his public presentation. Another week of open hearings then followed, during which the Commission brought forward such witnesses as it wished to testify affirmatively in its behalf. The final phase of the inquiry took place in executive session and mainly involved discussion of FBI reports covering personnel-security cases. Altogether, the joint committee held 45 separate meetings connected with the investigation—24 of them in public, and the remaining 21 in private. The printed record discloses no classified data, but it contains more new and pertinent information about Commission activities than has ever before been assembled in one place.

Strenuous efforts were made throughout to assure fairness, to maintain dignity, to protect secrets, and generally to follow the principles enunciated in the committee chairman's opening statement. Senator Hickenlooper, Mr. Lilienthal, and the Commission, and each individual committee member all had unfettered opportunity to suggest witnesses, to criticize and defend, and to illuminate publicly such facts as may properly be discussed at open hearings. Now, through this report, the joint committee must review the evidence and submit its verdict.

STANDARDS OF JUDGMENT

In looking back upon the investigation, the committee confronts several basic questions. Are the specific charges, as developed through the hearings, substantiated by the facts? If so, are the specific charges adequate to support such general charges as "maladministration," "misplaced emphasis," "equivocation," "waste," and "incredible mismanagement"? In a larger sense, do the American people have cause to fear for the essential soundness and well-being of their atomic energy enterprise?

This latter question clearly raises the issue of the Commission's responsibilities. The nature of those responsibilities needs careful definition if the many hundreds of pages of testimony are to be viewed in perspective. What is the Commission legally obliged to accomp sh? Which of its missions take priority, and which are secondary? What is the kind of activity which, if incredibly mismanaged, would give the American people most reason for concern? These matters bear much the same relation to the evidence presented at the committee hearings as the law bears to evidence presented at a court trial.

Section 1 of the McMahon Act for domestic control of atomic energy, approved by Congress in 1946, contains the following fundamental statement outlining the policy framework within which the Commission operates:

> * * * it is hereby declared to be the policy of the people of the United States that, subject at all times to the paramount objective of assuring the common defense and security, the development and utilization of atomic energy shall, so far as practicable, be directed toward improving the public welfare, increasing

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the standard of living, strengthening free competition in private enterprise, and promoting world peace.

The McMahon Act also contains a section entitled "International Arrangements," which reads as follows:

SEC. 8. (a) DEFINITION.—As used in this Act, the term "international arrangement" shall mean any treaty approved by the Senate or international agreement hereafter approved by the Congress, during the time such treaty or agreement is in full force and effect.

(b) EFFECT OF INTERNATIONAL ARRANGEMENTS.—Any provision of this Act or any action of the Commission to the extent that it conflicts with the provisions of any international arrangement made after the date of enactment of this Act shall be deemed to be of no further force or effect.

(c) POLICIES CONTAINED IN INTERNATIONAL ARRANGEMENTS.—In the performance of its functions under this Act, the Commission shall give maximum effect to the policies contained in any such international arrangement.

It is a tragedy—the ultimate tragedy of our time—that no international arrangements have yet been achieved. Three years ago the United States officially offered to relinquish atomic weapons, to forego atomic secrets, to admit foreign inspectors inside its borders, and even to permit international operation of its atomic plants and facilities. In return, the United States asked only that other powerful countries accept corresponding regulation for the protection of one and all against the danger of violations. Although the United Nations General Assembly has endorsed this proposal and although an overwhelming majority of the world's statesmen consider it to be just, generous, and urgently necessary, Soviet Russia blocks its adoption.

Consequently, the section of the McMahon Act dealing with international control has no present application. The Atomic Energy Commission lacks responsibility for giving "maximum effect to the policies contained in any * * * international arrangement." Instead, the Commission is still governed by the basic policies set forth in section 1 of the act, which states that "the common defense and security" are the "paramount objective" and that all other objectives are subordinate thereto. Fortunately, under the circumstances, the development of atomic energy for war follows much the same paths as development for peace. Advances in the one sphere mean advances in the other. The two cannot be segregated or compartmentalized. Our accomplishments in a military sense will therefore help us to exploit the atom for the welfare and ennoblement of the human race. But the stern fact remains that, since Soviet Russia rejects international control, the Commission is duty-bound to consider first and foremost "the common defense and security."

These words expressing the Commission's supreme responsibility, however, require interpretation in light of the world situation existing at the time the charge of "incredible mismanagement" was made if they are to serve as a clean-cut standard for evaluating evidence produced at the hearings. The Commission must be praised or condemned largely according to its successes in strengthening the ability of the United States to defend against aggression. Yet, there are various kinds of defense. What approach does sound judgment dictate in the field of atomic energy?

Until recently we regarded ourselves as possessing a monopoly of atomic weapons, and we counted heavily upon it to deter potential aggressors or to defeat them if they thrust war upon us. But we also knew that our monopoly could not last forever, that it was bound to

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be broken in a short time, and that we would then have little left in the atomic field to sustain us except superiority: i. e., more and better weapons than a possible opponent. This logic meant that, during the period of our monopoly, the Commission was profoundly obligated to press forward in basic and applied research, to hasten reactor development, to accelerate production of fissionable materials, and to fabricate atomic explosives with the utmost sense of urgency as insurance against the day when totalitarian countries would complete their own initial bombs. In that way alone could our superiority, the only advantage remaining to us after our monopoly had vanished, be maximized. The inevitable came to pass sooner than expected: on September 23, 1949, we learned that the Soviet Union had created an atomic explosion. But the need for rapid progress in our own project was as obvious before the event as afterward, since Russia's acquisition of the bomb through her own independent efforts had been foreseen and predicted by every authority qualified to judge.

Thus the law's "paramount objective" of "assuring the common defense and security," has always placed greatest emphasis upon an affirmative task: protecting our country by keeping it far ahead of rivals in the sciences, in nuclear reactors, and in quality and quantity of bomb output. This over-all task may appropriately be called "security by achievement," in recognition of the positive character of the activities which, from the outset, contributed most to our atomic defenses. So strong an accusation as "incredible mismanagement" surely means that the Commission is derelict in essentials and not merely in nonessentials. Such a charge, to be proven, must consequently show that the Commission has failed to furnish us with "security by achievement"—failed, in other words, to prosecute research with satisfactory vigor, failed to develop reactors adequately, and failed to make as many superlative weapons as could and should have been made under all the circumstances.

Another standard for appraising evidence given at the hearings is the Commission's record in safekeeping atomic energy secrets. The correct use of secrecy as a technique of "assuring the common defense and security" furnishes us a measure of negative protection, in the sense that we avoid helping rival nations to manufacture the bomb, and hence contrasts with the positive protection afforded us through our own continuing progress. Guard posts, barbed-wire fences, investigations of personnel, materials accountability, documents control, and all the apparatus mobilized to suppress information leaks that might benefit a foreign power may conveniently be considered under the heading "security by concealment."

It requires no argument to show that both broad types of security—"by achievement" and "by concealment"—are indispensable. But much confusion has surrounded the nature of atomic secrets, notwithstanding the conscientious efforts of the Nation's scientists to clarify this aspect of public thinking. There existed, for instance, an unfortunate notion that one marvelous "formula" explains how to make bombs and that it belonged exclusively to the United States. Actually, the basic knowledge underlying the explosive release of atomic energy—and it would fill a library—never has been the property of one nation. On the contrary, nuclear physicists throughout the world (including those who live behind the iron curtain)

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were thoroughly familiar with the theoretical advances which paved the way for practical development of an atomic bomb. Such towering scientific figures as Niels Bohr of Denmark and Sir James Chadwick of Great Britain, together with dozens of associates from almost all countries except Russia, came to the United States during the war, participated intimately in the Manhattan District project, rendered priceless service, and returned to their native lands when hostilities ended. Equally notable figures from abroad—Enrico Fermi of Italy and Hungarian-born Leo Szilard, for example—shared in our atomic effort and established permanent American residence following the war. The Soviet Union, for its part, possesses some of the world's most gifted scientists, as well as technical experts imported from Germany—men whose abilities and whose understanding of the fundamental physics behind the bomb only the unrealistic were prone to underestimate. Russian success in breaking our monopoly dramatically exposes the fallacy that atomic secrets relate principally to pure science.

On the other hand, the vast American enterprise which culminated in Hiroshima and Nagasaki was not only a scientific tour de force but also an industrial and developmental feat of the first magnitude. It is here—in the field of engineering, design, and applied research—that real atomic secrets were and are mainly concentrated. The fact that we are dealing with secrets in the plural and not with one single secret cannot be overstressed; for the blueprints of our facilites at Oak Ridge, Hanford, and Los Alamos, the construction drawings, the material-order sheets, the technical papers, operating manuals, weaponeering studies, statistical surveys, and similar documents of value to a foreign power cover millions of pages. However, this tremendous collection of data, plus thousands of tons of precious metals, plus the almost limitless fund of classified information which atomic workers collectively carry about in their minds, must all be kept from trickling into the wrong hands.

The philosophy of "security by concealment," as related to the situation that existed during the period of our monopoly, rested upon two chief concepts. First, if we successfully withheld key techniques from Russia, she could not borrow our know-how and exploit it to advance the date when she completed her earliest atomic weapons. It follows that secrecy on our part tended somewhat to delay completion of the first Soviet bombs and to extend the duration of America's monopoly; and during this period of extension (however brief it may have been) we enjoyed extra opportunity to increase our atomic "head start." Such reasoning acknowledged that Russia would eventually acquire her own bombs, regardless of how effectively we ourselves concealed what we knew, but stressed the importance of postponing the development as long as possible. The second main concept which justified secrecy during the period of our monopoly was that of shielding from others the latest American accomplishments, especially applications of basic knowledge: the details of new weapon models, the engineering intricacies of a new industrial process, and the like.

The repressive requirements of "security by concealment," if carried far enough, come into conflict with the constructive requirements of "security by achievement." In the spring of 1948, for example, experiments involving the detonation of three atomic weapons were staged at Eniwetok atoll, and the National Military Establishment

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(the Commission approving) permitted thousands of men under its control to participate in this operation without a full FBI field investigation into their loyalty. From the viewpoint of "security by concealment"—considered alone and disregarding every other factor—it would have been wisest not to conduct the tests at all, for such a decision would have eliminated any possibility of the test results reaching a foreign nation and thereby assisting that nation in its quest for atomic stature. A second best alternative, exclusively from the viewpoint of guarding secrets, would have been to defer the Eniwetok operation for several months while each and every participant received a complete FBI investigation. But the demands of "security by achievement"—getting a critical job done—decreed that the tests take place without delay. Otherwise the test results would not have been available to us until a later date; those results would not have been translated into the design of new weapons so soon; and we would not now possess as many improved bombs as have actually been incorporated into our stock pile.

Whenever the Commission constructs a laboratory, builds a reactor, erects a metal-fabrication facility, or even leases extra office space, it unavoidably broadens the opportunities open to a foreign agent and, therefore, enlarges the risk that some atomic secrets will escape to our totalitarian competitors overseas. If the only consideration were "security by concealment," the ideal solution would be to dismantle all plants at Hanford and Oak Ridge, raze Los Alamos, stop manufacturing bombs, and destroy all papers containing classified information. In such fashion the danger of leaks could be held at an absolute minimum. Conversely, whenever a technical document is stamped "top secret," "secret," or "confidential" the circulation of knowledge from one qualified expert to another becomes confined to officially sanctioned channels; the mutual stimulation of minds through exchange of ideas—the lifeblood of science—suffers proportionately; and the end result may be a diminution of our ability to outstrip rivals in the struggle for atomic preeminence. Similarly, whenever policemen must patrol an installation; whenever a group of employees needs clearance for access to restricted data; whenever, for secrecy reasons, a contract is negotiated instead of awarded through competitive bids; whenever code words, armed couriers, and special safes are necessary, an impeding element is introduced that adds expense, multiplies red tape, and encumbers our advance toward more and better weapons. If "security by achievement" were the only consideration, the ideal solution would be to abolish all secrets and to concentrate single-mindedly upon actual accomplishments.

It is apparent that the defense of the United States calls for the striking of a sane and judicious balance between the two indispensable but competing types of security: "by achievement" and "by concealment." Just where this balance should be struck in particular instances depends upon circumstances, and upon a weighing of the fact that, on the one hand, Russian success in achieving first a bomb and later a stock pile has always been a foregone conclusion and that, on the other hand, American secrecy slows the rate of foreign progress but may hamper our own progress as well.

Many problem cases present themselves. Assume, for example, that a question before the Atomic Energy Commission is whether or not to downgrade the classification of a certain document from

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"secret" to "unrestricted." Assume further that the document, if published, might be expected to assist Soviet technicians in some indeterminate degree, but that a decision not to publish might so hamper research throughout the United States as to delay the fundamental work foreshadowing an important new weapon by 3 or 4 years. Should the Commission help Russia and simultaneously help ourselves, or should it conceal the document from Russia and simultaneously retard our own advancement? Again, suppose that the issue is whether or not to hire a brilliant scientist whose abilities are unique and whose contribution could not be duplicated. Suppose, further, that the FBI investigation report on him discloses sufficient derogatory information to raise a doubt regarding his loyalty. Should the Commission, as a calculated risk, employ the scientist and strengthen the technical phase of our project, or should it, as an equally calculated risk, refuse to employ him and suffer the consequences of taking a less able substitute? Luminous wisdom must be brought to bear upon such dilemmas if they are to be solved in a manner that best serves "the common defense and security."

Accordingly, an appreciation of the issues in all their ramifications suggests two principal ways of proving "incredible mismanagement" so far as secrecy is concerned. It might be shown that the Commission has been so obsessed with "security by concealment" as to bungle "security by achievement," thus leaving us in a relatively feeble position when totalitarian powers accumulate a real atomic-bomb stock pile through their own unaided exertions. Alternatively, the exact opposite might be shown, to wit, that the Commission is so preoccupied with positive accomplishments that it has let slip secrets of genuine significance. If the latter alternative were chosen, a rough rule-of-thumb test might be applied by asking this question: Is there evidence that Russia has gleaned knowledge from Commission sources which speeded development of her first bomb or which might help make better bombs than she could design independently?

A further standard for judging the testimony relates to the Commission's administration of funds. Once again the striking of a sensible balance between opposing objectives figures prominently. Here the conflict involves, on the one hand, incentive to build certain novel facilities quickly and, on the other hand, pressure to complete exhaustively considered design plans and cost estimates before breaking ground so as to minimize possibilities of waste. During the recent war the Manhattan Engineer District spent more than $300,000,000 in hastily constructing two major plants for the isotopic separation of U–235 from normal uranium. One plant (known as Y–12 and exploiting the electromagnetic principle) operated about 2½ years, whereupon efficiency dictated that it be placed in permanent stand-by except for small-scale activities. The other (known as S–50 and exploiting the thermal diffusion principle) operated only a few months and then proved to be so uneconomical that it was placed in stand-by and finally dismantled altogether. But the large investment which both plants represent was eminently justified in terms of wartime emergency and the state of knowledge existing at the time construction began. The "cost-be-damned" philosophy then wisely and properly prevailing may not have been equally tenable between January 1947, when the Commission took over from the Manhattan District, and September 1949, when we learned of Russia's bomb test. Nevertheless, enough urgency still

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underlay our atomic endeavors so that the Commission would merit severe criticism if it failed to expedite crucial defense tasks without waiting for all the conventional deliberations and planning niceties which would have been desirable if economy were an overriding factor. Of course, this is hardly to imply that the Commission should have thrown financial caution to the winds. Moreover, a different order of permissible license attached to the new facilities needed in research and weapons production than to the houses, schools, stores, and recreation centers needed in Commission-owned communities.

Yet another relevant standard to be focused upon testimony developed through the hearings is whether or not the Commission has ever violated the terms of the McMahon Act. Section 1 of that act furnishes still further criteria: whether or not, "subject at all times to the paramount objective of assuring the common defense and security," the Commission has directed its efforts "toward improving the public welfare, increasing the standard of living, strengthening free competition in private enterprise, and promoting world peace." All Commission endeavors are so intertwined and intermingled with administrative policies, practices, and procedures that to evaluate the one is also to throw critical light upon the other.

Such, then, is the committee's opinion respecting the standards which should be applied and which, if the charge of "incredible mismanagement" were litigated in a court, would guide judge and jury. A verdict may be reached according to the answer given a simple question which takes precedence over all others: in terms of the record before the committee is there evidence that the Commission has failed to discharge its defense responsibilities?

With the applicable standards thus established, the testimony must now be examined. (Each statement of fact in the following discussion complies with the secrecy provisions of the McMahon Act.) The first part of this committee report deals with "security by achievement" and with the general topics most germane to that top-priority defense against aggression; namely, weapons, production, research, reactor development, and community affairs. The second part of the report discusses "security by concealment," and there follows a statement of the committee's conclusions.

SECURITY BY ACHIEVEMENT

The harnessing of atomic energy, like any other industrial and military activity requiring metal, begins with a search for ore located in the earth's crust. While uranium, the basic material, is about 1,000 times as prevalent as gold; while a ton of it inheres in each cubic mile of sea water; and while an average of one-seventh of an ounce per ton occurs in all granitic and basalt rocks (which comprise more than 90 percent of the earth's crust by weight), concentrated deposits are extremely rare and arduous to locate. To date, by far the larger share of uranium used by the United States issues from the Belgian Congo and Canada, with supplementary quantities derived from Colorado. Exploration on a scale recalling the "gold rushes" of the last century has pushed forward throughout the globe; but notwithstanding numerous "strikes" of lean ore and scattered lodes, there have been no reported new discoveries of extensive veins. Exploitation of such low-content sources as shales and phosphates awaits development of a satisfactory recovery technique. Uranium,

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apart from its rarity, presents difficult processing and toxicity problems—factors which condition its whole career from the mines to atomic weapon or atomic reactor.

After the ore, once obtained, has been dried, crushed, and weighed, it goes to specially equipped plants for conversion into "brown oxide" (UO_2) and simultaneous removal of impurities. The next step, also a complicated one, sees the "brown oxide" converted into "green salt" (UF_4). At this point the path branches, depending upon whether the material is destined for Hanford plutonium piles or Oak Ridge separation plants. In one case the "green salt" must be reduced to metal billets, another industrial project of complexity; and the billets are then processed into "slugs" of suitable size and shape for insertion in the Hanford reactors. If Oak Ridge is the terminal point, however, material in the "green salt" stage becomes converted, again through special and large-scale plants, into uranium hexafluoride (UF_6). Such is the "feeding" operation, one often neglected in public discussion although it engages an entire specialized segment of the Nation's chemical industry.

The next phase of the production chain, in contrast, has acquired almost household familiarity: It either involves manufacture of the toxic, man-made element, plutonium, or else separation of the fissionable isotope U–235, as contained in uranium hexafluoride, from the 140 times more plentiful isotope U–238. That the plants performing these tasks are wholly new, that they cost hundreds of millions, that they pose far-reaching safety problems, and that the quantities of ingeniously contrived equipment represent an order of magnitude previously unknown, has by now become commonplace knowledge. The site of the Hanford plutonium works covers some 400,000 acres, more than half the area of Rhode Island. Richland, the community attached to Hanford, has a population approaching 25,000 persons. Oak Ridge, Tenn., site of the U–235 production facilities, occupies a 93-square-mile Government reservation, and the number of residents living in the town itself exceeds 35,000.

When uranium hexafluoride, enriched in the isotope U–235, has emerged from the great "cascade" of stages at the gaseous diffusion plant, there remains final chemistry and other processes. At Hanford, the plutonium, after it appears in irradiated "slugs," is separated chemically from residual uranium and fission products; and the radiation hazard requires that many cubic yards of concrete shield remotely controlled apparatus from the nearest human workers. The plutonium, too, must undergo various additional processes.

Here the material is at the threshold of use, either as an atomic explosive or as fuel for an atomic reactor. With the right auxiliary equipment, itself a techno-scientific-industrial challenge of the highest order, the energy residing in the nucleus of the atom may be released almost instantaneously—on the order of microseconds—with fantastic explosive violence. The identical material, surrounded by different auxiliary equipment, can be made to release its latent energy slowly, in the form of heat and radiation—for research, eventually for industrial power, and for the general economic, academic, and physical well-being of mankind. At the same time, the two-faced nature of this force again thrusts itself forward; for the same atomic reactors which hold forth the promise of altering and enriching human life may likewise serve, in time, to power a warship or a military aircraft.

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Even further, the fissionable material inserted in or manufactured by a reactor is translatable to bomb use through modern technology.

Behind the long sequence of mining, processing, producing, fabricating, and assembling lie intangible ideas. The secrets of the weapon could not have been captured and the secrets of future improved weapons and reactors will remain hidden without the investigations of many men, some working in laboratories, others working only with pad and pencil, and often concentrating upon matters seemingly devoid of relation to any practical use. Science presupposes cross-fertilization of minds, "playing by ear," exploration of details, and pursuing this path or that path as vaguely apprehended deductions and experimental evidence may suggest. The tentative and unpredictable quality of basic research is well known to all who have traced the events that brought forth the first atomic bomb. But upon this delicate foundation rests our ability to excel foreign rivals and thus to earn continuing military supremacy.

Atomic achievement, nevertheless, requires people. They are the ones who conceive ideas, staff laboratories, dig ore, and operate plants. A Ph. D. degree in nuclear physics or microchemistry does not render a man or woman indifferent to home, family, and community. The human beings who comprise the backbone of our project, in fact, display all the ordinary tastes and desires. If their houses are submarginal, the schools for their children overcrowded, and their towns lacking in recreational centers, they are apt to seek employment elsewhere—a privilege which, be it noted, is not available to scientific and technical workers in a totalitarian country. For this reason, the size and quality of our weapons stock pile bears a definite relationship to the size and quality of living facilities in Oak Ridge, Richland, and Los Alamos. The development of these towns is a task of first-rate importance, however prosaic in a field otherwise novel and startling.

WEAPONS

Uncontradicted testimony shows that in 1947, when responsibility was formally transferred from the Manhattan District to the Commission, our weapons position verged upon the tragic. The United States then possessed so few bombs, according to Mr. Lilienthal that we might have tempted fate if public statements even mentioned the importance of numbers in building an atomic deterrent to aggression. Dr. Robert F. Bacher, an original member of the Commission and now chairman of the California Institute of Technology Physics Department, told the joint committee that he personally made an inventory of our stock pile early in 1947 and that he was both surprised and "very deeply shocked" by the meager findings.

Los Alamos Laboratory

The Commission also found itself faced at the outset with flagging morale and unsettled conditions in the crucial Los Alamos Laboratory. Brig. Gen. James R. McCormack, Director of the Commission's Division of Military Application, remarked that Los Alamos was "on its back"; and Dr. Bacher depicted the job of building the laboratory anew as "difficult" and "heartbreaking." All witnesses took pains to stress that this condition implied no reflection upon the Manhattan District. It arose from many causes inevitably connected with the

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end of a great war and a great wartime enterprise, such as the exit of scientists to civilian employment, uncertainty as to the future of the project pending a congressional policy determination, the temporary nature of housing construction, and the like. Certain activities ranging from pure research to development and engineering to outright production, moreover, were lumped together at Los Alamos—interfering with the efficient prosecution of all three. Dr. J. Robert Oppenheimer, chairman of the Commission's General Advisory Committee and former director of the laboratory, asserted that as matters stood in early 1947, Los Alamos "could have gone to pieces."

Mr. Lilienthal and his four colleagues took the situation to mean that "production must be drastically stepped up; that from being a nation virtually unarmed atomically * * * we must become a nation which had a leadership unmistakable and unquestioned." A half-dozen witnesses told of the efforts exerted in the past 2½ years to bring about rapid improvement of our weapons status. When Congress passed the McMahon Act, providing for civilian control and giving assurance of future project stability, morale at Los Alamos gradually took a turn for the better. It rose higher with the formulation of a definite research program, both short and long range, and with an accelerated rate of permanent community construction. In addition, steps were taken to ease the development and production burdens which Los Alamos had sustained and to make it, for the most part, a center of weapons research. The Commission built a facility for fabricating plutonium into bomb parts at Hanford and undertook projects of a related nature elsewhere. Equally important, engineering and applied research have been progressively shifted from Los Alamos to other locations—including the Sandia Base at Albuquerque, N. Mex. The Commission also brought elements of industry and "certain technical bureaus of the Army and Navy" into the weapons operation and geared their work to the revised and stepped-up activities focusing through the installations at Los Alamos, Sandia, Hanford, Oak Ridge, and elsewhere.

We have applied throughout the process of revitalizing and expanding the weapons program—

said General McCormack—

the highest attainable sense of urgency. Both Dr. [Norris E.] Bradbury [present Director of the Los Alamos Scientific Laboratory] and Mr. Tyler [the Commission's area manager] have worked under the whip since 1947. It has been the Commission's policy that there shall be no slacking of impetus and incentive if we can possibly avoid it.

New plants and facilities directly connected with weapons, according to the testimony, have cost in excess of $100,000,000; thousands of people are employed to operate them; and hundreds of contractors and subcontractors are involved. Dr. Mervin J. Kelly, executive vice president of Bell Laboratories, appeared before the committee after making a special survey of Los Alamos and Sandia at the Commission's request. He found a "very good organization doing a fine job," adding that, as a citizen, he feels comforted to have gained this first-hand impression.

I do not wish to imply that all was perfect, for it was not—

he said; but—

considering the low point reached after the war * * * tremendous progress has been made in less than 3 years.

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In particular, Dr. Kelly noted that "the environment for the technical people [is] excellent"; that a proper delegation of broad technical authority and freedom to the laboratory director has been accomplished; that a "splendid Commission staff" supports the enterprise; and that those involved in technical management "rate high in their competence for the job."

The University of California operates Los Alamos as a Commission contractor; it also operates Sandia, although its role there will soon be taken over by Western Electric and Bell Laboratories. Dr. Kelly and others who testified found this contractual relationship to have functioned well in practice; that the quasi-academic atmosphere created by the university's participation has quickened progress; and that keymen have become available who might not enter Government service. Besides these points, Dr. Kelly found sound liaison and "good close connections of knowledge" between the activities at Los Alamos and other Commission installations scattered throughout the country.

Eniwetok tests

Several witnesses highlighted the significance of the Eniwetok tests held in the spring of 1948. They made clear that knowledge gained from the three atomic weapons experimentally shot at Eniwetok has impacted heavily upon weapon design and weapon stock piling. Dr. Bacher, Dr. Oppenheimer, General McCormack, and Dr. Bradbury all indicated that our planning had originally proceeded on the assumption of partial success in attaining the hoped-for test results; that these results exceeded expectations by a considerable margin; and that revision of plans to the extent necessary has been quickly consummated. The test data are already reflected in improved bomb models entering our stock pile—models which, Dr. Bacher twice repeated, "will make considerably better use of fissionable material than any weapons we knew about before." Each bomb "proved in" at Eniwetok, said the witnesses, reflects credit upon the high caliber of work that had gone before. A question arose as to whether or not the Eniwetok weapons had been conceived under the Manhattan District or whether they had evolved under Commission auspices. The weight of the evidence seems to show that, while several of the essential ideas were generated during or shortly after the war, the major research and development was accomplished during the first 12 months of the Commission's life—and the results were not only new but even contrary to some ideas entertained during the war. Dr. Bacher observed—

> One of the principles incorporated in the Eniwetok tests had been thought of and planned for prior to the end of the war * * * but one of the major developments—I would say the major development that was tested at Eniwetok—we would not have dared to do at that time.

Previously Dr. Oppenheimer had said—

> Some features of the weapons tested were features which I asked General Groves to let me incorporate in the bomb that did not go to Japan because the war was over. Other features were features which we did not then know how to realize, though we knew very well that we ought to try.

The testimony is clear, in any event, that Eniwetok represents a milestone in our advancement and that, as Dr. Bacher said—

> we learned more about how atomic bombs work and what we might do in further design work * * * than had ever been learned before.

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Relations with military

In this same connection, extensive testimony developed that the Commission worked intimately and in close harmony with the National Military Establishment throughout the Eniwetok operation. Both agencies, as well as the President of the United States, expressed satisfaction with the way matters had been conducted and the positive results achieved.

Commission cooperation with the Military Establishment also extends to "requirements." Under the McMahon Act, sections 4 (c) (2) and 6 (a), the number of weapons and the amount of fissionable material which must be manufactured are not determined by the Commission but by the President at least once each year. Mr. Lilienthal briefly explained that the Commission and the Secretary of Defense submit joint reports to the President recommending the "requirements" which they believe should be fixed. By custom the full Commission, the General Manager, and the Secretary of Defense personally present such joint reports at the White House. When the President approves a program, its detailed fulfilment involves frequent and lengthy consultation between the Commission and the Department of Defense. No allegation pertaining to "requirements" was placed before the committee during the investigation.

The only difference of opinion between the Commission and the Defense Establishment mentioned in the testimony affects section 6 (a) of the McMahon Act. This provision expressly authorizes the President to decide whether atomic weapons shall be held in the custody of the Commission or the armed forces.

There have been discussions raised by the military—

said Mr. Lilienthal—

as to the custody of the weapons, which are in the hands of the Atomic Energy Commission. * * * The suggestions from the Military Establishment were that the President should change that custody. He concluded for a number of reasons within his purview as Commander in Chief and Chief Magistrate not to do so, and since that time I have assumed, and I believe I am correct in assuming, that the decision has been accepted by the Military Establishment and all of its individuals, both in their official and their private capacity.

Mr. Lilienthal went on to say that "working relations" between the Commission and the military "are as good and as wholesome and as wholehearted as I have ever seen in any phase of public service anywhere."

Hanford overrun

The only point in Senator Hickenlooper's specific indictment bearing directly on the manufacture of weapons had to do with the cost of a plutonium fabrication facility erected at Hanford. He used an intraorganization report prepared by members of the Commission staff to bring out two main points: That the fabrication facility was originally expected to cost $6,255,000, whereas present estimates place its final cost at more than $25,000,000; and further, that the Commissioners themselves were not aware of the overrun until January 1949, when Dr. Bacher discovered the matter during a routine inspection tour of Hanford. Briefly, the chronology of the cost estimates is as follows: $6,255,000 on December 3, 1947; $10,432,900 on February 9, 1948; $11,933,900 on March 12, 1948; $13,000,000 to $15,000,000 on June 28, 1948; $8,230,959 on July 6, 1948 (due to elimination of

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one portion of the work initially planned and substitution of another portion); $8,760,324 on November 23, 1948; and, finally, $25,219,000 by January 1949. In other words, when the Commission first examined this project early in 1947, anticipated expense was about $6,000,000; and the figure climbed during 1947 and the first half of 1948 to about $9,000,000. It was during the latter half of 1948 that the estimate increased almost 300 percent without the knowledge of the five Commissioners.

Senator Hickenlooper also brought out that, according to the Commission report, "a ventilating system when ready for installation was found not to fit" inasmuch as "the design had been changed after the steel had been ordered." Moreover, "the steel in the roof was spliced to raise the roof, and it was found that still the ventilating system would not fit even with spliced alterations to the building, and so a new building was constructed to house this ventilating system that had originally been planned for the one building, adding to the cost." The report suggests that if the Commission had known about the overrun in time, it might have decided to compromise its plans and build a decidedly less ambitious facility. Over and above these items, the report cites gaps and changes in administrative control. "There seems to have been no clear understanding either in the General Electric Co. [the Commission contractor which operates all Hanford] or at the AEC as to whose responsibility it was to follow the cost." Likewise, the Commission overseer was first one individual, then another, and then the first individual again.

Mr. Lilienthal based his answer mainly on the ground that the project in question is directly related to the Eniwetok tests. These did not occur until spring 1948, and construction of the plutonium facility started more than a year previously. Mr. Lilienthal stated, however, that—

> * * * a very considerable time before the tests were held, there was a very good reason to believe that the tests would be successful, although they were rather daring in their design. In order to take advantage of the test results and do so promptly—that is to say, to redesign and refabricate weapons based upon the results of the tests of these new models—the Commission had to be ready as far in advance as possible with facilities for the refabrication of the nuclear components.

As further justification he mentioned the strategic advantage in duplication and dispersion of important facilities. Mr. Lilienthal added that self-criticism in an internal staff report is wholesome and illustrative of good management practice; but the relationship between the Federal Government and a leading institution of business, such as the General Electric Co., is not improved if "we have a press conference or a big microphone out in front of the Commission building every time we criticize each other."

Mr. Harry A. Winne, vice president of General Electric, advised the joint committee that, in less than 2 years' time, approximately 65 major construction projects have been undertaken at Hanford and that the estimates for all these projects combined (involving a final cost of some $235,000,000) reflect an overrun of only 3 percent (or about $7,000,000). A document later submitted for the record by General Electric refers to 57 major construction projects, rather than 65, and asserts that the total overrun will be less than 1 percent. Mr. Winne dwelt upon the exceedingly dangerous nature of plutonium

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and the consequent necessity of building extraordinary health precautions into the design of the fabrication facility. As first conceived, plans would have permitted a concentration of plutonium dust in the air amounting to about 1 part per 50,000,000,000,000 parts of atmosphere. Such a margin was later determined to be inadequate, and the completed structure will reduce the concentration to "as low as 1 part in 100,000,000,000,000." Ventilating equipment, air filters, remote manipulating apparatus, special decontamination devices—all were multiplied and refined beyond original calculations because new knowledge, said to have been obtained after construction began, reveals that health and safety so require. Mr. Winne described the earliest cost figure of $6,255,000 as a mere "horseback guess." "Even as late as July 1948," he said, "there were no completed designs for this entirely novel facility adequate to support a reliable estimate." Like Mr. Lilienthal, Mr. Winne underscored the sense of urgency that pushed along construction. According to his testimony, the facility is a good one; it is worth what it cost; and, in particular, it has started operating about 6 months earlier than originally had been deemed possible. Although the Atomic Energy Commissioners only learned about the cost overrun in January 1949, Mr. Winne admitted that the top executives of his own company also lacked knowledge of the true facts until late 1948 and that the matter was never called to the Commission's special attention. No extenuating testimony can gloss over the fact, however, that the Commission did not grasp the situation until far more than a reasonable time had elapsed.

Yet this failure appears in perspective only if considered along with three basic and interwoven phases of atomic management: Commission relations with operating contractors; Commission fiscal administration; and the Commission policy of decentralization, whereby broad authority is delegated from Washington to on-the-site area managers.

Contractor relationships

The Manhattan District did not itself undertake to build and run atomic plants; instead it let out contracts with private companies, notably du Pont, Monsanto, Carbide & Carbon, Kellex, and Tennessee Eastman. The civilian Commissioners inherited such a system, weighed its merits, and decided to continue it. Mr. James W. Parker, president of the Detroit Edison Co. and Chairman of the Commission's Industrial Advisory Committee, testified that a contractor system is sound and that it draws upon native manufacturing genius more effectively than any other method of operation. General Manager Carroll Wilson notes "that if atomic energy is to become a generic part of the American scene it should have its roots deep in the institutions which are so productive a part of American progress in science and technology." Mr. Lilienthal referred to the conjoining of Government and industry as a new development in our national life—"a hybrid of public and private enterprise" and a relationship so "dynamic and growing" that the word "contractor" inadequately conveys the continuing, mutually stimulating partnership involved. At the same time, as the Hanford plutonium facility shows, the system is still at an awkward stage.

Mr. Winne explained, for instance, that General Electric receives only a token profit of $1; but it is also guaranteed against loss—wherefore its contract with the Commission establishes an "adminis-

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trative overhead fund" of $200,000 monthly. All costs not otherwise directly reimbursable are charged to the fund, such as parts of certain salaries and the expense of atomic energy work performed by branches of the GE organization mainly engaged in commercial business. When the contract expires, an independent firm of certified public accountants acceptable to the Commission will audit all the monthly charges; and any excess payments will then revert to the Government. This "administrative overhead fund" or its equivalent seems a necessity under the circumstances, but it complicates the problem of fiscal accounting.

The investigation brought another curious aspect of Commission-contractor relations into focus when it touched upon the status of atomic energy personnel under the Veterans' Preference Act (which benefits Federal employees who have served in the armed forces). If the Commission itself hires an ex-serviceman, he is, of course, a Federal employee and comes under the Preference Act; but if he works for a contractor, his employment is not considered to be Federal and the act has no application. Yet Senator Hickenlooper pointed out, while disavowing any intention of raising an issue, that contractor employees are paid from public funds; that the Commission must give its consent before they may be hired; and also that the Commission determines the general policies governing their jobs.

> * * * I think there is much to be said on the side of the argument that * * * contractor employees are in fact, to all practical intents and purposes, except for the convenience of handling the checks and dealing with labor relations, perhaps, * * * actually Government employees.

Dr. Oppenheimer lent substance to such an argument when he recalled that the University of California, wartime contractor at Los Alamos, "was really distinguished primarily by [its] absence." More recently, he added—

> the university has been allowed to take a somewhat more active part. But the Commission is dealing with technical people who are paid and protected by the University of California, but who are not normal employees of the University of California * * *. And the policies under which the laboratory is run, the technical directives for the laboratory, the employment policies, the conditions of work, are not determined by the contractor. They are determined by the Commission.

The situation at Los Alamos is not typical, both because secrecy curbs reach peak intensity there and because the contractor is an academic institution. But at Hanford the Commission clearly purchases managerial talent, as well as know-how and the services of a technical and operating staff. Yet the Commission must keep watch upon activities, and for that purpose it has its own staff of 340 people located on the site. How avoid overlapping effort and duplicate personnel? How, on the one hand, may GE's managerial talent be put to full use with the Commission people sharing in every important decision; and how, on the other hand, may the Commission feel certain that the national defense and security are being properly promoted unless it insists upon consultation before its contractor acts? The testimony shows that, in an effort to overcome such dilemmas, the GE Hanford manager and the Commission area manager keep offices in the same building on the same floor; that they and their subordinates confer daily; and that the Commission attempts to exercise reasonable restraint in its demands upon GE personnel, whereas GE endeavors to

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keep the Commission fully advised and to follow instructions. Mr. Carleton Shugg, area manager at Hanford in 1947 and 1948 when construction was rapidly proceeding, described his experience with the General Electric people thus:

> * * * the life in those days was just one continuous discussion of a whole lot of things that were in disagreement. We had plenty of disagreements and plenty of times we were wrong, and sometimes the contractor was wrong, and it was a very busy time of arguing over this job from all angles.

Mr. Winne explained how the situation looks from GE's viewpoint:

> * * * our contract * * * provides that our whole program, in fact our whole operations, are subject to the Commission's direction. * * * Our program and our operations must be reviewed by them, and that sort of thing, so that the whole policy of operation and the objectives are laid down by the Commission. We do the job of carrying out these various policies and projects.

He also said—

> * * * we usually feel that we get plenty of checking from the Commission and that more certainly would not be justified. * * *.

Here, indeed, is an unusual modus vivendi illustrating the "hybrid of public and private enterprise" to which Mr. Lilienthal made reference. It suggests, in addition, the danger of diluted responsibility and a liaison break-down such as occurred in the cost aspects of the plutonium fabrication facility.

The General Electric Co. has displayed both patience and patriotism in doing its utmost to carry out the mountainous assignments given it at Hanford. The picture also has another side, in that the Commission is entitled to place some reliance upon calculations like the $6,255,000 figure which GE originally estimated for plutonium fabrication. Equally relevant is the fact that GE derives no monetary advantage (not even patent rights) regardless of how well it practices economy. Only a lump-sum, unit-price, or similar-type contract, offering maximum opportunities for profit, creates highest incentive to keep down costs. This system has been applied successfully in the case of certain feed material processes; but whether it might work in the operations at Oak Ridge, Hanford, and Los Alamos is a difficult question which the Commission must face at sometime in the future.

Decentralization

The Hanford plutonium facility not only throws the many-sided problem of contractor relationships into relief but also raises the question why Commission officials at the Washington, D. C., headquarters did not keep so intimately in touch with construction as to suspect that costs had risen sharply. One answer is that our atomic project embraces hundreds of separate installations. The Commissioners, in one of their first and most vital decisions, concluded that an on-the-spot manager could view localized issues at better vantage than a headquarters group peering remotely from Washington; and also that the atomic high command should not pursue a penny-wise, pound-foolish policy of losing itself in minutiae and therefore slighting the broader policy matters. In keeping with this philosophy, operations were decentralized; Washington division directors filled a "staff" rather than a "line" capacity, exercising relatively little authority over the field; and five principal area managers—at Oak Ridge, Hanford, Los Alamos, New York, and Chicago—wielded broad, though well-defined, powers.

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This decentralization at no time went so far as to undermine Dr. Bacher's statement that all installations are "technically very closely tied together" and "the participation by the Commission here in Washington is not just a participation on paper but it is actual participation." Nevertheless, decentralization did originally go far enough to evoke the only real criticism which, according to Dr. Oppenheimer, individual members of the General Advisory Committee have ever leveled at the Commission. For a year and a half, all division heads and all managers of field operations reported directly to the General Manager, deluging him with detail and tending to delay execution of pressing programs. The situation, if continued, might even have tempted area managers to take matters more and more into their own hands. Mr. Parker testified that he and his colleagues on the Industrial Advisory Committee saw a clear need for tighter and more functional headquarters control. In the summer of 1948, then, the Commission, apparently influenced by its own studies and experience as well as by its advisers, modified the flow of administrative authority. No longer do the division directors play a "staff" role; they are now interposed, in a "line" capacity, between the General Manager and the area managers; and they supervise field operations. Today only these division heads, together with the Deputy General Manager, report directly to the General Manager himself. After a year of testing, the new system strikes a sufficiently practical balance between the need for over-all direction and the need for on-the-site management that both Dr. Oppenheimer and Mr. Parker indicated approval. A defect lies in the Hanford manager's failure to learn about the plutonium cost overrun and his consequent failure to notify Washington. He possessed ample authority, however, to establish liaison machinery with General Electric that would have procured him this knowledge; and Mr. Winne assured the joint committee that steps have been taken to prevent a recurrence.

The chain of command emerging from the testimony shows the Commission at the top determining policy, need, urgency, and money. It states that such-and-such a plant is to be built; it approves a given set of plans and cost estimates; and it stipulates the degree of urgency. Thereupon the General Manager and the appropriate division manager in Washington implement the Commission directive, using the area manager at the site as their instrument but permitting him considerable latitude in accordance with prescribed rules. He has authority, at Hanford and Oak Ridge, to approve a contract involving as much as $5,000,000 provided that its purpose and provisions lie within the framework of Commission-defined policy. During the course of a construction project the area manager and his staff are obliged to maintain daily contact with the contractor. They submit progress reports periodically to Washington and consult with the division director and even the General Manager as need arises. The General Manager, in turn, advises the Commission of developments through systematic weekly oral reports and monthly written reports, plus special information papers numbering more than 500 in 1948.

Fiscal accounting

But apart from the Commission's contract and management policies, an industrial-type cost-accounting system might have flagged the Hanford plutonium overrun. Such a system has already been

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adopted by two major contractors, Carbide & Carbon Chemicals Corp. and the University of California; and it is in process of installation elsewhere. But the change-over has proven to be slow and laborious because it requires a departure from time-honored Government procedures and also because the historical data on costs are all based on Army-type records. To quote the Commission Controller, Mr. Paul M. Green—

> financial controls as a tool of management were largely lacking in the Manhattan District. There was, for example, no coordination between property records, fiscal accounting, and budgeting. In the main, the Manhattan District financial management was aimed merely at justifying the reimbursement of expenditures made by cost-type contractors, in conformity with law and Government regulations.

The investigation touched briefly on accounting when Senator Hickenlooper read an extract from the House Appropriations Committee report on the 1950 independent offices appropriation bill. This extract states that the Commission's budget presentation "was substantially improved" but that "there still exists a serious deficiency in that the budget was not established on a cost basis * * *." Mr. Fred C. Schlemmer, present Hanford area manager, later testified that in 1947 "the urgent thing was to get the work going" and that "close, detailed controls beyond a point of reasonableness at that time would have been a mistake * * *." Fifty people in his office now devote themselves to fiscal and accounting matters; controls are being progressively placed in effect; and it was these, as a matter of fact, which finally gave notice that the cost of building the plutonium facility had far outstripped estimates.

The contractual, managerial, and fiscal background circumstances surrounding this facility are applicable, in greater or lesser degree, not only to weapon operations but also to production of fissionables, reactor development, research, and community affairs.

Regarding weapons generally, all witnesses who spoke to the point—and they went unchallenged—represented that our current position is strong as compared with early 1947. Dr. Bacher, for instance, declared that "bomb production is in the best shape ever" and that "I am not at all ashamed of where we stand today * * * on the production and development of weapons." While warning against complacency, he permitted himself to acknowledge that we are "'way out in front" of any other nation. Dr. Oppenheimer remarked that it is not his business, as Chairman of the General Advisory Committee, to be satisfied with anything the Commission accomplishes, but that he is in fact satisfied with our weapons progress. General McCormack, for his part, stressed that bomb production has been placed on a firm and stable footing, both for the short and long term, and that proper strategic dispersion of installations has been effected. Mr. Lilienthal emphatically assented to the proposition that, although the Commission has custody of atomic weapons, "they are available instantly without undue delay of any type to the military in case there is need for them to take the bomb and deliver it." Senator Hickenlooper said, "I think we have gone ahead and produced weapons in this program, and I have never disputed that. I am raising no issue on that score."

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PRODUCTION

Raw materials

The investigation record contains only occasional, though significant, references to the problem of procuring and processing raw materials. Dr. Bacher recalled that in January 1947 the Commission found supplies of uranium ore to be less than "we wanted and needed." A two-fold objective was therefore given priority: To secure additional ores and to produce more end product from a given quantity of input.

According to Mr. Walter J. Williams, the Commission's Director of Production, "constant attention" has been paid "to arrangements which would increase the amount of uranium obtained from foreign producers." Cooperation among the governments concerned, mainly Britain, Canada, Belgium, and ourselves, has resulted in markedly larger shipments entering the United States. In early 1947, moreover, American output of uranium ores was at a standstill. The Manhattan District had built plants on the Colorado plateau to extract uranium contained in tailings dumps accumulated over the years by the vanadium industry; but these facilities were dismantled when the war ended. A Commission-sponsored domestic program gained headway more than a year ago and, to date, has brought about uranium production from three of the five vanadium plants located on the Colorado plateau. A fourth plant is to start operation shortly, and a fifth will be ready in 1950. Ore taken from Colorado "has nearly tripled during the past year," Mr. Williams declares, "and is increasing." The Commission also fixed a 10-year guaranteed minimum price, with a discovery bonus of $10,000 for high-grade uranium "strikes"; and Mr. Williams depicts the result as "a great surge of prospecting activity on the North American Continent." With the help of the United States Geological Survey the Commission "is carrying out a comprehensive examination of virtually every rock formation in the country, mine and smelter products, gas and oil wells, and other places where uranium might occur." Associated with such efforts is a new Commission laboratory located at New Brunswick, N. J., "to give precise assays of raw and feed materials * * * [and] to assure improved analytical control of chemical specifications * * * [plus] accurate figures upon which payments for raw materials are based. * * *"

While Dr. Bacher mentioned "major successes in the technical work which should lead to the utilization of low-grade ores," both he and Mr. Winne of General Electric especially emphasized steps taken at Hanford to "reduce very greatly the amount of raw material required." Dr. Fermi testified that the Commission has tackled the ore problem with "extreme energy" and that "nice progress is being made."

Feed materials

An aspect of production which received relatively slight attention is the feed materials program. Mr. Williams asserts that the average price of all intermediate and finished uranium feed products has declined to the point where we now pay 69 cents for what formerly required $1. At the same time, average over-all yields have increased 5 percent since January 1947; health hazards have diminished; stock piles have been accumulated as an insurance measure; and newly

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developed processes for producing "green salt" and uranium hexafluoride, he states, will lower the costs 60 percent or more when placed in operation.

Pile deterioration

The Commission's experience in manufacturing fissionable materials—plutonium and U-235—dominated considerable testimony. Dr. Bacher is authority for the statement that in 1947 pile deterioration at Hanford had caused production to be cut back; and since complete stoppage seemed a distinct and imminent possibility, the situation was regarded as grave. The Commission directed special efforts toward extending the life span of the piles, and eventually it achieved encouraging results without interrupting production.

During 1947 and more particularly during 1948—

said Dr. Bacher—

there were some major technical accomplishments at Hanford which gave us more information on the nature and origin of this [pile] deterioration and how it might be circumvented.

Later he stated that—

The plutonium production is today increasing and greater than it has been, and we can expect more in this direction in the near future, based on steps that have already been taken.

Such "steps already taken" refer partly to new pile construction started on a rush basis at the time when deterioration in the old war-built piles was causing most anxiety. The Commission decided that it needed two strings to its bow: an attack on the deterioration problem and, if that failed, replacement facilities ready for use at the earliest possible date. The resultant Hanford building program (which also included the plutonium fabrication plant, among other items) was perhaps the largest in the Nation's peacetime history and had widespread repercussions. It meant that the new piles could not incorporate as many improvements and design features as might have been possible under conditions of lesser urgency. It meant that Hanford, which is located nearer to foreign air bases than most areas in the United States, became a still more attractive potential target. It meant that the population of Richland, the community serving Hanford, swelled rapidly, creating many town-management difficulties not generated at Oak Ridge. It meant also that General Electric, the contractor, needed a top-flight construction expert to supervise operations. Mr. Winne testified that GE found such a man in Mr. Frank Creedon and entered into a special 2-year contract with him, paying the highest salary directly reimbursable by the Government in the atomic energy project, $39,000. Senator Hickenlooper noted this figure and contrasted it with the $14,000 received by Dr. Bradbury, director of the Los Alamos Laboratory. The building of "a replacement pile * * * has been completed," Dr. Bacher observed; and "the construction of further units was also undertaken." Both Mr. Winne and Carleton Shugg, Deputy General Manager of the Commission, testified that if deterioration in the war-built piles had not been checked, further replacement units, costing $150,000,000, would have become mandatory. In the words of Mr. Williams—

* * * it has been possible to defer indefinitely over $150,000,000 worth of construction that was considered essential in 1947 to keep the program going and to meet the new goals

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Chemical processes

Scattered references were made to "chemical processing" at Hanford.

There were considerable improvements—

said Dr. Bacher

* * * both in the efficiency of the present process which is used and in the development of new processes which we hope can be installed in the future and which will contribute still further to the conservation of raw material.

Asked if he felt satisfied with progress in waste recovery, Dr. Bacher replied:

The atomic energy project in general is not one to be satisfied with, regardless of what the accomplishments are * * *. I think in any phase of the project, waste recovery included * * * we could always do better.

Mr. Winne commented that—

We have reduced by 20 percent, and expect to increase this to 50 percent, the amount of liquid waste which must be stored. That will result in a saving on the order of a million dollars a year at least. We have reduced very materially the loss of plutonium going into these waste solutions * * *.

Dr. Fermi, for his part, remarked:

I would not be entirely truthful if I did not mention that there are very serious problems with which your committee doubtlessly is familiar, with which the Commission is struggling at present. They are problems of recovery, problems which will have to be solved. I believe that the steps are being taken and have been taken that will lead to such a solution.

The record quotes General Manager Carroll Wilson as saying:

The du Pont Co. * * * has recently undertaken to make a complete survey [costing $400,000, according to Mr. Shugg] of chemical-process problems involved in plutonium manufacture—a field in which there will already be found working several major industrial concerns, such as Blaw-Knox, Dow Chemical, General Electric, Kellex, Monsanto, and Standard Oil Development Corp.

Finally, the testimony brings out that Oak Ridge National Laboratory is conducting "numerous pilot-plant experiments" in the same area of endeavor.

Wende letter

Senator Hickenlooper read into the record a letter of resignation written by Dr. C. W. J. Wende, formerly a Hanford engineer in charge of the General Electric pile technology group. This letter appears to spring partly from the fact that GE has accepted wider responsibilities than any other Commission contractor. The writer charges that GE is overextended in its Hanford work; that it lacks an adequate staff; that its qualified people are unreasonably burdened; that it has no coherent program of its own; and that important functions have been neglected in the press of other duties. Mr. Winne, commenting on the letter, acknowledged that Dr. Wende "is a very distinguished scientist and has contributed much to the operation of the Hanford works." It was suggested, on the other hand, that Dr. Wende has "a scientific type of temperament—a very impatient type of temperament" and that the positive accomplishments of General Electric at Hanford constitute a sufficient rebuttal to his charges.

Lumber stock pile

Another Hanford matter, a lumber stock pile acquired in 1947, entered into Senator Hickenlooper's presentation. He showed that

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the Commission, operating through the Corps of Engineers and using a Government priority, purchased some 100,957,000 board feet for $89.631 per thousand, an inflated price reflecting the Nation-wide housing shortage. He showed further that about 22 percent of the total still remains at Hanford, with no prospect of its being used for the purpose intended. Moreover, the lumber had cost about $2 per thousand board feet over and above the price then being paid by Army-Navy procurement agencies. Deputy General Manager Shugg explained that, at the time of purchase, the problem of Hanford pile deterioration reached its peak; and those responsible feared that all the war-built piles might require separate replacements. In anticipation of such a project, the General Electric Co.—acting for the Commission and with the Commission's consent—bought up lumber as rapidly as it could. Extra cost amounting to $1.80 per thousand board feet was accepted for the sake of securing the lumber rapidly despite the tight market. Solution of the pile deterioration problem, according to Mr. Shugg, removed the need for a new construction program on the scale contemplated when the lumber was procured; and this factor, together with unexpected success in moving certain barracks from the Pasco Naval Station near Richland to the Hanford construction camp, accounts for the present surplus in stock pile. Mr. Shugg added, however, that the lumber is "strip-stacked, so we are not losing on the worth of the lumber." It may eventually be transported to Arco, Idaho, for use in connection with the Commission's reactor development program at that site. Although the price of lumber has not yet dropped, Mr. Shugg testified, some financial loss may be suffered through a future price decline and also through rehandling and reshipping costs. In response to a suggestion that the lumber might not be of sufficiently high grade and quality to be usable on the Hanford project, Mr. Fred C. Schlemmer, the Commission's Hanford area manager, stated that on the contrary, it is usable and that actually it "has an enhanced value at the present time."

Oak Ridge production

The Oak Ridge gaseous diffusion plant—i. e., the so-called K–25 facility which extends over a half mile, covers 130 acres, and cost a half-billion dollars—continued functioning and increased output while decreasing staff. In the first 2½ years of its life the Commission did not attempt to build new equipment for the isotopic separation of U–235; but within the last month construction started upon K–29, a large addition which will be "hooked on" to and integrated with K–25. The diffusion principle exemplified in the mammoth K–25 plant, according to Dr. Bacher, "outstripped the developments in the electromagnetic process represented by the so-called Y–12 facility." The Commission therefore put Y–12 in stand-by and later "in even more remote stand-by condition."

The Carbide & Carbon Chemicals Corp. has operated K–25 from the beginning, and more recently it also took over the limited activities at Y–12. Mr. Clark Center, the firm's Oak Ridge superintendent, cited—

> notable * * * improvements in the final method of handling the product from K–25.

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Both Mr. Center and Dr. Fermi called attention to a special plastic known as fluorothene, the fruit of developmental work connected with K–25 and useful in processes requiring highly corrosion resistant material. Another topic mentioned was Oak Ridge manufacture of improved barriers, the material containing billions of holes per square inch that make possible the diffusion separation of U–235 from U–238. Mr. Center indicated that the Commission's "outlook toward our operation has been very helpful, and has been a great aid to us in accomplishing our work."

Senator Hickenlooper directed a series of questions at Mr. Isaac Harter, head of the Babcock & Wilcox Tube Co., and a member of the Commissions Industrial Advisory Committee. This interchange showed that the Manhattan District, rather than the Commission, had built Los Alamos, had built Oak Ridge, had started Sandia, and had built Hanford (apart from the new piles and other additions elsewhere). Mr. Harter commented that while a "going concern" existed at the time the Commission took charge, it had not been made successful "in the sense of a long-term industrial affair." He, along with other witnesses, stressed that the Commission not only "shored up" and expanded what it found originally but also placed the entire project on a long-run, stable foundation, simultaneously effecting economies and efficiencies. As an illustration of improved operation from a dollars-and-cents viewpoint, Mr. Williams brought out that "the Commission is producing about 40 percent more plutonium per dollar spent on operating costs than was produced in the beginning of 1947." At Oak Ridge, furthermore, "the total number of employees engaged in production * * * has been reduced from about 11,400 to 4,700, an over-all reduction of 6,700." Since added activities brought 500 new employees into Oak Ridge, "the actual reduction in personnel performing the same operations in 1947 has been approximately 7,200 or 63 percent."

Personnel turn-over

These figures bearing upon "involuntary separations"—i. e., people dismissed by the Commission for economy or other reasons and against their own wishes—tie in with the first charge which Senator Hickenlooper developed during the investigation. He pointed to personnel turn-over statistics within the project: 54 percent for 1947; 33 percent for 1948; and 87 percent for the 2 years combined. These statistics, however, include persons whom the Commission released as well as those who left of their own choice. Eliminating "involuntary separations," the 2-year turn-over rate is 50.7 percent, a figure that compares favorably with Government as a whole and private industry. Less susceptible to statistical analysis was the associated charge that high turn-over rates have characterized several key positions within the Commission's own organization; three general counsels, for example, in 2½ years; three directors of organization and personnel; and a vacancy in the security directorship until August 1947, and again a vacancy from May 1949 to the present. Commission witnesses replied that it takes time to secure properly qualified people; that high salaries paid by private industry narrow the field of choice; that persons replacing those who resigned nevertheless display equal or superior ability; and

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that administrative employment in the project often involves peculiarly discouraging factors as evidenced by the case of a recent resignee, Mr. John C. Franklin. He became Oak Ridge area manager, expecting to spend most of his time on technical and production problems connected with the plants; but he actually found himself so burdened with issues arising from the Commission-owned Oak Ridge community as to leave little opportunity for other work.

Natural-gas pipe line

But the main challenge of the Commission's record expressly in the field of production concerns construction of a natural-gas pipe line to fuel the Oak Ridge power plant serving K–25. This power plant now operates on coal but will convert to gas after completion of the pipe line in question, which is to extend some 115 miles and connect with a major line already transmitting fuel from Texas to the North Central States.

About 4 weeks before the investigation commenced, a subcommittee of the joint committee (under the chairmanship of Congressman Durham) had inquired into the pipe-line matter and had submitted a unanimous report. The subcommittee did not recommend that the Commission abandon plans for the pipe line. But it did conclude that sufficient facilities for coal stock piling are available at Oak Ridge to insure continuous operation of the power plant; that a transfer to natural gas as the main fuel source is not dictated by considerations of national defense; and, further, that the Commission had neither consulted with the National Security Resources Board nor taken into account recent improvement in the national fuel picture. The joint committee as a whole unanimously adopted the subcommittee's report 1 day after the investigation began and 3 weeks after the Federal Power Commission finally issued a certificate of public convenience and necessity authorizing the Tennessee Natural Gas Co. (the Commission's contractor) to proceed with actual building of the pipe line.

Senator Hickenlooper, making use of the committee's report, suggested that the pipe line is not justified either from the viewpoint of economics or national defense. One entire morning and the balance of a second morning were devoted to discussing this project. Mr. Sumner T. Pike, a member of the Commission, and Mr. Williams were principal occupants of the witness chair. They prefaced their remarks by saying that continuous operation of K–25, and consequently of the power plant which serves K–25, is absolutely essential—a point which evoked no hint of disagreement from any member of the joint committee.

The increased safety factor obtainable through two main sources of fuel, natural gas in the first instance and coal as a reserve; general uncertainty in the coal industry and especially an experience encountered during 1946, when the Oak Ridge coal stock pile was drawn down to a point where only about 6 weeks' supply remained available; the prospect of saving $1,250,000 annually by using natural gas for the power plant rather than coal, plus additional savings attainable through a like use in the Oak Ridge community—these factors were emphasized by the witnesses as vindicating the pipe line. The

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Commission pointed out, moreover, that it had approved the project on January 27, 1948, about a year and a half previously, and that a construction contract had been signed on June 23, 1948, about a year previously. Letters addressed to the chairman of the joint committee described these developments on February 9, 1948; March 18, 1948; June 23, 1948; and October 5, 1948. The committee, nevertheless, did not take formal action until nearly 17 months had elapsed after receipt of the initial letter. By the time the Federal Power Commission finally issued a certificate and the joint committee had thereafter adopted the subcommittee's report, a decision to abandon the pipe line would have rendered the Federal Government liable in damages to the Tennessee Natural Gas Co. Furthermore, this firm had previously committed itself to the extent of making fiscal arrangements and construction plans and also procuring the necessary allocation of steel. All such reasons were offered as justification for going ahead despite the joint committee's critical report. Even further, if any agency had responsibility for consulting with the National Security Resources Board—it was said—that agency is the Commerce Department, which allocated the steel for construction, and not the Atomic Energy Commission. The testimony included statements that the committee's viewpoint is mistaken and that considerations of security, as well as economy, render the pipe line what Mr. Pike called "a pretty good deal."

A canvassing of the economic issues brought out that Oak Ridge lies in the heart of a coal-producing region; that unemployment might afflict miners in the area if the K–25 power plant ceased using coal; that neither the coal operators nor the coal unions had been approached respecting a possible guaranty of uninterrupted deliveries during strikes; that production stoppages and pipe-line break-downs are not unknown in the natural-gas industry; and that the neighboring Johnsonville steam plant, scheduled for construction at a site only 12 miles from a natural-gas outlet, is expected to operate on coal. There were still other points: that changes in the fuel price structure might wipe out anticipated savings through the use of gas; that oil purchased locally might furnish a partial alternate source; that the availability of coal had been a factor in the original selection of Oak Ridge as a suitable location for the production facilities there established; that the Nation's total proven reserve of natural gas may last only 20 or 30 years, according to present estimates, whereas coal deposits are adequate for centuries; and that steel needed to construct the pipe line had been allocated at a time when this metal was in critically short supply.

On the opposite side, it was argued that, while the Oak Ridge reservation contains almost unlimited space for coal storage, increases in the 90-day stock pile now maintained would severely raise costs. It was further shown that natural gas for Oak Ridge would emanate, not from supplies already being piped over the trunk line from Texas, but from supplementary supplies to be transported after additional construction along the main route is completed. Thus natural-gas users in the North Central States will not be deprived of fuel previously furnished them. Likewise, the possibility of technological

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unemployment among coal miners in the Oak Ridge area was described as a consideration which should not control the managers of an industrial enterprise such as our atomic project, they being responsible for an efficient and businesslike operation. In line with this viewpoint, the Commission witnesses placed principal stress upon their contention that natural gas would save the Government and the taxpayer substantial sums of money over a period of years.

The economic argument, however, was not the one most emphasized before the Federal Power Commission. There strong representations were made that national security requires the pipe line; and a certificate issued largely on the strength of those representations. If national security is indeed involved, economics may be disregarded. If not, the question of economics should alone have decided whether or not a certificate would be granted. Testimony given the joint committee does illuminate the fact that, logically, two sources of fuel are bound to furnish a better guaranty of continuity in power-plant operation than one source alone. But considering the unlimited coal stock-piling opportunities at Oak Ridge; considering truck-barge transportation as alternates to rail cars in the delivery of coal; considering the far greater menace to continuity in production that accompanies the existence of only three boilers in the power plant, two of which must always operate to service K-25; and considering that the Commission has not deemed it necessary either to build a fourth boiler or to increase the coal stock pile as an interim precaution pending completion of the pipe line—considering all these factors, whatever added protection may be gained through two basic fuel sources, instead of one, is to the last degree marginal.

The specific charges directly relating to production—the lumber stock pile, Mr. Frank Creedon's salary, the pipe line—cover items costing less than 1 percent of all sums expended in this field. The favorable evidence on production as a whole includes three similar statements by Dr. Oppenheimer, Dr. Fermi, and former Commissioner Waymack. Each comments that the situation today is substantially brighter than he had anticipated in 1947. Senator Hickenlooper said:

> From the standpoint of actual production the atomic energy program has gone forward due to the zeal and the loyalty of the scientific and technical personnel in charge of the various projects.

Later he added:

> I may say in passing that the operations of the technical facilities and production of materials have not been a question that I have raised.

Reactor Development

The people of the United States now own the production reactors at Hanford, plus five far smaller research reactors, plus a sixth improved research reactor in the final stages of construction at Brookhaven National Laboratory. The difference between the massive piles which produce plutonium for weapons and the half-dozen experimental units is somewhat like the one between a model ship used in a testing basin and a full-sized vessel that sails the high seas. One research reactor was built at Oak Ridge as a pilot plant for Hanford; and it now serves, among other purposes, to manufacture radioactive isotopes. Two more are located at Argonne National Laboratory in Chicago; and one of them uses "heavy water" both as

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a coolant and as a moderator to "slow down" neutrons. The other is the celebrated pile originally built under the Chicago University athletic stadium at Stagg Field and the first unit ever to demonstrate the feasibility of a self-sustaining chain reaction. Of the two remaining reactors, both at Los Alamos, one is exceptional because of its use of plutonium as a fuel and its fast-neutron principle. Designed at the end of the war and constructed under the Commission, it differs from the principle of an atomic bomb largely in that special neutron-absorbing materials prevent a violent release of energy.

Today's urgent challenge consists in spanning the gap between low-power research reactors and future high-power reactors capable of propelling a ship or turning industrial dynamos and turbines or perhaps driving an airplane. This gap is broader than the one which once separated the simple uranium-and-graphite lattice-work at Stagg Field, Chicago, from the production piles at Hanford. The Commission, however, is preparing to freeze design work and commence actual construction and the results may conceivably range anywhere from startling progress to expensive radiation accidents or even both. The element of hazard is one reason why the Du Page site near Chicago—originally purchased as a reactor testing station but now the scene of laboratory development only—has given way to the 100-times-larger site located away from centers of population near Arco, Idaho. There three atomic machines are expected to begin taking shape, the first late in the present year or early next year.

Arco reactors

This lead-off project is the fast reactor, which—in keeping with its name—will exploit fast neutrons and will explore possibilities of "breeding," that is, creating new fissionable material in the same process as generating energy. The second project, already in the stage of detailed design, is a materials testing reactor; and it will enable scientists to experiment, at high neutron densities, with the various novel and little-understood substances needed to withstand extreme temperatures and radiation. Such studies may open the way toward developments now altogether beyond reach. The stakes are enormous; for 1 pound of U–235 or plutonium has a potential fuel value, if it can be tapped, equal to many hundred thousands of tons of coal. The stakes are equally enormous in a military sense, as evidenced by the third project planned for Arco—a Navy thermal reactor intended to be a land-based prototype of a submarine power plant. If successful, it may affect naval operations as profoundly as the atomic bomb has affected strategy in general.

Knolls reactor

Still a fourth venture is known as the intermediate reactor, so named because of its intermediate-speed neutrons. The hope is that it will throw light upon the "breeder" principle and also point to usable industrial power. For some time uncertainty has existed as to whether this reactor would be situated at Arco, along with the other three, or at the Knolls Laboratory near Schenectady, N. Y.—which General Electric operates in addition to its Hanford commitments. Senator Hickenlooper referred to that uncertainty and to $570,000 already spent for development of the Knolls reactor

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site by asking Mr. Winne if General Electric had yet been advised of a firm Commission decision. Mr. Winne replied that, so far as he knew, the choice between Arco and Knolls was still under discussion. The joint committee has since learned that present plans envisage the intermediate reactor at Knolls. It will function at lower power levels than the three units scheduled for Arco and hence safety factors do not require that it be erected in such a remote locality.

The joint committee believes that reactor development should proceed with all possible speed, and disappointment therefore follows from reflection that, in 2½ years, the Commission has not broken ground on a single new-type high-power reactor. Both Dr. Fermi and Dr. Bacher seemed to share this feeling; but the one pointed out that "reactor problems indeed were more difficult than had been estimated," and the other declared that "the serious way in which materials would deteriorate in a reactor and the problems that this would cause in designing and building reactors to operate at high power and under conditions of high specific power were greatly underestimated." Dr. Lee A. DuBridge, president of the California Institute of Technology and member of the General Advisory Committee, told the committee that the Commission's top priority job in 1947 was "restoration of the bomb-development program at Los Alamos" and that No. 2 priority went to strengthening production of fissionable materials. Reactor development enjoyed only a third priority, in Dr. DuBridge's opinion, and "the Commission could not give adequate attention to this task until the first two were placed on an adequate footing. * * *"

Reactor Division

During 1947 the laboratories at Oak Ridge, Los Alamos, Knolls, and Argonne all performed reactor work, but as imperfectly coordinated entities. In 1948, after some manifestations of rivalry among these four, the Commission concentrated responsibility in Argonne so as to focus all problems through a single research headquarters. The Argonne director is Dr. Walter H. Zinn, the Nation's leading expert in this field; and he personally has been the principal proponent of the fast reactor—often called the Zinn reactor on that account. Oak Ridge prepared the initial designs of the materials testing reactor and is still cooperating in the formulation of final blueprints. Westinghouse Electric Co. has contracted to carry forward the Navy thermal reactor, in close collaboration with Argonne; and the Knolls Laboratory is devoting itself to the intermediate reactor, again in close collaboration with Argonne. Meanwhile, the Commission created a Division of Reactor Development under Dr. Lawrence H. Hafstad, former Secretary of the Research and Development Board; and he exercises administrative authority over Argonne, Knolls, and Arco.

The testimony furnishes illustration of the practical difficulties that beset even so esoteric a Commission program as reactors. The Knolls Laboratory, for instance, is another war-built center suffering from the common malady of temporary structures and facilities. Three years ago an important Oak Ridge group moved into a collection of huts and sheds that it found vacant behind a power plant and has continued there ever since. Argonne is not one site but a half-dozen scattered from metropolitan Chicago through such suburban areas as Du Page; and thousands of miles stretch between the Idaho testing station and

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the nodal research points in New Mexico, Tennessee, New York, and Illinois. It was Knolls which generated the most dramatic Commission labor-relations problem; for many employees of that laboratory belong to a local of the United Electrical Workers Union, whose national officers refused to sign non-Communist affidavits as required by the Taft-Hartley law. The Commission decided that since the national officers exercise some supervisory, negotiating, and disciplinary authority over members of the local, collective bargaining with such a union would not best serve the national defense and security; and the contractor, General Electric, was therefore ordered to withdraw recognition of the union. To take an entirely different example, also affecting Knolls, Dr. Bacher mentioned recent "critical assembly tests" of the intermediate reactor that failed to bear out certain advance predictions and forced an alteration in plans. "This is the course of a normal development in a new field and should be expected," he said—adding that "a great deal was learned" from the "critical experiments."

Argonne and Brookhaven

Senator Hickenlooper read a letter into the record written him by a man who describes himself as a mechanical engineer and as a former Argonne construction worker. The letter charges that certain temporary facilities, costing "probably $6,000,000 or more," merely duplicate permanent facilities "being designed and built nearby"; that "armed and uniformed guards were on duty at the office and the site day and night," although they had nothing valuable to protect; and that "this project was by far the most incompetent, unorthodox, and wasteful I have ever been connected with." Such charges were not pursued beyond the point of reciting the letter in which they appear; and the Commission made no reply. Senator Hickenlooper read another letter saying that the Brookhaven research reactor was to have been built in 1 year and cost an estimated $16,000,000, whereas construction has actually continued for 2 years and the estimated final cost is now about $23,000,000. Here the Commission commented that the $16,000,000 figure had been "unofficial"; that it overlooked sharp price rises in the labor and materials market; and that it sprang from "minimum estimates" based upon the Oak Ridge reactor, which differs from the Brookhaven project in power level, design features, and safety precautions. Plans were changed during construction with thorough awareness of the added cost, said the Commission, in order to incorporate improvements and to allow for "additional pile material [which] was found to be required."

This Brookhaven experience suggests, in miniature, the kind of problem encountered and to be encountered as the Commission presses the materials-testing, Navy thermal, intermediate, and fast reactors. Dr. Bacher and Dr. Fermi went out of their way to state, respectively, that "all of the answers are by no means clear" and that "complete solutions are not available"—thereby implying that the future will see more obstacles and disappointments. On the other hand, Dr. Bacher cited the structural materials and the fuel elements for reactors, together with the use of liquid metal coolants, as problems that "are beginning to be licked"—though they involve metallurgical advances "which 4 or 5 years ago were thought to be impossible and which 2 or 3 years ago looked extremely difficult." Dr. Fermi noted "very substantial progress * * * in ironing out

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that great mass of detail which, in a technical problem of this magnitude, constitutes the core of development." Thus the failure actually to break ground, pour concrete, and start building a large new-type reactor is not necessarily a measure of the results attained during the past 2½ years. Dr. Bacher said that "I believe today we stand on the threshold of a very great development in this field"; and he called for boldness on pain of a "major set-back of the atomic energy program." Senator Hickenlooper had stated previously that "* * * the reactor program and its development has always been one of prime urgency in the requirement for the progressive development of atomic energy."

RESEARCH

"We were strong in the last war because we were strong in science. It will be even more important, if there should be another war, to have this strength to count upon." These words of Dr. DuBridge's typify many similar sentiments expressed by qualified witnesses during the investigation. Dr. Kenneth S. Pitzer, Director of the Commission's Division of Research, submitted a statement for the record observing that in 1939 two Americans and a Chinese jointly published a one-page scientific paper on delayed neutrons—the first such article to appear. By 1943 the production piles were rising at Hanford, their operation and control dependent upon the same delayed-neutron concept described in the one-page paper. Basic research, pure seeking after knowledge for its own sake, had uncovered a fact which happened to mesh unpredictably into a persuasive hypothesis, which in turn excited the men of applied science to seek out unpredictable uses, which in turn helped build the unpredicted Hanford reactors: all in less than 4 years' time. The "delayed-neutrons" of the future lie waiting to be discovered and exploited; if we, and not our totalitarian rivals, are to mobilize them first, the method is tireless research.

Shortage of scientific personnel

But in this competition, and in the closely related struggle to make atomic energy perform peacetime tasks, we start at a disadvantage; for ours was the only major nation participating in World War II that failed to exempt scientific and technical students from military service. There is no substitute for educated brains. Men trained in the laboratory may save the lives of thousands of soldiers in the field. The injurious effect of the World War II draft upon American science is little short of grave. Elsewhere the flow of trained men through universities continued largely as before; in the United States it slowed almost to a trickle.

Dr. DuBridge described another severe handicap affecting others as well as ourselves: the ultimate source of the atomic bomb, radar, the proximity fuze and other extraordinary weapons was not the great war laboratories but the reservoir of fundamental knowledge accumulated through pure research before hostilities began. In the war years that reservoir was drawn upon to the utmost. Theoretical scientists and basic research workers, instead of keeping the reservoir replenished, dropped their efforts to understand nature and joined the laboratory teams endeavoring to translate those aspects of nature

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already understood into warlike applications. Their remarkable success does not alter the fact that science, far from advancing, stood still or actually retrogressed.

Therefore, as Dr. Bacher recalled—

> it has been one of the central ideas in the development of the regional laboratories for atomic energy, to provide facilities for the carrying out of more research and for the training of many new people in this field, since I am quite sure that in the days to come the limitation of trained people will be a very serious one.

Basic research laboratories

The testimony reflects that two Commission laboratories, one at Berkeley, Calif., and the other at Brookhaven, N. Y., are primarily devoted to replenishing the well-nigh exhausted reservoir of fundamental knowledge. Both had been initiated by the Manhattan District, although the conversion of Brookhaven from a former Army camp to a first-rate research establishment is only now becoming complete. In large measure the activities at Brookhaven and Berkeley are confined to nonsecret and publishable work because, in the words of Dr. DuBridge:

> the support of pure science, with which also goes the education of new scientists, is a totally different task from that of developing weapons of war and must, therefore, be treated on a totally different basis.

He merged this point with another which Dr. Oppenheimer, Dr. Fermi, Dr. Bradbury, and Dr. Bacher all underscored in various ways:

> * * * secrecy imposed upon basic science is actually inimical to national security. Thus, we have the paradoxical situation that for greatest national security in the field of pure science there must be a minimum of the so-called security regulations.

The Brookhaven reactor is intended not only to foster studies in nuclear physics and pile technology but also to attract, as Dr. Bacher put it, "many people who would otherwise be working on subjects which are quite unrelated to atomic energy." The $23,000,000 cost of this Commission-made reactor gives an indication why private universities, with their slender budgets, cannot alone bear the burden of basic research. No less indicative is the work at Berkeley, a radiation laboratory whose investigations into the more than 1,000 different kinds of atomic nuclei require what Dr. Bacher called "a very great concentration of energy." Such a concentration is achieved through the various multi-million-dollar particle accelerators. One of these now under construction at Berkeley will use a magnet containing 10,000 tons of steel, and another now under construction at Brookhaven will so accelerate particles as to send them a distance equal to six times around the earth in less than one second's time. The 184-inch Berkeley cyclotron, most powerful in the world today, achieved the first laboratory production of mesons—particles whose existence, according to Dr. Spitzer, was first suggested by a Japanese physicist and which "are intimately connected with the forces holding the atomic nucleus together." While discussing Brookhaven and Berkeley, Dr. DuBridge said:

> I would * * * like to pay tribute to the Commission for the wisdom it has shown in providing, as far as possible within security requirements, for the atmosphere of freedom in both of these laboratories, which is most essential to their success.

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Other research centers

Other Commission research centers are by no means idle in the field of pure science. Los Alamos and Argonne, for example, succeeded in liquefying helium 3, which has the lowest boiling point of any material—within three degrees of absolute zero—and which, in nature, occurs as only one part to a million parts of normal helium. Mr. Richard W. Cook, the Commission's Manager at Oak Ridge, also pointed out that the great laboratory there is measuring the neutron cross sections for all elements and studying the genetic effects of radiation as observed through experiments with thousands of mice. Additionally, the Commission-supported center at Ames, Iowa, has a theoretical physics division, plus a group concentrating upon the chemistry of rare earths. But, except for Brookhaven and Berkeley, Commission-supported science tends toward the applied and developmental side: Weapons at Los Alamos; reactors at Argonne and Knolls; the metallurgy of uranium, beryllium, and thorium at Ames; highly classified research at the Mound Laboratory, Miamisburg, Ohio; raw materials at the recently completed center in New Brunswick, N. J.; production problems at laboratories connected directly with the Hanford piles and the K–25 gaseous-diffusion plant; industrial research at the Battell Memorial Institute, Columbus, Ohio; and, to quote Mr. Cook, "numerous pilot-plant experiments on plutonium- and uranium-separation processes, reclaiming of uranium from various solutions and decontamination and disposal of radioactive wastes" at Oak Ridge. The closer these programs and many others veer toward practical uses, the more likely they are to be wrapped in the secrecy which all scientists find distasteful and which some scientists so dislike that, according to Dr. Oppenheimer, they are hesitant to accept Commission employment under any circumstances.

Scientist morale

The adverse effect of secrecy upon scientific morale is being reduced through periodic seminars and conferences attended exclusively by people who possess security clearance. Dr. Bradbury depicted these sessions as a vehicle whereby Commission experts not only exchange ideas and stimulate one another's thinking but also gain recognition, within the limits of the cleared group, for accomplishments which once might have attracted the applause of scientists generally. Circulation of technical papers among cleared personnel produces the same result. An ambitious young physicist is, therefore, less likely to reject atomic energy employment for fear that secrecy would prevent him from building a reputation. As a matter of fact, the number of cleared professionals available to grant recognition has become fairly extensive; for project employees include 10 percent of all the Nation's active Ph. D. physicists, 3 percent of the Ph. D. chemists, and about 1 percent of the Ph. D.'s engaged in such life sciences as biology, medicine, and agriculture.

Salary scales, another factor conditioning scientific morale, are described by General Manager Carroll Wilson as comparing favorably "with leading industrial research laboratories" except on the highest level. The directors of Los Alamos, Argonne, Oak Ridge, Brookhaven, and the like are all paid $14,000 annually, less than their services might command in industry but "comparable with good top

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salaries in the leading academic organizations and institutions of the country."

It is important,

Mr. Wilson said—

and we have endeavored to bring about a reasonable degree of comparability for comparable levels of scientific ability within these several laboratories. This is essential, lest we initiate a spiral of increases of salaries among these people or set up such differentials that there come about important shifts of people from one laboratory to another.

The record discloses that, apart from the five Commissioners, the General Manager, the Deputy General Manager, the Hanford area manager, the former Oak Ridge area manager, and 19 contractor officials supervising construction work, no one whose salary is directly paid or reimbursed by the Commission receives more than the $14,000 given laboratory directors. On the other hand, it is a fact that a number of uniquely qualified scientists are not employed full-time in the project—although the extent to which salary levels account for their absence is problematical.

Research contracts

Besides supporting four major laboratories and seven other important centers, the Commission has sought to encourage the training of new men and the revival of war-enfeebled activity in pure science by undertaking a joint program with the Office of Naval Research. From Dr. DuBridge's testimony, it appears that the Navy, appreciating the vital defense role of fundamental knowledge, had made funds available to private institutions before the Commission came into existence. The two agencies therefore consolidated their efforts and together sponsored contracts for basic research in the physical sciences. Dr. DuBridge deplored the fact that a military organization, even though it "has shown exceptional wisdom," originally furnished the sole Federal aid in this field. "Universities and scientists," he said, "feel more comfortable in having also a civilian agency with which to work and which can lend support, such as the Atomic Energy Commission." The joint program makes possible some 60 projects in more than 50 institutions; and it includes by far the largest share of all basic work which American universities perform in nuclear physics. By March 1949, however, the Commission began letting research contracts independently of the Navy, and negotiations for about 40 university projects are either under way or completed. Dr. DuBridge felt that this step might wisely have been taken sooner; but he noted that "more urgent tasks" made it impractical at an earlier date.

Biology and medicine

One broad phase of research, both basic and applied, had necessarily received only minimum attention under the Manhattan District; that is, biology and medicine. The Commission found itself (quoting Dr. Bacher) "unable to understand in any great detail the fundamental question of hazards associated with radioactive materials and particularly with the production and handling of fissionable materials." There is also the problem of civil defenses against atomic attack. How thick must the walls of concrete bomb shelters be made in order to protect people from a given quantum of radiation? What is the

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correct first-aid technique for treating casualties? How much exposure to radioactivity can a human being withstand and under what circumstances? All such civil defense questions involving biology and medicine assume considerable significance now that Russia has achieved an atomic explosion. On the peaceful side, biology and medicine range over a wide gamut from the use of radioactive materials for cancer research to genetic studies to experiments with plant fertilizers.

Consequently, the Commission appointed a group of advisers. This advisory-committee device may lead to diffusion of responsibility, procrastination, or exploitation of well-known names as a shield against criticism. But here the need for distinguished outside help was predicated upon a novel and puzzling problem; and the Commission followed the counsel given it. There came into existence, as the result, a separate Division of Biology and Medicine, under the directorship of Dr. Shields Warren. He appeared before the joint committee and declared that "our very survival is involved" in this field. His testimony called attention to the splendid project safety record: not one radiation fatality during the Commission's tenure and not a single case of radiation injury except where regulations designed to prevent known and anticipated dangers were violated. At Hanford the percentage of absenteeism is only 1.37 percent despite the potentially hazardous nature of the work; and the Commission-owned town of Richland has a mortality rate about two-thirds lower than the United States as a whole. Activities intended to procure us civil defense knowledge and know-how are under way.

AEC fellowships

As one means of repairing the damage done our science prospects when selective service interrupted the stream of oncoming university graduates during the war, the Commission acted to create a fellowship program. No National Science Foundation had been established to assume the burden of encouraging students; and hence Commission grants for studies relating to atomic energy were regarded as one immediate way of helping infuse new blood into the sciences upon which our atomic progress depends. The National Research Council of the National Academy of Sciences contracted to administer the program and to allocate fellowship funds, it being the same organization which had once awarded privately endowed scholarships to such men as Dr. Oppenheimer, Dr. DuBridge, and Dr. E. O. Lawrence, Director of the Berkeley Laboratory. Atomic energy fellows are not deemed to be "employees" within the provisions of the McMahon Act dealing with FBI investigations into the "character, loyalty, and associations" of persons given access to secret data. As a matter of judgment, the Commission decided against investigating fellows engaged in nonsecret work. If they later joined the project, the investigation would occur at that time. During their student phase, the Commission apparently reasoned, they were in the same position as an Oak Ridge school janitor or housing-construction worker, or other project employee who had no access to secrets and who consequently required no investigation.

Some weeks before the formal investigation of the Commission commenced, Vice Chairman Durham called the joint committee's attention to the fact that an avowed Communist, Hans Freistadt, had been awarded a fellowship to undertake nonsecret studies in

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physics at the University of North Carolina. By reason of this advice, as well as questions involving the fellowship program which Senator Hickenlooper raised during the confirmation hearing of Commissioner Henry D. Smyth on May 12, 1949, the joint committee considered Commission aid to students during several open sessions. Mr. Freistadt appeared before the Committee and openly testified that he is a Communist. Evidently as the result of opinions then expressed by individual committee members and by other Congressmen, the Commission altered its policy and required all fellows to execute a loyalty oath and affidavit. Moreover, a check of existing FBI records (though not a full FBI field investigation) was henceforth to be made in each instance. Mr. Freistadt and one other fellow refused to sign the affidavit, and their grants were consequently withdrawn; and 19 other scholars, of 497 in all, had not been heard from at the time a tabulation was submitted for the record.

In Senator Hickenlooper's original May 22, 1949, press release charging the Commission with "incredible mismanagement," he made no reference to Mr. Freistadt; but he did name as one specific "fiasco" the case of Dr. Isadore S. Edelman, who received a fellowship notwithstanding alleged doubt as to his loyalty. Dr. Edelman testified before the joint committee during the interim between the issuance of Senator Hickenlooper's statement and commencement of the formal investigation. He strongly denied Communist leanings or any taint of disloyalty, although he admitted that out of curiosity he and his wife had attended two Communist meetings.

While the fellowship topic was thoroughly canvassed during prior hearings, it figured somewhat in the investigation itself. Dr. DuBridge and Dr. Fermi, among other witnesses, argued that FBI field investigations of students doing nonsecret work would constitute a menace to academic freedom. Their testimony cites the danger of bringing "police-state apparatus" into the lives of young men still inclined to test whatever new ideas attract their attention and entitled to "speak carelessly" as a privilege of their youth. The purpose of the fellowship program is not to train future employees of the Commission, it was said, but to increase the total supply of scientific talent available in the United States.

According to one estimate, only about 15 percent of the fellows would ever enter the project; and hence investigations now, without waiting to see which people would finally need secret information, could only waste public funds. Scientific ability was held to be an eccentric factor which manifests itself in young men without regard to political conviction. The point most frequently appearing in the testimony is this: Nearly everyone would prefer that Government funds not be used to educate even one or two Communists; but the methods needed to identify a stray subversive student are worse than letting him escape unnoticed. Finally, the suggestion was made that the "GI bill of rights" occasionally assists a Communist and that no valid distinction can be drawn between such assistance and the rare Communist who may slip into the fellowship program.

On the opposite side of the discussion it was strongly maintained that the American people will not and should not tolerate the allocation of public money to anyone conspiring against the Government. Communists benefiting under the "GI bill of rights," it was stated,

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fall in a unique category, since their stipend represents a species of payment for services rendered to the Nation in time of war. Furthermore, no man has a vested right to Government financial aid; and the people of the United States are justified in attaching such conditions as they, through their representatives, deem fit when making fellowship awards. The argument that a gifted student, by training himself, is performing a national service and not receiving a gratuitous "hand-out" was met by the counterargument that, in the field of atomic energy, unusual safeguards are necessary, and that a subversive might use his skills to profit a foreign rival of the United States. In reply to the argument that FBI investigations represent the first small-scale wedge leading to grave encroachments upon academic freedom, it was stressed that Communist infiltration also begins on a small scale and that it, too, must be taken seriously and determinedly curbed for the welfare of all American institutions. As for the argument that a young man who exhibits subversive leanings is probably not a "hard-core Communist" and that, with greater maturity, he may well see the fallacy of totalitarian dialectic, it was contended that such an outcome falls short of certainty and that the risk is not worth taking. Also relevant is the point that employees of the Government and members of the armed forces are all subject to FBI investigation, and yet they raise no objection: Why, then, should scientists protest?

The Congress of the United States has now resolved the fellowship issue. It subscribed to the arguments favoring a full FBI investigation of students in the nonsecret field and incorporated an amendment to this effect into the independent offices bill of 1949. Congress also endorsed the over-all program by appropriating money to support it.

Isotopes

An important tool in refilling the reservoir of basic knowledge drained during the war is the radioactive isotope. It differs from "normal" stable isotopes of whatever element is involved, not in its chemical properties, but in its spontaneous emission of particles which can be traced and measured. According to the testimony of Dr. Oppenheimer, radioactive isotopes—or radioisotopes—were discovered and progressively exploited during the last decade before the recent war. At that time they were manufactured principally through "atom smashers"; i. e., cyclotrons or other types of particle accelerators. With the development of atomic piles and reactors, it became possible to irradiate materials and to create radioisotopes far more cheaply and plentifully than before. Distribution of these pile-produced isotopes at cost to research laboratories thus gives a fillip to the advancement of fundamental science.

On September 3, 1947, President Truman announced a Commission decision to export certain isotopes outside the United States. Strict conditions were attached. Foreign governments whose scientists request a shipment must agree to supply our Commission with progress reports on the use made of the isotopes once every 6 months and, in addition, to permit publication of such progress reports. Foreign governments must also promise that the isotopes will actually be devoted to the purposes given as justification for the request: namely, biology, medicine, or basic research in other fields. Finally,

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qualified scientists, irrespective of nationality, are entitled to visit the laboratories utilizing American-made materials and to obtain information freely on the results achieved.

The State Department was consulted at the outset and, on the strength of Commission assurances that the program would not impair national security, it expressed approval. Members of the Military Liaison Committee, as well as Secretary of Defense James V. Forrestal, were individually aware of developments, and they interposed no objection. The statutory General Advisory Committee had unanimously recommended the policy which the Commission followed, and a special advisory group was appointed to give counsel on implementation. The Commission issued detailed regulations to its staff at Oak Ridge, the main center of isotope production, governing the eligibility of nations to receive radioisotopes. Provision was made for the State Department to screen applicant countries. In analogous fashion, the Commission developed a procedure to insure that the Military Liaison Committee would review any additions to a prescribed list of exportable isotopes. Notice of all these matters was submitted to the Joint Committee on Atomic Energy, which considered them extensively in executive session. Since 1947 the Commission's staff at Oak Ridge has dispatched more than 8,000 isotope shipments, most of them to laboratories inside the United States, but some 600, or about 8 percent, to laboratories abroad. No shipment has ever been consigned to an iron-curtain country.

On June 8, 1949, however, Senator Hickenlooper raised a question in this phase of research which occupied the investigation throughout the better part of three meetings. He pointed to the fact that one millicurie of Iron 59 (contained in 4.7 cc. of iron chloride in solution) had recently been sent the Norwegian Military Establishment for studies upon the diffusion of iron in steel at high temperatures. Senator Hickenlooper suggested that such a shipment—particularly to a military establishment—could assist the receiving country to develop jet engines or industrial appliances; therefore it has a "potential imperilment to our national security" and constitutes "a violation of the spirit and, I believe, the letter of the law." During the three meetings mainly devoted to isotopes, he several times stated that his charge went exclusively to the one iron 59 shipment and that he neither raised the issue nor expressed approval or disapproval of the foreign program as a whole. But a month later, on July 8, he expanded the area of criticism by saying:

> * * * it is my opinion that the [McMahon Act] does not give any authority for the distribution of isotopes outside of the jurisdictional limits of the United States.

Accordingly, the isotope program must be examined in some detail. Three main issues are presented: (1) whether or not the iron 59 shipment to Norway violated the law; (2) whether or not all isotope shipments abroad violate the law; and (3) whether or not such shipments represent wise judgment and sensible policy.

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The foundation of any argument that sending isotopes outside the country is illegal lies in section 10 (a) of the act, which reads:

SEC. 10. (a) POLICY.—It shall be the policy of the Commission to control the dissemination of restricted data in such a manner as to assure the common defense and security. Consistent with such policy, the Commission shall be guided by the following principles:

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

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

Commissioner Lewis L. Strauss, who had dissented from his colleagues when they first voted for foreign isotope shipments, informed the committee that he regards section 10 (a) as a prohibition.

In August 1947—

Mr. Strauss testified—

I apprehended what today I know to be a fact, that radioactive isotopes would be increasingly useful in providing information not only for atomic energy research but also in a vast field of industrial and military applications not involved in production of the atomic bomb itself.

This statement, read in the general context of Mr. Strauss' remarks, suggests a legal syllogism: Isotopes may be used to acquire information for industrial purposes; the McMahon Act forbids "exchange of information with other nations * * * for industrial purposes"; therefore the McMahon Act forbids the export of isotopes.

If there be a flaw in such a syllogism, it involves equating the possible with the actual. France or Britain or Norway might conceivably take isotopes received from us and furtively exploit them for applied research in the industrial and military sphere. Yet the conditions of shipment dictate that foreign recipients confine their use to biology and medicine and basic research, leaving applied research alone. If these recipients have in fact abided by their agreement, then assuredly there has been "no exchange of information with other nations * * * for industrial purposes." Furthermore, the conditions of shipment—biannual reports, publication, and reception of visitors—give assurance that any violator would be discovered and his supply of American-made isotopes shut off. If such assurance were regarded as inadequate, the remedy might well consist in stiffening the conditions of shipment and not in halting the shipments themselves. No witness argued, however, that the friendly countries which alone receive our isotopes have deviated from their promise to keep within the bounds of biology and medicine and fundamental science. By the same logic, no witness argued that a real "exchange of information * * * for industrial purposes" has taken place.

Commissioner Strauss once proposed, as an alternative to the Commission program, that certain foreign research workers be allowed to undertake medical and biological studies with a limited class of isotopes in United States laboratories and further that, "in cases where isotopes were urgently required abroad for medical treatment of sick people, they be provided in all locations where supervision could be supplied from the staffs of our consulates." It is interesting to note that the

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foreign shipment feature of this proposal raises the theoretical possibility that recipient nations would seize the isotopes intended for sick people and devote them instead to industrial research. If the possible must invariably be equated with the actual, therefore, any export of isotopes—even for the sole use of sick people and under the control of our consular staffs—might be considered an illegal "exchange of information with other nations * * * for industrial purposes." Another way to view the matter is to assume that both Mr. Strauss and his four colleagues favor some foreign shipments under some circumstances and that they differ only on a difficult question of judgment, namely, the kind of shipment conditions needed to prevent use of isotopes "for industrial purposes." The dissenting Commissioner himself observed that "the legal question may not be so important as in this case what seemed to me to be prudence and judgment."

It is of course true that a long chain of causal relationships connects basic research with the unpredictable practical results which may eventually follow. But unless pure science and applied research are recognized as separable, the simplest calculation in arithmetic might come under the heading of sensitive data; for science is a seamless web, and any knowledge, however banal, may ultimately play a role in the making of a bomb. As Dr. Oppenheimer said:

> You can use a shovel for atomic energy—in fact, you do; you could use a bottle of beer for atomic energy—in fact, you do * * *. There is no hard line but there is such a great difference between development and engineering on the one side, and science on the other, that I think it is a clear-cut thing.

The McMahon Act itself recognizes this distinction. While it forbids "exchange of information with other nations * * * for industrial purposes" (i. e., applied research), it also declares—

> That the dissemination of scientific and technical information relating to atomic energy [i. e., pure research] should be permitted and encouraged so as to provide that free interchange of ideas and criticisms which is essential to scientific progress.

This last provision ties in with section 1 (a) of the act which states that—

> subject at all times to the paramount objective of assuring the common defense and security, the development and utilization of atomic energy shall, so far as practicable, be directed toward improving the public welfare * * * and promoting world peace.

On the assumption that export of certain isotopes has no adverse effect upon our national security, a Commission decision not to send any shipments abroad for biology and medicine and pure research might perhaps merit criticism as a failure to permit and encourage "dissemination of scientific and technical information" [required by sec. 10 (a) (2)] and as a further failure to improve the public welfare and promote world peace [mentioned in sec. 1 (a)]. These parts of the law, although the dangerous international situation restricts their application, are still not dead letters.

The committee spent considerable time discussing whether or not an isotope is "atomic energy" within the meaning of the clause, "* * * there shall be no exchange of information with other nations with respect to the use of atomic energy for industrial purposes." Section 18 (a) in the "Definitions" portion of the act has this to say:

> The term "atomic energy" shall be construed to mean all forms of energy released in the course of or as a result of nuclear fission or nuclear transformation.

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Dr. Smyth, scientist Member of the Commission, noted that pile-produced isotopes may result directly from nuclear fission (appearing as "fission products") or from neutron bombardment made possible through fission. Senator Hickenlooper then advanced the argument that isotopes are "forms of energy released in the course of or as a result of nuclear fission"; that isotopes are therefore "atomic energy" as defined by section 18 (a); and that hence isotopes are "atomic energy" for purposes of section 10 (a) (1) which prohibits "exchange of information with other nations with respect to the use of atomic energy for industrial purposes." On the other hand, the Commission's General Counsel, Mr. Joseph Volpe, Jr., suggested that "atomic energy" as defined in section 18 (a) "is the process within the reactor itself and not the byproduct, radioisotopes"—in other words, "the method by which the isotopes are produced and not the isotopes themselves." Dr. Oppenheimer was asked what the definition of "atomic energy" in section 18 (a) means to him as a scientist, and he replied:

> * * * coal is atomic energy by this definition; oil is atomic energy by this definition; people are atomic energy by this definition * * * because all result from "nuclear fission and nuclear transformation."

Dr. Oppenheimer echoed a previous remark of Dr. Smyth's by adding that—

> If I were to define "atomic energy" for the purposes of this act, I would exclude radioactive isotopes from the definition.

Later Mr. Volpe called attention to section 5 (c) which deals with "Byproduct materials" and which clearly defines them to include radioisotopes—thus impliedly placing these outside the act's separate definition of "atomic energy." Section 5 (c), furthermore, authorizes distribution of byproduct materials "for research or development activity, medical therapy, industrial uses, or such other useful applications as may be developed." The next subsection—5 (d)—forbids the Commission to export fissionable material, such as plutonium and U–235. "Therefore," Mr. Volpe observed, "we find in section 5 specific and express authorization for the distribution of radioisotopes, and in the very same section a flat prohibition with respect to the export of fissionable material." From this sequence he inferred that Congress did not intend its use of the phrase "atomic energy" in section 10 (a) (1) to cover isotopes or to prevent their export for humanitarian and basic research purposes.

It may also be wondered whether or not the inclusion or exclusion of isotopes within the term "atomic energy" makes any difference in assessing the charge that the Commission's foreign shipment program violates the law. Let it be supposed that isotopes are in fact "atomic energy" under the act. The word "isotopes" might then be substituted for the words "atomic energy", in which case section 10 (a) (1) would read—

> * * * there shall be no exchange of information with other nations with respect to the use of isotopes for industrial purposes.

Such an exchange of information was not alleged by any witness during the investigation.

A more pertinent inquiry is whether or not isotopes are "information"—that is, whether or not section 10 (a) (1) may properly be taken to mean "* * * there shall be no exchange of isotopes [substituting the word 'isotopes' for the word 'information'] with

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other nations with respect to the use of atomic energy for industrial purposes." But the impropriety of this substitution at once becomes apparent. "Information" consists of intangible ideas and relationships; isotopes are physical, material substances. Surely the two may not be identified if the law is read literally. The spirit of the law might tend to justify stretching the literal language and associating isotopes with "information" only if the basic question in issue were whether or not we should allow foreign nations to use our shipments "for industrial purposes". Yet this is not the question in issue. The real question is whether a section in the law dealing with "industrial purposes" affects a Commission export program which restricts the beneficiaries to pure science and biology and medicine.

During the hearings Chairman McMahon, original sponsor of the Act, observed:

> * * * I may say that the problem of the shipment of radioactive isotopes was very carefully considered in the committee when we deliberated on this Act, and we, equally deliberately, provided that the uses of atomic energy for industrial purposes and the prohibition on the dissemination pertaining thereto did not include radioactive isotopes.

Accordingly, the legality of sending one millicurie of iron-59 to the Norwegian Defense Establishment may well be determined by asking how the isotope has been used. In requesting it the Norwegians expressed a desire to study the diffusion of iron into low-iron alloys. "This," according to Dr. Oppenheimer, "is a basic problem in metallurgy which is being studied on an open basis in several centers, Stevens Institute, Carnegie Institute, and one other place in this country, open and publishable." From Dr. Oppenheimer's testimony it appears that the Norwegian Defense Establishment resembles the United States Navy, which lets out contracts to perform much of our own fundamental work in physics. Thus the one millicurie of iron 59, though consigned to a foreign military organization, is said not to have involved applied research or to have deviated from the original policy approved by the Commission.

The judgment factors bearing upon the isotope program are intertwined with the broad legal issues; for the architects of the McMahon Act sought above all else to foster the national defense and security. This objective must therefore underlie and sustain any sound opinion as to the wisdom of exporting isotopes.

Mr. Lilienthal recalled the fact that the Manhattan District, in the last year before it relinquished control, "allocated" certain isotopes to Britain and Canada. The Manhattan District, in addition, issued announcements which "indicated that sales to foreign nations would be initiated after domestic requirements had been met and the necessary distribution procedures developed." A memorandum written by Col. (now Maj. Gen.) Kenneth D. Nichols, third in command of our wartime project, states that—

> The Atomic Energy Commission might logically approve sale to foreign nations of isotopes * * * provided these isotopes are surplus to United States requirements and are to be used for publishable scientific investigations or clinical investigations or treatment.

Documents read into the record at the hearings seem to make clear that the Manhattan District did intend to export isotopes to Britain and Canada; that it committed itself morally, if not legally, to benefit

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other foreign countries in a similar way; and that if it had retained responsibility, a program similar to the one now operating would probably have been undertaken.

Commission records, according to Dr. Oppenheimer, disclose that the United States Defense Establishment—despite its tremendous scope and the hundreds of millions it spends upon research, basic and applied—has not once sought to utilize radioisotopes for any purpose. He drew the inference that foreign military activities in western Europe, being on a much smaller scale, are not apt to depart markedly from our own experience.

The isotopes here considered—

Dr. Oppenheimer continued—

are isotopes which would exist and which would be useful if there were no uranium, if the fission process were impossible, if the number of neutrons emitted were too small to sustain a chain reaction, or if the Government of the United States had not allocated a nickel to the atomic energy program.

It could hardly be maintained that the isotope program, standing alone, will win us the unreserved good will of European scientists; but our program certainly does not reduce the chance that such scientists, in an international emergency, would side with the United States rather than with Soviet Russia. Again, American export of isotopes might save the recipients thousands of hours during which their own cyclotrons would otherwise have been tied up producing the same material which we provide them at cost. This saved cyclotron time might possibly enable them to manufacture material desired in applied research and engineering. The Commission stipulates only that foreign nations employ American-made isotopes for pure science and biology and medicine—not that they employ locally made isotopes for those purposes. Nevertheless, a refusal on our part to cooperate would stimulate scientists abroad to expand and perfect their own producing facilities and to make themselves independent of us. Already Britain, France, and Canada possess piles; and they are engaged in distributing isotopes. The record discloses, for example, that Finland once requested a certain substantial shipment from the United States. While our Commission deliberated, the Finns procured what they wanted from Great Britain, thereupon withdrawing their American application.

Even more important, we lead the world in translating fundamental scientific advances into tangible results. Such practical uses as may flow from isotope experiments abroad should profit America faster than any foreign nation and consequently enhance our "security by achievement." To quote Dr. Oppenheimer:

History again and again shows that we have no monopoly on ideas, but we do better with them than most other countries.

He emphasized that Europeans were the ones who, for the most part, blazed the research trail which led to atomic bombs—

but it was not in Europe but in the United States that the first atomic bomb was actually manufactured.

Later Dr. Fermi added:

* * * I believe that the generous distribution of isotopes, both within the United States and to foreign countries is exceedingly right, and has done much good to this country.

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Dr. Oppenheimer summarized his presentation by saying that isotopes—

> were discovered in Europe; they were applied in Europe; they are available in Europe; and the positive arguments for making them available have been * * * laid before you * * *. They lie in fostering science; they lie in making cordial effective relations with the scientists and technical people in western Europe; they lie in assisting the recovery of western Europe; they lie in doing the decent thing.

It would be a tragic day for America and for the world if our atomic energy policy left even the faintest impression that "doing the decent thing" is suspect because it happens to be humanitarian.

Where the Department of State, the Department of Defense, and the Military Liaison Committee have no objection to a program; where the General Advisory Committee unanimously underwrites it; where the military would apparently have undertaken the same program had they remained in charge; where a foremost expert, Dr. Oppenheimer, states unequivocally that "no security jeopardy is involved"; and where testimony tends strongly to instill the belief that our national defenses are strengthened, not weakened—where such circumstances obtain, the committee would find itself hard-pressed indeed to conclude that the law has been violated or that defective judgment has been exercised.

But this conclusion by no means reflects upon the quality of judgment individually exercised by Commissioner Strauss in his dissent on the isotope issue. Difference of opinion is a symptom of health within the Commission, tending to guarantee a fuller and richer analysis of problems. The existence of invariable unanimity would create doubt as to whether the five-man directorate were functioning as Congress intended. The presence of dissent, on the other hand, implies that democratic methods underlie Commission management and, not incidentally, that the dissenting Commissioner contributes keen and independent thinking to policy formation.

Our over-all research efforts, of which isotopes are only a phase, appear from the testimony to be progressing, insofar as they lend themselves to measurement. Since mid-1947 the number of scientific and technical personnel in the project has increased from 4,100 to 6,500.

> * * * during 1946—

said Dr. Bacher

> the technical developments * * * had slowed not to a stop but were so slow that motion was hard to detect.

Today from one-third to one-half of all research recently reported in the Physical Review, leading journal of nuclear physics, is supported wholly or partly by the Commission; and further substantial Commission-aided research is reflected in technical journals covering many additional scientific fields. Dr. Pitzer declares:

> The time lag between discovery and exploitation is being shortened. The Commission is equipped to follow leads immediately. The facilities and the laboratories and the manpower are available to develop a fundamental discovery, to run it through the pilot stage and into production.

In Senator Hickenlooper's words:

> * * * I have tried to make utterly clear that I feel the scientific people who are engaged in this process, this whole program, have done a tremendously fine

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and integrated job. I believe their integrity has been high and within the limitations of the tools and the programs that they have to work with; I think they have done a reliable job for the country and for the whole atomic energy set-up. * * * Scientific and technical development, I think, has gone forward, after the hiatus that occurred after the dropping of the bomb on Hiroshima. * * *

COMMUNITIES

The Commission's 1947 legacy from the Manhattan District included Oak Ridge, Richland, and Los Alamos—each a war-built, Government-owned, Government-directed, single-industry town consisting mainly of temporary structures and serving unique plants which require high-grade operators and which function under conditions where interrupted production is unthinkable. Dr. Bradbury of Los Alamos testified:

> I cannot emphasize to you too strongly the importance of providing for technical personnel adequate homes, adequate community facilities, adequate schools, and adequate medical care.

The Manhattan District employed 7,100 scientists during the war; by mid-1947 about 5,500 of them—or nearly four in every five—had departed to other pursuits. How attract and hold such experts as these, not to mention thousands of skilled and unskilled workers, guards, secretaries, foremen, engineers, technicians, craftsmen, designers, and specialized help of all descriptions?

The Commission might perhaps have elected to sell the hutments, quonsets, dormitories, and submarginal edifices that largely comprised the three towns and to withdraw from community government and affairs—thereafter letting economic winds blow as they may. But Los Alamos was and still is surrounded by a fence, with stores, dwellings, and recreation centers located in juxtaposition to highly classified technical areas. Barricades also enclosed the town of Oak Ridge until April 1949. If the communities had been cast adrift, people urgently and continuously needed in the plants might possibly have been persuaded to accept employment; yet the hardship and isolation pay furnished them as an inducement would have soared to startling levels and would still not have averted a high turn-over rate. No such decision to cut loose the communities was made. The Commission determined, instead, to retain all three; to operate them through contractors; and to carry out a developmental and permanent construction program—with the goal of establishing towns which (to quote Mr. Schlemmer, Hanford area manager) "will ultimately approach normalcy."

Richland, which serves the Hanford Works, grew from a prewar population of 200 people to 16,000 in 1947 and 23,000 at present (exclusive of a construction camp located nearby). Some 1,857 permanent-type houses, two large schools, churches, and other structures have been built during the Commission's tenure; about 50 private commercial concerns (an increase of 13 over the concessionaires active in 1947) now lease real estate from the Government and run various businesses; Commission and contractor personnel required to administer the community have declined from 809 to 659 since 1948, a total of 18.5 percent; house rents were recently increased to the accompaniment of local protest even though the charges remain lower than those paid in neighboring communities; and a town council, having an advisory function only, has been elected. The testimony reflects a somewhat similar pattern for Oak Ridge:

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1,582 permanent new housing units completed or under construction; overhauling of school plant and fire and police protection; rent increases accompanied by protest; an elected advisory council; and a 40 percent reduction in community service and administrative personnel. At Hanford, however, the General Electric Co. contracts to operate not only the plants but the town as well; whereas, at Oak Ridge, Carbide & Carbon operates the plants and a separate contractor, Roane-Anderson, operates the town. Los Alamos differs from the Richland and Oak Ridge situation principally in that it supports a smaller population—some 8,400 people—and its ambitious permanent construction program is closer to the terminal point.

Free enterprise

The hearings produced allegations that free enterprise is not given sufficient scope in the three atomic energy communities. Senator Hickenlooper, for instance, read a resolution sent him by the Allied Daily Newspapers of Washington State and charging that the Commission intended "to permit but one newspaper to be established" in Richland. Later testimony developed that any publisher may gather news and circulate his editions through the town; that official plans related to establishment of a newspaper printing plant; that one such plant was first contemplated; that criticism of the "monopoly" conditions which might exist if only a single plant were built led to a change in plans; and that, finally, the Commission invited bids for six sites "without restriction on the number of successful bidders up to six." The record also reveals that 2 years ago a plumbing firm was verbally encouraged to enter Richland, lease space, and prepare to do business. It expected to take over the plumbing maintenance work performed by GE. But after $70,000 had been spent upon equipment and a building, GE evidently changed its mind and decided not to divest itself of responsibility for community plumbing. The new firm in consequence lost a substantial sum of money and has decided to leave town as a result. Under the circumstances this firm should not have been encouraged to enter Richland in the first place.

Senator Hickenlooper objected to—

> what I believe is a continuation of the utter monopolistic control or paternalistic control, if you please, over what is supposed to be or bandied about as being a free-enterprise operation of the town of Richland now.

As documentation he had read a typical lease provision in which a private firm—

> agrees to abide by such rules and regulations as General Electric or the Commission may from time to time establish pertaining to the use of the structures, *the operation of the business*, or to the health, sanitation, fire protection, and safety of the residents of Richland. [Emphasis supplied.]

The Commission's general counsel, Mr. Volpe, admitted that under such a clause the Commission could require private firms to operate on what it alone considered to be a businesslike basis; and the suggestion was then made that "you have got a perfect pattern here for fascistic control over business * * *." But Mr. Volpe argued that in Richland the Government is not only the landlord but also the municipality—and that the terms of leases with private firms are far from improper or unduly repressive making allowance for municipal as well as landlord functions. In other words, he contended, Commission "rules and regulations * * * pertaining to the operation of the business" are equivalent to fire and safety ordinances in a

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normal American city. Asked what the Commission had done at Richland to control the operation of private businesses, Mr. Shugg mentioned one "spot-check survey" of market prices in the surrounding area that he himself initiated.

It did not show any hiking of prices except possibly in the instance of one chain store, and we * * * called that to the attention of the General Electric concession department, and asked them to have that operator explain those prices. No other action was necessary.

Mr. Shugg agreed with Senator Hickenlooper that Richland is not a place where any enterprising person has carte-blanche to start a business and succeed or fail according to his own merits. On the contrary, a would-be entrepreneur must submit a competitive bid and, if successful, pay rent calculated on the basis of gross receipts—and bidding opportunities are limited by the amount of land available in strategic commercial locations and also by Commission-formulated zoning regulations and long-range development plans. Mr. Shugg said he had considered and rejected the alternative of a rent-free "first-come, first-served" system.

It almost looked to us as though, if we were to open this up to let nature take its course, we would have to open up a very large piece of that desert land. There was not any of it available in the center of town where these businesses would be wise to set up, and then we would have to practically set, after advertisement, a starting point and a dead-line date and fire a gun and let the first-come, first-served principle take effect.

Moreover, the population in and around Richland tripled from 11,500 to 36,000 within less than a year and a half. Both labor and materials were in short supply locally, and if business firms desiring to enter the town had been given free rein, Mr. Shugg feared, they would have absorbed resources needed for essential plant construction.

Apart from these arguments, he noted that space now open to private companies in Richland has not been filled—pointing up the difficulty of creating a competitive situation. It is also possible that the unfilled space reflects a feeling on the part of businessmen that Commission regulations are too restrictive to afford them opportunities for a successful venture; and the Committee calls the Commission's attention to the clause in the McMahon Act which requires the encouragement of free enterprise so far as national security permits. According to Mr. Shugg, however, Oak Ridge has made more progress than Richland toward a sound commercial policy, that is, one based upon many units mutually in competition. Mr. Carroll Tyler, manager of the so-called Santa Fe office, added that the drifting state of Los Alamos town affairs current in 1947 contributed to low morale and that careful administration and direction in the past 2 years has produced a reverse effect.

Water system

Senator Hickenlooper called attention to two Richland community projects which cost the Government more than necessary. One involved a sanitary water system upon which work was started and then abandoned in favor of a substitute method after about $241,000 had been spent. Mr. Shugg explained that unexpected construction

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snags, plus technical advice different from that originally followed, brought about the decision to start along a new, cheaper path.

* * * moneywise we have not lost out—

he said—

We have gained. * * * Now, of course, we would not like even to have incurred the cancellation charges of $241,000, but the question was * * * whether or not we would keep bullheadedly ahead on it or recognize the chance of something better and change fast, which is, anyway, what we did.

Carmichael School

The other Richland project, known as the Carmichael Junior High School, was initially estimated to cost $1,786,000 and will end by costing about $3,996,000—an overrun exceeding 100 percent. According to Mr. Lilienthal, "* * * the Commission made the decision that there was a matter of urgency here; speed was necessary," because of the school's role in helping persuade first-rate technical and administrative personnel that isolated Richland would be a suitable place for them to live and educate their children.

With that decision—

Mr. Lilienthal continued—

went a realization that you could not have a detailed set of drawings, estimates, the way you would carry on a normal undertaking. Therefore, we had to accept the responsibility then for the likelihood that these estimates would not be as close to actual costs as * * * something else, carried on under different conditions of urgency.

Despite the rush methods used in building the project, however, it was not finished by the scheduled completion date of September 1948.

Mr. Winne, of General Electric, testified that the original estimate does not reflect the added expense of preparing a 500-car parking lot; increasing the size of the school building from 86,000 square feet to 101,000 square feet; overtime and materials premiums; and the use of a sloping site which constituted the only available space convenient to the community. The final estimate, moreover, includes $742,000 in "indirect costs" representing depreciation of construction equipment, various administrative and overhead expenses, and $100,000 isolation pay arbitrarily allocated to the school for accounting purposes. (Only employees who "work behind the barricades"—i. e., on the Hanford atomic plants—receive isolation pay; but because GE conducts all activities, in town and at the production center, it spreads some charges pro rata throughout the entire enterprise for convenience in bookkeeping.) Dr. Winne again mentioned that all Hanford building jobs, involving some $235,000,000, had produced a composite overrun of only 3 percent; and he observed that General Electric, in its private commercial business, recently experienced upset cost estimates somewhat similar to the Carmichael School. Mr. Schlemmer added that Congress had altogether appropriated $335,000,000 for Hanford projects and that, in light of current estimates, $10,000,000 less than this sum will actually be spent.

On the other hand, Dr. Winne said:

Now, looking back with hindsight, this design, in my opinion, is somewhat more elaborate than is needed for that school. Probably you may say that the General Electric Co. should have caught that in the design stages, and looking back with hindsight we can say the same things to ourselves and criticize our-

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selves for not doing it. Of course, at this same time we were carrying on a construction program of important production facilities many, many times in volume of the school item, and so that it probably suffered in supervision as compared to the important production facilities, and if we were doing this alone, I think we could make—doing it over again—we could make a considerable reduction in costs. We must admit that.

The joint committee, by action of its chairman, engaged the firm of E. J. Kump and Mark Falk, consulting architect and engineer, San Francisco, Calif.—which has extensive experience with school construction—to make a survey of the Carmichael project and submit its independent findings. The resulting report (fully set forth in the appendix to the investigation hearings, together with Commission and General Electric comments) lists the following conclusions:

1. The determination to construct a single large central junior high school was inadequately made. This project was ultimately abandoned [in favor of building two schools] with considerable loss of time and money. This was a major factor that contributed to the formulation of an unrealistic time schedule for construction of the Carmichael School. This resulted in the adoption of inefficient and costly construction policies.

2. The policy adopted for the general administration of the work resulted in inordinate allocation of costs for management and overhead for a project of this type.

3. The planning and programing, as a basis for the design of the project was inadequate, and manifested a lack of cooperation with State and local agencies.

4. The original estimate of direct construction cost for the project, $1,488,000, was reasonable and apparently soundly made relative to the cost of other schools in the area.

5. The school as built is not unreasonable in quality of materials, equipment or facilities relative to projects of a similar nature in the area or the Pacific coast region generally.

6. The school project as finally constructed could be considered of average quality in plan and design although it fails to meet in numerous instances generally accepted minimum educational standards for a building of this type, as well as those recommended by the State of Washington.

7. The time schedule for the design and construction of the project was unrealistic. This contributed in a large degree to the adoption of inefficient policies concerning the methods to be employed in the construction of the project.

8. In the opinion of this firm, a reasonable estimate of cost for the work, considering all factors and following usual and normal procedures for construction of the work, would be $1,917,692.

9. The reported cost of the work to date is approximtely $3,650,835 or $1,733,143 in excess of the cost of other school projects similar in nature, scope, and quality constructed in the State of Washington and other States of the Pacific coast region.

10. In general the excessive cost of the work was primarily the result of the policies and conditions under which the project was planned and constructed. The complexities in the building design are unquestionably a result of these policies and not the basic cause of the high cost of the work. The fixed conditions and quality of materials were relatively minor factors.

11. It is entirely possible that as a result of this preliminary study additional information and data may be produced or developed which may modify or affect the conclusions reached on the basis of presently available information.

Los Alamos matters

Several community matters at Los Alamos were made a part of Senator Hickenlooper's presentation. He remarked that Fuller Lodge—the Los Alamos visitors' quarters—had been expanded by 28 guest rooms at a cost of $329,220 or about $12,000 per room. Mr. Carroll Tyler replied that the $329,220 figure also covers office space, a new lobby, a kitchen, storage facilities, and sleeping space for service personnel.

The total cost per square foot, including the addition of the furniture and the addition of the kitchen equipment, the addition of the ice boxes, and all the

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equipping of this thing, including rugs and curtains * * * came to a total of $21.41 per square foot * * * well within reason on hotel construction.

Senator Hickenlooper next suggested—

that the Boy Scout lodge was built at Los Alamos at a cost of approximately $50,000 and paid for by the Government.

Here Mr. Tyler replied that the facility is in fact a youth lodge used by numerous organizations, made "more cheaply than stucco," and built through the same lump-sum type of contract that now characterizes all Los Alamos community construction. As regards remodeling of the so-called Kellogg-Manley House, which Senator Hickenlooper said may have cost some $48,000, Mr. Tyler sketched in background factors. When he arrived during July 1947, the top scientists and technical people tended to congregate in a remotely located residential area which was becoming known as "Snob Hill." By way of reducing this harmful trend toward social stratification, he persuaded the distinguished occupants of the Kellogg-Manley House—a double dwelling located in the center of town—to remain there; and in return he promised needful repairs. The contractor "did not do a good job" and later "went broke completely," so that recovery of damages was impossible; and the remodeling costs then turned out to be unexpectedly high.

Senator Hickenlooper raised questions about $10,000 contained in the 1950 budget to landscape Mr. Tyler's home and some $18,000 to pay for his furniture; also about operating losses in the Fuller Lodge restaurant, as well as in a separate cafeteria; and about two $38,000 houses planned, according to a newspaper account, for top officials at Sandia Base. Mr. Tyler indicated that the landscaping affects a number of residences in the area where he lives and that he is not aware of any special attentions being paid himself. The furniture is Government-owned and was bought, without authorization, by the contracting firm which had once remodeled his house—creating confusion in the account books. The cafeteria now operates at a profit; and the Fuller Lodge, with its restaurant, lost $600 in April 1949 but is expected to break even within a few months. The two Sandia houses are not to be built, despite a need for them, because no contractor came forward with a reasonable construction offer.

Buckled roofs

Considerable attention was given to a block of 350 Los Alamos dwelling units, some of whose roofs buckled or gave way. Twenty-seven families lost the use of one room; two families were compelled to move out during repairs; and the Government paid a bill of $250,000. These 350 units had been started by the Manhattan District after the war, as a result of what Dr. Bradbury described as the "drastic step" of undertaking permanent-type construction—drastic, it may be inferred, because such a commitment tended to preclude consideration of relocating the Los Alamos Laboratory at some more functional and less expensive place than the top of a high mesa. W. C. Kruger & Associates had been the architect-engineer for the 350-unit project and William H. McKee Co. the contractor. Some mystery surrounds the origin of the roofing defects; but one theory is that an Army officer authorized "waiving of the moisture content" in the only lumber obtainable and permitted its use, contrary to original specifications, because of the desperate housing shortage. This matter was referred

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to the Attorney General for possible damage action against Kruger on May 27, 1947, almost a year after an investigative group had completed a report and filed it with Mr. Tyler. Asked to explain the delay, he indicated that further investigation, file checking, and consultation with Washington headquarters had been essential as a means of assembling enough evidence to decide whether or not a damage suit would lie against Kruger. To date the Attorney General has declined to institute legal proceedings.

Los Alamos contractors

During the past 2 years Kruger supervised about $45,000,000 worth of construction at Los Alamos, receiving more than $2,000,000 in fees; and next year he will participate in projects estimated to cost about $9,000,000. The mistake on the 350 units—if it was Kruger's mistake in part—constituted so small a portion of the total work that he performed as not to "damn him as an incompetent architect" in Mr. Tyler's mind.

> I think he is no less competent than most any architect of that type that I could get. * * * However, I have, as I say now, six architects, A–E's * * *, and Kruger is now confining his work solely to the town type of construction, housing and hospitals, and things of that nature.

In the Manhattan District period McKee, the contractor, had achieved a powerful status at remote Los Alamos; his employees lived on the site; he accumulated equipment; and, as Mr. Tyler expressed it—

> * * * this company * * * [was] in a very advantageous position to bid and to underbid anyone from without that had to bring their equipment in and establish the contacts and develop the personnel necessary to do the job.

Shortly after his arrival Mr. Tyler ordered McKee to remove his employees from the town; and, as a consequence, the average number of bids received in open Los Alamos bidding has risen from 2 during 1947 to 4.3 during 1948 to 8 at present. McKee, on the other hand, still performs one-fifth of the work—notwithstanding whatever blame may or may not attach to that company by reason of the roof cave-ins. "I hold no special brief for [McKee]," Mr. Tyler observed, but "I must say in full fairness that the company did an excellent job" during and since the war.

McKee ties in with the next topic which Senator Hickenlooper and the committee canvassed; for the head of that construction firm, Mr. Robert E. McKee, is the principal stockholder in the Zia Co., which operates Los Alamos. Also the head of Zia is Mr. McKee's son.

When the Army engineers saw that they were going out of Los Alamos, and the Commission was coming in—

Mr. Tyler commented—

> they recognized that some permanent set-up had to be made to insure the continuation of the maintenance and the operation; and, as I understand it, they searched that part of the field to try to find somebody who would do that, and they received no help from anybody.

The Army therefore approached the elder McKee and invited him to undertake the town-operating job.

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He formed a corporation; he staffed it naturally, I would say, out of people whom he knew. They were mostly construction people and not maintenance people.

On the other hand—

I can say that except for the corporate structure and stockholding, and so forth, that the Zia Co. and the McKee Co. are two complete and separate concerns, and I can say that advisedly because I have watched projects which the Zia Co. was going to occupy—well, they might easily not even be members of the same family because they fight rather bitterly about the construction work.

The degree of separateness between McKee and Zia may be subject to varying interpretations; but whether or not such separateness or identity gives cause for criticism is another matter. At Hanford construction and town-management functions are combined outright in one corporation; and if the practice is valid there, presumably a like practice is valid in Los Alamos. The larger issue is whether or not efficiency and policy factors favor a number of contractors or concentration upon one or two firms which fill many roles. Bearing on this issue is the remoteness of Los Alamos and, to a lesser extent, Hanford and the attendant practical difficulty in persuading qualified companies to compete for local jobs.

Operating fees

But Zia appears in an anomalous light for a different reason: it employs 1,500 people, whose salaries are reimbursed by the Government, to perform operation and upkeep work in a town whose total population is about 8,400; and it receives an annual fixed fee of $204,000. Mr. Tyler pointed out, however, that 600 of the Zia employees undertake housekeeping tasks at the laboratory since the contractor in charge, the University of California, is not equipped to repair and maintain its various facilities. The Los Alamos Reservation, furthermore, contains 33 development sites spread over 65,000 acres, and Zia has responsibility for maintenance from one end to the other.

If the Government pays everything anyway, if the Government is responsible for all the expenses, why does not the Government run the situation or why does not the AEC put somebody in there who is skilled to do that and save the taxpayers $204,000 [in fixed fees] on that situation?

asked Senator Hickenlooper. The reply did not eliminate the possibility of direct Government operation; such a solution is being studied; but Mr. Tyler seemed to entertain serious doubts about the wisdom of any basic change.

* * * when an insurance company * * * builds a group of a thousand houses—

he said—

they hire a man to maintain and operate that, and they pay him a profit.

Two years ago Zia hired more than twice as many people as at present. If the Commission had eliminated the company at that time, according to Mr. Tyler, it would nevertheless have been obliged to rehire most of the same employees itself—still leaving the operation overstaffed and unwieldy. The first task, then, was to cut out excess personnel—"cleaning that up and getting the operation into decent shape." Thereupon a basis would be laid, he suggested, to compare the cost of Government versus contractor administration.

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The $204,000 annual saving in fixed fees, if the Commission took over, might be offset by the cost of added supervisory responsibilities. "I would have to have personnel to hire, fire, and handle it—I would end up with a very similar type of set-up," Mr. Tyler argued. Today, in contrast, "I do not have to worry as to whether [Zia] can hire competent engineers or whether he can fire competent engineers. He runs his own organization, and I get the results out of it that I want." Also Zia saves some money by paying no retirement funds and allowing its personnel only 15 days a year for leave, whereas the Government pays retirement funds and allows 26 days leave. Moreover, "nobody hires Government employees in an outlying site unless they can provide housing for them. I could not guarantee all those people housing." There is a paradox involved that went unmentioned: the Commission is obligated to encourage free enterprise and has been charged with deficiencies on this score, and yet direct Government operation of Los Alamos would amputate free enterprise altogether.

The same query as to why private firms should be brought into a Government-owned town and paid a fee, though they undergo no financial risk, threads through the committee's discussion of Oak Ridge. There the operating contractor is Roane-Anderson, a wholly owned subsidiary of the Turner Construction Co., with headquarters in New York City. Again the history of the relationship between community and contractor dates back to the Manhattan District; and again the number of employees on the contractor's pay roll has been reduced by half during the recent past—from 3,192 in mid-1948 to 1,589 at present. Some 70 Federal employees staff a special Commission office of community affairs. The contractor fee in this instance is about $192,000, plus additional amounts for letting and administering certain subcontracts as agent for the Government. These subcontracts themselves involve a profit for the firms undertaking them, although the award is usually based on competitive bidding and a lump-sum or unit-price form of payment. The close connection between the parent construction company and the subsidiary operating company, both at Oak Ridge and Los Alamos, has not resulted in the subsidiary being in a position to give the parent a contract. The testimony is clear that, while McKee performs extensive construction work at Los Alamos, he receives his assignments through the Commission office; and Turner has done no work of any description either at Oak Ridge or in the project as a whole since 1946. On the other hand, the parent-subsidiary environment is such that the subsidiary might conceivably be in a position to benefit a subcontractor to whom an obligation is owed by the parent.

Oak Ridge transport

Challenges were directed at several specific Oak Ridge items, such as the handling of the local transportation system. The American Transit Bus Co. serves the town and conveys workers to and from the production plants; and for this service it recovers its costs, plus an annual fixed fee of $90,000. The company furnishes six executives whose salaries are not reimbursed, however; and if the value of their work is subtracted from the fixed fee, net profit is reduced to what Mr. Cook, Oak Ridge manager, estimates as $39,000. The bus operation lost $455,812 in fiscal 1949 and is expected to lose $354,656 in fiscal 1950. Mr. Cook stated that "* * * in spite of the obstacles

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confronting an economical operation, the cost per mile of operation of the Oak Ridge system was 37.5 cents and the national average was [42] cents per mile during the first quarter of calendar year 1948 * * *." Thus, he said, "The deficiencies in revenue, and not the cost of operation per mile are obviously responsible for the net operating loss of the system * * *." A transportation engineering firm employed to survey the problem and make recommendations "were able to conclude only that the unique character of the service required, plus abnormal features of terrain, precluded a profitable operation."

Other Oak Ridge matters

It also developed that 3,550 Oak Ridge houses were each provided with a concrete slab, partly or wholly surrounded by a picket fence, to accommodate garbage cans and shield them from the street. These houses have no basements and no back yards because of the uneven terrain, and kitchens face the street—accounting for the garbage-can arrangement. The original estimated cost per unit was $30, but the actual cost turned out to be $18.32; and the concrete slabs were procured for $1.34 each, reflecting the lowest of six bids received. Senator Hickenlooper quoted from a complaint letter which alleges that house tenants are not themselves allowed to replace burned-out light fuses but that they must call in a Roane-Anderson electrician—thus creating expense defrayed by the Government. The author of this letter adds that Roane-Anderson installed a special "fustat" in his home, thereby preventing him from making replacements with standard fuses. Mr. Williams commented that "* * * I happened to have lived at Oak Ridge for a couple of years * * * and Roane-Anderson never interfered with me unplugging my sink or putting in a fuse or doing anything else I wanted to do." Mr. Cook added that "Those special-type fuse boxes were installed to prevent overloading of circuits. We had quite a bit of difficulty at one time with people using higher amperage fuses than the circuits were designed to withstand, causing fire hazards."

The evidence submitted on community affairs confirms that the Commission is doing a job. The three towns are gradually developing into livable places conducive to high morale. Dr. Oppenheimer observed that the Commission has actually "babied" Los Alamos, but he also said:

> A fair, considerate administration is one indispensable thing, and it is my belief—I would like to testify to this—that one of the real reasons for the success of the project is that the Atomic Energy Commission, the Commissioners under the Chairman of the Commission, have understood that the program was only so good as the morale of the men that were doing the work.

Thus one threat to the project has been removed—the threat of wholesale resignations and refusals to accept employment. But another threat is taking its place—the threat that tangled community problems will so distract and preoccupy the Commission as to divert it seriously from other responsibilities.

SECURITY BY CONCEALMENT

Denying information to the potential enemy involves a probe into the minds and hearts of the human beings who work on our atomic energy project. If their "character, associations, and loyalty" fail

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to meet certain standards, they are refused access to "restricted data" as defined in the McMahon Act. Since direct contact with the complete inner workings of a man's brain cannot be established by any means, even through hypnosis or the use of drugs, reliance is placed upon his spoken utterances, the company he keeps, the organizations he joins, the reputation he enjoys, and similar matters—as developed through an FBI investigation. This phase of guarding secrets is known as personnel security. It transcends all other phases in importance; for a person who is cunningly disloyal or addicted to alcohol or merely indiscreet might betray confidences despite all additional checks designed to keep information inviolate.

One such check is physical security: The erection of fences around plants and laboratories, the maintenance of guard posts and inspection stations, the use of vaults and safes, aircraft patrols, antisabotage measures, and the like. Another check has come to be known as materials accountability, that is, the tracing and tracking of substances valuable to a potential enemy, through each level of the Commission's many-tiered operations. Control of information, a further check, raises the issue of classification and declassification: whether a given item of knowledge should be considered "top secret," "secret," "confidential," "restricted," or suitable for publication. Documents control, the final check, presents the task of tabulating and safekeeping papers in the Commission's custody.

Personnel Security

"Case A"

On June 6, 1949, during the fourth open hearing, Senator Hickenlooper undertook to criticize the Commission's procedure in handling personnel security problems. He announced that he would avoid identifying individuals but would discuss particular employees through such symbols as "case A," "case B," "case C," etc., at the same time passing their real names, written on a slip of paper, to Mr. Lilienthal. Previously the Commission, in a letter to Senator McMahon, had protested against this procedure. The letter stated that—

> * * * a description of the place where a person is employed, the kind of work he is doing, and other such information, even though the person is not named, may identify a person as fully as if he were named.

Fairness to the Commission and justice to individuals, reasoned the letter, decree that the committee examine all the relevant facts, not merely excerpts, and unless this were done behind closed doors, confidential FBI reports would be exposed to public view. Mr. Lilienthal orally predicted that an attempt to continue in open session would reveal the identity of each alleged security risk. Senator Hickenlooper nevertheless proceeded with "case A," having first given assurances that he would not compromise FBI files and also that he would seek to avoid "bracketing" and "identification by inference."

> "Case A" entered on duty by way of the emergency clearance device—

according to Senator Hickenlooper; and later—

> the serious derogatory information which was developed by the FBI in its investigation of the character, loyalty, and associations of this individual are contained in 50 single-spaced typed pages.

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Senator Hickenlooper went on to present an account of various happenings: Commission security officers analyzed the "case A" files; the employee was given a "statement of charges" and suspended from work; the Assistant General Manager appointed a so-called local board consisting of "a lawyer and two scientists"; the local board held hearings and only 3 of the "24 informants mentioned in the FBI report" gave testimony; the local board unanimously recommended clearance; the Commission's Director of Security (Admiral John E. Gingrich) and the General Manager concurred in the recommendation; and "Mr. A" immediately returned to work with his clearance reinstated. Senator Hickenlooper ended by recalling that in the course of a public meeting, held 6 months previously, an armed courier from the Commission delivered a written report to the joint committee chairman. Mr. Lilienthal had then described the report as "top secret" and "perhaps one of the hottest documents that has yet been assembled." With this incident in mind, Senator Hickenlooper made a final comment on "case A":

> Mr. Chairman, a man against whom serious doubt was raised, warranting suspension, warranting a hearing before a board that I believe was not adequate to judge, a man upon whom there was a substantial file, creating serious doubt, is in charge of that report that was such a top secret and such a hot document that it had to be delivered by an armed courier. * * *

At this juncture Mr. Lilienthal objected, saying that his apprehensions had been realized and that Senator Hickenlooper—

> has identified the individual in the Atomic Energy Commission program who is responsible for the preparation of the quarterly reports of the Commission.

(These quarterly reports are compiled once every 3 months and submitted to the joint committee as one means of keeping it "fully and currently informed.")

After considerable discussion, which included suggestions that "Mr. A" be given opportunity to testify personally and to rebut any implied reflection upon his loyalty, the committee decided that it should go into executive session and there decide whether to take up individual cases in public or in private.

At an open hearing 2 days afterward, however, Senator Hickenlooper again referred to "case A," noting that Dr. Shields Warren, one of those who sat on the three-man local board, had once admitted a lack of competence to pass upon "Communist backgrounds or affiliations." Mr. Lilienthal then commented on all that had been said about the case. He denied that the employee in question entered on duty by way of the emergency clearance device. Rather, said Mr. Lilienthal, "Mr. A" began work only after a full and regular FBI field investigation had been completed, and the investigation brought to light no sign of derogatory data. So matters stood for some months until an anonymous letter was received, one which stimulated the Commission to request that the FBI make further inquiry. This subsequent investigation, which would not have been undertaken except for the anonymous letter, did produce unfavorable information. Mr. Lilienthal observed that the transcript of the local board hearing which followed covers 350 pages; and one witness who had earlier given the FBI damaging advice declared under oath that "he had no basis in fact whatever to support" his statements. The local board urged four persons who furnished the principal statements casting

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doubt upon "Mr. A" in the FBI report to attend the hearing; and three voluntarily testified. The fourth made known that he did not wish to appear.

Mr. Lilienthal indicated that the procedures followed in "case A" were "careful"; that they "show the difference between charge and proof"; and that a scrutiny of all the facts would remove any doubt as to "Mr. A's" loyalty. Regarding the caliber of the three-man local board, Mr. Lilienthal said:

> The assumption that only an intelligence officer or an individual with that background has judgment about people is, I think, fallacious. It is well known that physicians and lawyers frequently have as good, and I would say often better, judgment about people and their character, and better ability to judge people than do intelligence officers and security officers * * *.

Open versus closed session

The joint committee promptly held four closed sessions, during which it conscientiously and with keen awareness of the serious issues, debated whether to discuss selected evidence from the personnel cases in public or to look at the entire picture away from press, radio, newsreel, and television.

Senator Hickenlooper reiterated what he had already said before launching into "case A":

> * * * I have no desire or intention to attack any individual. The purpose of my presentation is to show [Commission] procedure and to show it in the interest of protecting the overriding rights of the whole public * * *.

There were those who regarded this distinction as unrealistic. They felt that Senator Hickenlooper's method of demonstrating procedure (as illustrated by "case A") amounted in substance and effect to charges of individual disloyalty and Communist infiltration of the project. When such charges had once been made the stuff of headlines, it was feared, the accused would either lack opportunity to reply or else would divulge the intimate contents of FBI files, apart from the possibility that any rebuttal, however complete and convincing, would fail to counteract the publicity impact of the allegation. To spread out a few apparent "bad" facts in the open and to veil the offsetting "good" facts behind a cloak of secrecy impressed many committee members as inappropriate. On the other hand, there were those who contended that, as a matter of courtesy, Senator Hickenlooper should enjoy unrestricted scope to build an indictment in his own way. If presentation were public, ran the argument, he would labor under the same handicaps as the Commission; that is, he could not refer directly to FBI files. It was therefore suggested that restraints on both sides would be identical and parallel and hence fair.

The committee, endeavoring to explore all facets of the problem, finally staged an experiment during executive session. It requested Senator Hickenlooper to develop his "case B" and the Commission to reply, just as they both would proceed if the same topic were later considered publicly. The purpose of this experiment was to provide committee members with added perspective, through a further concrete example, so that they could better decide upon a course of action. As had been true of "case A," however, the Commission challenged Senator Hickenlooper's statement of facts and also cited what it deemed to be serious omissions. That the experiment took place with no newspapermen present was fortunate, for the ensuing dis-

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cussion brought out details which would have violated the FBI files and would also have thrown definite light upon "Mr. B's" identity.

The viewpoint which ultimately prevailed within the committee is set forth in a letter which Senator McMahon wrote to Senator Hickenlooper. It reads:

JUNE 9, 1949.

Senator B. B. HICKENLOOPER,
Senate Office Building, Washington, D. C.

DEAR SENATOR HICKENLOOPER: The Joint Committee on Atomic Energy faces a difficult procedural problem in deciding how to conduct the personnel security phase of the current investigation of the Atomic Energy Commission.

Here, in outline, are my thoughts on the subject.

In handling the 15 or 20 personnel cases which you wish to use, I think at least 7 objectives should be kept in mind: (1) Providing you, as a United States Senator and as a member and former chairman of the committee, with full and fair opportunity to present your indictment against the Commission; (2) furnishing the Commission with full and fair opportunity to answer your charges; (3) protecting confidential FBI files; (4) fairness to the individuals involved in personnel security cases; (5) avoidance of steps which would lower the morale of employees in the Nation's atomic project; (6) conduct of the investigation in a way that will reflect credit upon the committee, which is ultimately responsible for whatever procedure may be adopted; and (7) enabling the American people to arrive at a balanced and correct judgment of the Commission's record.

I believe that discussion of your remaining personnel security cases in open hearing would negate each of these seven objectives. You, yourself, could not particularize, for fear of divulging the details of FBI files and identifying individuals. Therefore, you could not make out the strongest possible case against the Commission. While you personally may be willing to accept this handicap, I feel that the committee cannot fairly pass judgment upon the merit of your grave charges unless it has the benefit of the most powerful and most documented indictment which you can present. Such an indictment, as regards personnel security, is feasible only in the privacy of executive session.

Furthermore, if security cases were discussed at open hearings, the Commission would either bring out details in its reply, in which event it would expose FBI files and "bracket" the identity of individuals, or else it would be judged on the basis of selected evidence. In the current trial of Miss Judith Coplon on espionage charges, the court ruled that the defendant cannot be tried solely on evidence selected by the prosecution, that she must be allowed to introduce her own evidence even at the risk of disclosing the contents of secret documents. You may conceivably take the position that the mere existence of derogatory information on a particular individual is sufficient to disqualify him for atomic energy employment. But the law, as it now stands, permits the Commission to exercise discretion, to weigh favorable against unfavorable data. That being the case, the Commission is clearly entitled to discuss any detail which would help vindicate it in its exercise of judgment.

To my mind, the individual involved in case A, has already been sufficiently identified to cause him genuine embarrassment. If discussion of other cases had the same result, the investigation might not redound to the committee's credit; and the effect on the morale of Atomic Energy employees might become serious, since no one of them could ever feel sure that a malicious anonymous informant would not cause a spotlight of adverse publicity to be focused upon himself and family.

Finally, I fear that an examination of security cases in public would produce the very confusion against which you warned in your original statement calling for the resignation of Mr. Lilienthal. So many collateral issues would be raised, so many doubts and suspicions would be cast upon various individuals, so much time would be consumed in hearing character witnesses and the like, and so many libel and perjury suits of the Hiss-Chambers variety might eventuate that the American people could hardly be expected to formulate an ordered opinion as to the Commission's general record.

However, it seems to me that the traditional procedure of handling this phase of the investigation in closed session would achieve all the desirable objectives which I have mentioned. You could document your criticism and the Commission could document its defense without reserve; nevertheless, the committee's obligation to protect FBI files would be fulfilled. Likewise, the rights of individuals

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and the morale of Atomic Energy employees would remain unimpaired. The public, moreover, could integrate personnel security issues into its over-all verdict through a special section in the committee report to be issued after the investigation has ended. That special section might indicate the general nature of your comments on personnel security and the general nature of the Commission's reply, together with the committee's own conclusions. It might even be possible to include many specific details in the report, without prejudicing FBI files, if the committee had time to weigh and review its choice of words free from the impromptu give and take which characterizes a hearing.

Accordingly, I suggest that the open sessions continue on such portions of the investigation as can properly be discussed publicly. Then I suggest that we undertake a series of closed sessions to consider personnel security and other matters which should be reviewed privately. Meanwhile, the relevant FBI files and other documents, plus summaries prepared by the staff, can be circulated among committee members so that they will be acquainted with the cases you wish to explore by the time meetings on personnel security commence.

In this connection, I feel that the committee should base its conclusions principally upon the written record—i. e., FBI files and the transcripts and reports of AEC loyalty boards and loyalty reviewers—since the Commission itself relied exclusively upon a written record whenever it considered particular cases. We are passing judgment upon Mr. Lilienthal and his colleagues, and therefore we need have no more evidence before us than was before them. If that evidence impresses the committee as inadequate, the inference can only be that the Commission was derelict in failing to insist upon additional evidence.

It is true that AEC loyalty boards heard testimony from live witnesses and that these boards were the trusted appointees of the Commission. But in my opinion this fact is not sufficient reason for us to call a host of live witnesses. Their words are all recorded on AEC transcripts; the Commissioners did not hear these witnesses; and we, like the Commissioners, are pressed for time.

The point may be made that committee members are not competent to evaluate personnel security cases, since they lack specialized training in this field. However, we are interested in ascertaining whether or not the Commission is guilty of incredible mismanagement. Consequently, as to personnel security, we need only decide whether or not the Commission's judgment was clearly erroneous or unreasonable. Whether or not we would have acted differently, if we were the Commission, is irrelevant, assuming we should agree that reasonable men might have acted as did the Commission. Considering the nature of the inquiry, then, I feel that we are in fact competent to act. Just as a court judge need not be a technical expert in order to review the decision of an administrative body, so need we not possess special competence in the field of personnel security in order to review the Commission's actions.

Sincerely yours,

BRIEN MCMAHON, *Chairman.*

The committee membership was unanimous throughout that it must give FBI files scrupulous protection and therefore that only extracts from the total record available could be allowed to reach the Nation's press. Its choice lay between two alternatives, neither one wholly satisfactory: discussing a fraction of the evidence in public, and discussing the entire evidence in private. When a vote was at last taken, eight members favored selected facts and open hearings, whereas nine members favored all the facts and closed hearings. Senator Hickenlooper abstained, saying that he had made his position clear, that the question was one for the committee to settle, and that he preferred not to influence its decision by casting a ballot.

Thirty-four cases

Accordingly, the investigation pursued other fields of inquiry for more than a month before returning to personnel security. The committee thereupon held 6 executive sessions on this subject and had before it 34 specific cases, 32 of them brought to its attention by Senator Hickenlooper. The committee staff, aided by outside consultants

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having an FBI and legal background, prepared factual summaries of each case, giving a synopsis of all derogatory data and all favorable data plus an outline of the administrative procedure which the Commission had followed. The summaries were circulated among committee members and formed the principal basis for discussion at the six meetings.

Of the 34 cases, 12 have to do solely with the "character" portion of that clause in the McMahon Act which calls for an FBI investigation into the "character, loyalty, and associations" of atomic employees. In two such instances the files contain allegations of sexual perversion. Neither person concerned has ever had access to classified information, and one resigned after only a brief period of service. In another file, certain informants accuse the subject of frequent drunkenness. Here clearance was granted, apparently on the theory that no question of loyalty had been raised, the individual performed his work consistently and well, and many of those who knew him best vouched for his trustworthiness and ability to retain confidences.

Character cases

Three "character" cases involve women and allegations of promiscuity. All worked as secretaries; two never had access to secret data and resigned sometime ago; and the third, a woman whose employment dates back to the Manhattan District, finally received clearance upon the recommendation of Admiral Gingrich, the Commission's Security Director, after analysis of conflicting advice from FBI sources. (The issue in this case arose as a result of the McMahon Act, which provides that the FBI must reinvestigate persons originally hired by the Army and retained by the Commission.) A male subject whose employment also began with the Manhattan District is described by some informants as a troublemaker and possible thief. After he had been reinvestigated, security officers recommended withdrawal of his clearance; and a short time later he resigned. Of three more Manhattan District hold-overs, one, an alleged drunkard and adulterer, was released following reinvestigation; but a Commission contractor secured permission to rehire him on condition that he perform unclassified work only. The second and third hold-overs, like nearly all the "character" cases, are semiskilled laborers. The extensive favorable information which the FBI developed on both is marred, as to one, by suggestions that he often tells lies, and as to the other, by suspicion that he may once have committed a felony. Each was given clearance.

A final pair of files involving "character" shows that the individuals in question falsified their personnel security questionnaires by concealing a past arrest. These two persons were dismissed when the AEC Washington office reconsidered their records. Until that time they worked several years as cleared employees, first for the Manhattan District and later for the Commission; and no action was taken by reason of the falsification, except that the attention of their superiors had been invited to this derogatory circumstance as a fact which should be kept in mind. In an open hearing, however, the General Manager testified that where personnel security questionnaires contain false testimony, the offending persons are dropped.

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One of the 34 files before the committee contains no unfavorable data and must have been suggested by inadvertence. Another relates to a person who never became a Commission employee. He applied for a job and was rejected as a security risk on the basis of his associations, whereupon he renounced any desire to serve with the Commission but demanded a hearing and full loyalty appraisal as a means of exonerating his name. Normally the Commission reserves the benefits of its security review procedure to actual employees about whom a question has arisen, excluding job applicants. In this case, however, the individual believed that his friends and associates knew why he had been rejected; that his chances of securing employment elsewhere were bound to suffer; and that his damaged reputation entitled him to a clean-cut, official finding. Under the circumstances the Commission made a special exception and appointed a local board. After a hearing and evaluation by ranking AEC security officers, the individual was finally determined to be eligible for clearance assuming that he were an employee; and thus he succeeded in removing the original imputation of disloyalty.

AEC witnesses informed the committee that applicants present a puzzling problem: If the Commission or a contractor desires to hire them, they must be encouraged to mark time for 2, 3, 4, 5, or even 6 months without accepting other regular employment, while the FBI completes an investigation; then, if the investigation means that they cannot be hired for security reasons, the encouragement previously given causes them to make inquiries and often, with the help of rumors and gossip, to glean the truth; in that event they are apt to press tirelessly for a full explanation and an opportunity to clear themselves. The committee itself knows of at least one eminent scientist who refuses to seek Commission employment for fear that, if rejected on security grounds, he could not—as a mere applicant—be permitted a local board hearing and a chance to confront accusers who may be listed in his FBI file.

Loyalty cases

The remaining 22 cases, of the 34 submitted to the committee, all touch upon loyalty and associations. In one, the subject is allegedly a member of a rare religious sect and a pacifist, although no informant links him to subversion. Another, who had worked for the Manhattan District almost since its inception, is evidently a former member of the Communist Party; and the Commission fired him some months after reinvestigation. A third case involves a widely renowned scientist on whom the derogatory data suggests political naivete but whose records also reflect a number of anti-Communist deeds, as well as testimonials to his integrity and loyalty from highly placed sources. A fourth file recalls the situation encountered in what Senator Hickenlooper called "case A." The individual was fully investigated and cleared; later, as a result of a "tip," the FBI procured additional information; and suspension of clearance immediately followed. In contrast to "Mr. A," however, this person resigned without requesting a local board hearing. The past associations of two other employees are alleged to have included several Communist sympathizers. Yet, in each instance, responsible informants intimately acquainted with the employees testify strongly to their loyalty. The Commission took the precaution of asking for supplementary FBI reports; these tended to

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alleviate any doubt; and, with the approval of security officers, clearances were issued.

Roberts Board cases

Thirteen cases before the committee had been referred to the Roberts Board—i. e., the Commission-appointed advisory group headed by former Supreme Court Justice Owen J. Roberts and consisting of Karl T. Compton, former president of the Massachusetts Institute of Technology and now Chairman of the Research and Development Board; Joseph C. Grew, former Ambassador to Japan and former Under Secretary of State; George M. Humphrey, president of the M. A. Hanna Co., and H. W. Prentis, Jr., president of the Armstrong Cork Co. It is difficult to imagine, short of the United States Supreme Court itself, a reviewing panel whose judgment more peremptorily commands respect.

In three cases the Roberts Board recommended clearances, which were duly granted. In three more cases the Board also recommended clearance, adding that the activities of the employees concerned should be periodically checked. This counsel has been followed. In two cases the Board recommended that employment be continued but that access to classified data be denied, and the Commission so acted. The Roberts group recommended that another case be referred to a local board. Such a board was appointed; it held hearings; and the subject received clearance, all members approving. In still another case, the Roberts group recommended further FBI investigation. Consequently, on the basis of added reports from the FBI and the unanimous verdict of a local board, clearance was given. Here the derogatory data solely affected the employee's wife who, when a teen-ager, is alleged to have associated with Communists. All the Roberts Board cases so far enumerated involve people who came to the Commission from the Manhattan District and who, for the most part, have worked in the project more than half a decade. In one case before the committee, however, the Roberts group did consider an employee originally hired by the Commission, recommending clearance but stipulating that he be watched; and again the recommendation was followed. The committee does not feel disposed to challenge the judgment of so outstanding a group as the Roberts Board.

Two cases, of the 34, remain to be discussed; and one is "Mr. A" (who wrote Senator McMahon requesting a committee hearing in order to answer any charges against him). A careful reading of this file persuades the committee that beyond rational doubt "case A's" complete loyalty has been established. The last case illustrates the "calculated risk" concept. During the Manhattan District period a brilliant scientist, whose abilities cannot be duplicated in his field, had prolonged and detailed access to vital atomic information. He continues as a cleared Commission employee, although his present labors, while highly important, no longer bring him into contact with the innermost secrets of the enterprise. The FBI reports contain no allegations that he is a Communist; but they do raise a genuine question as to his steadfastness in the event of war between the United States and a Soviet country. Yet his dismissal now might generate bitterness pressuring him to divulge the crucial knowledge he acquired under the Manhattan District, whereas his retention

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permits the Commission to maintain at least a partial check upon him. Also, if he left the project, his loss would definitely retard our rate of atomic progress. He has demonstrated by his work over a period of years, moreover, that he is presumably trustworthy. Among those who approve keeping him as a "calculated risk" is Admiral Chester W. Nimitz, who studied the circumstances involved.

Presumably the 34 cases were placed before the committee to document a charge appearing in the original indictment, to wit:

> We have learned from the records that there are numerous persons employed on our atomic projects who have strong Communist leanings.

The 12 "character" cases bear little relation to this charge and therefore must be subtracted. Subtract also "Mr. A," as well as the employee whose file includes no derogatory material and the applicant who never worked for the Commission. Subtract further the alleged pacifist; the employee who was fired upon reinvestigation; the scientist who demonstrated his anticommunism through deeds; the man who resigned when a "tip" led to the discovery of damaging new information; and the two "association" cases where an FBI double check merely confirmed the generally favorable data already contained in their files. Nothing is left except the Roberts Board cases (all but one of which involved Manhattan District hold-overs) and the single "calculated-risk" case (another Manhattan District hold-over). If "there are numerous persons employed on our atomic projects who have strong Communist leanings," the 34 cases imply that poor judgment must be attributed not only to the Manhattan District but also to Justice Roberts and Messrs. Compton, Grew, Humphrey, and Prentis.

Clearance statistics

The 34 specific cases, moreover, were culled from tens of thousands of files and apparently represent the "worst" examples that can be uncovered. In the life of the Commission the FBI has completed about 150,000 atomic energy investigations. Of these, some 2,125, or 1 in every 70, produced data, usually involving character alone, that required special attention. Clearance was ultimately granted in 702 such cases and formally denied in 216. Clearance was also denied through an expedient in 333 more cases: The people concerned were job applicants, and the Commission simply refused to hire them as a result of their FBI reports. In the remaining 874 cases the people concerned were again job applicants, who withdrew their requests for clearance because they had meanwhile decided to work elsewhere. In this context another relevant factor is the Commission's compartmentation system, whereby the individual employee receives access only to such information as he needs in the performance of his duties. People entitled to "top secret" items are limited in number, and even these know merely the fraction of all "top secret" data that focuses directly through their work. In most instances where an employee secures clearance, he learns very little that is new to him.

Further charges

The committee's probing of personnel security problems, however, covered more territory than the 34 specific files. When Senator Hickenlooper discussed "case A" in open session, for example, he stated by way of preface that "the law provides adequate standards,

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of using local boards is poorly suited to debate, for the act expressly covers the matter. Section 12 (a) reads, in part, as follows:

> SEC. 12. (a) In the performance of its functions the Commission is authorized to—
>
> (1) establish advisory boards to advise with and make recommendations to the Commission on legislation, policies, administration, research, and other matters;
>
> (2) * * *.
>
> (3) make such studies and investigations, obtain such information, and hold such hearings as the Commission may deem necessary or proper to assist it in exercising any authority provided in this Act, or in the administration or enforcement of this Act, or any regulations or orders issued thereunder. * * *
>
> (4) * * *. The Commission shall make *adequate* provisions for *administrative review* of *any* determination to dismiss *any* employee. [Emphasis supplied.]

The emphasized words might well support an argument that, if the Commission failed to utilize local boards, and if it failed to utilize a quasi-appellate board such as the Roberts group, it would be guilty of dereliction.

Apart from the provisions of the law and the added light which a hearing sometimes throws upon FBI reports, one Commission witness went so far as to assert that our atomic energy project would almost collapse unless employees were assured some regular and fair-seeming method of presenting a defense where their clearance is suddenly questioned. Otherwise they would feel that their jobs permanently hang on the thread of an anonymous letter writer's whim—and the attendant morale effects would reflect themselves in the size of our weapons stock pile and our general success in harnessing atomic energy for national defense.

The lawyers, doctors, scientists, and other reputable citizens appointed to sit on local boards do not qualify as "professors of loyalty." But neither do Commission security officers, notwithstanding their familiarity with the characteristics and habits of subversives. To know that in such-and-such year all New York Communists were ordered to join the American Labor Party; that at another time the Communist line stressed "cooperation" with liberals; and that such-and-such a device is commonly used by Communists for concealing their identity—to know these things, as a security officer does, is valuable in combing files, perceiving hidden relationships, and setting precautionary machinery in motion; yet it hardly guarantees a balanced and mature end decision. The local board brings a fresh viewpoint and experience in human relations to cases which security officers have already threshed to the limit. Board conclusions, far from being final or dispositive, have no more status than a mere recommendation—which the General Manager or the Commissioners, those ultimately responsible, may accept or disregard. Equally, the recommendation of security officers, made in light of evidence developed at local board hearings, may be accepted or disregarded. It is a fact of human nature that witnesses are more likely to speak freely when conversing with a single FBI agent than when testifying before a local board, even though the board sessions are invariably secret. But this circumstance is merely one more item to be weighed in the making of an over-all judgment.

The General Manager has overruled the AEC Security Division on two occasions, both being Manhattan District hold-over cases where the Roberts Board advocated clearance. Since the McMahon Act

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vests supreme authority in the Commission and General Manager, security officers could dictate the result in every instance only if they exercised powers illegally delegated to them by their statutory superiors.

Caesar's wife concept

Senator Hickenlooper emphasized another point, namely, that if a man commits forgery and 50 people who are unaware of it praise his character, their words should count for naught alongside the testimony of a lone witness who does have knowledge of the crime. The 34 files before the committee show that the Commission has indeed directed its main attention, at least in these cases, to the equivalent of the lone hostile witness and not to the many favorable ones. Senator Hickenlooper, however, used his illustration of the single informant who knows evil, versus the 50 who do not, as a basis for upholding the "Caesar's wife" concept that the loyalty of an atomic energy worker must be "above suspicion." The committee of course found itself thoroughly in accord with this objective. Yet a total and unyielding "Caesar's wife" policy means that if a 10-year-old child advises the FBI that a long-term project employee has discussed the metallurgy of plutonium with strangers, he must be discharged forthwith as no longer "above suspicion."

Fortunately the committee discovered upon closer inspection that the alternatives are not so difficult as might at first be supposed. In a few "calculated risk" cases, where the subject is a scientist possessing irreplaceable abilities and where he has already acquired knowledge of key secrets under the Manhattan District, derogatory data of a limited kind and degree may possibly be tolerated—provided that authorities of the highest caliber and judgment weigh the matter and make certain the risk is calculated correctly. In applicant cases, where the subject has never enjoyed access to secret information, the general "Caesar's wife" approach may properly come into play and bar clearance if even a slim doubt exists. All other cases involve employees who have received clearance but who later become suspect for one unusual reason or another. Here an opportunity to present evidence before a local board is indicated. Thereafter the "Caesar's wife" principle may again become operable. If the board hearing fails to dispel any lingering question, the employee should be dismissed. The committee has reason to believe that the Commission's present policy harmonizes with these views.

All committee members and all Commission witnesses agreed that no one has an inherent right to atomic energy employment. All agreed that doubts must be resolved against the individual and in favor of national security. No criticism was specifically directed at the actual, concrete tests which the Commission has evolved as its "criteria for determination of eligibility for security clearance."

Emergency clearances

The McMahon Act, however, contains an exception to the rule that a full FBI field investigation must precede granting of clearance. Since Senator Hickenlooper made the Commission's use of this exception a major point in his case—alleging "very substantial contravention of the intent and letter and the spirit" of the law—it again becomes necessary to quote subsections 10 (b) (5) (B) (i) and (ii):

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but in the administration of the law those standards have been circumvented." Thus the Commission was accused of deviating from or disregarding the statutory provisions controlling personnel security. Later in the same open session Senator Hickenlooper referred to the local board which held hearings on "case A" and said:

> * * * the chairman of this board announced at the outset that this was an investigation in accordance with the terms of the * * * act, despite the fact that the FBI had already accomplished an investigation, the report of which covers some 50 pages.

These words seem to mean that the McMahon Act does not authorize local board proceedings and further that the Commission should have decided "case A" exclusively on the basis of the FBI files, without taking into account any other evidence, even sworn testimony given the local board by the same persons whom the FBI had contacted. Senator Hickenlooper developed other points either in open or closed session or both: That those who sit on local boards are not security officers and therefore not competent to judge; that security officers alone understand all the issues involved and that their opinion based upon analysis of FBI files should be decisive; that employees appearing before local boards are denied clearance only if affirmatively proven to be security risks and that such a procedure violates the law; and that, in keeping with the so-called "Caesar's wife" theory, each person cleared must be "above suspicion" and consequently that any derogatory data in the FBI report should bring about automatic disqualification.

Legal requirements

It is necessary to consult the law direct. Subsections 10 (b) (5) (B) (i) and (ii) read as follows:

> (B). (i) No arrangement shall be made under section 3, no contract shall be made or continued in effect under section 4, and no license shall be issued under section 4 (e) or 7, unless the person with whom such arrangement is made, the contractor or prospective contractor, or the prospective licensee agrees in writing not to permit any individual to have access to restricted data *until the Federal Bureau of Investigation shall have made an investigation and report to the Commission on the character, associations, and loyalty of such individual and the Commission shall have determined that permitting such person to have access to restricted data will not endanger the common defense or security.*
>
> (ii) Except as authorized by the Commission in case of emergency, no individual shall be employed by the Commission until the Federal Bureau of Investigation shall have made an investigation and report to the Commission on the character, associations, and loyalty of such individual. [Emphasis supplied.]

The only standard which the act lays down, and it is a general one, appears in the emphasized language; the Commission, before granting clearance, must determine that permitting a person "to have access to restricted data will not endanger the common defense or security." In screening applicants for clearance the Commission has invariably made reference to and based its conclusion upon this standard. Since the law does not furnish precise, detailed criteria, the Commission itself evolved a series of concrete tests which have been published under the title "Criteria for Determination of Eligibility for Security Clearance." These are stated to be guides in carrying out basic principle described thus:

> 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*

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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. [Emphasis supplied.]

The members of a local board are instructed to hold hearings and to arrive at a recommendation with the same fundamental precept uppermost in their minds. The Commission's "Interim Procedure," which outlines the administrative review available to employees, contains the following stipulation:

If, after considering all the factors [the local board members] are of the opinion that *it will not endanger the common defense and security to grant security clearance to the employee, they should so recommend.* If they are unable to find that it will not endanger the *common defense and security* to grant security clearance, they should recommend that this clearance not be granted. [Emphasis supplied.]

This language makes plain that the burden of proof is upon the employee, that the local board should consider him guilty, in effect, until proven innocent; and that he must affirmatively show the reasons why granting of clearance would not "endanger the common defense or security." At least in a formal sense, then, the Commission appears to have heeded the law so far as standards are concerned.

FBI reports

Likewise, the wording of the McMahon Act in no way enjoins the Commission to consider FBI files and nothing else, or to disregard all data furnished from sources other than the FBI. If such were the case, personnel security questionnaires would have to be ignored even though they showed present membership in the Communist Party, for these questionnaires are not a part of FBI reports. Conversely, "Case A" serves as warning that an informant may perhaps give the FBI highly unfavorable advice but, when placed under oath before a local board, deny all that he had said, admit that he knows little or nothing about the employee, and admit further that he bore him a grudge.

Mr. J. Edgar Hoover, the distinguished Director of the Federal Bureau of Investigation, has never condoned the notion that FBI files contain only verifiable "facts." He has frequently taken pains to point out that the function of any intelligence organization such as his own is to collect all information obtainable—whether it later turns out to be true or false, hearsay or direct testimony, biased or unbiased. The FBI has been able to build a splendid record solely because it does report everything its agents hear. Another widespread misapprehension which Mr. Hoover deplores is to the effect that the FBI itself sifts and evaluates data and makes known its conclusions. On the contrary, the FBI performs exclusively a gathering function; the unanalyzed material gathered is then transmitted to other agencies, like the Atomic Energy Commission, for whatever inferences they believe should be drawn. FBI files must therefore be recognized for what they actually are and what Mr. Hoover represents them to be—not an infallible touchstone, but an accumulation of miscellaneous advice in which the derogatory data, if any, merit varying degrees of weight depending upon circumstances.

Local boards

It follows that the Commission is not without practical justification in establishing local boards and considering their recommendations for whatever they may or may not be worth, along with the opinion of security officers and the contents of FBI files. However, the validity

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(B) (i) No arrangement shall be made under section 3, no contract shall be made or continued in effect under section 4, and no license shall be issued under section 4 (c) or 7, *unless the person with whom such arrangement is made*, the contractor or prospective contractor, or the prospective licensee *agrees in writing not to permit any individual to have access to restricted data until* the Federal Bureau of Investigation shall have made an investigation and report to the Commission on the character, associations, and loyalty of such individual and the Commission shall have determined that permitting such person to have access to restricted data will not endanger the common defense or security.

(ii) *Except as authorized by the Commission in case of emergency*, no individual shall be employed by the Commission until the Federal Bureau of Investigation shall have made an investigation and report to the Commission on the character, associations, and loyalty of such individual. [Emphasis supplied.]

The exception "in case of emergency" is contained only in the subsection which refers to direct employees of the Commission and not in the previous subsection which refers to employees of Commission contractors. Yet the Commission itself employs relatively few people—about 6,000—as compared with some 60,000 people on contractor pay rolls. Emergencies, therefore, are more likely to affect employees of contractors than employees of the Commission. By the same token, if only Commission personnel could be issued emergency clearances, there would be no way—unless the entire policy of working through contractors were revamped—to meet many special situations requiring immediate attention.

The subsection dealing with contractors, however, merely requires that they *agree in writing* not to permit their employees access to restricted data until the FBI has completed a full investigation and the Commission has acted favorably. This prior agreement in writing is for the Commission's benefit, enabling it to control all clearances. Consequently, once the written agreement has been executed as required by the subsection, the Commission is in the same position as any other party to a contract which contains a clause solely for that party's advantage. It may presumably waive its rights, that is, authorize a contractor to give employees access on an emergency basis and before the FBI has submitted a full report. Such an interpretation of the act—while not entirely free from doubt—would seem to carry out congressional intent that, in emergencies, the Commission enjoy some degree of latitude.

This interpretation, as a matter of fact, was not challenged during the investigation. Instead Senator Hickenlooper concentrated his comments upon the clause, "Except as authorized by the Commission in case of emergency"—impliedly granting that these words apply to contractor employees no less than to Commission personnel. He showed that from January 1947 through May 1949 the Commission granted 3,317 emergency clearances with access to restricted data. The individuals so cleared not only included scientists and technical people but also secretaries, guards, firemen, photographers, draftsmen, construction workers, and the like. Senator Hickenlooper indicated that emergency clearances on such a scale and covering such occupations exceed the authority conferred in the act.

Mr. Lilienthal replied that the 3,317 emergency clearances were issued as a result of staff action, based upon Commission-approved standards and criteria. He personally might not have agreed with every separate decision had each one passed across his desk, but he defended the governing administrative rules. They provide that if an operation is "essential," if it must be undertaken before the FBI has time to complete full investigations, if no employees already cleared can be obtained to do the job, and if a file and fingerprint

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check with the FBI discloses no derogatory data—if these conditions are met, the necessary people may receive emergency clearance pending receipt of a complete FBI report. Thus, according to Mr. Lilienthal, the upright "character, loyalty, and associations" of such people are not assumed wholly on faith. The FBI maintains records on most citizens suspected of disloyalty as a part of its regular intelligence routine; and therefore the chance that an undesirable applicant for AEC emergency clearance would appear in those files is by no means remote. The testimony brought out that a would-be infiltrator might falsify his signature on the personnel security questionnaire (which all employees must complete before receiving any type of clearance) but that he could not falsify his fingerprints. These, at least, might guide the FBI to whatever information it had learned about the man.

The Commission Chairman also observed that emergencies relate most often to situations demanding the speedy services of many individuals, not just one individual. There have not been 3,317 distinct emergencies, he said, but enough emergency situations to require clearance of that many people. If a graphite plant must be hurriedly constructed or if pile deterioration at Hanford calls for prompt action—to cite Mr. Lilienthal's own examples—a whole complex of personnel, from top-flight scientists to unskilled workmen and from key executives to guards, are immediately required. Again, if a leading industrial corporation agrees to undertake urgent Commission business, clearance of the firm president and his lawyer accomplishes nothing. Such men, Mr. Lilienthal suggested, are helpless without secretaries, file clerks, deputies, auditors, program managers, and subordinates of all kinds. General McCormack later added:

> The matter of emergency clearances is, in a sense, like a chain reaction. You have to clear first a person who can discuss a problem to see whether he thinks in general his organization can do it or to see in general how he should map out his organization to do it.
>
> Next, when he has made up his mind—and he might say, "No, I cannot do it," and then you have to go to another place and start over again.
>
> When he makes up his mind, then there must be one, two, three, four, five, or six key people who have to build their part of the pyramid. It builds downward. The question is not, "Does it take 2 weeks versus 3 months as between emergency clearance and the full procedure for an organization?" The question is, "How many successive steps are there to which this gap applies?" If there happened to be four steps, if the difference happens to be a month, then it is not 1 month, it is 4 months. The armed forces, too, would have been, I think terribly handicapped in creating the [Eniwetok] task force, which was so very ably created, had it not been for emergency clearances. * * *."

In this connection Senator Hickenlooper stressed that the law reads—

> Except * * * in case of emergency, no individual shall be employed * * *—

the word "case" being singular rather than plural. He did not spell out the significance of that usage; but supposedly he meant that Congress, by choosing "case" and not "cases," may have intended to exclude total situations where many individuals are needed quickly and to include only a narrower class of emergencies where one or two individuals will answer. Yet the linguistical reasons underlying such a deduction—and the reasons why an opposite deduction would not be still more appropriate—are far from obvious. An emergency, moreover, remains an emergency even though it is large scale and requires a number of people in its solution.

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Senator Hickenlooper developed the additional fact that the Commissioners had not themselves formally declared 3,317 separate emergencies to exist before each of the 3,317 emergency clearances were granted. The act states,

> Except *as authorized by the Commission* in case of emergency, no individual shall * * *.

Nevertheless, the act also states (through subsecs. 2 (a) (4) (A) and (B)) that the General Manager—

> shall discharge such of the administrative and executive functions of the Commission as the Commission may direct—

and that—

> the Commission shall require each * * * [division director] to exercise such of the Commission's powers under this Act as the Commission may determine * * *.

Considering these subsections it would be difficult to show that the five Commissioners, by permitting the General Manager and division directors to issue emergency clearances in accord with a definite directive, have improperly delegated authority.

Mr. Joseph Volpe, Jr., the Commission general counsel, testified that he and Mr. Lilienthal had conferred with the Attorney General in 1947 regarding the interpretation to be placed upon the emergency clearance section. In Mr. Volpe's words—

> The Attorney General agreed immediately that from his reading of the law, the Congress did not intend that everyone be investigated by the FBI and cleared by the Commission before work could be undertaken. He recognized immediately that the problem which faced us was one whether we should jeopardize by delay the common defense and security of the United States by providing for a full FBI investigation and clearance of all individuals.
>
> As a matter of fact, one assistant remarked that the Congress could not possibly have thought that the Commission should direct its attention at FBI investigations and clearance of all individuals and forget about the need for getting jobs done.

The general counsel then testified that he had discussed this matter with Senator Hickenlooper, who seemed to take the same view as the Attorney General. Senator Hickenlooper explained, however, that he meant to convey no such impression. He said:

> I remember the discussion in 1947, but my recollection of the discussion was that it went entirely to cases of emergency, where some emergent situation came up, and the Commission would find it necessary to get in some noted scientist or some noted specialist to discuss that particular situation, see if a solution would come up for it, and I was in agreement that under the provision of section 10, which starts out "except as authorized by the Commission in the case of emergency"—I was of the opinion, and I think I so agreed at that time, that there were situations where that would arise, where the law had recognized that emergent situations would arise, where the Commission would be authorized to do that, and where 90 days could not possibly be allowed to elapse before the benefit of this specialized judgment could be brought to a certain problem.
>
> There was no discussion or contemplation at that time, as I recall it, about the wholesale policy of just hiring anybody and everything under the so-called emergency clearances.

It appears that, from every viewpoint, the issuance of some emergency clearances is legally permissible. But to concede that even one such clearance is proper under the act is also to concede the legal propriety of all 3,317 clearances actually granted, unless it be alleged that part of them were given whimsically or fraudulently or with a deliberate intent to injure the national security. In the absence of such an allegation—and none was made—the legal dispute centers

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solely upon the definition of one word, "emergency." The Commission is obliged to interpret is own statute. Unless and until a court overrules it, and while it acts in sincerity and good faith, its definition of "emergency" must be regarded as legally acceptable.

The soundness of the Commission's judgment is another matter. The record shows that between 2 and 3 percent of all employees cleared first had access to restricted data on an emergency basis. In no case did the full FBI investigation—when later completed—disclose an espionage suspect. In 4 cases of the 3,317 total, the FBI reports include some indication of questionable associations. One involved a boilermaker-welder who, in the course of a construction job, was allowed to enter a fenced area but who had no contact with technical or statistical information. In the second case "fringe" connections with Communists are ascribed to the employee's son during student days; the employee himself is not implicated. The subject of the third case allegedly signed a Communist Party nominating petition in 1941; but he denies this act and analysis by handwriting experts reveals substantial discrepancies between the signature on the petition and his true signature. In the fourth case the individual is an accountant who may well have associated closely with Communists, although his file also reflects considerable evidence of loyalty. All four persons have been dismissed due to the derogatory data appearing in the full FBI reports.

The Commission, through its Chairman, declared that emergency clearances are granted or withheld depending upon whether the risk of delaying a given job outweighs the risk of giving employees temporary access on the strength of an FBI file and fingerprint check. No evidence was presented tending to show that the Commission exercised faulty judgment in allowing any particular emergency clearance or set of clearances. Mr Lilienthal also stated that a different policy on these clearances would have meant production of fewer atomic weapons than actually exist today. Again, no evidence was presented tending to rebut his statement.

Other Safeguards

The tendency to regard security and secrecy as almost synonymous is a recent development traceable to the myth that we alone owned the atomic-bomb "formula" and that others could not possess themselves of our "formula" independently. But security in its classic connotation refers particularly to physical protection of plants, laboratories, and storage centers. Here, in this classic sense, the Commission came upon real and troublesome problems. The record contains a striking example, described by General Manager Wilson thus:

> Perhaps the most serious situation which required prompt attention in 1947 was the concentration and lack of adequate protection for the stock pile of plutonium and uranium 235, bomb components and nuclear material. The major share of the Nation's stock pile of these weapons and strategic materials was concentrated in a single geographic location, in vulnerable storage structures which were poorly protected and lacked reliable communications or effective plans for safeguarding in case of emergency.
>
> The Commission took immediate action to disperse such materials in more secure storage while the design and construction of bomb-proof, underground vaults were being completed. As we have reported to the joint committee, these storage facilities incorporate protective devices to meet any contingency.

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Closely associated with storage is the problem of transporting raw ores, processed uranium, fissionables, bomb components, and various unique equipment from one point to another. According to Mr. Wilson, shipments are made, "by rail, air, water, and highway"; they represent about 2,000,000 ton-miles per month; and "since January 1, 1947, there has been no known instance of loss or compromise in transit of this heavy volume of secret and strategic material."

Plant security

The Manhattan District turned over to the Commission a list of 729 locations throughout the United States considered as requiring safeguards and where security programs were actually in effect. During 1947 the Commission added 632 more locations to the list. "Of these," Mr. Wilson states, "227 were involved in production, fabrication research or development for Los Alamos * * *." Some had not been guarded previously and many personnel performing highly sensitive work had not been cleared because the very existence of our atomic project was once an official secret. The Manhattan District evidently reasoned that to insert a record of certain "undercover operations" in its central files would create greater security risk than to omit the usual precautions altogether. Similarly, when the war ended, "troop demobilization made the emergency defense plans for atomic energy installations obsolete." The Commission Security Division therefore established direct liaison with the military in order to arrange new emergency plans; and an Army ground division, as well as Air Force units, now figure in the defense of Hanford. Special squads of FBI agents have been given a series of Commission-sponsored technical lectures and stationed at Richland, Los Alamos, and Oak Ridge. "Thus," Mr. Wilson reports, "FBI agents are alert to warn us of sabotage or espionage attempts and are better able to evaluate information that might indicate possible danger to atomic energy facilities." Studies of sabotage vulnerability have been made at each of the 1,300 and odd locations in the United States. About 9 percent of all contractor employees (some 6,000 people) and about 20 percent of all Commission employees (some 950 people) devote full time to guard details and other aspects of "security by concealment."

An inquiry was made as to fire hazards in the Los Alamos technical area. The record indicates that, while some hazard remains, it has been reduced since 1947 through the introduction of sprinkler systems, increased water supply, and strengthened fire-fighting services. Danger will decline to the irreducible minimum as construction of a new technical area, now under way, is completed.

Green stickers and guest list

Apart from this matter, physical protection of facilities gave rise to three questions which came to be known as "the green stickers," "the guest list," and the "Hanford slugs." The first two of these involved instructions controlling guards at the Argonne National Laboratory. Did the authorities there issue green stickers for display on automobile windshields, enabling the drivers to pass in and out of various establishments without security inspection? Also, did a memorandum directed to "all guards" state that a list of 87 people "and their guests will be allowed unlimited access to all areas of the

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property at all times, upon identification of themselves"? Detailed testimony reveals that an automobile parking lot serves one of the Argonne sites and that this parking lot occupies part of a construction area which contains no secret information or equipment. The construction area is watched, however, for such administrative purposes as keeping out vagrants and preventing theft of Government property. The driver of an automobile displaying a green windshield sticker is entitled to enter or leave the parking lot; but the sticker gives access to no other location. The guest list fills a similar function: it signifies that all guards supervising a particular construction area must identify and then admit 87 named officials and their guests. This area, too, contains nothing of a classified nature and is watched for administrative purposes only. Guests are the responsibility of the official escorting them, the assumption being that they are unlikely to steal or damage Government property while in his company. The testimony also makes clear that secret documents are kept in three-combination safes located in an exclusion zone surrounded by fences and patrolled 24 hours a day. No one, regardless of rank, may enter such a zone without submitting to the regular inspection procedure that includes presentation of formal credentials.

Hanford slugs

The matter of the Hanford slugs developed from a test, one of many, designed to check the adequacy of protective measures. A Commission security officer, with the approval of his superiors, entered a Hanford exclusion zone. He possessed credentials authorizing such entry and used them to make his way past three guard stations. Once inside he picked up two slugs of normal uranium, concealed them on his person, and departed—again using the valid credentials to pass through three sets of guards. The slugs were then locked in a safe under the control of security officers, who waited to see whether or not the loss would be noticed. Some months later one slug was finally reported as missing; the taking of the other went undetected. The results of this test leaked to a radio commentator, and his broadcasts stimulated the president of the Hanford Guards Union to write a letter which Senator Hickenlooper read into the record. It alleges security laxness on the part of policy-making authorities and through no fault of the guards themselves; it declares that searches of people entering and leaving the plants are infrequent: and it complains that the guards have had little opportunity to know what a uranium slug actually looks like. Mr. Schlemmer, Hanford area manager, denied any lax attitude toward security. He commented that the author of the letter is a patrolman and has no assignment in the area from which the two slugs were removed. Also the guard union is in process of organization, and General Electric did not agree to a consent election proposed under the Taft-Hartley law. The testimony implies that unionization difficulties, plus a recent reduction in the guard force, may have influenced the writing of the letter.

Materials accountability

The Hanford slugs relate more to materials accountability than to the efficiency of guards, however. Mr. George R. Prout, General

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Electric manager at Hanford, stated that accountability practices have been tightened as a result of the slugs incident. He explained:

> Accountability up until this time had been carried on primarily by lot shipments, and accountability by weight of material, because there were so many pieces involved, and, of course, this is the raw material, and accountability has been consistently accounting for all of the material received to within less than a half of 1 percent, so that the portion of the material that is difficult to account for is lost in machining operations; some of it goes into dust, which goes into the ventilating system and goes through the filters; some of that material is dissolved in the processing and is lost in the solutions. Some of it goes into chips which are subsequently washed, and, therefore, the dust is washed from them and goes down the drain. The balance, of course, is weighed and recast into ingots for further use.
>
> It was felt up until that time that accountability for the raw material to within that very small percentage was adequate. It was not considered really feasible, or would not be considered desirable for anyone to remove a piece of the raw material because that would disclose nothing to anyone. As I said previously, a slug after processing would reveal perhaps some secret information, but the guys who do it can reveal a heck of a lot more by what they have in their heads than they can by taking a piece of material out.
>
> Now, we are hard at work trying to develop—we think we have the answer so that no one, no matter who he might be, will be able to carry a piece of this stuff out in his pocket or a dinner pail.

Another materials accountability incident is listed as a "fiasco" in Senator Hickenlooper's original indictment: the lost container of uranium oxide at Argonne. Dr. Walter H. Zinn, director of that laboratory, and others explored the affair throughout two public hearings. Their testimony, together with reports and papers in the committee's possession, would fill a thick volume; but the trend of the evidence may be summarily outlined.

A quantity of uranium salt, partly enriched in U–235, was reduced to metal, cast into an ingot, and then machined. Certain debris resulted from the machining: chips, floor sweepings, the coolant used to cool the machine, ashed filter paper on which some material had been recovered, and other items in addition to the finished article. Each type of debris was collected, placed in a separate container, and stored within the vault at the Argonne metallurgical building. One such container, a small glass mason jar, housed about three-quarters of a pound of uranium oxide evolving from the chips or machine turnings. Somebody having access to the vault apparently took the mason jar, poured its contents into a galvanized steel can used for waste recovery, and threw the jar itself into another can used for waste disposal.

At that time the metallurgical building handled only normal uranium, hundreds of pounds and even tons of it. The enriched ingot had been machined at this building because no other facilities were available to prepare it for an important experiment. The usual practice was to place machine debris, when no longer needed, in the steel cans used for waste recovery and at intervals ship the accumulated scrap to a processing plant for purification and use as production feed material. The enriched oxide looked like ordinary oxide; the label on the jar displayed code symbols easily misunderstood; and during the course of a clean-up operation which took place in the building because it had become contaminated with beryllium, someone carelessly discarded what seemed to be the usual and relatively valueless product of machine turnings. Placement of the jar itself in a steel

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waste-disposal can was also a habitual step; for uranium traces adhering inside the jar, even after cleansing, might upset experimental calculations if it were reused to store other material. The contents of waste-disposal cans are dumped periodically into large steel crates at the Argonne burial ground, as a safeguard against radiation.

After the enriched oxide and jar had been relegated to cans but before their loss became known, debris from the machining work was ordered transferred to a new location. Because the individual directly in charge lacked adequate training and technical background, all items of debris were listed as moving to the new location even though the jar of oxidized chips did not in fact enter the shipment. A recheck disclosed the error and searches began. The waste-recovery can was sent to Oak Ridge for detailed isotopic analysis, which showed all of the missing U–235 to be present except about 4 grams, or one-seventh of an ounce. Later tests reduced this margin of discrepancy and even eliminated it altogether if experimental error is calculated favorably. Since the Argonne metallurgy building dealt with some depleted uranium (i. e., metal containing less U–235 than that found in nature) and since portions may have reached the same waste can as the enriched material, the one may have partly offset the effect of the other—thus explaining the discrepancy which still exists if experimental error is resolved unfavorably. Workers clothed in rubber suits and wearing gas masks probed for the jar at the Argonne burial ground, while an FBI agent watched them, and they located a container which further analyses demonstrated to be the one in question.

The joint committee engaged the services of Dr. Ernest W. Thiele, assistant director of research of the Standard Oil Co. of Indiana, and asked him to make an independent investigation and report. His conclusions are as follows:

> After a careful survey of the data (including analyses recently completed) relating to the disappearance of a jar of uranium enriched in the fissionable isotope, uranium 235, at the Argonne National Laboratory, I have reached the following conclusions.
>
> There can be no reasonable doubt that the enriched material detected by Argonne in the can of ordinary uranium scrap is the material which was in the missing jar.
>
> A perfectly accurate determination, either of the amount of uranium in the containers or the fraction of that uranium which was uranium 235, is not possible; there is always a margin of uncertainty in analytical work. The weight of analytical evidence indicates that the amount of uranium 235 in the missing jar was between 30.3 and 31.7 grams (slightly more than an ounce). Similarly, the evidence indicates that the amount of uranium 235 in the enriched material found in the scrap uranium can was between 29 and 31.1 grams. Since these figures overlap, it follows that the best available data do not indicate the loss of any uranium, by theft or otherwise, but neither do they exclude the possibility that some small amount may have been stolen. The attendant circumstances make it extremely unlikely that any was stolen. The remaining uncertainty cannot be substantially reduced by any further measurement.
>
> The original report of a discrepancy of 3½ grams arose from an erroneous analysis of the amount of uranium 235 in the scrap uranium can. This analysis showed a content of uranium 235 lower than the correct value by about one-twentieth to one-tenth of 1 percent.

The Commission employs the full-time services of 610 scientific, technical, and other workers, representing in salaries alone an annual cost of almost $2,500,000, for the purpose of materials accountability. These employees inventory, weigh, analyze, assay, measure, and trace natural and enriched uranium, plutonium, thorium, and other metals while they are being combined chemically with different

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substances and being processed as gases, solutions, or solids through many stages of refinement. In the opinion of Mr. Williams, director of production—

> Possibly the best illustration of the effectiveness of our present system is the fact that relatively minor discrepancies in the uranium inventories have been discovered and investigated. If the accounting system had not been effective, these amounts would have gone unnoticed. With an industrial operation so large and so complex as the atomic energy program, we would have cause for being suspicious of any accounting system that did *not* show minor discrepancies from time to time.

Documents control

Two other security programs assume great importance, although they attracted only passing attention during the investigation and generated no issues. One is the control of, and accountability for, classified documents. Hundreds of thousands were in existence when the Commission took over, according to Mr. Wilson, but no complete tabulation had ever been made. "The first job was to set up regular inventories of such documents throughout atomic energy plants and laboratories and a check system of accounting for them." Each month 10,000 new classified documents are originated and hundreds move each day from one installation to another, constantly increasing the scope of the security problem. "Substantial progress has been made in establishing controls, setting up an accountability system, and developing inventories," reports Mr. Wilson. But "this job is not finished, and we are still working hard on it in every office throughout the country where classified documents are used."

Control of information

The remaining security program is control of information: The method whereby the Commission decides whether or not a given piece of knowledge may be published. A hierarchy of scientifically qualified reviewers pass upon such matters, guided by detailed technical directives; and they determine the classification given each of the 10,000 documents created monthly, as well as the hundreds of thousands of documents inherited from the Manhattan District. Mr. Lilienthal summarized the problem and its solution in these words: "How do we inform ourselves reasonably, without injury to the national defense? And the balance always is: Is it better for us to know this information, would we derive more strength from it than a potential enemy would derive strength?" He presented a detailed example:

> Let me give one situation in which there was—one other—when there was disagreement, within my clear recollection, as contrasted to radioisotopes—that was not in the radioisotopes—this was in the declassification of a particular item. I am not mentioning the item, but it was a matter of the declassification of a single piece of information.
>
> Here there were literally months of discussions between the staffs [of the Commission and the Military Liaison Committee] and, as I recall, some three discussions between the two bodies on the wisdom or lack of wisdom from the security point of view, military point of view, of the declassification of this item, and in the end the strong views against its declassification held initially by our colleagues of the Military Liaison Committee changed in the direction—changed, and they concurred in the idea that this, on the whole, was a proper decision.

Here, in the field of classification and declassification, the Soviet could most easily gain valuable data if our policy were unwise. Dr.

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Oppenheimer left no doubt that he approves of the judgment exercised in this field. The Commission has recognized that information, once published, can never again be retracted and made secret. Therefore, according to Dr. Oppenheimer, it uses caution even where there is strong temptation to release data in the hope of gaining military advantage through stimulation of scientific progress.

CONCLUSION

The foregoing review of the evidence exposes several paradoxes which merit inspection as a preliminary to the drawing of major conclusions. The Commission has been specifically accused of breaching the law; and yet the original indictment concentrates criticism upon only one member of the Commission, namely, Mr. Lilienthal—an approach which itself implies a misunderstanding as to what the law provides. Section 2 (a) (1) of the McMahon Act is as follows:

> There is hereby established an Atomic Energy Commission (herein called the Commission), which shall be composed of five members. Three members shall constitute a quorum of the Commission. The President shall designate one member as Chairman of the Commission.

From this subsection and from the remainder of the Act it becomes evident that the direction of our atomic enterprise is vested in five men and not in one man. It is equally plain that, in line with the law, the credit for successes and the blame for failures attach to five men collectively and not to one man individually. At the first Commission meeting ever held, furthermore, Messrs. Lilienthal, Pike, Waymack, Bacher, and Strauss decided that they would not divide up administrative responsibilities but would act invariably as a unit.

Another paradox flows from section 2 (c) of the act. It confers upon the Military Liaison Committee, representing our armed forces, a right of appeal to the Secretary of National Defense and, if he concurs, to the President. This right may be invoked whenever "any action, proposed action, or failure to act of the Commission is adverse to the responsibilities" of the Defense Department. Thus the McMahon Act creates a special review of the Commission's national defense activities, since each issue in this area may become one which the Military Liaison Committee decides to contest through its appeal procedure. Members of that committee are told how many bombs and how much fissionable material have been manufactured. They consequently take into account information unknown to the Joint Committee on Atomic Energy, which has preferred not to inform itself of weapons stock-pile data. They have the perspective furnished by lifelong specialization in defense matters. Yet the Military Liaison Committee, with knowledge of how many bombs we possess, with professional background and training, and with a duty to protest decisions harmful from a security viewpoint, has never taken an appeal against a Commission action or failure to act—whether in the field of weapons, production, research, or protection of secrets. Only one difference of opinion between the Military Liaison Committee and the Commission is known to have reached the President's desk: the question of who should have custody over atomic bombs. This issue was resolved more than a year ago, not under the section 2 (c) appeal procedure, but under section 6 (a), which specifically states that the President shall determine

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weapons custody. He reaffirmed his January 1947 decision that the Commission hold atomic bombs in its hands.

The President's attitude toward Commission conduct generally is inconsistent with the mismanagement charges. He took note that Mr. Lilienthal had been selected from among the five Commissioners for special censure and, on May 26, 1949, issued the following public statement:

> I personally know the country's position in atomic energy.
>
> We are making good progress.
>
> Our situation has been vastly improved in the last 2 years under the Atomic Energy Commission.
>
> I deplore the fact that relatively trivial items have been blown up to proportions that threaten the integrity of the program.
>
> It is time that people stopped getting hysterical when the word "atom" is mentioned. The plain fact is that the atomic energy program is in good shape—and in good hands. I hope the Commission will soon be able to get back to work and that the atomic energy program will cease to be used for preelection campaigns.
>
> I have entire confidence in Mr. Lilienthal. He has done a good job.

As the President observes at the outset of his statement, he—like the Military Liaison Committee—knows how many atomic weapons we possess and speaks with that information in mind.

The serious character of the indictment might raise a supposition that able men having access to all the facts are divided on basic policy and that the five Atomic Energy Commissioners themselves frequently disagree. The evidence shows, however, that in more than 500 formal Commission decisions, a dissenting vote was cast 12 times. In each of these dozen ballots the minority consisted of one Commissioner who was throughout the same individual, Mr. Strauss. The framers of the McMahon Act deliberately established a five-man directorate, rather than a single administrator, to control our atomic enterprise for the very purpose of assuring that diverse viewpoints would be brought to bear upon issues so far-reaching as those here involved. The possibility of split votes was not only anticipated but regarded as wholesome. The fact that one Commissioner has demonstrated the courage and independence to dissent upon occasion lends added validity to decisions in which he concurred. The further fact that a lawyer (Mr. Lilienthal), a newspaper editor (Mr. Waymack, recently resigned), a scientist (Dr. Bacher, recently resigned), a financier (Mr. Strauss), and a former member of the Securities and Exchange Commission (Mr. Pike) have achieved unanimity in the great majority of cases suggests the existence of an atomic energy program which most patriotic and intelligent men regard as sensible.

The conflict between this inference and the charges of mismanagement may be seen in sharper focus by introducing the views of the Commission's General Advisory Committee. The 12 scientists, engineers, and industrial leaders comprising that Committee are appointed by the President; and they convene once every 2 or 3 months to formulate advice on important Commission business. Section 2 (b) of the McMahon Act provides for the Committee as a means of mobilizing, on a part-time basis, the ablest brains to be found in private life. This Committee prepared and unanimously endorsed a statement which its Chairman, Dr. Oppenheimer, read into the record:

> The General Advisory Committee, in accordance with its statutory obligations, has followed the scientific and technical activities of the Atomic Energy Commission with considerable care since January 1947. We have seen at first hand the grave difficulties which the Commission faced in assuming responsibility for an extremely complex enterprise which had been disrupted by the ending of the war

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and by a year of uncertainty pending the establishment of the Atomic Energy Commission.

When the Commission took over, the future of the whole enterprise was uncertain, the continuity of production of fissionable materials was far from assured, the design and development of improved weapons was nearly stagnant. In each of these respects, the picture has radically changed. Better weapons have been developed and tested, the production of materials has been substantially increased and assured, and a sound and forward-looking program has been established.

There have been occasions on which the Advisory Committee has criticized the Commission and offered suggestions for the improvement of its program, which suggestions have largely been followed. In all of our examinations of the Commission's activities we have seen a frank recognition of the problems of management inherent in any new undertaking and a steady progress in their solution. The improvement which has been achieved during the Commission's administration appears to us to offer clear proof of competence and devotion to duty by the Commission.

Dr. Oppenheimer himself added that in matters of scientific secrecy, such as the declassification of documents and the shipment of isotopes, the Commission "has been a little more conservative than we would have been, but otherwise it has followed our advice."

To round out the contrast between allegations of gross mismanagement and the different viewpoint prevailing in other respected quarters, Secretary of Defense Louis Johnson sent Senator McMahon a letter dated June 6, 1949, advising that "the Military Establishment has not attempted, and will not attempt, to take atomic energy away from civilian control * * *," and further that "we have had no desire to handle the matter." This same letter observes that former Secretary of Defense James V. Forrestal, in his annual report to the President and the Congress, said:

I want to record my personal satisfaction with the existing statute governing matters in the field of atomic energy, and to express my pleasure, also, at the way in which relationships between the National Military Establishment and the Atomic Energy Commission are being conducted.

The role of the Joint Committee on Atomic Energy as a "watchdog" for Congress brings to light another paradox different from those already encountered. The facts surrounding Commission policy on emergency clearances, foreign isotope shipments, and personnel security procedures—topics stressed during the indictment portion of the investigation—were furnished the joint committee in 1947 or early 1948 and became familiar to the membership through executive discussions held at that time. The committee took no formal action respecting such matters. It passed no resolutions of censure; it approved no recommendation that policies be changed. Nevertheless, in the late spring of 1949, these same matters were portrayed as significant examples of dereliction.

The committee would have welcomed an opportunity to hear the charges of "incredible mismanagement" in executive session before they were made public. Had the committee been consulted beforehand, it would have immediately requested a bill of particulars and would have acted vigorously to eliminate defects found in the project. The committee would also have given careful thought to the possible international effect of any published implication that America's atomic project is in grave trouble.

At this point a final paradox—having a double aspect—presents itself. The original indictment not only refers to "incredible mismanagement" but also to "misplaced emphasis," "maladministration," "fiascos," "waste," and "equivocation." These words, given their ordinary meaning, leave the impression that we lack a substantial

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bomb stock pile, that little progress has been made in weapon design, that production of fissionable material is slow, and that our research efforts are faltering. But when the indictment was made specific at the investigation, such matters were left outside the area of criticism. In fact, the results achieved during the past 2½ years were conceded to be good. Here is one phase of the paradox.

The other phase becomes clear by considering that the committee has before it an indictment which, on the one hand, says the results are good but which, on the other hand, insists the management is bad. How may good results and bad management coexist? An effort was made to answer this question by suggesting that Commission contractors and their scientific and technical personnel have done well, whereas the top administrators have done poorly. But such a suggestion is somewhat like saying that the hand of a painter alone produces a beautiful picture, whereas the brain directing the hand only serves as an obstruction. The presence of contractors and scientific and technical personnel in the project, the definition of their authority, the nature of their work, the equipment they use, their objectives, duties, and morale all stem back to five Commissioners—who bear the final responsibility for whatever is done or not done. Every axiom of experience leads toward the conclusion that both management and results have been good or that both have been poor.

Accordingly, since the indictment itself concedes that results are commendable, this same indictment tends to rebut its own allegations of mismanagement. If there is "misplaced emphasis," no program was cited which the Commission should have undertaken but did not or which it did undertake but should have left alone, and no program which is receiving either excessive or inadequate attention in relation to other programs. The only partial exception is foreign isotope shipments which, apart from one instance, were at first described as outside the scope of the issues and then later described as illegal. If there is "equivocation," examples are not to be found in the frank admission of mistakes connected with the Carmichael School, the jar of uranium oxide at Argonne, and the cost overrun on the plutonium fabrication facility. The one possible example of "equivocation" consisted in representations before the Federal Power Commission which heavily stressed national defense as requiring the Oak Ridge natural-gas pipe line and the differently stressed representations before the joint committee which cited economics as the main justification. The only dramatic "fiasco" illuminated during the investigation had to do with caved-in roofs among houses built by the Manhattan District. One marked example of "waste" was developed (the Carmichael School), one lesser example (the Hanford sanitary water system), and one minute example (the remodelling of the Kellogg-Manley house at Los Alamos). On the other side of the "waste" picture are unchallenged assertions that improved plant operations at Hanford will save the Government as much as $40,000,000 annually; that operating expenses at Oak Ridge for fiscal 1950 will show a decrease of $30,000,000 over fiscal 1947; that the unit cost of producing U–235 has been cut 50 percent; that personnel involved in town management at Los Alamos and Oak Ridge have likewise been cut 50 percent and at Hanford by 19 percent; and that $150,000,000 in new construction has been deferred through successful attack upon the Hanford pile deterioration problem. One instance of what might be called "maladministration" came to light: the overrun on the plutonium facility. Here the error—which would have been far greater if the facility had

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not started operating 6 months sooner than was originally believed possible—lay in the Commission's long unawareness of the true cost situation. If there has been over-all "maladministration" or "incredible mismanagement" it apparently involves taking a vast enterprise which was falling apart at the seams and reshaping it into a formidable deterrent against aggression.

A large body of uncontested evidence shows that the Commission is bringing to the people of the United States and to all freedom-loving peoples the most precious of defense commodities: "security by achievement." In 1947 the democratic world found itself with only such atomic protection as was conferred by its temporary bomb monopoly, not the protection conferred by numbers of bombs. Today, according to the allegations of all witnesses before the committee, the situation is being altered; our country is now atomically armed; and each month and year sees us raise our atomic strength to a higher level.

The Commission's success in driving our project uphill was only one possible outcome. The exodus of scientists and technicians to private life might have continued unchecked after 1947; the Hanford piles could have deteriorated beyond repair; construction of additional piles might have faltered; and improvements in the K–25 gaseous diffusion process might have been relegated to the future. A timid approach would have counseled delay in building metal-fabrication facilities, postponement of the Eniwetok tests, hesitation in converting the Commission-owned communities into places where highly educated people are willing to make their homes, and a skeptical attitude toward fundamental research. Disregard of biology and medicine might have left us largely without the scientific foundation for civil defenses against atomic attack. Lack of raw materials might have limited production; bomb assembly might have remained a "bread board" operation; and strikes and shortages might have closed down plants. If weapons output were today the merest trickle, the Commission could advance a number of plausible excuses.

The extensive testimony on "security by concealment" includes no evidence hinting that Russia obtained secrets from the Commission which advanced by 1 day the date when she completed her first atomic bomb. Likewise, no evidence hints that Russia has acquired information from the Commission which would enable her to improve, by so much as mucilage and tissue paper, the current Soviet bomb designs.

According to one of the charges, "We have learned from the records that there are numerous persons employed on our atomic projects who have strong Communist leanings." If this charge had foundation in the evidence—if even one case of "strong Communist leanings" were successfully cited—the committee would be first to speak out. But the charge has no foundation in the evidence. The only qualification relates to the handful of "calculated risk" cases where a combination of irreplaceable ability, access to key secrets during the war, and derogatory data limited mainly to associations may mean that a scientist gains clearance where normally it would be denied. The joint committee has known about these cases for more than 2 years; the validity of the "calculated risk" concept under the right circumstances was not challenged during the investigation; and the role which such authorities as the Roberts Board and Admiral Chester

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W. Nimitz have played in reviewing the hazard involved gives assurance of correct assessments.

It is noteworthy that the main "security by concealment" charges had to do with protective machinery which existed only in rudimentary form before the Commission took over. The matter of the Hanford slugs and the misplaced container at Chicago, for example, pertain to materials accountability. In this field, where process losses, experimental error, and the presence of impurities introduce uncertainty into every calculation, the Commission took upon itself a complex task. No specific language in the act compels it to establish a scientific routine of accounting for materials. Physical plant protection and FBI investigations of personnel, considered alone, furnish antispy insurance to a degree previously unknown in America. If the accountability program had not been undertaken as an added safeguard beyond the letter of the law, the incidents at Hanford and Chicago would have passed unnoticed and hence could hardly have been used as a basis for criticism. Here is a situation where the Commission's special concern for "security by concealment" exposed it to hostile fire. Under these circumstances the Commission might well have testified that there exists an irreducible margin of human error; that the uranium incidents illustrate such error; and that tight material controls brought the error to light as had been foreseen and intended.

Similarly, the matter of emergency clearances and the 34 personnel cases are tied to a still infant experiment in gauging human loyalty. The Commission, guided by unprecedented legislative principles laid down in the McMahon Act, started from scratch. It passed through a "shake-down" period, testing one administrative review procedure and then another—as may not be inappropriate in a radical venture so new to American life and so instinct with peril both to our Government if the disloyal evade exposure, and to personal liberty if the loyal are victimized. The outline of a policy has now emerged, one designed to ferret out all subversives and also to assure the individual fair play—thereby averting the morale split and sense of insecurity which would develop if employees at a particular installation believed that one of their associates had been capriciously or arbitrarily "purged."

Behind broad assertions that the Commission has been lax in security matters lies a species of naivete. It formerly expressed itself through the hope that, by pyramiding fence upon fence, vault upon vault, FBI check upon FBI check, we could somehow prevent Russia from making her own atomic bombs. Equally involved was an underestimation of Soviet capacity. Between January 1, 1947, and April 28, 1949, the Commission considered security matters at 151 of its 262 formal meetings. According to one estimate, it devoted one-third of its meeting time in 1947 and 1948 to personnel security alone. It employs nearly as many people who do nothing except guard secrets as the entire population of Los Alamos. It has organized five fold protection against security leaks: creating a materials accountability system where none existed before; imposing new controls upon the documents to which it fell heir; fashioning loyalty safeguards without democratic parallel; regulating the flow of information; and improving the physical barriers stretched around all atomic plants. Sixfold and sevenfold protection could not be attained; they were mirages.

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Pursuing them would not merely have wasted funds but would also have played havoc with our "security by achievement." Realistic thinking, without illusion, was no less necessary before Russia broke our monopoly than it is today. Soviet acquisition of the bomb was always a predictable and certain outcome. No mobilization of guards, vaults, and fences could ever protect us so well—before or after the Soviet bomb test—as the powerfully deterring American stock pile which the Commission has striven to accumulate.

It is the committee's duty and pleasure to state that, from the evidence submitted at the hearings, a satisfactory balance has in fact been struck between the competing demands of "security by achievement" and "security by concealment." Any different conclusion would run counter to the testimony, which indicates that atomic secrets have been kept at the same time our enterprise made forward progress. If secrecy leaks appreciably assisted the Soviet, and probably they did not, the record implies that all occurred before the Commission assumed responsibility.

Passing now to other matters, the committee is satisfied that the investigation discloses no instance where the Commission violated the McMahon Act. The committee, while it approves the foreign isotope program, believes that the law is ambiguous as regards cases which may arise in the future and intends to consider a clarifying amendment. The committee further believes that the Commission's decision to retain control of the Los Alamos, Oak Ridge, and Richland communities was dictated by necessity; and that the policy of operating through private contractors is also appropriate. At the same time, the committee doubts whether adequate aggressiveness has been shown in moving toward a point where the Commission withdraws from the anomalous and distracting business of running three American communities. A detailed plan for disengaging these towns should be drawn up and a definite timetable established for executing it. Relationships between the Commission and contractors still contain many kinks, not the least of which is insufficient machinery for making contract opportunities available to a maximum number of interested firms. Results are what count; and by that standard the rate of progress in reactor development for military purposes is overslow, notwithstanding the many good reasons which account for it. The committee urges every possible effort in this field.

But entries on the debit side of the Commission's ledger involve account books covering an industry which extends through 41 States in our own country alone and 1,270 locations ranging through half the world. This industry occupies more land than all the area of Rhode Island; it utilizes more than 1,000 contractors and subcontractors, plus other thousands of suppliers; it directly conditions the lives of 200,000 people, including employees and their dependents; and it spends a billion dollars yearly. In proportion to the scope of the account books, debit entries are well scattered through pages of accomplishment.

The investigation conducted by the Committee, while fruitless in proving the charges of "incredible mismanagement", has served to highlight the nature of our atomic project and its manifold problems and ramifications, and has further served to bring home to the people of the United States that in operations of such a unique character mistakes and errors of judgment are bound to occur. The present report has conscientiously sought to illustrate this fact.

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The Joint Committee's overriding concern has been and is the security of the United States in the field of atomic energy. Its regular investigative function under the McMahon Act continues. In exercising that function the committee will review many matters upon which it might have preferred to elaborate during the recent hearings. This report and the record supporting it necessarily relate in greater measure to the specific charges and only in lesser measure to topics which the national defense imbues with greatest significance. The committee may, from time to time, voice criticism of past, present, and future Commission actions. If so, its comments will attempt to throw perspective, as well as light, upon shortcomings in the interest of a stronger atomic energy program. The project has moved a long way from the bleak days of 1947 when our weapon stock-pile position bordered upon complete inadequacy. Yet the Commission, as trustee for the American people, faces a problem-studded future. Many difficulties remain outstanding, and as they are overcome, others will take their place. Russia's ownership of the bomb, years ahead of the anticipated date, is a monumental challenge to American boldness, initiative, and effort.

There were those who thought that Hiroshima marked the death knell of freedom, that atomic energy is a poison which would gradually spread throughout our institutions and undermine them with militarization and hysterical curbs. The investigation suggests, on the contrary that free men can grapple with the atom, use it to invigorate their defenses, and hope for the day when effective and enforceable international safeguards abolish the fear of atomic war from this earth.

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A REPORT ON THE INTERNATIONAL CONTROL OF ATOMIC ENERGY

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DEPARTMENT OF STATE

For the press
No. 235

April 9, 1946

The Department of State, on March 28, 1946, made public a publication entitled "A Report on the International Control of Atomic Energy". In the public discussion of the Report questions have arisen with respect to the denaturing of materials utilized in atomic explosives.

After consultation with the Department of State, Maj. Gen. L. R. Groves called together a group, representative of the outstanding scientists connected with the Manhattan Project during the development of the atomic bomb and all of whom are still connected with the project either on a full-time or consulting basis. This group has met and has just completed a conference in which the measure of safety afforded by the use of denaturants was discussed. They prepared among other papers a report which can be released without jeopardizing security. Their report is as follows:

"The possibility of denaturing atomic explosives has been brought to public attention in a recent Report released by the State Department on the international control of atomic energy. Because, for security reasons, the technical facts could not be made public, there has been some public misunderstanding of what denaturing is, and of the degree of safety that it could afford. We have thought it desirable to add a few comments on these points.

"The Report released by the State Department proposes that all dangerous activities in the field of atomic energy be carried out by an international authority, and that operations which by the nature of the plant, the materials, the ease of inspection and control, are safe, be licensed for private or national exploitation. The Report points out that the possibility of denaturing explosive materials so that they 'do not readily lend themselves to the making of atomic explosives' may contribute to the range of licensable activities, and to the overall flexibility of the proposed controls. The Report does not contend nor is it in fact true, that a system of control based solely on denaturing could provide adequate safety.

"As the Report states, all atomic explosives are based on the raw materials uranium and thorium. In every case the usefulness of the material as an atomic explosive depends to some extent on different

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properties than those which determine its usefulness for peacetime application. The existence of these differences makes denaturing possible. In every case denaturing is accomplished by adding to the explosive an isotope, which has the same chemical properties. These isotopes cannot be separated by ordinary chemical means. The separation requires plants of the same general type as our plants at Oak Ridge, though not of the same magnitude. The construction of such plants and the use of such plants to process enough material for a significant number of atomic bombs would probably require not less than one nor more than three years. Even if such plants are in existence and ready to operate some months must elapse before bomb production is significant. But unless there is reasonable assurance that such plants do not exist it would be unwise to rely on denaturing to insure an interval of as much as a year.

"For the various atomic explosives the denaturant has a different effect on the explosive properties of the materials. In some cases denaturing will not completely preclude making atomic weapons, but will reduce their effectiveness by a large factor. The effect of the denaturant is also different in the peaceful application of the materials. Further technical information will be required, as will also a much more complete experience of the peacetime uses of atomic energy and its economics, before precise estimates of the value of denaturing can be formulated. But it seems to us most probable that within the framework of the proposals advanced in the State Department Report denaturing will play a helpful part.

"In conclusion we desire to emphasize two points, both of which have been challenged in public discussion. (1) Without uranium as a raw material there is no foreseeable method of releasing atomic energy. With uranium, thorium can also be used. (2) Denaturing, though valuable in adding to the flexibility of a system of controls, cannot of itself eliminate the dangers of atomic warfare.

"L. W. Alvarez
R. F. Bacher
M. Benedict
H. A. Bethe
A. H. Compton
Farrington Daniels
J. R. Oppenheimer
J. R. Ruhoff
G. T. Seaborg
F. H. Spedding
C. A. Thomas
W. H. Zinn"

The background of the individuals who have signed this report follows below:

Dr. L. W. Alvarez worked for the Manhattan Project on the development of the bomb, first at the Metallurgical Laboratory at Chicago and then as group leader at the Los Alamos Laboratory. He is now a professor of physics at the University of California Radiation Labo-

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ratory, where under the direction of Professor Ernest O. Lawrence he is engaged on full-time work for the Manhattan Project.

Dr. R. F. Bacher, during the development of the atomic bomb, was chief of the physics division at the Los Alamos Laboratory of the Manhattan District. He has returned to his professorship of physics at Cornell University and still is a consultant to the Manhattan Project.

Dr. M. Benedict is head of an important division of the Kellex Corporation which designed the gaseous diffusion plant built at the Clinton Engineer Works for the Manhattan Project. He was formerly research chemist with the M. W. Kellogg Company and is now a consultant to the Manhattan Project.

Dr. H. A. Bethe, during the development of the atomic bomb, was chief of the Theoretical Physics Division of the Los Alamos Laboratory of the Manhattan District. He has returned to his professorship of physics at Cornell University and still is a consultant to the Manhattan Project.

Dr. A. H. Compton, now as chancellor, is the head of the Washington University of St. Louis; formerly the director of the Metallurgical Laboratory of the Manhattan District and still a consultant to the project. It was the Metallurgical Laboratory at Chicago which developed the scientific basis for the plutonium process.

Dr. Farrington Daniels is director of the Metallurgical Laboratory of the Manhattan Project. This laboratory is operated by the University of Chicago and is continuing research and development work on atomic energy. He is on leave of absence from the University of Wisconsin where he is professor of chemistry.

Dr. J. R. Oppenheimer is former director of the Los Alamos Laboratory of the Manhattan District. It was at this laboratory that the atomic bomb itself was developed. He remains a consultant to the project, although he has returned to his professorship of physics at the University of California at Berkeley and at the California Institute of Technology at Pasadena. Dr. Oppenheimer was a member of the Board of Consultants which prepared *A Report on the International Control of Atomic Energy* for the Secretary of State's Committee on Atomic Energy.

Lt. Col. John R. Ruhoff, prior to the organization of the Manhattan District, was director of inorganic research and development at Mallinckrodt Chemical Works, and an important officer in the Manhattan Project from the start, first in the development of processes and the procurement of raw materials, then as unit chief of the electromagnetic plant; presently heads the group handling declassification.

Dr. G. T. Seaborg, co-discoverer of plutonium, supervised for the Manhattan Project the general program on the basic chemistry of

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the heavy elements, especially plutonium. At present he is engaged full-time on further work of this nature for the Manhattan Project. He is on leave of absence from the University of California where he is professor of chemistry.

Dr. F. H. Spedding is director of the Iowa State College Laboratory, which, among other things, developed the successful method for the production of uranium metal for the Manhattan Project and which is continuing work for the project. Dr. Spedding is also professor of chemistry at Iowa State College.

Dr. C. A. Thomas is vice president of the Monsanto Chemical Company, general over-all chemical adviser for the Manhattan Project in the development of the atomic bomb. He also had complete charge of all phases of Monsanto's work in connection with the project and is still in complete charge of their continuing work for the Manhattan Project in research and development of atomic energy for peacetime applications. Dr. Thomas was a member of the Board of Consultants which prepared *A Report on the International Control of Atomic Energy* for the Secretary of State's Committee on Atomic Energy.

Dr. W. H. Zinn was a project leader at the Metallurgical Laboratory of the Manhattan Project during the early days of pile development. He is now director of the Argonne Laboratory which is operated by the University of Chicago for the Manhattan Project. Experimental pile work is conducted in this laboratory. He was former assistant professor of physics at the City College of New York.

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A REPORT ON THE INTERNATIONAL CONTROL OF ATOMIC ENERGY

Prepared for

THE SECRETARY OF STATE'S COMMITTEE ON ATOMIC ENERGY

by a Board of Consultants:

Chester I. Barnard
Dr. J. R. Oppenheimer
Dr. Charles A. Thomas
Harry A. Winne
David E. Lilienthal, Chairman

Washington, D. C. March 16, 1946

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FOREWORD

By The Secretary of State

This "Report on the International Control of Atomic Energy" is in the main the work of a Board of Consultants to the Department of State. The Board carried out its assignment under the general direction of a Committee on Atomic Energy which I set up on January 7, 1946 with Dean Acheson, Under Secretary of State, as Chairman. A letter of transmittal at the beginning of the Report embodies the comments which Mr. Acheson's Committee made on the unanimous findings and recommendations of the Board of Consultants.

In thus transmitting to me the detailed report of the Board, the Committee emphasizes the Board's observation that the Report is not intended as a final plan but "a place to begin, a foundation on which to build". The Committee also states that it regards the consultants' work as "the most constructive analysis of the question of international control we have seen and a definitely hopeful approach to a solution of the entire problem".

The intensive work which this document reflects and the high qualifications of the men who were concerned with it make it a paper of unusual importance and a suitable starting point for the informed public discussion which is one of the essential factors in developing sound policy. The document is being made public not as a statement of policy but solely as a basis for such discussion.

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OFFICE OF
THE UNDER SECRETARY OF STATE
WASHINGTON

March 17, 1946.

DEAR MR. SECRETARY:

Your committee was appointed on January 7, 1946, with the following terms of reference:

"Anticipating favorable action by the United Nations Organization on the proposal for the establishment of a commission to consider the problems arising as to the control of atomic energy and other weapons of possible mass destruction, the Secretary of State has appointed a Committee of five members to study the subject of controls and safeguards necessary to protect this Government so that the persons hereafter selected to represent the United States on the Commission can have the benefit of the study."

At our first meeting on January 14, the Committee concluded that the consideration of controls and safeguards would be inseparable from a plan of which they were a part and that the Commission would look to the American representative to put forward a plan. At that meeting we also agreed that it was first essential to have a report prepared analyzing and appraising all the relevant facts and formulating proposals. In order that the work should be useful, it was necessary to designate men of recognized attainments and varied background, who would be prepared to devote the major part of their time to the matter.

On January 23, 1946, we appointed as a Board of Consultants for this purpose:

Mr. David E. Lilienthal, Chairman of the Tennessee Valley Authority, who acted as Chairman of the consulting Board,

Mr. Chester I. Barnard, President of the New Jersey Bell Telephone Company,

Dr. J. Robert Oppenheimer, of the California Institute of Technology and the University of California,

Dr. Charles Allen Thomas, Vice President and Technical Director, Monsanto Chemical Company, and

Mr. Harry A. Winne, Vice-President in Charge of Engineering Policy, General Electric Company.

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The Board of Consultants has spent virtually its entire time, since the date of appointment, in an intensive study of the problem, and has now completed its report, which is transmitted herewith.

A preliminary draft of this report was first presented to your Committee ten days ago. Extensive discussion between the Committee and the Board led to the development of further considerations embodied in a subsequent draft. Still further discussion resulted in the report now transmitted.

We lay the report before you as the Board has submitted it to us "not as a final plan, but as a place to begin, a foundation on which to build." In our opinion it furnishes the most constructive analysis of the question of international control we have seen and a definitely hopeful approach to a solution of the entire problem. We recommend it for your consideration as representing the framework within which the best prospects for both security and development of atomic energy for peaceful purposes may be found.

In particular, we are impressed by the great advantages of an international agency with affirmative powers and functions coupled with powers of inspection and supervision in contrast to any agency with merely police-like powers attempting to cope with national agencies otherwise restrained only by a commitment to "outlaw" the use of atomic energy for war. In our judgment the latter type of organization offers little hope of achieving the security and safeguards we are seeking.

We are impressed also by the aspect of the plan which concentrates in the hands of the international agency only the activities which it is essential to control because they are dangerous to international security, leaving as much freedom as possible to national and private research and other activity.

We wish to stress two matters brought out in the Board's report—matters of importance in considering the report's proposals as they affect the security of the United States both during the period of any international discussion of them and during the period required to put the plan into full effect.

The first matter concerns the disclosure of information not now generally known. The report points out that the plan necessitates the disclosure of information but permits of the disclosure of such information by progressive stages. In our opinion various stages may upon further study be suggested. It is enough to point out now that there could be at least four general points in this progression. Certain information, generally described as that required for an understanding of the workability of proposals, would have to be made available at the time of the discussions of the proposals in the United Nations Atomic Energy Commission, of the report of the Commission in the Security

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Council and General Assembly of the United Nations, and in the national legislatures which would be called upon to act upon any recommendations of the United Nations. We have carefully considered the content of this information, and in our discussions with the Board have defined it within satisfactory limits. We estimate the degree of its importance and the effect of its disclosure to be as follows: If made known to a nation otherwise equipped by industrial development, scientific resources and possessing the necessary raw materials to develop atomic armament within five years, such disclosure might shorten that period by as much as a year. Whether any nation—we are excluding Great Britain and Canada—could achieve such an intensive program is a matter of serious doubt. If the program were spread over a considerably longer period, the disclosure referred to would not shorten the effort appreciably.

The next stage of disclosure might occur when the proposed international organization was actually established by the action of the various governments upon the report of the United Nations. At this time the organization would require most of the remaining scientific knowledge but would not require the so-called technical know-how or the knowledge of the construction of the bomb.

By the time the organization was ready to assume its functions in the field of industrial production it would, of course, require the technological information and know-how necessary to carry out its task. The information regarding the construction of the bomb would not be essential to the plan until the last stage when the organization was prepared to assume responsibility for research in the field of explosives as an adjunct to its regulatory and operational duties.

The second matter relates to the assumption or transfer of authority over physical things. Here also the plan permits of progress by stages beginning in the field of raw material production, progressing to that of industrial production, and going on to the control of explosives.

The development of detailed proposals for such scheduling will require further study and much technical competence and staff. It will be guided, of course, by basic decisions of high policy. One of these decisions will be for what period of time the United States will continue the manufacture of bombs. The plan does not require that the United States shall discontinue such manufacture either upon the proposal of the plan or upon the inauguration of the international agency. At some stage in the development of the plan this is required. But neither the plan nor our transmittal of it should be construed as meaning that this should or should not be done at the outset or at any specific time. That decision, whenever made, will involve considerations of the highest policy affecting our security, and must be made

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by our government under its constitutional processes and in the light of all the facts of the world situation.

Your Committee, Mr. Secretary, awaits your further instructions as to whether you believe it has performed the task you assigned to it and may now be discharged or whether you wish it to go further in this field under your guidance.

Respectfully submitted,

DEAN ACHESON
Chairman
VANNEVAR BUSH
JAMES B. CONANT
LESLIE R. GROVES,
Major General, U.S.A.
JOHN J. MCCLOY

The Honorable
JAMES F. BYRNES,
Secretary of State,
Washington, D. C.

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INTRODUCTION

The board of consultants met for the first time on January 23d, conferring briefly with the Secretary of State's Committee on Atomic Energy respecting the board's assignment to study the problem of international control of atomic energy. For more than seven weeks since that time we devoted virtually our entire time and energies to the problem we were directed to study and report upon. We visited the plants and installations at Oak Ridge, Tennessee, and Los Alamos, New Mexico, and spent days consulting with numerous scientists, industrial experts, and geologists, authorities in the technical fields concerned with atomic energy. Since February 25th this board has met almost continuously, developing and writing the following report. Our absorption in this task does not, of course, assure the soundness of the recommendation which is the product of our deliberations. But it is relevant as a measure of how important and urgent we feel it to be that the Government and the people of the United States develop a rational and workable plan, before the already launched international atomic armament race attains such momentum that it cannot be stopped.

We have concluded our deliberations on this most difficult problem, not in a spirit of hopelessness and despair, but with a measure of confidence. It is our conviction that a satisfactory plan can be developed, and that what we here recommend can form the foundation of such a plan. It is worth contrasting the sense of hope and confidence which all of us share today with the feeling which we had at the outset. The vast difficulties of the problem were oppressive, and we early concluded that the most we could do would be to suggest various alternative proposals, indicate their strengths and limitation, but make no recommendations. But as we steeped ourselves in the facts and caught a feeling of the nature of the problem, we became more hopeful. That hopefulness grew not out of any preconceived "solution" but out of a patient and time-consuming analysis and understanding of the facts that throw light on the numerous alternatives that we explored. Five men of widely differing backgrounds and experiences who were far apart at the outset found themselves, at the end of a month's absorption in this problem not only in complete agreement that a plan could be devised but also in agreement on the essentials

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of a plan. We believe others may have a similar experience if a similar process is followed.

We have described the process whereby we arrived at our recommendation, to make it clear that we did not begin with a preconceived plan. There is this further reason for describing this process. Others would have a similar experience if they were able to go through a period of close study of the alternatives and an absorption in the salient and determining facts. Only then, perhaps, may it be possible to weigh the wisdom of the judgment we have reached, and the possibilities of building upon it.

The plan of the report itself may be briefly described, as an aid in reading it:

In Section I. we examined the reasons that have led to a commitment for the international control of atomic energy and the early proposal for realizing this objective by a system of inspection.

In Section II. the essential characteristics of a workable plan for security are stated, and the considerations that favor the development of a plan are set out. By the time this discussion is concluded, the outlines of a workable plan as we see it are apparent.

In Section III. the essentials of an organization that puts such principles into effect are described.

In Section IV. we consider the problems of the transition period leading from the present to the full operation of the plan.

We have tried to develop a report that will be useful, *not as a final plan, but as a place to begin, a foundation on which to build.* Many questions that at later stages should and must be asked we have not touched upon at all. We recognize that securing the agreement of other nations to such a plan will raise questions the precise contours of which can hardly be drawn in advance of international meetings and negotiation. We have not, of course, undertaken to discuss, much less to try to settle, problems of this character. The newly created Atomic Energy Commission of the United Nations, when its deliberations begin, will deal with many of these in joint discussion. Indeed, this process of joint international discussion is itself an integral part of any program for safeguards and security.

We desire here to express our great indebtedness to the Secretary of the Secretary of State's Committee on Atomic Energy, Mr. Herbert S. Marks, Assistant to the Under Secretary of State, and to the Secretary of this board, Mr. Carroll L. Wilson. They have contributed in many ways to the work of the board. Whatever value our work may prove to have owes a great deal to their acumen, diligence, and high quality of judgment. We wish especially to thank General Groves and his associates in the Manhattan District and the

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industrial contractors for facilitating our inspection of the installations at Oak Ridge and Los Alamos, and Captain Joseph Volpe, Jr., for his liaison services. We are also indebted to a number of other officers and staff members of the Manhattan Project for their cooperation. As a result of this cooperation we have had unlimited access to the entire range of facts and activities involved in our assignment, and this has been most helpful.

It has not been possible for security reasons to set forth in this report all of the facts which we have taken into account, but we believe that those which are set forth are a sufficient basis for a useful appraisal of our conclusions and recommendations.

WASHINGTON, D. C.
March 16, 1946

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SECTION I

Background of the Problem

This report is a preliminary study of the international control of atomic energy. It has been prepared to contribute to the clarification of the position of the U. S. Representative on the United Nations Commission on atomic energy set up by resolution of the United Nations General Assembly to inquire into all phases of this question.

The Commitment for International Control.

We were given as our starting point a political commitment already made by the United States to seek by all reasonable means to bring about international arrangements to prevent the use of atomic energy for destructive purposes and to promote the use of it for the benefit of society. It has not been part of our assignment to make a detailed analysis of the arguments which have led the Government of the United States in concert with other nations to initiate these steps for international action. By way of background, however, it is useful to review some of the main reasons which have influenced the people of the United States and its Government in this course. These reasons were first definitely formulated in the Agreed Declaration of November 15, 1945, issued by the President of the United States and the Prime Ministers of the United Kingdom and Canada. An understanding of the declarations in that document will itself throw considerable light on the criteria by which any specific proposals for international control may be judged.

The Agreed Declaration cites three reasons for seeking international control. This Declaration recognizes that the development of atomic energy, and the application of it in weapons of war, have placed at the disposal of mankind "means of destruction hitherto unknown." The American people have been quick to recognize the really revolutionary character of these weapons, particularly as weapons of strategic bombardment aimed at the destruction of enemy cities and the eradication of their populations. Enough has been said to make unnecessary a repetition of the probable horrors of a war in which atomic weapons were used by both combatants against the cities of their enemy. But it is hardly possible to overestimate the deep im-

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pression of horror and concern which insight into these future possibilities has made so widespread.

The second point recognized in the Agreed Declaration is that there can be no adequate military defense against atomic weapons. A great mass of expert testimony is involved in an appreciation of the firmness of this point, but it appears to be accepted without essential reservation, and subject only to an appropriate openmindedness, about what the remote future of technical developments in the arts of war may bring.

The third point, and again we quote from the Agreed Declaration, is that these are weapons "in the employment of which no single nation can in fact have a monopoly." Of the three, this is perhaps the most controversial. Strong arguments have been brought forward that the mass of technical and scientific knowledge and experience needed for the successful development of atomic weapons is so great that the results attained in the United States cannot be paralleled by independent work in other nations. Strong arguments have also been put forward that the degree of technical and industrial advancement required for the actual realization of atomic weapons could hardly be found in other parts of the world. These arguments have been met with great and widespread skepticism. It is recognized that the basic science on which the release of atomic energy rests is essentially a world-wide science, and that in fact the principal findings required for the success of this project are well known to competent scientists throughout the world. It is recognized that the industry required and the technology developed for the realization of atomic weapons are the same industry and the same technology which play so essential a part in man's almost universal striving to improve his standard of living and his control of nature. It is further recognized that atomic energy plays so vital a part in contributing to the military power, to the possible economic welfare, and no doubt to the security of a nation, that the incentive to other nations to press their own developments is overwhelming.

Thus the Agreed Declaration bases its policy on the revolutionary increase in the powers of destruction which atomic weapons have injected into warfare, and on the fact that neither countermeasures nor the maintenance of secrecy about our own developments offers any adequate prospect of defense.

There are perhaps other considerations which have contributed to the popular understanding of the necessity for international control, although they do not appear explicitly in the Agreed Declaration. The United States is in a rather special position in any future atomic warfare. Our political institutions, and the historically established

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reluctance of the United States to take the initiative in aggressive warfare, both would seem to put us at a disadvantage with regard to surprise use of atomic weapons. This suggests that although our present position, in which we have a monopoly of these weapons, may appear strong, this advantage will disappear and the situation may be reversed in a world in which atomic armament is general.

The atomic bomb appeared at the very end of hostilities at a time when men's thoughts were naturally turning to devising methods for the prevention of war. The atomic bomb made it clear that the plans which had been laid at San Francisco for the United Nations Organization would have to be supplemented by a specific control of an instrument of war so terrible that its uncontrolled development would not only intensify the ferocity of warfare, but might directly contribute to the outbreak of war. It is clear, too, that in the solution of this relatively concrete and most urgent problem of protecting mankind from the evils of atomic warfare, there has been created an opportunity for a collaborative approach to a problem which could not otherwise be solved, and the successful international solution of which would contribute immeasurably to the prevention of war and to the strengthening of the United Nations Organization. On the one hand, it seemed unlikely that the United Nations Organization could fulfill its functions without attempting to solve this problem. On the other hand, there was hope and some reason to believe that in attempting to solve it, new patterns of cooperative effort could be established which would be capable of extension to other fields, and which might make a contribution toward the gradual achievement of a greater degree of community among the peoples of the world. Although these more general considerations may appear secondary to the main purposes of this report, they are not irrelevant to it. There is another phrase of the Agreed Declaration which rightly asserts "that the only complete protection for the civilized world from the destructive use of scientific knowledge lies in the prevention of war."

The proposals which we shall make in this report with regard to the international control of atomic energy must of course be evaluated against the background of these considerations which have led to the universal recognition of the need for international control. We must ask ourselves to what extent they would afford security against atomic warfare; to what extent they tend to remove the possibility of atomic weapons as a cause of war; to what extent they establish patterns of cooperation which may form a useful precedent for wider application. We ourselves are satisfied that the proposals in this report provide the basis of a satisfactory answer to these questions.

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Early Ideas on Safeguards.

So much for the main outline of the political action that led to the setting up of the United Nations Commission on atomic energy. There is a further aspect of the general background that also requires discussion at the outset. When the news of the atomic bomb first came to the world there was an immediate reaction that a weapon of such devastating force must somehow be eliminated from warfare; or to use the common expression, that it must be "outlawed". That efforts to give specific content to a system of security have generally proceeded from this initial assumption is natural enough. But the reasoning runs immediately into this fact: The development of atomic energy for peaceful purposes and the development of atomic energy for bombs are in much of their course interchangeable and interdependent. From this it follows that although nations may agree not to use in bombs the atomic energy developed within their borders, the only assurance that a conversion to destructive purposes would not be made would be the pledged word and the good faith of the nation itself. This fact puts an enormous pressure upon national good faith. Indeed it creates suspicion on the part of other nations that their neighbors' pledged word will not be kept. This danger is accentuated by the unusual characteristics of atomic bombs, namely their devastating effect as a surprise weapon, that is, a weapon secretly developed and used without warning. Fear of such surprise violation of pledged word will surely break down any confidence in the pledged word of rival countries developing atomic energy if the treaty obligations and good faith of the nations are the only assurances upon which to rely.

Such considerations have led to a preoccupation with systems of inspection by an international agency to forestall and detect violations and evasions of international agreements not to use atomic weapons. For it was apparent that without international enforcement no system of security holds any real hope at all.

In our own inquiry into possibilities of a plan for security we began at this point, and studied in some detail the factors which would be involved in an international inspection system supposed to determine whether the activities of individual nations constituted evasions or violations of international outlawry of atomic weapons.

We have concluded unanimously that there is no prospect of security against atomic warfare in a system of international agreements to outlaw such weapons controlled *only* by a system which relies on inspection and similar police-like methods. The reasons supporting this conclusion are *not merely technical,* but primarily the inseparable political, social, and organizational problems involved in enforcing agreements between nations each free to develop atomic energy but

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only pledged not to use it for bombs. National rivalries in the development of atomic energy readily convertible to destructive purposes are the heart of the difficulty. So long as intrinsically dangerous activities may be carried on by nations, rivalries are inevitable and fears are engendered that place so great a pressure upon a system of international enforcement by police methods that no degree of ingenuity or technical competence could possibly hope to cope with them. We emphasize this fact of national rivalry in respect to intrinsically dangerous aspects of atomic energy because it was this fatal defect in the commonly advanced proposals for outlawry of atomic weapons coupled with a system of inspection that furnished an important clue to us in the development of the plan that we recommend later in this report.

We are convinced that if the production of fissionable materials by national governments (or by private organizations under their control) is permitted, systems of inspection cannot by themselves be made "effective safeguards . . . . to protect complying states against the hazards of violations and evasions."

It should be emphasized at this point that we do not underestimate the need for inspection as a component, and a vital one, in any system of safeguards—in any system of effective international controls. In reading the remainder of this section it is essential to bear in mind that throughout the succeeding sections of this report we have been concerned with discovering what other measures are required in order that inspection might be so limited and so simplified that it would be practical and could aid in accomplishing the purposes of security.

The remainder of this section, however, is concerned with outlining the reasons for our conclusion that a system of inspection superimposed on *an otherwise uncontrolled exploitation of atomic energy by national governments* will not be an adequate safeguard.

The Technical Problem of Inspection.

Although, as we have said, a system of inspection cannot be judged on technical grounds alone, an understanding of the technical problem is necessary in order to see what an inspection system would involve. The general purpose of such inspection (that is, inspection as the sole safeguard) would be to assure observance of international agreements according to which certain national activities leading more or less definitely to atomic armament would be renounced, and others which have as their purpose peaceful applications of atomic energy would be permitted. The fact that in much of their course these two types of activity are identical, or nearly identical, makes the problem one of peculiar difficulty.

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In our study of the technical factors involved in appraising systems of inspection, we were greatly aided by consultations with the Technical Committee reporting to the War Department on the technical aspects of this problem.* We are indebted to this uniquely qualified group of experts for helpful discussions and for making available to us many of their reports, without which we should doubtless have been very much slower to understand the situation.

As a result of our work with this Committee, we are clear: That every stage in the activity, leading from raw materials to weapon, needs some sort of control, and that this must be exercised on all of the various paths that may lead from one to the other; that at no single point can *external* control of an operation be sufficiently reliable to be an adequate sole safeguard; that there is need for a very extensive and technically highly qualified and varied staff if the job is to be done at all; that the controlling agency must itself be active in research and development, and well informed on what is an essentially living art; and that, for effective control, the controlling organization must be as well and as thoroughly informed about the operations as are the operators themselves. Finally—and this we regard as the decisive consideration—we believe that an examination of these and other necessary preconditions for a successful scheme of inspection will reveal that *they cannot be fulfilled in any organizational arrangements in which the only instrument of control is inspection.*

A fundamental objection to an agency charged solely with inspection is that it will inevitably be slow to take into account changes in the science and technology of the field. One cannot look intelligently for a factory of whose principle of design and operation one has never heard. One cannot effectively inspect if the purpose of the operator is to conceal the discoveries by which he hopes to evade inspection. In a field as new and as subject to technical variation and change as this, the controlling agency must be at least as inventive and at least as well informed as any agency which may attempt to evade control.

Human Factors in Inspection.

Even more important than the technical difficulties of realizing an adequate system of inspection, against a background of national rivalry in the field of atomic energy, or through an organization whose major or whose sole directive is suppressive, are the many human factors which in such an arrangement would tend to destroy the confidence and the cooperation essential to its success. The first

*Membership of this Technical Committee on Inspection and Control established by the Manhattan District included L. W. Alvarez, R. F. Bacher, L. A. Bliss, S. G. English, A. B. Kinzel, P. Morrison, F. G. Spedding, C. Starr, Col. W. J. Williams, and Manson Benedict, Chairman.

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of these appears when we ask whether it would in fact be possible to recruit the very large and very highly qualified organization of experts and administrators needed for the work. The work itself, which would be largely policing and auditing and attempting to discover evidences of bad faith, would not be attractive to the type of personnel essential for the job. The activity would offer the inspectors a motive pathetically inadequate to their immense and dreary task.

The presence of a large number of "foreigners" necessarily having special privileges and immunities inquiring intimately and generally into industrial and mining operations would be attended by serious social frictions. For adequate inspection the numbers are large. As an example, it has been estimated that for a diffusion plant operated under national auspices, to offer any real hope of guarding against diversion, 300 inspectors would be required. They would have to check not merely accounts and measuring instruments but also individuals personally. Inquiries would need to be made of individuals without regard to rank or general status. Moreover, it would be especially important to check the location and employment of scientists and many technologists, probably including students. Industrial secrets would be at least to some extent open to "prying". The effect of this would vary with countries. It would probably be as obnoxious to Americans as to any others. Its corrosive effect upon the morale and loyalty of the inspecting organization would be serious.

Some of the organizational difficulties involved in intimate inspection "down the line" of one organization by another are known from experiences that are undoubtedly mild compared with what we should anticipate here. The following are illustrative of the political difficulties of practical operation (quite apart from those to be expected in adopting the international system to begin with). Adequate surveillance by inspection as the sole or primary means of control involves a persistent challenge of the good faith of the nations inspected. If this were confined to relations between the chancelleries and general military staffs the difficulty while serious might not be insuperable. But official questioning of the good faith of a nation by concrete action of inspectors among its citizens is another matter and would tend to produce internal as well as external political problems. A somewhat similar problem is involved when a government (or its officials or employees) interferes with the functions of inspectors or molests or threatens them personally, or bribes or coerces them, or *is accused of doing any of these things.* Such incidents could not be avoided.

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Some may question whether nations would possess strong incentives to illicit operations, if they actually agreed to forego the production and use of fissionable materials for purposes of war. It is obvious, however, that suspicion by one nation of the good faith of another and the fear engendered thereby are themselves strong incentives for the first to embark on secret illicit operations. The raw materials of atomic energy, potentially valuable for new peacetime purposes and of critical importance for war, are already a matter of extreme competition between nations. The forces growing out of this situation and making for acute rivalry between nations seem to us far more powerful than those which cause the present rivalries with respect to such resources as oil. The efforts that individual states are bound to make to increase their industrial capacity and build a reserve for military potentialities will inevitably undermine any system of safeguards which permits these fundamental causes of rivalry to exist. In short, any system based on outlawing the purely military development of atomic energy and relying solely on inspection for enforcement would at the outset be surrounded by conditions which would destroy the system.

There is much technical information which underlies our belief that inspection can be effective only if it is supplemented by other steps to reduce its scope to manageable proportions, to limit the things that need to be inspected, to simplify their inspection, and to provide a pattern of organization which on the one hand will be of assistance to the controlling agency, and on the other will minimize organizational sources of conflict and the inducements to evasion. Much of this technical information is interwoven with later sections of this report. As the facts on which we base our recommendations for a workable plan of control are discussed, the detailed considerations which led to the conclusion stated in this section will appear more concretely than in the foregoing summary.

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SECTION II

Principal Considerations in Developing a System of Safeguards

At the outset of our inquiry we were preoccupied with some way of making an inspection system provide security. This is a preoccupation that is apparently common to most people who have seriously tried to find some answer to the extraordinarily difficult problem presented by the atomic bomb. But as day after day we proceeded with our study of the facts concerning atomic energy, and reflected upon their significance, we were inescapably driven to two conclusions: (a) the facts preclude any reasonable reliance upon inspection as the primary safeguard against violations of conventions prohibiting atomic weapons, yet leaving the exploitation of atomic energy in national hands; (b) the facts suggest quite clearly a reasonable and workable system that may provide security, and even beyond security, foster beneficial and humanitarian uses of atomic energy.

What Should be the Characteristics of an Effective System of Safeguards:

It may be helpful to summarize the characteristics that are desirable and indeed essential to an effective system of safeguards; in other words, the criteria for any adequate plan for security.

a. Such a plan must reduce to manageable proportions the problem of enforcement of an international policy against atomic warfare.

b. It must be a plan that provides unambiguous and reliable danger signals if a nation takes steps that do or may indicate the beginning of atomic warfare. Those danger signals must flash early enough to leave time adequate to permit other nations—alone or in concert—to take appropriate action.

c. The plan must be one that if carried out will provide security; but such that if it fails or the whole international situation collapses, any nation such as the United States will still be in a relatively secure position, compared to any other nation.

d. To be genuinely effective for security, the plan must be one that is not wholly negative, suppressive, and police-like. We are not dealing simply with a military or scientific problem but with a problem

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in statecraft and the ways of the human spirit. Therefore the plan must be one that will tend to develop the beneficial possibilities of atomic energy and encourage the growth of fundamental knowledge, stirring the constructive and imaginative impulses of men rather than merely concentrating on the defensive and negative. It should, in short, be a plan that looks to the promise of man's future well-being as well as to his security.

e. The plan must be able to cope with new dangers that may appear in the further development of this relatively new field. In an organizational sense therefore the plan must have flexibility and be readily capable of extension or contraction.

f. The plan must involve international action and minimize rivalry between nations in the dangerous aspects of atomic development.

The facts we have come to think essential, and the elements of our thinking as we moved toward the plan we herein recommend, are set out in this section, in the form of the considerations that are relevant to an effective program for security, and that have led us to devise what we believe is an adequate plan.

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CHAPTER I

The Problem Has Definable Boundaries

This problem of building security against catastrophic use of atomic energy is not one without boundaries. This is important. For if the fact were that tomorrow or a year hence we might reasonably expect atomic energy to be developed from clay or iron or some other common material then it is apparent that the problem of protection against the misuse of energy thus derived would be vastly more difficult. But such is not the case. The only scientific evidence worthy of regard makes it clear that in terms of security uranium is indispensable in the production of fissionable material on a scale large enough to make explosives or power. The significance of this fact for effective international control will appear.

As a first step in our work, we undertook a study, with the help of the qualified members of our group, aimed at an understanding of the well-established principles of nuclear physics upon which, among other things, the conclusion is based that uranium is indispensable as the primary source of atomic energy. These scientific principles are not familiar, but they are capable of being appreciated by laymen. Because the specific content of any system of control will be importantly influenced by the scientific principles and facts, we would emphasize the importance of an appreciation of them. For present purposes, we shall state in greatly simplified terms certain conclusions that are drawn from a full technical account of this subject.

Until 1942 the energy which man had learned to control for his useful purposes derived almost exclusively (except for water, wind, and tidal power) from chemical reactions. For practical purposes, chemical combustion was the main source of energy. This energy is the product of rearrangements of electrons in the periphery of atoms and results from the change in *chemical structure* which occurs in the process of combustion.

"Atomic energy," as that term is popularly used, refers to the energy that results from rearrangements in the structure of atomic nuclei of elements. There are very strong forces which hold such nuclei together and account for their stability. The nature of these forces is not adequately understood, but enough is known about their behavior, not only to make it certain that the energy of an atomic

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bomb or an atomic power plant comes from the work done by these forces when the structure of atomic nuclei is rearranged, but also to explain one major fact of decisive importance: Only in reactions of very light nuclei, and in reactions of the very heaviest, has there ever been, to the best of our knowledge, any large-scale release of atomic energy. The reasons for this can be given in somewhat oversimplified form.

As to the light nuclei—The forces which hold all nuclear particles together are attractive. When lighter nuclei combine to make heavier ones, and in particular when the lightest nucleus of all, that of hydrogen, is combined with another light nucleus, these attractive forces release energy. This combination of light elements to form somewhat heavier ones occurs in the stars and of the sun; in the sun effectively what happens is that hydrogen nuclei combine to form the more stable nuclei of helium. Almost all sources of the energy used on earth come to us from the sunlight which this great atomic energy plant provides. But the conditions which make this plant possible are very special, and we do not know how to duplicate them on earth; we may very well never learn to do so. They depend on maintaining matter deep in the interior of the sun at very high temperatures—many millions of degrees. The nuclear reactions themselves provide the energy necessary to keep the matter hot; and it is kept from expanding and cooling by the enormous gravitational forces of attraction which hold the sun together and provide a sort of container in which this temperature and pressure can be maintained. For the foreseeable future the maintenance of such reactions on earth will not be possible; in the immediate future it is certainly not possible.

As to the heaviest nuclei—Although nuclear reactions can be carried out in the laboratory for all nuclei, and although in some cases a given nuclear reaction may release energy even for nuclei of intermediate weight, the properties which make the large-scale release of such energy possible are peculiar, to the very light nuclei and to the very heaviest. And the very heaviest nuclei have a property shared by none of the the other elements. These very heavy nuclei generate energy if they can be caused to split into lighter ones; this unique process is called "fission." Perhaps a dozen nuclear species are known which can be made to undergo fission; under more drastic treatment no doubt the list will be extended. But to make atomic energy takes more than the property of fission. The fission process itself must maintain itself or grow in intensity so that once it is started in a few nuclei a chain of reactions will be set up and a large part of the material will become potentially reacting. The agency which initiates this process is the neutron. In fission neutrons are emitted; and in certain nuclei bombardment by neutrons is enough to cause fission.

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There are several substances for which this is true, but there is only one substance which occurs in nature with any significant abundance for which it is true—that substance is uranium. Uranium is the only natural substance that can maintain a chain reaction. It is the key to all foreseeable applications of atomic energy.

One may ask why there are so few materials which undergo fission, and why so few of these can maintain a chain reaction. The reason lies in the fact that only the heaviest nuclei are sufficiently highly charged to come apart easily, and that only the most highly charged of all are sufficiently susceptible to fission on neutron bombardment to maintain a chain reaction. It is not to be anticipated that this situation will be invalidated by further scientific discovery.

A word needs to be said about the role of thorium, which is slightly more abundant than uranium, and for which fission is also not too difficult to induce. Thorium cannot maintain a chain reaction, either itself or in combination with any other natural material than uranium. Nevertheless, it occupies an important position with regard to safeguards. The reason for this is the following: Without uranium, chain reactions are impossible, but with a fairly substantial amount of uranium to begin with and suitably large quantities of thorium a chain reaction can be established to manufacture material which is an atomic explosive and which can also be used for the maintenance of other chain reactions.

Absolute control of uranium would therefore mean adequate safeguard regarding raw materials. Yet, since any substantial leakage of uranium through the system of controls would make possible the exploitation of thorium to produce dangerous amounts of atomic explosive, provisions governing thorium should be incorporated in the system to compensate for possible margins of error in the control of uranium. The coexistence of uranium and thorium in some natural deposits makes this technically attractive.

There can be little hope of devising a successful scheme of control unless the problem can somehow be limited to the immediate future, by arrangements that have a reasonable prospect of validity for the next decade or two, and which contain sufficient flexibility to accommodate themselves to inevitably changing conditions. We believe that a system of control which disregards all materials except uranium and thorium satisfies these conditions. Indeed if a successful system of control can be commenced now, based upon these materials, and if the time should ever come when other materials lend themselves to the same activities, it should in fact be far easier to include them within the system than it will be to set up the initial control system with which we are now concerned.

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Because the constituent raw materials of atomic energy can be limited to uranium and thorium, the control problem is further narrowed by the geological conditions under which uranium and thorium are found, and the fact that at present those elements have only a restricted commercial significance. Although they are distributed with relative abundance throughout the world, and although it is clear that many sources beyond the known supplies will be discovered, it is apparently the view of the authorities that these elements occur in high concentrations only under very special geologic conditions. This would seem to mean that the areas which need to be surveyed, to which access must be had, and which would ultimately have to be brought under control, are relatively limited.

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CHAPTER II

The Adequacy of Present Scientific Knowledge

There can be no question that its dynamic changing quality is one of the dominant features of the present situation in the field of atomic energy. Advances in knowledge must be expected in a constant stream. Does this mean that a system of safeguards is impossible because new knowledge will completely change the nature of the problem from year to year or even month to month? The answer is in the negative.

When the atomic bomb was first used there was a widespread belief that its development involved a few simple, static secrets. As it became possible for people to learn how rapidly ideas and techniques had changed in this field in the last years, and how many further developments the future seemed to have in store, the original opinion was replaced by another: that we knew very little of the possibilities and limitations of this field and that it was so rapidly changing that no account of the present technical situation would have much validity. This view has been expressed both in the preamble to a pending Bill, which indicates that too little is known of the technical facts to provide a firm basis for political action, and in such statements as one attributed to a high official, that it would not be long before we could extract atomic energy from common materials such as clay.

Neither the initial view of a static body of knowledge nor the later one of unpredictably rapid change accurately describes the present situation. As the preceding chapter has shown, there is a great deal that we know about nuclear reactions—know solidly, firmly, and with vast, interrelated experimental checks on the soundness of the description. Novelty will of course appear in scientific discoveries, but it will appear for the most part not as a negation of present knowledge but as the result of new types of physical experience made possible by new methods of physical exploration, and in turn requiring new modes of description. This future experience may have something to do with the basic knowledge involved in release of atomic energy, but there is no basis for believing this, and the chances are against it. There is another type of novelty that lies in ingenious applications of the fundamental facts as they are now known. This does not lessen the importance of the underlying facts and of conclusions which can unambiguously be drawn from them.

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For the limited but useful objective of devising a system of control valid for the reasonably foreseeable future, we believe the present knowledge in the field of atomic energy is adequate. We know, for example, that uranium occupies a unique role in the production of fissionable substances and that without it atomic explosives cannot be made. We know that there is no evidence whatever that this situation will soon change. We know that a vast scientific and industrial effort is necessary in order to produce atomic bombs. This is not to say that the effort, however vast, cannot be concealed—although we believe that measures can be taken to reduce this danger. We know that the release of atomic energy does demonstrate the convertibility of mass to energy, but we also know that the familiar example of this physical principle—that the annihilation of a kilogram of any kind of matter is equivalent to all the power consumed in the United States in a period of three months—is a statement of a possibility, the realization of which is so remote that for the purposes of devising a system of safeguards it may be entirely disregarded.

We know, too, that many areas in this field which are now unclear will be clarified by further investigations. Within a few years much more could be learned about atomic explosives. Within a relatively few years the technology of atomic energy power plants will become clearer. It seems likely that before very long we shall have discovered many useful therapeutic and technological applications for the radioactive substances which can be made in the production of fissionable materials. Nor can there be much question that ways will be found to cheapen and simplify the processes involved in the production of the fissionable materials themselves.

But what needs most to be emphasized is that the dynamic quality which has so excited popular interest must be seen in its proper perspective in relation to the general field of scientific knowledge. The prophecies as to future discoveries must not be permitted to obscure the fact that there are at key places throughout the field of knowledge firm anchor points around which it should be possible to construct an effective and adequate system of control.

In this report it is possible for us to do little more than record our own sense of the soundness of this statement. Those who must assume responsibility for political action should test for themselves the correctness of our conclusions. This testing will require an examination of difficult and complicated technical facts, but we are confident that the process is one which other laymen with the appropriate help of experts can readily repeat. We are also confident that unless the effort is made it will be impossible to come to grips with the problem of devising political measures to prevent atomic warfare and to promote the beneficent use of atomic energy.

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CHAPTER III

Constructive Applications for Atomic Energy

To "outlaw" atomic energy in all of its forms and enforce such a prohibition by an army of inspectors roaming the earth would overwhelm the capacity and the endurance of men, and provide no security. This conclusion has a further implication in a search for a security system. While suppression is not possible where we are dealing with the quest for knowledge, this thirst to know (that cannot be "policed" out of existence) *can* be used, affirmatively, in the design and building of an effective system of safeguards.

Human history shows that any effort to confine the inquiring human mind, to seek to bar the spirit of inquiry, is doomed to failure. From such efforts comes subversion fraught with terrible consequences: Gestapo, inquisitions, wars. The development of atomic energy is one of a long, long line of discoveries that have their well springs in the urge of men to know more about themselves and their world. Like the jiu jutsu wrestler whose skill consists in making his opponent disable himself with his own thrusts, the designers of a system of safeguards for security should and can utilize for enforcement measures that driving force toward knowledge that is part of man's very nature.

If atomic energy had only one conceivable use—its horrible powers of mass destruction—then the incentive to follow the course of complete prohibition and suppression might be very great. Indeed, it has been responsibly suggested that however attractive may be the potentialities for benefit from atomic energy, they are so powerfully outweighed by the malevolent that our course should be to bury the whole idea, to bury it deep, to forget it, and to make it illegal for anyone to carry on further inquiries or developments in this field.

We have concluded that the beneficial possibilities—some of them are more than possibilities, for they are within close reach of actuality—in the use of atomic energy should be and can be made to aid in the development of a reasonably successful system of security, and the plan we recommend is in part predicated on that idea.

That mankind can confidently look forward to such beneficial uses is a fact that offers a clue of not inconsiderable importance to *the kind of security arrangements* that can be made effective.

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The difficulty of recruiting enforcement officers having only a negative and policing function, one of prohibiting, detecting, and suppressing, is obvious. Such a job lacks any dynamic qualities. It does not appeal to the imagination. Its future opportunities are obviously circumscribed. It might draw the kind of man, let us say, who was attracted to prohibition squads in years past. Compare this type of personnel with those who could be expected to enter a system under which it is clear that the constructive possibilities of atomic energy may also be developed. Atomic energy then becomes a new and creative field in which men may take pride as participants, whatever their particular role. They are in "on the ground floor" of a growing enterprise. Growth, opportunities, future development—these are the characteristics, let us say, of the field of air transport that have made it possible for the airlines to attract a high grade and youthful personnel.

The importance of this fact that atomic energy has beneficial uses as well as destructive uses, in terms of the attraction of personnel in a security organization will, of course, depend upon the functions given to that organization. If the security organization has not only enforcement but also *development functions*, then this consideration of beneficial possibilities becomes a most weighty one.

What are the beneficial possibilities? We have had the benefit of a thoughtful, unpublished report on the technical possibilities now apparent in this field. This report was prepared for the Secretary of War's Interim Committee on Atomic Energy by a panel of scientists who worked with a large additional group of leading scientists in the field.* The conclusions there stated represent an appraisal of these possibilities, that is, in our opinion, challenging and at the same time balanced and restrained.

In introducing its conclusions the report observes that "We are probably no more able to foresee the ultimate fruits of development than were Faraday's contemporaries to understand what would come of the discovery of electro-magnetic induction." It gives a further sense of perspective in emphasizing that "The unique preoccupation of the war years in the use of atomic energy for military weapons . . . has probably retarded our understanding of other applications." We believe that this is equally true at present.

The report discusses two "great fields" for beneficial use, "the development of atomic energy as a controlled source of power" and "the application of radiations and radioactivities to the growth of the

*This panel included A. H. Compton, E. Fermi, E. O. Lawrence, and J. R. Oppenheimer. Their report was prepared in consultation with S. K. Allison, Zay Jeffries, C. C. Lauretsen, I. I. Rabi, C. A. Thomas, H. C. Urey, and with the further help of numerous specialists.

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sciences and the practical arts." It gives a sober appraisal of each of these possibilities: "It is probable," the report states, "that the exploitation of atomic energy as a tool for research will outweigh the benefits to be derived from the availability of a new source of power." But this new source of power is itself regarded as of great significance, and is thought to be "the most appropriate focal point for the work of the next few years."

"We have examined in some detail [the report continues] the technical problems of making available heat and power on the scale of present world consumption from controlled nuclear reactors. We see no significant limitations on this development, either in the availability or in the cost of the fundamental active materials. We see characteristic limitations and characteristic advantages in atomic power which make us regard it in great measure as a supplement to existing sources, and an incentive to new developments, rather than as a competitor, let us say, to coal or to petroleum products. We see no foundation in current science for the hope that atomic power can be effectively used for light, small portable units such as are required for aircraft and for automotive transportation; but we believe that the development of rather large power units for heat and conversion to electrical energy is a program for the near future; that operating units which will serve to demonstrate the usefulness and limitations of atomic power can be in existence within a few years, and that only the gradual incorporation and adaptation of such units to the specific demands of contemporary economy will involve a protracted development."

Finally, the report takes up the opportunities which have been opened in the field of research by the prospect of a plentiful supply of radioactive substances as byproducts of the manufacture of fissionable materials, a circumstance which it has been said may well be as significant for scientific progress as the ready availability of microscopes for every laboratory.

"It should be understood [the report says] that work specifically focused on atomic power need not and should not interfere with making available to biology, medicine, chemistry, and physics the radiations and activities characteristic of this field . . . We should not be astonished if the greatest benefit of this program were in fact to lie in therapy for some of the neo-plastic diseases, such as cancer, or in the increased understanding of biological systems or of the realities of the physical world, which will in turn open up new fields of human endeavor."

The full report contains descriptions in more concrete terms of some of these possibilities. We are convinced that in the vigorous exploita-

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tion of them lies one of the greatest hopes of developing a successful system of international control.

Under the most favorable conditions, the peril of atomic warfare can be averted only by drawing upon the best human resources of good will, imagination, and ingenuity. All experience teaches that these resources cannot be tapped except by challenging opportunities. One of the most serious dangers to the promotion of effective international action is the danger that our natural preoccupation with the destructive aspects of atomic energy may blind us to its useful aspects. Upon searching investigation, some of the latter may prove illusory. But if the lessons of past scientific and technological progress mean anything, we also know that many of these opportunities will materialize. We believe that only a system of safeguards which is built around these hopeful prospects can succeed. We have tried throughout this report to make explicit the connection between a system of safeguards and these opportunities.

Important, perhaps even decisive, in the proposals we put forth in this report is the fact that many of the constructive activities required in the development of atomic energy involve no risks of providing a material basis for weapons of war. This aspect of the matter is dealt with in detail in Chapter V of this Section.

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CHAPTER IV

The Elimination of International Rivalry

It is clear that uranium and thorium are materials of great strategic importance to nations seeking to establish for themselves a powerful position in the field of atomic energy. The fact that rich sources of such materials occur in a relatively few places in the world, as compared, for example, with oil, creates a competitive situation which might easily produce intolerable tensions in international relations. We believe that so long as nations or their subjects engage in competition in the fields of atomic energy the hazards of atomic warfare are very great indeed. We assume the General Assembly of the United Nations, in setting up an Atomic Energy Commission, had this disturbing fact much in mind.

What is true in respect to the dangers from national competition for uranium is similarly true concerning other phases of the development of atomic energy. Take the case of a controlled reactor, a power pile, producing plutonium. Assume an international agreement barring use of the plutonium in a bomb, but permitting use of the pile for heat or power. No system of inspection, we have concluded, could afford any reasonable security against the diversion of such materials to the purposes of war. If nations may engage in this dangerous field, and only national good faith and international policing stand in the way, *the very existence of the prohibition* against the use of such piles to produce fissionable material suitable for bombs would tend to stimulate and encourage surreptitious evasions. This danger in the situation is attributable to the fact that this potentially hazardous activity is carried on by nations or their citizens.

It has become clear to us that if the element of rivalry between nations were removed by assignment of the intrinsically dangerous phases of the development of atomic energy to an international organization responsible to all peoples, a reliable prospect would be afforded for a system of security. For it is the element of rivalry and the impossibility of policing the resulting competition through inspection alone that make inspection unworkable as a sole means of control. With that factor of international rivalry removed, the problem becomes both hopeful and manageable.

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To restate the conclusion: It is essential that a workable system of safeguards remove from individual nations or their citizens the legal right to engage in certain well-defined activities in respect to atomic energy which we believe will be generally agreed to be intrinsically dangerous because they are or could be made steps in the production of atomic bombs. We schematically describe what we regard as intrinsically dangerous steps later in Chapter V. Those activities thus classified as dangerous we conclude are far less dangerous when carried on not by competing nations but by an international organization whose obligation it is to act for all nations. They can, in our opinion, be rendered sufficiently less dangerous to provide an adequate measure of security.

We can illustrate the force of these conclusions in a few simple cases. (*a*) Take the case of uranium ores. If any nation may engage in prospecting for and mining uranium ore, subject to inspection as to the proper, i. e., peaceful use thereof, inspection is a most difficult thing. But if the *only legal ownership and development of uranium ore* is in the hands of an international agency manned by and representing all nations, the problem of detection of evasions is, by a single stroke, reduced tremendously. Indeed, we are persuaded that it is reduced to quite manageable proportions in the light of existing knowledge about uranium ore deposits through the world. For then it would be true that not the purpose of those who mine or possess uranium ore but the *mere fact of their mining or possessing it becomes illegal,* and national violation is an unambiguous danger signal of warlike purposes. The very opening of a mine by anyone other than the international agency is a "red light" *without more;* it is not necessary to wait for evidence that the *product* of that mine is going to be misused.

(*b*) Take another illustration involving the building and operation of a plutonium pile. The product of that operation is a material that can be used for atomic weapons. The product is also useful for power piles. If all such piles are designed and operated exclusively by an international agency, then the building or operation of such a pile or any move in that direction by *any one else* is illegal without respect to the use he says he plans to make of it, and constitutes a plain and simple danger signal calling for action of a preventative character by an international agency.[1] Nor could there be a clearer sign of danger calling for immediate international action or countermeasures than interference with the operation of an international plant.

We conclude that the international development and operation of potentially and intrinsically dangerous activities in connection with

[1] In Section III we discuss what would happen if the international organization should fail or an international plutonium plant should be seized by a nation; we shall not digress from the present point to discuss that here.

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atomic energy would bring the task of security within manageable proportions because of the elimination of the hazards of rivalry between nations. But there is a further advantage to vesting exclusively in an international agency these activities so hazardous to world security. That advantage grows out of the nature of the development of atomic energy itself.

This is a growing and changing field. New advances in technology may be confidently expected. It therefore becomes absolutely essential that any international agency seeking to safeguard the security of the world against warlike uses of atomic energy should be in the very forefront of technical competence in this field. If the international agency is simply a police activity for only negative and repressive functions, inevitably and within a very short period of time the enforcement agency *will not know enough* to be able to recognize new elements of danger, new possibilities of evasion, or the beginnings of a course of development having dangerous and warlike ends in view. There is a striking example of this. The art of atomic weapons is in its infancy and we are quite ignorant of the possibilities in this field. Such ignorance, such uncertainty of such catastrophic weapons, is itself a source of danger, and its continuation, through the prohibition of further study and development, would in our opinion not only be hard to effect, but would itself be dangerous. Yet the development of atomic weapons can hardly be left to national rivalry.

A further example: The present separation plants for U 235 at Oak Ridge are huge and bulky in the extreme, and use enormous amounts of power. Quite probably this will always be true. But it is not a law of nature. Those in whose hands lies the prevention of atomic warfare must be the first to know and to exploit technical advances in this field.

We have, therefore, concluded that here was an additional reason and a very practical one why a responsibility for the *development* of atomic energy should be vested in the same international agency that has also responsibility for developing and enforcing safeguards against atomic warfare. For unless the international agency was engaged in development activities itself (as, for example, in the design and operation of power piles or in the surveying and exploration of new sources of raw materials) its personnel would not have the power of knowledge or the sensitivity to new developments that would make it a competent and useful protection to the people of the world.

We have therefore reached these two conclusions: (*a*) that only if the dangerous aspects of atomic energy are taken out of national hands and placed in international hands is there any reasonable prospect of devising safeguards against the use of atomic energy for bombs, and (*b*) only if the international agency was engaged in

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development and operation could it possibly discharge adequately its functions as a safeguarder of the world's future.

Such a development function also seems essential in terms of attracting to the international agency the kind of scientists and technicians that this problem requires, recognizing that a mere policing, inspecting, or suppressing function would neither attract nor hold them.

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CHAPTER V

"Safe" and "Dangerous" Activities

It is true that the internationalization of activities intrinsically dangerous to security reduces the hazards in the way of security and does bring into more manageable form the problems of enforcement and the suppression of atomic weapons. If it were necessary, in such a scheme of safeguards, to vest in an international agency a total monopoly as to all aspects of atomic energy, disadvantages would arise so great as conceivably to make the prospect of effective internationalization itself beyond realization. Such an overall grant of exclusive right to develop, operate, and utilize, conferred upon an international agency, would change many of the industrial and economic practices of this country, for example, and would change them quite disadvantageously.

Such a complete international monopoly would be hard to live under. Its restrictive limitations would chafe, and might in time cause serious loss of support to the security purposes that lay behind the proposal itself. Many of the considerations of complexity, irritation, the engendering of suspicion, the encouragement of deceit that we found militated against a system of safeguards based upon national operation and international inspection would to a lesser degree be repeated by such an all-out proposal for centralization.

This problem need not arise. For there are important areas in the field of atomic energy where there is no need for an international monopoly, and where work may and should be open not exclusively to the international organization, but to private and to national institutions in a quite free manner. These fields are among those of the greatest immediate promise for the beneficial exploitation of atomic energy. They are technically complex and closely related to the central scientific problems. That open and, in some respects, competitive activity is possible in much of the field should go a long way toward insuring contact between the experts of the international organization and those outside it, in industry and in scientific and educational organizations. The same fact should help correct any tendencies that might otherwise develop toward bureaucratic inbreeding and over-centralization, and aid in providing healthy, expanding national and private developments in atomic energy.

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The technical facts which underlie the possibility of regarding many developments in the field of atomic energy as safe for national and private exploitation are in themselves rather complex; to the discussion of these we must now turn. These are, of course, activities which without reliance on the conscious determination of the operators, and with a minimum of control and supervision, are physically incapable of contributing to the making of atomic weapons.

A word may be in order about our views on what constitute "dangerous activities"—those that, in our opinion, ought to be subject to an international monopoly. It will be appreciated at the outset that this distinction between the "safe" and the "dangerous" can be useful without being completely sharp or fixed for all time.

In our view, any activity is dangerous which offers a solution either in the actual fact of its physical installation, or by subtle alterations thereof, to one of the three major problems of making atomic weapons:

I. The provision of raw materials,

II. The production in suitable quality and quantity of the fissionable materials plutonium and U 235, and

III. The use of these materials for the making of atomic weapons.

Thus we regard the mining and processing of uranium as a dangerous activity even though it must be supplemented by plants and ordnance establishments if atomic weapons are to result. We regard the facilities for making atomic weapons as dangerous even though some control be exercised over the provision of the fissionable material; and we regard the operation of reactors or separation plants which make the material for bombs or which, by relatively minor operational changes, could make the material for bombs, as dangerous even though they in turn would have to be supplemented by supplies of raw material and by installations for assembling atomic weapons.

We need not regard as dangerous either amounts of material which are small in relation to those needed to make a weapon or installation whose rate of production is small in these terms. A further point which will prove important in establishing the criteria for the safety or danger of an operation is this: U 235 and plutonium can be denatured; such denatured materials do not readily lend themselves to the making of atomic explosives, but they can still be used with no essential loss of effectiveness for the peaceful applications of atomic energy. They can be used in reactors for the generation of power or in reactors useful in research and in the production of radioactive tracers. It is important to understand the sense in which denaturing renders material safer. In the first place, it will make the material unuseable by any methods we now know for effective atomic explosives unless steps are taken to remove the denaturants. In the second place, the development of more ingenious methods in the field of

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atomic explosives which might make this material effectively useable is not only dubious, but is certainly not possible without a very major scientific and technical effort.

It is possible, both for U 235 and for plutonium, to remove the denaturant, but doing so calls for rather complex installations which, though not of the scale of those at Oak Ridge or Hanford, nevertheless will require a large effort and, above all, scientific and engineering skill of an appreciable order for their development. It is not without importance to bear in mind that, although as the art now stands denatured materials are unsuitable for bomb manufacture, developments which do not appear to be in principle impossible might alter the situation. This is a good example of the need for constant reconsideration of the dividing line between what is safe and what is dangerous.

We would, however, propose as criterion that installations using material both denatured and insufficient in quantity for the manufacture of bombs could be regarded as safe, provided the installations did not themselves make large quantities of suitable material. With some safeguards in the form of supervision, installations in which the amounts of material are small, or in which the material is denatured, might also be regarded as safe; but installations using or making large amounts of material not denatured, or not necessarily denatured, we would call dangerous.

Let us see now what we regard as safe activities in this field.

(1) Perhaps the clearest case is the application of radioactive material as tracers in scientific, medical, and technological studies. This is a field in which progress may be expected to be very rapid, and we can see no reason at all for limiting, on grounds of safety, the activities using such tracer materials.

(2) It is easy to design small nuclear reactors which use denatured U 235 or plutonium. These reactors can be operated at a power level low enough to be incapable of producing dangerous quantities of fissionable materials but high enough to provide neutron sources and gamma ray sources of unparalleled intensity. The material in these reactors is neither in quantity nor in quality significant for bomb production; even if one combined the material from many, no practical method of making weapons would be available. On the other hand, reactors of this kind can and almost inevitably will be designed to operate at so low a power level that they cannot be used to produce quantities of fissionable material which are of military significance. Reactors of this general kind have the following important applications:

(*a*) They may be used to make radioactive materials, and as such may be a supplement, and a valuable supplement, to the more dangerous reactors operating at higher power levels;

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in particular, they can make useful radioactive materials that last too short a time to permit them to be provided from remote plants.

(*b*) As a source of radiation, primarily of neutron radiation, such reactors are research tools for physics, for chemistry, and for biology. This may, in fact, be one of the most important applications of the release of atomic energy.

(*c*) The high intensity of radiation from such reactors will bring about changes in chemical and biological systems which may be of immense practical value, once they have been understood.

(3) More marginal from the standpoint of safety, but nevertheless important, is another case of an operation which we would regard as safe. This is the development of power from the fission of denatured U 235 and plutonium in high power-level reactors. Such power reactors might operate in the range from 100,000 to 1,000,000 kw. If these fissionable materials are used in installations where there is no additional uranium or thorium, they will not produce further fissionable material. The operation of the reactors will use up the material. If the reactors are suitably designed, a minimum of supervision should make it possible to prevent the substitution of uranium and thorium for the inert structure of the materials of the reactors. In order to convert the material invested in such reactors to atomic weapons, it would be necessary to close down the reactor; to decontaminate the fissionable material of its radioactive fission products; to separate it, in what is a fairly major technical undertaking, from its denaturant; and to establish plants for making atomic weapons. In view of the limited amount of material needed for such a power reactor, and of the spectacular character and difficulty of the steps necessary to divert it, we would regard such power reactors as safe provided there were a minimum of reasonable supervision of their design, construction, and operation. If the material from one such reactor (of a size of practical interest for power production) were diverted, it might be a matter of some two or three years before it could be used to make a small number of atomic weapons.

We attach some importance to reactors of this type because they make it possible in large measure to open up the field of atomic power production to private or national enterprise. It is, in this connection, important to note that the materials required to construct these reactors cannot themselves be produced in installations which we could regard as safe. It is, furthermore, important to note that for every kilowatt generated in safe reactors, about 1 kilowatt must be generated in dangerous ones in which the material was manufactured. Thus if atomic power is in fact developed on a large scale, about half

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of it will inevitably be an international monopoly, and about a half might be available for competitive exploitation. That is to say, the primary production plants necessary to produce the materials required to construct *safe* power plants will in that process of production produce large amounts of power as a by-product. It is, furthermore, clear that the stockpiling of appreciable quantities of fissionable material suitably denatured, must precede the development of these safe power reactors. We think it fortunate that the actual operation of such reactors will have to await the production of these essential materials, so that there will be time for further study of means by which they may be supervised and their safety insured.

All the above illustrations show that a great part of the field of atomic energy can be opened with relative safety to competitive activity. They also show that the *safe operations are possible only because dangerous ones are being carried out concurrently.* It is not possible to devise an atomic energy program in which safeguards independent of the motivation of the operators preclude the manufacture of material for atomic weapons. But it is possible, once such operations are undertaken on an international basis, to devise others of great value and of living interest in which safety is no longer dependent on the motivation of the operators.

We have enumerated elements of the large field of non-dangerous activities under (1), (2), and (3) above. Among the activities which we would at the present time classify as those dangerous for national exploitation are the following:

(4) Prospecting, mining, and refining of uranium, and, to a lesser extent, thorium.

(5) The enrichment of the isotope 235 by any methods now known to us.

(6) The operation of the various types of reactors for making plutonium, and of separation plants for extracting the plutonium.

(7) Research and development in atomic explosives.

Of these activities, (6), as we have indicated, not only plays an essential part in providing active materials, but involves installations capable of generating power.

It should be added in conclusion that to exclude even safe activities from international operation seems unwise, but these should not be an international monopoly. It would equally be unwise to exclude from knowledge and participation in the dangerous activities experts who are not associated with the international authority. As the next section will show, there are practical means for making this collaboration possible in such a way that security will be promoted rather

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than impaired. Only a constant reexamination of what is sure to be a rapidly changing technical situation will give us confidence that the line between what is dangerous and what is safe has been correctly drawn; it will not stay fixed. No international agency of control that is not qualified to make this reexamination can deserve confidence.

SUMMARY

1. If nations or their citizens carry on intrinsically dangerous activities it seems to us that the chances for safeguarding the future are hopeless.

2. If an international agency is given responsibility for the dangerous activities, leaving the non-dangerous open to nations and their citizens and if the international agency is given and carries forward *affirmative development responsibility*, furthering among other things the beneficial uses of atomic energy and enabling itself to comprehend and therefore detect the misuse of atomic energy, there is good prospect of security.

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SECTION III

Security Through International Cooperative Development

INTRODUCTION

In the preceding sections of this report we have outlined the course of our thinking in an endeavor to find a solution to the problems thrust upon the nations of the world by the development of the atomic bomb—the problem of how to obtain security against atomic warfare, and relief from the terrible fear which can do so much to engender the very thing feared.

As a result of our thinking and discussions we have concluded that it would be unrealistic to place reliance on a simple agreement among nations to outlaw the use of atomic weapons in war. We have concluded that an attempt to give body to such a system of agreements through international inspection holds no promise of adequate security.

And so we have turned from mere policing and inspection by an international authority to a program of affirmative action, of aggressive development by such a body. This plan we believe holds hope for the solution of the problem of the atomic bomb. We are even sustained by the hope that it may contain seeds which will in time grow into that cooperation between nations which may bring an end to all war.

The program we propose will undoubtedly arouse skepticism when it is first considered. It did among us, but thought and discussion have converted us.

It may seem too idealistic. It seems time we endeavor to bring some of our expressed ideals into being.

It may seem too radical, too advanced, too much beyond human experience. All these terms apply with peculiar fitness to the atomic bomb.

In considering the plan, as inevitable doubts arise as to its acceptability, one should ask oneself "What are the alternatives?" We have, and we find no tolerable answer.

The following pages contain first a brief summary of the plan we recommend, and then an expansion going into some detail.

Summary of Proposed Plan—The proposal contemplates an international agency conducting all intrinsically dangerous operations in the nuclear field, with individual nations and their citizens free to conduct, under license and a minimum of inspection, all non-dangerous, or safe, operations.

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The international agency might take any one of several forms, such as a UNO Commission, or an international corporation or authority. We shall refer to it as Atomic Development Authority. It must have authority to own and lease property, and to carry on mining, manufacturing, research, licensing, inspecting, selling, or any other necessary operations.

This chapter is not an attempt to write a corporate charter for such an international agency. It is the aim, rather, to show that such a charter can be written in workable terms, and that the nature of the organization and its functions will have decisive consequences for world security. We are satisfied that the differences between national and international operations can be exploited to make the problem of atomic energy manageable. This idea, we think, can become as familiar as the fact that the differences between individual enterprise and corporate enterprise have important consequences in the conduct of business.

If we are to do anything constructive in relation to atomic energy it must inevitably be novel and immensely difficult. We think that the weeks that we have spent in analysis of the problem have made it appear somewhat less difficult and somewhat less novel. A succession of such processes will be necessary, each building on the preceding analysis, before even the major ramifications of the problem can be understood and the major questions partially answered. What is chiefly important now is to describe the right course of action in terms sufficiently practical and valid to show that the further exploration is worthwhile.

The proposal contemplates an international agency with exclusive jurisdiction to conduct all intrinsically dangerous operations in the field. This means all activities relating to raw materials, the construction and operation of production plants, and the conduct of research in explosives. The large field of non-dangerous and relatively non-dangerous activities would be left in national hands. These would consist of all activities in the field of research (except on explosives) and the construction and operation of non-dangerous power-producing piles. National activities in these fields would be subject to moderate controls by the international agency, exercised through licensing, rules and regulations, collaboration on design, and the like. The international agency would also maintain inspection facilities to assure that illicit operations were not occurring, primarily in the exploitation of raw materials. It would be a further function of the Atomic Development Authority continually to reexamine the boundary between dangerous and non-dangerous activities. For it must be recognized that although the field is subject to reasonable

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division, the dividing line is not sharp and may shift from time to time in either direction.

The development agency itself would be truly international in character. Its staff would be recruited on an international basis. Its functions would be such as to attract a calibre of personnel comparable to our own activities in raw materials during the war and our own primary production and experimental work. It would be set up as one of the subsidiary agencies of the United Nations, but it would have to be created by a convention or charter establishing its policies, functions, and authority in comprehensive terms.

Whatever the formal organization, its integration with national structure would of course be one of the major problems. Measures to assure the proper degree of accountability to the United Nations and to individual nations, measures to assure that individual nations would have ample opportunity to be informed of the agency's activities, measures to make the agency responsive to the changing needs of nations—all these would have to be worked out with extraordinary care and ingenuity. But certainly our experience with business and government institutions, national and international, would afford a wealth of guidance in the development of such measures.

In the actual conduct of its operations the development organization would at all times be governed by a dual purpose, the promotion of the beneficial use of atomic energy and the maintenance of security. We believe that much can be done in a convention or charter to make these purposes concrete and explicit, to draw the line between the dangerous and the non-dangerous, to establish the principles determining the location of stockpiles and plants so that a strategic balance may be maintained among nations, to establish fair and equitable financial policies so that the contributions of nations to, and their receipt of benefits from, the organization will be justly apportioned. The most careful and ingenious definitions will be required in order to accomplish these purposes.

In what follows we shall attempt to develop and expand the foregoing statement of essentials.

We can best visualize the Atomic Development Authority in terms of the answer to these concrete questions:

(1) What will be the functions of the agency; what are the things that it will do?

(2) What kind of organization is necessary to carry out these functions?

(3) How will the organization be related to the United Nations and the individual nations that it will represent?

(4) What policies will guide the agency in determining its manifold actions?

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CHAPTER I

Functions of Atomic Development Authority

In the field of raw materials—The first purpose of the agency will be to bring under its complete control world supplies of uranium and thorium. Wherever these materials are found in useful quantities the international agency must own them or control them under effective leasing arrangements. One of its principal tasks will be to conduct continuous surveys so that new deposits will be found and so that the agency will have the most complete knowledge of the world geology of these materials. It will be a further function of the agency constantly to explore new methods for recovering these materials from media in which they are found in small quantities.

In this way there will be no lawful rivalry among nations for these vital raw materials. Through its surveys the agency will be better informed about their geology and extraction than any single nation could possibly be. It will be in a better position to discover whether and where illicit operations might occur than any inspection force could possibly be. This is not to say that there is no risk of illicit operations; any plan, any system of safeguards, involves some risk. The question that must be answered in appraising the dangers is whether the risk is so large that it is better to make no attempt at international control and abandon the world to national atomic armament.

As we have pointed out earlier, if the Atomic Development Authority is the only agency which may lawfully operate in the raw materials field, then any visible operation by others will constitute a danger signal. This situation contrasts vividly with the conditions that would exist if nations agreed to conduct mining operations solely for proper purposes; for surreptitious abuse of such an agreement would be very difficult to detect. It is far easier to discover an operation that should not be going on at all than to determine whether a lawful operation is being conducted in an unlawful manner.

For the purpose of its surveys, the international agency would require access to various nations for its geologists and mining engineers. But the known geology of the critical materials is such that it may be possible to limit the degree of access from the start. And, as explora-

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tions proceed and various areas are eliminated it may be hoped that the *need* for access would narrow, rather than expand, but at all times the right of access to any region for re-survey in the light of new knowledge would be necessary.

All the actual mining operations for uranium and thorium would be conducted by the Authority. It would own and operate the refineries for the reduction of the ores to the metal or salt. It would own the stockpiles of these materials and it would sell the by-products, such as vanadium and radium. It would also provide the necessary supplies of uranium and thorium for the present limited commercial uses. All these sales would presumably go through normal commercial channels.

In the field of raw materials as in other activities of the Authority, extremely difficult policy questions, with the most serious social, economic, and political implications, will arise. How shall nations and individuals be compensated for reserves taken over by the Authority? As between several possible mines in different areas, which shall be operated when it is clear that the output of all is not presently required? How can a strategic balance be maintained between nations so that stockpiles of fissionable materials will not become unduly large in one nation and small in another? We do not suggest that these questions are simple but we believe that practical answers can be found. An attempt to suggest an approach to such answers is made later where the general question of policies of the Authority is discussed.

Production Plants—The second major function of the Authority would be the construction and operation of useful types of atomic reactors and separation plants. This means that operations, like those at Hanford and Oak Ridge and their extensions and improvements, would be owned and conducted by the Authority. Reactors for producing denatured plutonium will be large installations and by the nature of the process they will yield large amounts of energy as a byproduct. As the technology of power development by this method expands, ways will be found for utilizing this power both as heat and as electricity. The existing plants are not designed to operate at a sufficiently high temperature for the energy to be used for the generation of electrical power. One of the first research and development problems of the Authority would be to develop designs of reactors such that the energy released would be in form usable for the generation of electric power.

These production plants are intrinsically dangerous operations. Indeed they may be regarded as the most dangerous, for it is through such operations that materials can be produced which are suitable for atomic explosives.

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In addition to questions similar to these mentioned in the case of raw materials, many new ones suggest themselves in relation to such production plants. What measures can be taken to assure the minimum degree of danger in design of plants and output? What measures can be taken to assure the minimum danger of diversion? What measures can be taken to assure location of plants that both will permit the disposition of byproduct power and heat in areas where they are most needed and at the same time will maintain a strategic balance between nations so that none may be inspired with fear lest the existence of plants in another would give that nation an advantage if it suddenly developed aggressive intentions? How will the vast amounts of byproduct power be disposed of by an international agency operating geographically within a national economy? Like the questions previously stated, these are not easy to answer. But here again we think that answers can be found and we venture later to suggest a way of going about the process of formulating answers.

Research Activities—We have already referred to the research that the Authority will conduct to extend the field of knowledge in relation to recoverable raw materials. We have referred to research in power development. There will be many other forms of research in which the Authority will have to engage, relating to simplifying reactors and the like.

Here we desire to emphasize that the field of research in its broadest sense is the field in which the greatest opportunities present themselves for national and private activities. For research in relation to the application of discoveries relating to atomic energy is a great area of work which in the context of the general plan of safeguards herein proposed is non-dangerous. For the reasons already indicated the Authority itself will have to engage in a wide variety of research activities. For example, one of the important things that the Authority will have to do is research in atomic explosives. We are by no means sure that important new discoveries in this field do not lie ahead. Possibly the study of atomic explosives may yield byproducts useful in peaceful activities. But this will not be the main purpose of the Authority's research. Only by preserving its position as the best informed agency will the Authority be able to tell where the line between the intrinsically dangerous and the non-dangerous should be drawn. If it turns out at some time in the future, as a result of new discoveries, that other materials lend themselves to dangerous atomic developments, it is important that the Authority should be the first to know. At that time measures would have to be taken to extend the boundaries of safeguards.

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But, as we have said, it seems highly desirable that while conducting its own necessary research the Authority must not discourage but rather must give vigorous encouragement to research in national or private hands. The universities and public technical agencies, industrial enterprises, research institutes, all will have a direct interest in participating in these activities. A good example of the opportunities in this direction is afforded by considering the situation with respect to radioactive isotopes. It will be possible for the Authority to produce these isotopes in primary production plants. The chemical separation and purification of them, however, is an involved industrial process, but involves no threat to security; states or private organizations should be encouraged to go into these activities. But for many purposes it will also be possible to produce these isotopes in small non-dangerous reactors that can be safely operated by nations or private institutions. In the interest of avoiding overexpansion of the international Authority, we think a deliberate effort should be made to encourage the production of isotopes in national hands.

It would be premature, of course, to seek now to draw any hard and fast line between the functions that the Authority should have in producing these isotopes and the functions which ought to be left to nations and their citizens. But it is important to be aware at all times of the necessity for taking advantage of the opportunity for promoting decentralized and diversified national developments and of avoiding unnecessary concentration of functions in the Authority. The field of research is an area in which the keenest awareness of this problem will be essential when the time comes to draft a charter and when thereafter the time comes for establishing the detailed administrative policies of the Authority.

Up to now we have been dealing with the exclusive proprietary functions of the Atomic Development Authority. Except as to the discussion just concluded we have been describing the things it must do wholly withdrawn from national hands. We turn now to a discussion of functions more regulatory than proprietary in character. These are the functions through which the agency will maintain moderate controls over the activities that will be conducted by nations or private agencies. For convenience we shall refer to these activities as "licensing" functions though we think that various devices besides licensing may in fact be developed to do the job.

Licensing Activities—The uranium and thorium which the Authority mines and the fissionable materials which it produces will remain the property of the Authority. By such ownership the Authority could determine the conditions under which these dangerous materials might be used. Through the lease of such denatured materials to

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those desiring to build and operate reactors of various non-dangerous kinds, the personnel of the Authority could have access to the establishment in which such material is used. Moreover, through its own research and development activities and through establishing cooperative relationships with research and development laboratories in this field throughout the world, the Authority would be in a position to determine intelligently safe and unsafe designs of reactors for which it might lease its fissionable materials.

In the following paragraphs we shall refer to three of the general types of activities of great importance in the field of atomic energy which, as already indicated, are or can be made sufficiently safe to be carried on by nations under suitable arrangements with the proposed Authority. These types of activity, as we have pointed out earlier, open up a broad field for national and private exploitation of the useful applications of atomic energy. In particular, they will permit broad scope for research and development in this field by nations and private groups within such nations.

One of the first licensing activities of the Authority might be in the field of research reactors for which it would furnish on lease denatured plutonium or U 235. In carrying on such operations, presumably those desiring to build such research reactors would submit their designs to the Authority both for approval and for advice as to improvements, and would obtain a license to build such a reactor and lease of the denatured fissionable material needed for it. There would be a minimum of danger involved in allowing the construction and operation of research reactors not exceeding a prescribed power level. As we have seen, the amounts of fissionable material which might be produced through their use would be so small that for any individual unit, or even for units in one country which might number a dozen or more, there would be no real danger in terms of producing material sufficient for use in atomic explosives. Presumably the Authority from time to time would send its research personnel, in the dual role of research workers and inspectors, to the laboratories in which these reactors were used, but a minimal inspection would be needed. Moreover, such research reactors would fulfill to a large extent the urgent requirements for further intensive scientific research in this field. Presumably licenses and leases of material would be arranged between the Authority and individual nations so that the Authority would not be dealing directly with private groups within nations.

The Authority would also license and lease in the same manner as described for research reactors the construction and operation of reactors for making radioactive materials. There may well be, as suggested above, a field for the national or private production of such radioactive materials which will require a pile to produce mate-

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rials for industrial and other peaceful uses. The fissionable materials leased by the Authority would always be in the form of denatured plutonium or U 235.

Within the next few years, the Authority should also be in a position to license the construction and operation of power piles and to furnish on lease denatured plutonium or U 235. The design of such piles would have to be carefully reviewed, and the construction perhaps should be inspected by the Authority, to insure that the pile was not readily convertible to a dangerous form. For example, there should be no provision within such piles for the introduction of uranium or thorium. Iron or lead might be required as structural materials and if these were made non-removable, there would be a large factor of safety against abuse. Such power reactors would "burn" the active materials and require replenishing from time to time. The fissionable materials for such power reactors would be derived from the operation of the production plants of the Authority. There is no prospect that for several years such power reactors as described here could be licensed, for the reason that there would not be enough fissionable materials produced in the plants of the Authority. Thus there is a reasonable period during which research and development may proceed both in the laboratories of the Authority and in national and private groups throughout the world, as a result of which much more will be known as to the safe and unsafe features of design prior to the time when decisions will be required.

The questions of policy that arise in relation to the licensing activities of the Authority will likewise require the utmost in ingenuity and resourcefulness for their solution. How shall control be exercised lightly enough to assure the free play of national and private enterprise without risk to security? How shall facilities and materials available for national and private exploitation be allocated and at what cost? How may safe activities, assigned to national hands, be withdrawn if new discoveries show them to be dangerous? Again, we do not minimize the difficulties. We say only that we believe them to be of manageable proportions, and that techniques can be devised to facilitate solutions.

Inspection Activities—Throughout this report we have recorded our conviction that international agreements to foreswear the military use of atomic weapons cannot be enforced solely by a system of inspection—that they cannot be enforced in a system which leaves the development of essentially dangerous activities in the field of atomic energy in national hands and subject to national rivalry, and, to insure against diversion of these activities to aggressive ends, relies upon supervision by an agency which has no other function. But inspection in a wide variety of forms has its proper place in the

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operations of the Atomic Development Authority—it has a proper and essential place. Sometimes it may take a form scarcely recognizable as inspection, but that may be regarded as one of the virtues of the proposal.

It may at the outset be useful to recall some of the factors which lead us to believe that as a function of the Atomic Development Authority inspection can be effective. We do not by this wish to suggest that the necessary inspection functions are trivial or that they can be carried out without inventiveness and effort. We do believe that the proposals of this report create a framework within which such inventiveness and such effort can be effective.

In the inspection of declared and legal activities—to be sure that they are really legal—it is of the greatest advantage that the operations can themselves be so conducted as to make this inspection and control easy. The Atomic Development Authority will have the double responsibility of technically effective development, and of safety. It would be in a position to insure that in the plan of operations, in the physical layout, in the system of audits, and in the choice of developments, full weight and full consideration can be given to the ease of detecting and avoiding diversion and evasion. Thus, the Authority may conceivably find it unwise to exploit certain types of deposits because of the difficulties they present to adequate auditing. The Authority may have reason to decide on one or another method of the separation of isotopes because it lends itself more readily to control. In the location of its operations, it will be in a position to take into account political and sociological factors which might make control difficult, or to allow such considerations to influence its choice of operating personnel and procedures. We attach great weight to the importance of unifying at the planning stage the requirements of development and control. We also attach great weight to the far-reaching inseparability of the two functions in the personnel of the development authority.

As we have pointed out repeatedly, the Authority will be aided in the detection of illegal operations by the fact that it is not the motive but the operation which is illegal. Any national or private effort to mine uranium will be illegal; any such stockpiling of thorium will be illegal; the building of any primary reactor or separation plant will be illegal. This circumstance is of very great importance for the following reason: It is true that a thoroughgoing inspection of all phases of the industry of a nation will in general be an unbearable burden; it is true that a calculated attempt at evasion may, by camouflage or by geographical location, make the specific detection of an illegal operation very much more difficult. But the total effort needed to carry through from the mine to the bomb, a surreptitious program of

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atomic armament on a scale sufficient to make it a threat or to make it a temptation to evasion, is so vast, and the number of separate difficult undertakings so great, and the special character of many of these undertakings so hard to conceal, that the fact of this effort should be impossible to hide. The fact that it is the existence of the effort rather than a specific purpose or motive or plan which constitutes an evasion and an unmistakable danger signal is to our minds one of the great advantages of the proposals we have outlined.

We have frequently emphasized the related difficulties of providing in an inspection agency personnel with the qualifications necessary for that work, and with enlightened and constantly improving understanding of the technical realities. We believe that these problems can be solved in an Atomic Development Authority to which is entrusted the technical exploration of the field, and in which inspection activities will be carried out in part by the very personnel responsible for the new developments and in part by the men of the same organization, who have access to, and who have an interest in, the research and development activities of the Authority. We do not wish to overemphasize the advantages that may arise from the free association of the Authority's scientists and experts with those engaged in private or national undertakings, but we believe that if a serious effort is made to cultivate this association it will greatly reduce the chance of evasive national or private action, or of the existence, unknown to the Authority, of technical developments which might constitute a potential danger. As an example of an association which would on technical grounds be most appropriate for the Authority, we may cite the problem of power. The Authority will be engaged in the production of power. It will be engaged in licensing power plants of non-dangerous type for private or national operation. It should take advantage of these associations to be informed about the power requirements which play so large a part in the operation of separation plants.

It will be seen that we do not contemplate any systematic or large-scale inspection activities for the Authority except those directed to the control of raw materials. It is our hope—and we believe it a valid hope—that when the Authority is in full operation it will, through the application of ingenuity to the problem, have obtained a sufficiently complete control over raw materials and the fissionable products so that no elaborate and formal inspection procedures will be needed to supplement it. It is clear that final decision on this matter must take into account the events of the transition period from our present condition to that of the full operation of the Authority. It is also clear that the more rapidly the initial steps leading to the Authority's control of raw materials are taken, the greater the chance of the elimination of the more burdensome forms of inspection.

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The geological survey, while in a sense inspection, will be focussed on a world-wide search and survey for the discovery of the essential raw materials. In the conduct of research and development, and through the location of the Authority's laboratories in various parts of the world, the Authority should become cognizant of a wide range of research and development activities in various countries. Therefore, the purpose of inspection would be served in that personnel of the Authority should be currently and intelligently informed regarding national and private research and development activities in this field.

In operating mines, refineries, and primary production plants in various countries, the personnel of the Authority will likewise acquire insight regarding the activities and trends in various countries. In its licensing activities the Authority will maintain contact with the research and development laboratories authorized to use reactors. Exchange of personnel, visits, and even formal inspection, may all be involved.

In licensing power reactors which are somewhat less safe than research reactors, the Authority would send its representatives to inspect or visit these plants at frequent intervals. Such personnel would presumably be trained in the development or engineering branches of the Authority and their primary purpose might well be to furnish engineering services and advice to the operators. The inspection that would actually result would be far more effective than any direct attempt to inspect.

Under the relations described between the Authority and national or private groups using denatured fissionable material, the inspectors would have a right of access deriving from the terms of the license and lease. Furthermore, if the Authority conducted the operations described, it would have within its organization a unique knowledge of the whold field of atomic energy and the changes in that field, which are almost certain to be rapid if it is developed in a healthy manner. To the extent inspection was required it could be done by competent engineers or scientists who would be far more knowledgeable than those inspected and who could furnish useful aid and advice at the same time.

In the course of its activities, the Authority might acquire information which would cause it to suspect evasions or violations in places to which it did not have the right of access for geological survey or for inspection of installations using leased material. Some means would have to be provided so that the Authority by making out a prima facie case would be granted access to the suspected plant or laboratory. This might be arranged through the presentation of such a request to some international body such as the International Court. If the Court

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were satisfied with the adequacy of the reasons presented by the Authority, it might then request the nation in which the suspected activities were located to grant access to representatives of the Authority. This seems to us one of the possible means of approach to the limited problem of detection of evasions that would be present even under the Atomic Development proposal. The procedure seems sufficiently limited in its effect upon national sovereignty to be practical. We recognize that the idea raises a host of questions that would have to be answered before the feasibility and effectiveness of the device could be established but we think it worthy of this further exploration.

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CHAPTER II

Organization and Policies of Atomic Development Authority

In the light of the scientific and technological facts and of broad human and political factors, we have undertaken, up to this point, to describe the kind of functions that an Atomic Development Authority would have to be given in order to be effective. In considering the problems of organizational structure and detailed policies for such an authority it is also clear that the facts concerning atomic energy are decidedly pertinent. But as to these problems, there is much relevant experience in the general field of international organization. Obviously the systematic approach necessary for a solution of these problems must draw heavily on that experience.

But there is an important question of timing. It would be premature now to seek definitive answers to many of the questions as to organization and policy. For in order to have validity the answers will have to be the product of international discussion and deliberation rather than any unilateral statement of a detailed plan.

In considering the type of organizational problem involved in setting up an Atomic Development Authority under the United Nations, it should be readily possible to find helpful analogies in other international operations, public and private, and even in national activities. In the course of our discussions numerous questions concerning these matters have naturally occurred to us as they would to anyone studying the international issues created by atomic energy. It has been necessary to reflect intensively on the possible answers to such questions as a means of testing the soundness of our main conclusions. We present here some of the results of our own discussion and reflection, not in the form of a systematic statement but rather for the purpose of illustrating the types of questions that arise and possible answers which occurred to this group.

One of the key problems of course will be the question of personnel. It will be of the essence to recruit that personnel on a truly international basis, giving much weight to geographical and national distribution. It does not seem to us an unreasonable hope that the organization would attract personnel of high quality. For the field of knowledge is one in which the prospects for future development have become an absorbing interest of the entire world. Certainly

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there is a far better chance that the Authority would attract personnel of a high calibre than that any purely policing organization would do so. At any rate, it is clear that the success of the organization would depend upon the quality of the administrators, geologists, mining experts, engineers, physicists, chemists, and other personnel, and every possible effort must be made to establish the kind of organization that will attract them.

It is not alone necessary for the organization to be thoroughly informed in the field of atomic energy. It will also be necessary for the nations of the world to be thoroughly informed at all times about the operations of the Authority. There are many ways of assuring this necessary degree of accountability on the part of the Authority to the nations and peoples whose instrument it will be. Some integral organ of the United Nations, perhaps the Security Council itself, will need to serve as the overseeing body for the Authority. But it could do so in ways generally comparable to those employed by congressional appropriations and investigating committees and the Bureau of the Budget in relation to governmental institutions in the United States. Detailed measures would have to be worked out to assure the proper connection between such an overseeing or "accountability" body and the Atomic Development Authority itself. Ways will also have to be worked out to assure that individual nations may maintain enough direct contact with the organization to give them a sense of intimate relations with it. This need will be served in part by the fact that the staff of the organization will be recruited from various nationalities. The operations of the Authority in its licensing activities, where it will be dealing directly with individual states, will also be one of the ways in which this objective is accomplished. For in this field there will be constant collaboration between the Authority and individual states in working out the detailed scientific, technological, and political problems which will cluster around the Authority's licensing activities. None of these matters appears to present insuperable difficulties.

The foregoing is intended merely as a statement of the possibilities for actually creating an organization that will have sound relations with the United Nations and with individual states. These possibilities must be made the subject of further exploration as intensive as that which we have directed to the scientific and technological facts concerning atomic energy itself.

Until qualified men set themselves the task of actually writing a charter, chapter by chapter, anything said about policies must be merely by way of preface. The actual statement of policy, like the form of organization, will have to grow out of the international discussions and deliberations.

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The fundamentals governing the Atomic Development Authority must of course be those which have been so well stated in the resolution of January 18, 1946 setting up the United Nations Atomic Energy Commission, that is, the strengthening of security and the promotion of the beneficial use of atomic energy. In our report we have adopted as the first principle in the accomplishment of these fundamental objectives the proposition that intrinsically dangerous activities in the field must not be left open to national rivalry but must be placed in truly international hands. To establish the boundaries between international and national action, we have grasped the fortunate circumstance that a dividing line can be drawn between dangerous and non-dangerous activities. We have emphasized that not the least in the fortunate circumstances that we have observed is the fact that the field of non-dangerous activities is so challenging that it provides an opportunity to avoid such centralization of authority as might make the price of security seem too high. In this connection it is important that a purposeful effort should be made to keep as broad and diversified as possible the field of activities which is left in national and private hands. Every effort must be made to avoid centralizing exclusively in the Authority any more activities than are essential for purposes of security.

These are the kind of basic considerations which we assume the United Nations Atomic Energy Commission would seek to make explicit in its recommendations for the charter of an Atomic Development Authority. Many others can be added to the list. We mention some now which are typical and illustrative and which are drawn from the kind of questions which have arisen in our own discussions.

We would expect that the charter itself should, so far as practicable, define the areas that are clearly dangerous, in which there must be an exclusive international operation, and the areas which now seem clearly non-dangerous, in which there may be national and private operations. One of the most difficult problems will be the creation of charter provisions and administrative machinery governing the manner in which the line will be drawn between safety and danger near the middle of the spectrum of activities where the division becomes less sharp. Another difficult problem will be to provide the means to redefine as either "dangerous" or "safe" when new knowledge shifts the line. In these matters close questions will arise, of course, as to the issues which must be referred for approval to the individual nations, the issues which need only be referred to some organ of the United Nations, like the Security Council, and the issues which can be determined by administrative action of the Atomic Development Authority itself.

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In strengthening security, one of the primary considerations will relate to the geographical location of the operations of the Authority and its property. For it can never be forgotten that it is a primary purpose of the Atomic Development Authority to guard against the danger that our hopes for peace may fail, and that adventures of aggression may again be attempted. It will probably be necessary to write into the charter itself a systematic plan governing the location of the operations and property of the Authority so that a strategic balance may be maintained among nations. In this way, protection will be afforded against such eventualities as the complete or partial collapse of the United Nations or the Atomic Development Authority, protection will be afforded against the eventuality of sudden seizure by any one nation of the stockpiles, reduction, refining, and separation plants, and reactors of all types belonging to the Authority.

This will have to be quite a different situation from the one that now prevails. At present with Hanford, Oak Ridge, and Los Alamos situated in the United States, other nations can find no security against atomic warfare except the security that resides in our own peaceful purposes or the attempt at security that is seen in developing secret atomic enterprises of their own. Other nations which, according to their own outlook, may fear us, can develop a greater sense of security only as the Atomic Development Authority locates similar dangerous operations within their borders. Once such operations and facilities have been established by the Atomic Development Authority and are being operated by that agency within other nations as well as within our own, a balance will have been established. It is not thought that the Atomic Development Authority could protect its plants by military force from the overwhelming power of the nation in which they are situated. Some United Nations military guard may be desirable. But at most, it could be little more than a token. The real protection will lie in the fact that if any nation seizes the plants or the stockpiles that are situated in its territory, other nations will have similar facilities and materials situated within their own borders so that the act of seizure need not place them at a disadvantage.

Various auxiliary devices, in addition to a strategic geographic division of plants and facilities and stockpiles, will also be necessary. Some of these have already been referred to. The design of primary production plants should make them as little dangerous as possible. The stockpiles of materials suitable for the production of bombs should be kept as small as possible consistent with sensible economics and engineering. So far as practicable, stocks should be denatured or kept in low concentrations unsuitable for the production of bombs. In other words, the design and operating procedures should definitely

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prevent the accumulation of substantial amounts of material quickly convertible into important quantities of explosives.

All these matters must be the subject of the most careful consideration in the writing of the charter itself.

With appropriate world-wide distribution of stockpiles and facilities; with design rendered as little dangerous as possible; with stockpiles of dangerous materials kept at the lowest level consistent with good economics and engineering; there will be no need for a sense of insecurity on the part of any of the major powers. Seizures will afford no immediate tactical advantage. They would in fact be an instantaneous dramatic danger signal, and they would permit, under the conditions stated, a substantial period of time for other nations to take all possible measures of defense. For it should be borne in mind that even if facilities are seized, a year or more would be required after seizure before atomic weapons could be produced in quantities sufficient to have an important influence on the outcome of war. Considering the psychological factors in public opinion, the fixing of danger signals that are clear, simple, and vivid seems to us of utmost importance.

There are other basic problems of only slightly less difficulty which will also need to be dealt with in the international deliberations. These have to do with such matters as compensation to nations and private agencies for the raw materials which the Authority would take over, they have to do with the problem of initial financing, they have to do with allocations and distribution of the materials and the facilities which the Authority will license or sell to individual nations and, through them, to their citizens. One of the difficult problems in this respect will be the question of priority in establishing non-dangerous power plants within various nations and the relation between these licensed activities and the power-producing activities of the Authority itself. A special word needs to be said on this subject.

The needs of nations for new power resources vary not only with industrial conditions, but also with their proximity to water power, coal, and petroleum. As we have emphasized before, the power supply from fissionable materials is of two entirely distinct kinds. Power will be produced in the very process of operating the production plants which make fissionable materials. These plants are of the dangerous kind which must be owned and operated by the Authority. The decisive consideration in determining the location of such plants will have to be strategic; otherwise the physical balance between nations will be impaired. In other words, the distribution of these plants throughout the world will have to be based primarily on security considerations. But there will still be ample room for an in-

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dividual nation, once it is decided that such a plant can be located within its borders, to determine where the plant shall be situated in relation to its own economic and social needs. It also appears fair to assume that the charter could provide specifically for the Authority to turn the power over to the nation or its designee at the bus bar of the power plant, thus leaving it to each individual state to determine policy in relation to transmission, distribution, and use, or the Authority might deliver steam to the individual state, leaving all electrical operation in national or private hands as determined by the policies of the particular nation. Problems of price will be difficult, but here again it should be possible to state basic policies in the charter which will give reasonable assurance of fairness in the fixing of cost.

The problem of power producing piles should be somewhat less difficult in the case of the non-dangerous plants. In these, fissionable materials will be denatured. The charter should be able to provide for their allocation of this type of plant in accordance with more conventional economic standards. It might be possible to provide that they should be located on the basis of competitive bids among interested nations. On such a basis, countries with ample power resources in water, coal, or oil would limit their bids to those warranted by the costs of alternative sources. Those countries having few or expensive ordinary sources of power might bid higher, but below the cost of other alternatives. In this way the maximum usefulness of fissionable materials with the greatest conservation of other sources of power would be secured.

Many other questions of the same order as those we have discussed can readily be imagined. These are enough to illustrate the nature of the problem.

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SECTION IV

The Transition for International Control

When fully in operation, the plan described in the previous section would, in our opinion, provide a great measure of security against surprise attack by atomic weapons. But it will take a considerable time before the plan can be adopted, and once the nations of the world have adopted it, a still further time will be required to put the plan into operation. It is essential to consider what will be the condition of affairs during the necessary period of transition.

In particular we must take note of the nature of the commitment already made for international action in order to determine whether the proposal satisfies the conditions attached to that commitment. In the pronouncements which the United States has made and sponsored in concert with other nations, the commitment for action has always been coupled with the requirement that the process of moving toward the goal of complete international collaboration must be accompanied at each stage by appropriate safeguards. It is the purpose of this section to describe the extent to which the suggested plan will satisfy this requirement.

The period of transition may be broken down into two sub-periods. In the first there will be no Atomic Development Authority. There will be discussions in the Atomic Energy Commission of the United Nations Organization, and as a result of these discussions, proposals will be referred to the United Nations Council and Assembly and to the several nations for further discussion and acceptance. From this process, there will result a charter that has been ratified by the various nations. It is at this stage that the Atomic Development Authority will come into being. All of this will inevitably require time. In the second period, when an Atomic Development Authority is created by the ratification by the several nations of the charter which establishes it, it will have an immense task before it, involving many different fields and many different activities. It would, of course, be possible to leave the ordering and sequence of these activities, or rather of undertaking them, to the discretion of the Authority. It seems far more likely that provisions governing the sequence of

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steps by which the Authority will come into full operation will be provided in the charter.

Two different kinds of consideration will be involved in setting up the steps of discussion and operation. On the one hand there are, as we shall see, certain indispensable requirements for the *adoption and the success of the plan itself*, which require that certain steps be taken before others can be effective. On the other hand, there is a wide range of schedules all equally compatible with the operability of the plan and *affecting primarily its acceptability* to the several nations. We shall be concerned in this section with outlining the requirements of the plan as to schedule, and pointing out what other elements are not fixed by the plan itself and in the fixing of which quite new considerations are essential. In other words, we shall attempt to describe those steps which must be undertaken in a particular order if the plan is to become effective at all. We shall also indicate other steps which are a necessary part of bringing the plan into operation, but as to which there is some freedom of choice in determining their sequence. The sequence of the first set of steps is fixed by the plan itself; the sequence of the second set is a matter that will have to be fixed by the negotiation between the nations.

The Position of the U. S. During the Transition

In order to have meaning, the examination of the transition period must take account of the present position of the United States in the field of atomic energy, and that position must be compared with the one that this country would occupy during the period when the plan for international action is being adopted and executed. Today's position must also be compared with the conditions that will prevail when the plan has finally been brought into full operation. We must also consider what our position would be some years hence if we were forced to abandon our present commitment for international action and pursue instead a purely national treatment of the problem.

Today the United States has a monopoly in atomic weapons. We have strategic stockpiles; we have extensive facilities for making the ingredients of atomic bombs and for making the bombs themselves; we have a large group of people skilled in the many arts which have gone into this project; we have experience and know-how obtainable only in the actual practice of making atomic weapons; we have considerable resources of raw material; and we have a broad theoretical knowledge of the field which may appear inadequate in future years, but which enables us to evaluate not only the performance of the past but also what the future is likely to hold.

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It is true that some part of our monopoly we hold in common with the United Kingdom and Canada. This applies principally not to material facilities or to weapons, but to the availability of raw materials, to theoretical knowledge, and to some elements of the know-how.

It has been recognized that this monopoly could not be permanent. There have been valid differences of opinion on the time which it would take other nations to come abreast of our present position, or to surpass it; but it is generally admitted that during the next five to twenty years the situation will have changed profoundly.

International control implies an acceptance from the outset of the fact that our monopoly can not last. It implies substituting for a competitive development of atomic armament a conscious, deliberate, and planned attempt to establish a security system among the nations of the world that would give protection against surprise attack with atomic weapons. Above all, it involves the substituting of developments which are known to the world for developments by the several nations which might well remain more or less secret, and where the very fact of secrecy would be a constant source of fear, incitement and friction.

Inherent in the adoption of any plan of international control is a probable acceleration—but only acceleration—of the rate at which our present monopoly will inevitably disappear, since our knowledge and our mastery of practical arts, and to some extent our physical installations, must ultimately be made available to an international agency in the process of establishing control.

Let us consider, for example, the plan we recommend in this report. If adopted and executed in good faith, this will have reached a reasonably full degree of operation in a period of years. At that time nearly all the factors making the present position of the United States in relation to atomic energy a preferred one will have been eliminated. For, when the plan is in full operation, no nation will be the legal owner of atomic weapons, of stockpiles of fissionable material or raw materials, or of the plants in which they can be produced. An attempt will have been made to establish a strategic balance in the geographical distribution of the internationally owned plants and stockpiles.

The security which we see in the realization of this plan lies in the fact that it averts the danger of the surprise use of atomic weapons. The seizure by one nation of installations necessary for making atomic weapons would be not only a clear signal of warlike intent, but it would leave other nations in a position—either alone or in concert—to take counter-actions. The plan, of course, has other security purposes, less tangible but none the less important. For in the very fact

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of cooperative effort among the nations of the world rests the hope we rightly hold for solving the problem of war itself.

It is clear that it would be unwise to undertake a plan based on the proposals which we have put forward unless there were some valid hope that they would be entered into and carried through in good faith; nevertheless, we must provide against the hazard that there may not be such good faith and must ask ourselves this question: What will be the state of affairs should the plan be adopted with the intention of evasion or should evasion be undertaken by any nation during the years when it is being put into effect?

The basis of our present monopoly now lies in two rather different things: knowledge, and physical facilities. The ultimate geographical balance toward which a plan for international control must work will witness the loss of both kinds of monopoly. Knowledge will become general, and facilities will neither in their legal possession nor in their geographical distribution markedly favor any one nation. Although both elements of our present hegemony will thus disappear over a period of years, quite different considerations are involved in the sharing of our knowledge and in the balancing of physical facilities.

The Material Aspects of the Transition

The transfer of such facilities to international control; the establishment under international control of similar facilities in other nations; the creation of stockpiles; the gradual building up of groups of men skilled in the various necessary arts—these are changes which from their very nature will require time to bring about, and which can, within not too wide limits, be scheduled and controlled. In the discussions within the United Nations Commission leading up to the adoption of the charter for the Authority, and even more in the early planning phases of the Authority's work, there will have to be some disclosure by us of theoretical information. But these discussions and these plans will not essentially alter the present superiority of the United States. They will not move its stockpiles of uranium or of fissionable material or its bombs or its operating plants, and need not alter the operation of these plants. These disclosures of information, now secret, will not create in any other nation the experience and the know-how which are so great a part of our present position of superiority.

No matter what may be the schedule of operations adopted, this situation cannot change overnight under any circumstances. Nevertheless, it is clear that very serious consideration must be given to the scheduling of those physical and legal changes which over a period of years will bring about a balanced international operation. On the one hand, the general principles underlying this scheduling will have

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to be the subject of negotiation, and the outcome will in one form or another have to be written into the charter. The charter may, for instance, provide that some things should not be done before a specified number of years have elapsed, or before the activities of the Authority, let us say, in the field of raw materials, have reached a certain stage of effectiveness. On the other hand, the Authority itself may by charter provision be given responsibility and discretion in the planning of its activities. It may, for instance, be called upon to certify that it is in satisfactory control of the raw materials situation before it undertakes certain of its other functions.

We are aware of the great importance which attaches to a prudent and reasonable scheduling of the step by step transition from our present position. But this problem is of a fundamentally different kind from those that have been discussed in this report. In this report we have attempted to discover and describe the conditions which, as we view the matter, a workable system of international control would have to satisfy.

The consideration of the steps of transition by which the special position of the United States may be relinquished involves quite other values. The sequence, the ordering, and the timing of these steps may be decisive for the acceptability of the international controls, but they will not affect its operability. Therefore, they present problems of negotiation between the nations within the UNO in the course of agreeing upon a charter for the Atomic Development Authority. Such problems of negotiation, in our opinion, are separable from the nature of the objective of the negotiation. They are problems which cannot be solved now, because they depend, among other things, on the motivation of the participating nations, on the political background of the negotiations, and on what may be conceived to be the separate, as opposed to the collective, interests of these nations.

The extent to which special precautions need to be taken to preserve present American advantages must be importantly influenced by the character of the negotiation and by the earnestness which is manifested by the several nations in an attempt to solve the common problems of international control. These questions lie in the domain of highest national policy in international relations.

We are convinced that the first major activities of the Authority must be directed to obtaining cognizance and control over the raw materials situation. This control may of course be subject to limitations, defined in the charter, on the freedom of the Authority in its early operations to alter the national distribution of raw materials. The problems of making a geological survey reliable and not prohibitively difficult are major technical problems. The raw materials control will bring the Authority face to face with the problem of access,

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which is both a technical and a political problem. It will bring it face to face with the need for establishing its own research agencies and for their coordination with private and national ones. These undertakings are fundamental for the operation of the Authority and to all of its future prospect of success.

There are other things which no doubt the Authority would wish to do at once. Without much delay it should set up laboratories for the study of nuclear physics and the technological problems that it must expect to encounter in its future work. It should attempt to establish suitable forms of liaison and interchange with private and national institutions working on atomic energy or on its applications or on the fundamental sciences which may be involved. In short, the Authority should get started on its research program and in establishing the patterns of its liaison with other agencies for which it will be responsible in the future.

It would be desirable that even in the earliest days the Authority act to permit the use of radioactive tracer materials and those laboratory reactors which use small amounts of denatured active material, and which seem to provide such valuable tools for research in a variety of fields.

The Authority may need to establish, even in its earliest days, planning boards to make studies of the difficult questions of stockpiling, power development, future plant construction; it may need to set up a system for the interim recording and accounting of operations in the field of raw materials, and in the production plants of the United States.

These seem to us reasonable plans for initial operations. All the other operations of the Authority are certainly subject to scheduling. They may accompany these initial operations, or they may come later. But the control of raw materials is an essential prerequisite for all further progress and it is the first job that the Authority must undertake. It will be a continuing activity, but what we are concerned with is that it should start.

In considering the special position of the United States, there are, as we have seen, the following important components, the discontinuance or transfer of which to the jurisdiction of the Authority will have to be very carefully scheduled by international negotiation: our raw material supplies; the plants at Oak Ridge and Hanford now operating to make atomic explosives; the stockpiles of bombs now in our possession; the stockpiles of undenatured fissionable materials; our atomic bomb plant and laboratory at Los Alamos. Our loss of monopoly in these elements cannot be indefinitely postponed. Some of the things we now have will have to cease; some will have to be transferred to the Authority; some will have to be paralleled by activities elsewhere.

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The scheduling will determine the rapidity with which a condition of international balance will replace our present position. Once the plan is fully in operation it will afford a great measure of security against surprise attack; it will provide clear danger signals and give us time, if we take over the available facilities, to prepare for atomic warfare. The significant fact is that at all times during the transition period at least such facilities will continue to be located within the United States. Thus should there be a breakdown in the plan at any time during the transition, we shall be in a favorable position with regard to atomic weapons.

Disclosure of Information as an Essential of International Action.

One of the elements in the present monopoly of the United States is knowledge. This ranges all the way from purely theoretical matters to the intimate practical details of know-how. It is generally recognized that the transmission of any part, or all, of this knowledge to another nation could provide the basis for an acceleration of a rival effort to make atomic weapons. Even that part of our knowledge which is theoretical, which can be transmitted by word of mouth, by formula, or by written note is of value in this context. If such knowledge were available to a rival undertaking it would shorten the time needed for the solution of the practical problems of making atomic weapons, by eliminating certain unworkable alternatives, by fixing more definitely design features which depend on this theoretical knowledge, and by making it possible to undertake the various steps of the program more nearly in parallel, rather than in sequence. It is not, in our opinion, possible to give a reliable estimate of how much such revelation would shorten the time needed for a successful rival effort. It is conceivable that it would not be significantly shortened. It is conceivable that it might be shortened by a year or so. For an evaluation on this point depends on information, which is not available to us, on the detailed plans and policies of such a rival undertaking, as well as on their present state of knowledge. It is, of course, clear that even with all such theoretical knowledge available, a major program, surely lasting many years, is required for the actual production of atomic weapons.

Our monopoly on knowledge cannot be, and should not be, lost at once. Here again there are limitations on the scheduling inherent in the nature of our proposals, and in the nature of the deliberations necessary for their acceptance. But even with the recognition of these limitations, there is a rather wide freedom of choice in the actual scheduling of disclosures. Here considerations of acceptability and of general political background will make a decisive contribution.

It is clear that the information, which this country alone has, can be divided more or less roughly into categories. The acceptance and

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operation of the plan will require divulging certain categories of this information at successive times. A schedule can outline the point at which this must occur. In particular, there is a limited category of information which should be divulged in the early meetings of the United Nations Commission discussing these problems. There is a more extensive category which must be divulged some years hence after a charter has been adopted and the Atomic Development Authority is ready to start its operations; and there are other categories that may be reserved until the Authority later undertakes some of the subsequent stages of its operations, for instance, those that involve research on weapons. We are convinced that under the plan proposed in this report such scheduling is possible, though it is clear, as we have pointed out, that many factors beyond the scope of this report, and involving the highest considerations of international policy, will be involved in such schedules. We wish to emphasize that it will involve an initial divulging of information, which is justifiable in view of the importance of early progress on the path of international cooperation.

It is true, as the Secretary of State has said, that there is nothing in the Resolution setting up the Atomic Energy Commission that compels the United States to produce information for the use of the United Nations Commission. But the point that needs to be emphasized is that unless we are prepared to provide the information essential to an *understanding* of the problem, the Commission itself cannot even begin the task that has been assigned to it.

Let us examine in a little more detail the nature of the information which is required in the early stages. What is important for the discussions in the United Nations Organization Commission is that the Members and their technical advisers have an understanding of the problem of the international control of atomic energy and of the elements of the proposals that the United States member will put forward. They must be in a position to understand what the prospects for constructive applications of atomic energy are and to appreciate the nature of the safeguards which the plan we here propose affords. They must be in a position to evaluate alternatives which may arise, and to have insight into the rather complex interrelations of the various activities in this field. Above all they must have a sound enough overall knowledge of the field as a whole to recognize that no relevant or significant matters have been withheld. For the process of reaching common agreement on measures of international control presupposes an adequate community of knowledge of fact. Much of the information which is required for this purpose is already widely known. We are convinced, however, that there are further items now held by us as secret without which the necessary insight will be

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difficult to obtain. These items are of a theoretical and descriptive nature and have in large part to do with the constructive applications of atomic energy. In our opinion, they are largely qualitative; and they involve almost nothing of know-how.

On the other hand, when the Atomic Development Authority is in existence and undertakes operations in a given field, it must have made available to it all information bearing on that field—practical as well as theoretical. Thus, if the Authority, as its first major undertaking, attempts to obtain control of raw materials, we must be prepared to make available to it *all* knowledge bearing on this problem. This will, of course, be a common obligation on all participating nations. Conversely, should it by charter agreement be determined that research and development in the field of atomic explosives will be undertaken by the Authority only at a late date, the specific technological information relating to such developments would not be required by it in the earlier phases. It is important to bear in mind that before the Authority can undertake some of its functions, such as the construction of reactors or the development of power, it will have to spend some time in planning these activities and in research directed toward them, and that information must be made available early enough to make such planning and research effective.

These are examples of requirements for information by the Atomic Development Authority at certain stages of its progress. In accepting the plan here recommended for international control, the United States will be committed to making available this information at the time, and in the full measure required by the operating necessities. Once the sequence and timing of stages has been fixed by negotiation and agreement between the nations, a minimum rate of disclosure of information will have been fixed by the agreement as well. A too cautious release of information to the Atomic Development Authority might in fact have the effect of preventing it from ever coming to life. For one of the decisive responsibilities of the Authority is the establishment and maintenance of the security of the world against atomic warfare. It must be encouraged to exercise that responsibility, and to obtain for itself the technical mastery that is essential.

We may further clarify the nature of the disclosures required by this board's proposals by a reference to a report. We have had the opportunity to examine in detail a report of December, 1945, prepared for the Manhattan District by its Committee on Declassification, a committee of seven scientists, including the wartime heads of all the major laboratories of the Project.[1] This Committee was

[1] Membership of this Committee included R. F. Bacher, A. H. Compton, E. O. Lawrence, J. R. Oppenheimer, F. G. Spedding, H. C. Urey, and R. C. Tolman, Chairman.

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directed to report on a policy of declassification—that is disclosure—of scientific and technical material now classified as Secret, a policy *which would best promote the national welfare, and protect the national security.* In interpreting its directive the Committee limited itself to a consideration of these objectives *in the absence of any system of international control.* It recommended against declassification at the present time of a very considerable body of technical, technological, industrial, and ordnance information, that is information bearing directly on the manufacture of weapons and the design and operation of production plants. But it recommended the prompt declassification of a large body of scientific fact and of technical information of non-critical nature and wide applicability. It expressed the view that the further declassification of critical items of basic theoretical knowledge would conduce, not only to the national welfare, but to the long-term national security as well—no doubt because of the damaging effect which continued secrecy in these matters could have on our own scientific and technical progress. Corresponding to these distinctions, the Committee divided our secret scientific and technical information into three categories, the first of which it recommended for immediate declassification; the second of which it recommended for eventual declassification in the interests of long-term, national security of the United States; and for the third of which it recommended against declassification in the absence of effective international control. We have tried to see what technical information this board would find essential for the sort of understanding that must be established as a basis for discussion in the UNO Commission, and to compare this with the items listed in the report of the Committee on Declassification. Many of the facts needed are already public; many are included in Class One; the remainder are all in Class Two, and comprise perhaps one-third of the items there listed. It is important again to emphasize that the Declassification Committee's recommendation was aimed at furthering our own long-term national security in the absence of international measures.

We wish to emphasize that the initial disclosures will place in the hands of a nation (should it be acting in bad faith) information which could lead to an acceleration of an atomic armaments program. We do not regard this circumstance as in any way peculiar to the plan recommended in this report. It is inherent in the concept of international control. The adoption of any workable scheme of international control may shorten the time during which the United States has a position as favorable as it has today. We cannot be sure of this, but we must be prepared for it.

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In this section we have been discussing the problem of transition to international control as it affects the security of the United States. During this transition the United States' present position of monopoly may be lost somewhat more rapidly than would be the case without international action. But without such action the monopoly would in time disappear in any event. Should the worst happen and, during the transition period, the entire effort collapse, the United States will at all times be in a favorable position with regard to atomic weapons. This favorable position will depend upon material things; less and less will it rest upon keeping nations and individuals ignorant.

When fully in operation the plan herein proposed can provide a great measure of security against surprise attack. It can do much more than that. It can create deterrents to the initiation of schemes of aggression, and it can establish patterns of cooperation among nations, the extension of which may even contribute to the solution of the problem of war itself. When the plan is in full operation there will no longer be secrets about atomic energy. We believe that this is the firmest basis of security; for in the long term there can be no international control and no international cooperation which does not presuppose an international community of knowledge.

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