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HISTORY OF THE ACTIVITIES OF THE

MANHATTAN DISTRICT RESEARCH DIVISION

10/15/45 - 12/31/46

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HISTORY OF THE ACTIVITIES OF THE MANHATTAN DISTRICT
RESEARCH DIVISION
Oct. 15, 1945 - Dec. 31, 1946

FOREWORD

The following history of Research Division's activities covers the period from its establishment on October 15, 1945, until December 31, 1946, when the work of the Manhattan District was transferred from the Army Corps of Engineers to the Atomic Energy Commission.

Chapter I describes the evolution of the physical organization, beginning with the consolidation of separate wartime research control offices and sections into the original Division in October, 1945, and concluding with a review of the functions of the Division's Executive Office and its six operating Branches.

The next five chapters (II-VI, incl.) are concerned with the conduct of Project research and development activities through the various research contractors. Chapter II summarized the History of Division activities involving administration of each contract, beginning with the Chicago Metallurgical Laboratory, later Argonne National Laboratory. Chapter III is concerned with a history of the general administrative activities involved in the Division's supervision of research contracts. In other words, the Division's dealings with each contractor are separately discussed in Chapter II, and a brief review of contractor technical activities is presented, while Chapter III deals with the more general overall Division responsibilities involved in administration of the contracts, including their negotiation, approval of programs and budgets, review of personnel and organizational problems, and various other duties

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entailed upon the Division's staff as individual contracting agents of the Manhattan District.

Chapters III, IV, and V deal respectively with District programs established to expedite and control contractor research activities in handling of special materials, production and transfer of radiation detection instruments and the interchange of scientific and technical information.

The remaining eight chapters (VII - XIV, incl.) are individual histories of Project-sponsored programs to control and encourage peacetime research in fundamental and applied nuclear science. Chapter VII properly introduces the subject with a history of the activities of the Advisory Committee on Research and Development, which played a signal role during 1946 in guiding Manhattan Project efforts in this respect. The next two chapters are concerned with research programs involving the District's unique technological processes and equipment. Chapter VIII covers the pile-reactor program, including chemical separation processes for recovery of fissionable, pile-product materials, and Chapter IX discusses physical and chemical isotope separation processes and the District program for construction of high-energy accelerators for nuclear particles.

Chapter X is concerned with the program for assisting other military agencies in atomic energy research, particularly the Navy ship propulsion project and the AAF-NEPA program for propulsion of aircraft by atomic energy. Chapter XI covers the establishment and operation of the District's program for nation-wide distribution of radioisotopes.

The last three chapters (XII - XIV, incl.) deal respectively with the program for establishment of national laboratories, the program for encouraging training and education of scientific and technical personnel in nuclear science, and the technical aspects of the District's relations with off-Project agencies and the public at large. To summarize the contents:

I: History of the Organization of the Research Division

II: Research Contractor Activities

III: Administration of Research Contracts

IV: Control of Special Materials

V: Control of Radiation Detection Instruments

VI: Control of Interchange of Information

VII: The Advisory Committee on Research and Development

VIII: The Pile-Reactor Program

IX: Programs for High Energy Accelerator Construction and Isotope Separation Processes Research

X: Program for Assisting Other Military Agencies in Nuclear Science Research

XI: The Program for National Distribution of Radioisotopes

XII: Establishment of the National Laboratories

XIII: Training and Education of Scientific Personnel

XIV: Technical Aspects of the District's Relations with Off-Project Agencies and the Public

A separate volume is devoted to the History of the Declassification and Publication Program.

HISTORY OF THE RESEARCH DIVISION

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Chapter I

History of the Organization and Establishment of the Research Division

General. In contrast to most normal peacetime academic and industrial research practice, Manhattan District emergency wartime research was entirely subordinated to the primary objective of producing atomic bombs. It was necessary that production requirements take priority over "academic", and often fundamental, research considerations; above all, it was imperative that the District's separate, diversified and highly compartmentalized research and development programs be closely supervised and integrated with the major process development and production operations, and that the primary military objective be kept clearly in mind at all times.

This policy resulted in an organization of relationship between Project research and production activities uniquely different from that normally encountered in ~~the normal organizational procedures of scientific and engineering~~ industry. In the latter sphere, it has always been axiomatic that for efficient and well-organized operation, research activities must be clearly diverced from production operations and must be closely integrated under a technical chain-of-command which operates with complete independence from other non-research activities, except at high-echelon policy levels. Obviously, security and emergency production requirements introduced unusual considerations into District organization which made such an arrangement impracticable.

It was far more important, from a short-term point of view, that research be carefully geared to the immediate, rapidly shifting needs of a concurrent full-scale production program, despite the inefficiency and duplication of effort inevitable from long-term operation under such an organizational procedure.

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With war's end, of course, the picture changed. Having successfully achieved its primary mission, the District's new objective was now to consolidate and reintegrate its organization in terms of less immediate military considerations -- to put its house in order during the interim period until a civilian agency could take over the administration of the huge project as a peacetime venture.

Physical Coordination of Production and Research during the War. The Manhattan District's three major operations projects for fissionable materials were directly under the administrative supervision of Colonel (later Brig. Gen.) K. D. Nichols, the District Engineer. The K-25 and Y-12 projects for U-235 production by gaseous diffusion and electromagnetic separation of isotopes were respectively supervised by unit chiefs, each of whom was responsible for both the production and research operations connected with his program. The Y-12 Unit Chief maintained an Area Engineer at the University of California and ~~H. I. T.~~, where major Y-12 research was concentrated, while K-25 had similar subordinate Area Engineers stationed at Columbia University, Buffalo, and other centers of gaseous diffusion process research.

Because of its greater magnitude, the Plutonium or Metallurgical Project found it necessary to separate control of research and production activities, although both operations reported directly to the District Engineer. Hanford production was placed under the Area Engineer who reported directly to Colonel Nichols' Office. The extensive research and development program was under the District's X-10 Research Operations Office, which maintained its separate Area Engineers and Operations Officers at the various laboratories and pilot-plant facilities connected with the Project. Coordination of

various technical and production operations with other District activities, and particularly of Plutonium Project production and research programs, was undertaken by the Coordinator for Production, Lt. Col. A. V. Peterson, assigned in a staff capacity to the District Engineer.

The Research Control Section. In addition to this wartime organization for research and production control, the District Engineer also maintained an advisory technical staff comprising the Legal, Patents, Medical, and Research Control Sections. The responsibilities of the last named body were:

a. To advise the District Engineer on technical matters.

b. To assist in the preparation and administration of research and development contracts.

c. To coordinate technical information, and maintain files of reports and other technical data developed by, or of interest to, the District Office and its associated installations.

The organization of the Research Control Section reflected these responsibilities. The group was headed by Dr. H. T. Wensel, Chief, on loan from the National Bureau of Standards. He was assisted by a Senior Chemist, Dr. J. R. Coe; a Senior Physicist, Dr. P. C. Aebersold, and a Records Unit Subsection which filed, recorded, distributed, and maintained custody over District technical and scientific reports, and research and development contracts. The immediate responsibilities of the Research Control Section were largely of an auxiliary nature, and actual direct control of specific research operations, as described above, was a major obligation of the various operations programs, second only in importance to production of weapon material.

Reasons for Establishing the Research Division. With war's end, it was felt essential that research operations be divorced from routine production activities and be consolidated within the frame of a comprehensive District research and development policy. No longer subject to emergency demand for all-out production, it was clear that the peacetime advance of fundamental and applied nuclear science would be in the hands of the research laboratories and their scientists and development engineers. In order to further their efforts, the District's diversified research projects had first to be coordinated under a single agency prepared to review overall Project programs from a comprehensive perspective uncircumscribed by the the necessary security which still compartmentalized research operations at the individual area laboratories. Specifically, this meant transferring supervisory responsibility for research activities from the operations offices and placing it under a central District Office. It further entailed the incorporation of the District Engineer's Research Control Section into the new Research Division, and the transformation of the former from its auxiliary status as an advisor and custodian of technical documents into a functional agency for control and distribution of authorized technical information and scientific reports.

Since the District anticipated that Congressional action would supplant Army supervision of the Manhattan Project with a civilian peacetime agency, it was realized that the new research control policy would be an interim affair. But this same contemplated development made all the more imperative the creation of such a central agency to review and consolidate District-wide research efforts, so that later transfer of the complex

responsibilities would be attained with maximum ease. At the same time, during its interim trusteeship, there were pressing peacetime responsibilities which the District was obligated to assume in order to assure continued progress both in fundamental nuclear research, and in the manifold military and civilian applications of atomic energy. Chief among these was (a) the establishment of a program of declassification, publication, and positive distribution of District-developed scientific information, insofar as was permitted by security restrictions; (b) the establishment of a program for distribution of the many stable and radioactive isotopes of chemical elements useful to scientific research which had been produced, and would continue to be regularly produced, in newly-developed District facilities; and (c) the positive encouragement of the many research and development programs in nuclear science which were being planned by other military agencies, non-military government agencies, academic institutions, and private engineering and scientific industries. It was desirable that the central District agency which would undertake the establishment of these new activities should also supervise the Project's own specific research efforts so that they might be integrated with the nation's comprehensive program for the development of nuclear science. Security was not the least in the considerations determining this policy. Finally, insofar as it was possible, a positive attempt was made to staff the Research Division with supervisory personnel from the various Area and Operations Offices, and the Research Central Section, whose duties were being incorporated into the newly-established agency. In this manner, transfer of responsibility from the widely-scattered areas to the central coordinating office at Oak Ridge could be effected with maximum efficiency.

The Establishment of Research Division: October 15, 1945.

Authorization. On October 15, 1945, the Research Division was officially established by a directive of the District Engineer to coordinate the overall research and development activities of the District under the supervision of one agency. The executive administration comprised a Director of Research, a Deputy Director, an Executive Officer and the respective Branch Chiefs who were to carry out the delegated functions of the new Division.

Branching. At the first, the new Division's chief objective was to establish coordinated, administrative control over the various functions which had, in a measure, been the responsibility of the superseded Research Control Section. Thus the duties of rendering technical advice were to be maintained by the newly-created Technical Branch, and the custody, control, and dissemination of reports and other technical and scientific information by a Records Branch. In addition, the diverse responsibilities of the separate "X-10 Research Project," which had supervised plutonium research, were bodily transferred from Plant Operations control and placed under a separate X-10 Operations Branch within the new Division.

But, as has been previously noted, the embryonic Division also anticipated the assumption of numerous new responsibilities. These were to be assigned either to its present Technical, Records (later Information) or Operations Branches, or were to be undertaken by newly created Branches. Consequently, in later months these operating units of the Division were augmented by the establishment of the Declassification and Publication

Branch, and by the Isotopes Branch. The increased routine clerical and administrative responsibilities of the Division also necessitated the institution of an Administrative Branch. By May 1, 1946, all of these Branches had been established within the Division, and the general organizational pattern was in existence which has persisted through the close of this history, December 31, 1946. Within this frame were the Executive Branch, assisted in its administrative functions by the Administrative Branch, and the five operating Branches: Operations (formerly X-10 Research Operations), Information (formerly Records), Technical, Declassification and Publication, and Isotopes. The organization and functions of these separate branches are discussed in detail below.

Executive Office.

General Functions. Acting in a staff capacity to the District Engineer, the Research Division was authorized to function only within the frame of policy prescribed and approved by that officer. As his delegated representative in research and development matters, the Division's staff was responsible for the coordination of all policy in this respect throughout all installations undertaking research for the District. This entailed review and recommendations for action by the District Engineer of all matters involving possible policy changes respecting Project-wide or non-Project research and development activities. Within its authorized powers, it established and maintained the physical machinery for reviewing, coordinating, approving, and expediting the incidental operations necessary for encouragement, initiation, continuation,

and successful completion of all authorized District research and development activities. The Executive Office, comprising the Director, Deputy Director, and Executive Officer, was assigned responsibility for administering the various Research Division Branches instituted to accomplish these objectives.

In general, the Executive Office attempted to delegate all routine activities to the appropriate Branches, confining its activities to reviewing and approving Branch actions, and assigning new responsibilities to these subordinate offices as they occurred. In the latter case, it initiated and followed the development of new research and development activities until District policy had crystallized sufficiently for further administration to be handled by the Branches. Because of the highly classified nature of certain operations, however, their administration was in some cases handled exclusively by the Executive Office.

Specific Functions.

Initiation of New Programs. The preliminary work in initiating new District research activities was handled exclusively by the Executive Office until policy and procedure had crystallized to a point where the program could be delegated to the subordinate branches. This was true of liaison conducted with agencies such as the Navy and C-E with respect to the ship propulsion program, in the establishment of relations with the AAF Material Command Laboratory, in overall coordination of the Naval nuclear science research program with the District, and in the determination of policies covering the hazards and criticality of fissionable materials from the standpoint of [illegible]. Once these projects had become well-defined in nature, they

would be delegated to the appropriate Branch for further supervision, as was done in the case of the Hope program.

Supervision of Highly Classified Programs. Certain activities and special materials which were of highly classified nature, however, were placed under the exclusive jurisdiction of the Division's Executive Office although otherwise they would have been delegated to subordinate Branches. Thus the administration of programs for controlling experimental investigations and production of special materials, such as boron-10, polonium, tritium, protactinium, and thorium was handled mainly by the Executive Office, although an effort was being made at year's end to transfer them to the jurisdiction of the Special Materials Section, Operations Branch. Liaison with the scientific activities of the Commissions at the Chalk River Laboratories, which would have normally devolved upon the Technical and Operations Branches, was also handled in the Executive Office.

Visit Control. All routine Division responsibilities connected with arranging for visits to Project research and development installations were handled by the Executive Office, which served as a central control clearing house in this respect and made the necessary arrangements with the Security Division, the appropriate Area Engineers, and other District offices.

Channels of Line Organization to Higher Supervision. The Research Division occupied a unique position among other District offices in that it served in a dual capacity as the staff advisory agency on technical questions to both the Washington Office of the Commanding General and the office of the District Engineer. In this respect the Division was distinct from those individual sections from which it had been originally

formal, such as Research Control, X-10 Research Operations, etc., and also from the other District staff offices on a division level, such as the Medical, Administrative, etc., all of which reported directly to the Deputy District Engineer. On matters relating to the Oak Ridge operations, particularly those of an administrative and non-technical nature, the Research Division also normally reported to the Deputy District Engineer. With the transfer of the District Engineer's Office to Washington in the Spring of 1946, the Commanding General established a second channel of supervisory control between the Washington Headquarters Technical Staff and the Research Division. This second "chain of command" placed the Research Division under Colonel K. D. Fields and henceforth all determinations of broad policy came directly through the latter office.

On July 23, 1946 Colonel O. G. Haywood, Jr. was delegated responsibility by Colonel Fields for following Research Division activities. In particular, Colonel Haywood followed developments in (1) contracts under Research Division supervision, (2) operations of Areas under Division supervision, including Hanford, (3) the national radioisotope distribution program, (4) interchange of reports, visitor control and Project technical meetings, (5) the declassification and publication program, and (6) the Manhattan Project Technical Series. This bifurcated line of organization persisted during the remainder of 1946. In general, approval for all District research and development policy came directly from Colonel Fields' Office, subject to prior approval by the District Engineer. Colonel Fields, in turn, was responsible to both the District Engineer and the Commanding General, conducting liaison between them on technical and scientific matters such as the Research Division itself

served in a similar liaison capacity between the District Engineer and Colonel Fields' Office.

Administrative Branch. The administrative functions of the Division were supervised directly by the Executive Officer and his assistant during the first several months of the Division's existence. These included the routine clerical functions of typing, filing, etc., and the important activity of procuring technically trained administrators and experienced clerical help for the rapidly expanding Division. Because of security restrictions and the marked extent of classified activities pursued by the Division, a careful control of classified mail and other information routed through the Division was maintained. Other responsibilities of the Branch included coordination of over-all Division administrative responsibilities, review of contracts and budgets, and the institution of the Division's filing system.

Operations Branch.

X-10 Operations Branch. Prior to establishing the Research Division, District research operations were controlled, as has been mentioned, by various Area Engineers assigned to the specific areas, such as the University of California, M.I.T., Columbia, etc., or, in the case of the Plutonium Project, by a special group known as X-10 Research Operations, under District Plant Operations. X-10 Research Operations supervised research and development for the Plutonium (or Metallurgical) Project undertaken by the University of Chicago, the prime contractor, at Clinton Laboratories and the Chicago Metallurgical Laboratory, and also by associated prime contractors at M.I.T., Battelle Memorial Institute, Iowa State University, the National Bureau of Standards, and Dayton. With

the inauguration of the Research Division, X-10 Research Operations activities were transferred bodily to the new organization's X-10 Operations Branch. On November 28, 1945, the research and development aspects of the District-supported activities at the University of California Radiation Laboratory, which had previously been under the Y-12 Operations Chief, were also transferred to the Research Division. Later, research and development activities of the Madison Square Area (Columbia, Massachusetts Institute of Technology, Rochester), the Evergreen Area, and the Schenectady Area, were placed under this Branch, which was known after January 1, 1946 as the Operations Branch.

Administration of the ensuing research and development operations by the Operations Branch at the various installations has been directly through the Area Engineers, where such officers of the District have been designated (Evergreen, Chicago, Berkeley, Hanford, Schenectady, Iowa, Trail) or, in the unique case of Clinton Engineer Works, through the respective Operations Officers (Clinton Laboratories, Y-12, K-25). Supervision of the associated prime contractors for the Metallurgical Project, however, has been direct wherever no intervening District area office has been established (Monsanto-Dayton, Massachusetts Institute of Technology, Battelle Memorial Institute, National Bureau of Standards and Vitreosem Instrument Company). Prior to the assignment of an Area Engineer to the Iowa State College activities, and the creation of the Iowa Area early in November 1946, this installation was also supervised directly by the Operations Branch. The Area Engineer, St. Louis Area, had exercised a dual function as Iowa Area Engineer up to this time.

Functions of the Operations Branch. The primary responsibility of the Operations Branch has been the coordination and administration of the activities of those various research and development installations supported by the District, either directly or by formal agreement with operating contractors. This has involved review of proposed programs, control over current programs and budgets, and administration of the contracts under which they have been established. (See Chapters II and III, "Research Contractor Programs", and "Administration of Research Contracts".)

An important function in this respect has been procurement and allocation of unique and secret special research materials and the special radiation detection instruments developed by the District. Two special Operations Branch sections were established to control, coordinate, and expedite requests for special materials and instruments. A detailed history of the Division's activities in administering both of these programs, including organization of the Special Materials and Instrument Production Sections, is given in Chapters IV and V, respectively. In other words, Chapters II-V, inclusive, are devoted to the three Operations Branch responsibilities: review and administration of research contractor activities; and coordination of special materials and radiation detection instrument production.

Technical Branch

General. The Technical Branch was established to continue and expand the advisory technical services which the scientific staff of the old Research Control Section had performed for the District Engineer.

In addition to advising higher levels within the District, it also performed important functions as the advisory group for other operating branches within the Division itself. Thus, it reviewed proposed and current research programs from a technical point of view for the Operations Branch, reviewed extensively the technical information declassified by the Declassification and Publication Branch, and assisted the Information Branch in the scientific problems involved in indexing and distributing scientific and technical information. It also closely followed the various District and contractor programs for training and educating Project and non-Project scientists in the principles and techniques of nuclear science. The chemists, engineers, physicists, and metallurgists of the Technical Branch maintained a continuous review of the District's activities and special problems in these respective fields, serving as consultants to other District divisions and area offices on technical problems and programs within their fields. Liaison with technical agencies in industry and government which are interested in District-sponsored research and development, including the AAF Nepa Program, the Navy's ship propulsion program, etc., has been conducted by the District through the Technical Branch. In contrast to the Operations Branch, which has its functions summarized in Chapters II-V, inclusive, the Technical Branch has played a part in each of the various programs described in the present history. By their very nature, its advisory responsibilities were too comprehensive to be confined to the bounds of one or more separate chapters.

Declassification and Publication Branch.

General. The Declassification and Publication Division was established as a separate staff division responsible directly to the District Engineer in February 1946. The primary responsibilities were to formulate, organize, and establish an organization prepared to carry out the declassification procedure for processing District technical information as outlined by an advisory group of leading American scientists. Actual processing of documents was first successfully begun in April, 1946. On May 1, 1946, the Declassification and Publication Division became the Declassification and Publication Branch of the Research Division, in which capacity it continued for the remainder of the year.

The functions of this Branch were two-fold: first, the review and processing of classified information for possible declassification; and second, following declassification, the determination of the most effective means of publication of the material. The former function was the responsibility of the Branch's Declassification Section. Publication policy was coordinated by the Publication Section. A major effort of this office was the review, selection, and preparation, after the authors' approval, of important classified and unclassified Project reports for orderly, authoritative presentation in the Manhattan Project Technical Series, of a set of published volumes which would cover the outstanding technical and scientific information produced by Project activities.

Physical reproduction and distribution of all declassified documents to Project installations and to the general public were conducted by the Information Branch, with which the Declassification and Publication

Branch maintained close liaison. The history of the District's declassification and publication program comprises a separate volume, "History of the Declassification and Publication Program", copies of which are available from the Commission's Technical Information Division [illegible] agencies. Information Branch [illegible]sibility was the formulation of a single, controlled [illegible]. The Records Branch, eventually to be known as the Information Branch, was established at the time the Division was first instituted to continue and expand the activities of the old Research Control Section's Records Unit Sub-Section. It has established a comprehensive library of all District classified and unclassified technical reports, and has organized a staff to undertake indexing, reproducing, and distributing this information, by direct distribution and by action on special requests from Project and non-Project agencies, in accordance with clearance District policy. It has also built up a scientific reference library on nuclear science and related technical fields and has, maintained close liaison with the Declassification and Publication Branch program for release of Project declassified information. In this regard, the Information Branch has undertaken the function of physical distribution of the information once declassification has been completed.

In February, 1946, the Records Branch was renamed the Information and Publication Branch and in May, 1946, it received the title Information Branch, which it retained during the rest of the year. Information Branch functions are described further in Chapter VI, "Control of Interchange of Information."

Isotopes Branch.

General. The Isotopes Branch was established in February, 1946, to coordinate and administer approved District policy for distribution of radioisotopes and subsequently stable isotopes to off-Project agencies. Its primary responsibility was the formulation of a single, controlled procedure and the organization of a staff to administer the program. In addition to receipt, review, coordination, allocation, and follow-up, where necessary, on specific requests, the Branch also undertook to encourage the purchase of the new materials and thus played an active part in the formulation of new standards and specifications for the measurement, handling, and production of these new scientific tools. It has maintained liaison with and furnished advice to hospitals, universities, institutions and other interested agencies regarding health, medical, scientific, and other aspects of radioisotope utilization. The history of Isotopes Branch activities is further discussed in Chapter VI, "The Program for National Distribution of Radioisotopes."

Chapter IX

Research Contractor Programs

General. The District's broad program for atomic energy research may be considered under two general categories of activities. First, There were the research contractor programs in which specific research objectives were undertaken by university or industrial laboratories under contract. Each contractor's program received prior approval by the District, and funds were separately earmarked in the contractor's budget to cover each of the research projects comprising an individual contractor program. All District research operations functioned according to this general procedure.

The second category in the District's overall system of organized research was the District's own research programs. Such District programs were administrative in nature, and were organized on a Project-wide basis in contrast to the numerous individual contractors' programs. While these District programs were established on a "horizontal" basis to effect overall research objectives, the actual operations were in most cases still carried out at the various contractor laboratories. Such broad objectives involved off-Project agencies as well as contractors, and represented the District's nation-wide responsibility in controlling all aspects of U. S. atomic energy research. Examples of these activities are the programs for construction of new piles, establishment of national laboratories, control of radiation detection instrument production, and distribution of radioisotopes and other special materials.

The present chapter is concerned with review of the Division's dealings with each of the separate contractors, while Chapter III summarizes general Division responsibilities involved in administration and control of research contracts for the District.

Following these are twelve chapters describing the Division's responsibilities in establishing broad policies for the continued encouragement and control of atomic energy research (1) within the District and (2) throughout the nation.

Development of the Division Operations Branch. After the X-10 Research Operations Control Unit was incorporated into the newly-established Division in October, 1945, it administered prime contracts with the Monsanto Company for operation of both Clinton Laboratories at Oak Ridge and the Dayton plant in Ohio, and with the University of Chicago for the Chicago Metallurgical Project. Under its direct jurisdiction were also the associated prime contracts between the District and Battelle Memorial Institute, Iowa State College, the National Bureau of Standards, Massachusetts Institute of Technology, Columbia University, and the Vitro-Rem Instrument Company.

Administration of research activities at the Metallurgical Laboratory and Clinton Laboratories was carried out through the Chicago Area Engineer and the X-10 Operations Officer stationed respectively at those installations. Supervision of Massachusetts Institute of Technology and Columbia work was shared between the Division and the Madison Square Area, with the understanding that administrative control and review of research and development aspects of the work would be vested in the Division, so that overall

coordination of District research policy would be possible. Maintenance of actual relations between the District and the various contractors, however, continued to be the prime responsibility of Madison Square Area, together with direct administrative control of all non-research and development activities.

The National Bureau of Standards' activities were of a varied nature, originally undertaken for the District under a broad and informal wartime agreement. The activities were re-integrated and placed on a more formal status by the Division and subsequently were supervised directly by the Operations Branch. Research at the Monsanto installation in Dayton and at Iowa State College was supervised directly by the Branch until the autumn of 1946. At that time the Iowa Area was created and further contact was carried on through its Area Engineer, although the Division continued to maintain administrative responsibility for all research work undertaken at Ames. Dayton operations were transferred from the Branch during this same period and placed under the District's Operations Division, although the Research Division continued to review activities in an advisory capacity.

In November, 1945, shortly after its establishment, the Division was also assigned responsibility for administration of research activities at the University of California Radiation Laboratory, which had hitherto been supervised by the Y-12 Unit Chief. Since this action extended its authority to research installations not connected with the X-10 program, the Division's X-10 Operations Branch was renamed the Operations Branch. As the District undertook support of new research activities, and issued new contracts during 1946, the Division's responsibilities continued to increase. When the

Metallurgical Laboratory at Chicago expired in June, 1946, to be replaced by the new Argonne National Laboratory, supervision of the latter continued to be an Operations Branch responsibility. Later, in September of 1946, when the General Electric Company supplanted du Pont as operator of the Hanford Engineer Works Plant, plans were formulated for an extensive research program to be undertaken at its Schenectady Laboratories. All District-supported research activities at Schenectady were placed under the Operations Division, which exercised its jurisdiction through the Schenectady Area Engineer, with the Research Division in advisory capacity.

Preliminary organization plans for the establishment of Brookhaven National Laboratory at Camp Upton, Long Island, were also followed by the Division, although no actual research operations had been authorized by year's end.

The present chapter is confined primarily to a brief outline of the major activities undertaken by each of these District research contractors: Argonne, Clinton Laboratories, Battelle Memorial Institute, Iowa State College, Massachusetts Institute of Technology, Columbia University, National Bureau of Standards, University of California, General Electric-Schenectady. Exceptions are Brookhaven National Laboratory and Dayton-Monsanto. The former is covered in Chapter XII, "Establishment of the National Laboratories," while the latter is in Chapter IV, "Control of Special Materials." The Operations Branch also maintained staff responsibility for supervision of District heavy water production at the Canadian Mining and Smelting Company Plant at Trail, B. C. Further details of this activity are also

covered in the section devoted to heavy water under Chapter IV.

Appended to this chapter are sections dealing with the Canadian Chalk River Project and the District's Medical Research contracts in which the Division maintained a divided responsibility. While supervision of the Office of the U. S. Representative at the Canadian Project stemmed directly from Washington, the Division maintained administrative and technical liaison with routine activities at Chalk River and expedited liaison contacts between that facility and District research installations within the limitations of established policy. The Division also took an active interest in medical research projects being undertaken at various District installations. This, of course, was administered in two distinct ways. Certain Research Division contractors, among them Clinton Laboratories, Argonne National Laboratory, University of California, included biological and medical projects in their programs. While the entire contract in these cases was under Research Division jurisdiction, the Medical Division assisted in review of the projects of most interest to them. At the same time the District also supported research at institutions such as the University of Rochester and Western Reserve University, which were devoted entirely to medical research and supervised by the Medical Division with Research Division assistance. In both types of work the Medical and Research Divisions worked closely together and mutually advised the District Engineer on problems relating to the conduct of medical research investigations.

It should be emphasized here that the remainder of this chapter is

merely a piecemeal survey of the various individual research contractor programs. For actual details the reader is referred to the separate contractor files maintained by the Operations Branch.

The Metallurgical Project (later Argonne National Laboratory)

General. The University of Chicago, as prime contractor, had operated and administered the Metallurgical Project, which consisted of the Metallurgical Laboratory at the University of Chicago, the Argonne Laboratory, and associated prime contractors. On 23 October 1945, ~~at the suggestion of Dr. A. H. Compton, Major General Groves put~~ placed the Argonne staff under the Metallurgical Laboratory for administrative purposes, thereby consolidating all District-sponsored research activities at Chicago under the one organization. At the end of fiscal 1946, the Metallurgical Laboratory was supplanted by the newly-established Argonne National Laboratory. During the remaining months of 1946, the Research Division continued to administer research activities at Argonne as it had previously for the Metallurgical Laboratory.

The history of the establishment of Argonne, in which the Research Division has played an important role, is covered separately in Chapter XII. The Director of the Research Division or members of his technical staff represented the District at the various organization meetings and carried out Project policy authorized by the District Engineer, Colonel K. D. Nichols, leading to establishment of the Argonne National Laboratory.

Specific Argonne Developments of Interest to the Division

Extension of the Argonne Lease. Negotiations with the Cook County Forest Preserve for acquisition by the District of some 45 acres for future permanent District research facilities were opened by the Director in October, 1945. An extended discussion resulted, the Chicago Area Engineer was directed to continue negotiations for the District with Forest Preserve authorities. Further action carried on by that office is recorded in Chapter XIII, "Establishment of the National Laboratories."

New Argonne Construction. At the request of the District Engineer, the Division directed on September 26, 1946 that plans for proposed construction of the new "L" building at Argonne during fiscal year 1947 be held in abeyance pending further justification of its needs. The "L" building was designed to hold and utilize laboratory's stock supply of plutonium and to provide space for solvent-extraction process research and experimental work on plutonium purification. Because of the hazards involved, the Argonne Laboratory staff felt location of these activities in a separate building was essential. As the result of this review, the Director recommended approval of construction on October 31, 1946.

Argonne-Metallurgical Laboratory Research Projects. The various research activities undertaken at the Metallurgical Laboratory during the last half of fiscal 1946 and at Argonne during the first half of fiscal 1947 were:

a. Pile problems: (For further details see Chapter VIII, "The Pile-Reactor Program.")

(1) Pile research and development:

(a) Operation and servicing of the existing heavy water thermal pile.

(b) Research and development of the new Zinn fast fission pile, including component parts.

(c) Research and development coordinated with Clinton Laboratories on the Daniels' power pile, emphasizing especially development of fabrication techniques for beryllium and thorium.

(2) Separation of Irradiated Pile Materials.

(a) Redox solvent extraction process for separation of plutonium from uranium.

(b) Extraction process for separation of U^{233} from thorium.

(3) Preparation of Special Materials for Irradiation in the Piles. (see Chapter IV).

b. Other Problems in Nuclear Science:

(1) Chemistry of heavy element isotopes.

(2) Technology:

(a) Design of a Van de Graaff generator (see Chapter IX)

(b) Design and development of radiation detection instruments. (See Chapter V).

(3) Biological and medical studies of:

(a) Radiation effects.

(b) Toxicity of special materials.

Clinton Laboratories

General: Supervision of Clinton Engineer Works research and

development activities at Oak Ridge was the direct concern of the Research Division. Since most activities in this respect were carried on at Clinton Laboratories, it was logical that this installation would be subjected to more extensive Research Division supervision than either of the two other Clinton Engineer Works sites, K-25 or Y-12.

Review of Clinton Laboratories Research Program.

General. The specific objectives of Clinton Laboratories during the existence of the Research Division were:

(1) Pile research and development (See Chapter VIII)

(2) Use of existing facilities for:

(a) Production of special fissionable materials (See Chapter IV)

(b) Production and distribution of isotopes (See Chapter XI)

(3) Training program (See Chapter XIII).

(4) Studies in fundamental nuclear science, including development and improvement of analytical methods.

Davies. (See Chapter IV, "Control of Special Materials," under "Postum")

Iowa State College.

General. Contract W-7405-eng-82 under direction of Dr. F. H. Spedding, has been concerned with the following activities:

a. Production Program: (See Chapter IV)

(1) Meeting a production schedule of approximately 250 pounds of thorium and 300 pounds of beryllium per month, for use in experimental piles.

(2) Production of pure beryllium and thorium salts for various purposes, as requested.

b. Research.

(1) Development of improved methods for production of pure beryllium, thorium, and their compounds.

(2) Preparation of plutonium complexes.

(3) Preparation and chemistry of uranium hydrides under high pressure.

(4) Preparation of pure rare earths.

(5) Development of an adsorption process for uranium isotopes separation.

(6) Development of new pile construction materials, including refractories capable of withstanding high temperatures.

Specific Developments of Interest to the Division.

Supplemental Work. Dr. Spedding requested District approval on May 25, 1946 for a supplemental contract to his present agreement, to cover the undertaking of problems 124, 125, 126, on: (See files). District decision on this matter was: (See files).

Dr. Spedding requested authorization for a construction program of $250,000, later increased to $650,000, for a building to house the thorium production program and an auxiliary laboratory. District decision on this was: (See files).

Specific Iowa work in support of the District's overall beryllium and thorium activities is covered in Chapter IV on Special Materials.

Establishment of Iowa Area. Prior to November, 1946, Iowa State College research activities were supervised directly by the Division's Operations Branch. Early in that month, however, an Area office was established to supervise all District activities, including the new construction program, and all further communication between the Division and the Iowa Project was channeled through the Area office.

Battelle Memorial Institute.

General. Under Contract W-7405-eng-92, research has been conducted at Battelle to furnish basic metallurgical information on materials to be used in new pile design and construction, as follows: (See also Chapter VIII, "The Pile-Reactor Program.")

a. Investigation of physical and chemical properties of uranium and beryllium metals, alloys, and compounds:

(1) Thermal conductivity.

(2) Corrosion.

b. Fabrication processes for these materials:

(1) Rolling, extrusion, etc., of fuel material for piles.

The Madison Square Area Engineer.

General. Prior to the organization of the Research Division, the Madison Square Area Engineer had maintained exclusive administrative control for the District Engineer over research activities being conducted in the northeastern United States in connection with uranium production operations. At the same time his office also retained an interest in all other research programs which directly concerned Madison

Square Area activities. This arrangement was set up by the District for the purpose of dealing with agencies in a single general region in a consistent manner. By October 22, 1946, the respective jurisdiction of Madison Square Area and the Research Division over District research activities were fairly well clarified on paper, as follows: Madison Square Area would administer Massachusetts Institute of Technology, Brookhaven, and Columbia directly, with the biology project at the last-named installation subject also to mutual review by the District Medical Division. Madison Square Area would administer the University of Rochester contract directly under the same policy as that governing the Columbia Biology Project. In all the above cases, however, narrative and monthly progress reports were to be submitted to the Division's Operations Branch by Madison Square Area, as for other installations. The Operations Branch would review and consolidate Madison Square Area budgets with the District's research budgets from other sites, and would also act as an intermediary between Madison Square Area and other District research and development projects in all matters other than routine.

At Battelle Memorial Institute the pile program research under Contract W-7405-eng-92 was administered directly by the Division. The Battelle Memorial Institute Contract W-36-034-eng-27 with Madison Square Area for ore-dressing research, however, remained directly under Madison Square Area, under authorization by Colonel K. H. Marsden on November 15, 1945 as a special exception to the standard District policy of having only one contracting officer for any one contractor.

At the Vitro Corporation Instrument Company, two District contracts were administered directly by the Research Division (See Chapter V). Madison Square, however, has also administered a special contract with this concern for development of a mechanical timing device. According to established District policy, the Research Division should also have administered this third Vitro Corporation project. Madison Square Area activities are nominal, however, since it merely acts as an agent for Los Alamos, Vitro Corporation, and three other contractors on the development of the mechanical device.

Massachusetts Institute of Technology

General. Under Contract No. W-7405-eng-175, research at Massachusetts Institute of Technology under Division jurisdiction has been conducted on various aspects of the pile metallurgy program, including fundamental research and development of technological processes, as follows: (See also Chapter VIII)

(a) Research:

(1) Irradiation effects on beryllium.

(2) Solubility of uranium in various metals and of tantalum and tungsten in uranium.

(3) Physical property studies of beryllium fabricated by various methods.

(4) Beryllium powder metallurgy.

(b) Forging, casting, extrusion, vacuum melting processes for fabricating beryllium.

Specific Research Division Action Regarding M. I. T. While Massachusetts Institute of Technology activities have been chiefly under Madison Square Area supervision, the Research Division has reviewed the former's activities to keep them in line with related research in other fields, and has authorized specific purchases approved by the District generally under the broad objectives of the program. On July 29, 1946, the Division approved purchase of an extrusion press from the War Assets Administration for Government-supported work at Massachusetts Institute of Technology after having investigated various other sources from which the equipment might be available. On September 24, 1946 purchase was also authorized of a spectrograph for use under the contract.

Columbia University.

General. Under Contract No. W-31-109-eng-17, research was being conducted at Columbia in fundamental nuclear physics on the following general subjects:

(a) Interaction between nuclear particles.

(b) Neutrons:

(1) Physical measurement of neutrons.

(2) Neutron interaction as a function of neutron energy for isotopes and elements.

(3) Influence of molecular structure, chemical bonding, crystal state, magnetic properties, presence of impurities, and other factors on neutron interaction.

(c) Development of radiation detection instruments.

Under Contract No. W-31-109-eng-14 research was being conducted in biology on neutron effects on small animals under Dr. G. Failla.

Contract W-31-109-eng-15 provided for reimbursement to Columbia for the planning work it was conducting for Associated Universities, Inc., in establishing Brookhaven Laboratory. (See Chapter XII, "Establishment of National Laboratories").

Continuation of Contract W-31-109-eng-17: Research under Contract W-31-109-eng-17 was unique among contractor research programs in that the specific investigations being pursued were in large measure left up to the discretion of the program director, Dr. J. R. Dunning. The work during the war had originally been conducted under Contract W-7405-eng-58 which terminated June 30, 1946. At that time, at the request of Columbia, the District agreed to the institution of a supplementary contract extending the work until year's end. It was felt that perhaps by then the Atomic Energy Commission would have assumed Project control and could determine policy for termination or further continuation of the work. By the end of 1946 several other requests had been received by the District for government financial assistance in support of research investigations in fundamental nuclear studies similar to the work being undertaken at Columbia. Inasmuch as no action had been taken by the District on these requests, since overall Government policy regarding financial research assistance to universities had not yet been determined, it was felt at year's end that further support of the Columbia project under these circumstances would be embarrassing to the Government. On December 16, at the request of Madison Square Area, the Division reviewed the Columbia program with the Washington Office and it

was agreed, for the above reasons, that the contract would be terminated as of December 31. On December 17, however, formal termination action was held up by the District Engineer pending further discussion with Columbia representatives and the newly appointed Commission. By year's end, extension of the contract to June 30, 1947 had been agreed upon.

Transfer of Activities to Chicago. An incidental, early Division activity in connection with Columbia research had been to arrange for the transfer of personnel from New York to Chicago to continue the "opacity" calculations being undertaken for the Los Alamos Laboratory under the direction of Dr. Edward Teller. A District contract with Columbia authorizing this work was terminated on January 1, 1946, and, as further District activities at Columbia were to be greatly reduced, the District Engineer requested the Division to review the status of the program and determine a suitable location for its completion. It was determined that six months or so would complete the Project and the District arranged for facilities to be made available by the Metallurgical Laboratory for continuation of the work with personnel transferred from New York.

The National Bureau of Standards.

Status of NBS Program at Establishment of Research Division. One of the first responsibilities of the New Research Division was the job of reviewing and clarifying the status of the Bureau of Standards position with respect to District research activities. Considerable work had been carried on by the Bureau for the Project under an informal

agreement, and in addition it had loaned a number of scientific and technical personnel to District installations at Oak Ridge and Los Alamos. Actual research activities undertaken by the Bureau's Laboratory were mainly concerned with making various analyses and measurements for the District, and conducting fundamental research to improve the efficiency of these analytical techniques. Funds were periodically transferred from the District to the NBS to support these activities and were administered by the Bureau's Laboratory Director under a rather broad directive authorizing expenditures for (1) tests and other research requested by various areas, (2) salaries and expenses of personnel transferred to the District on temporary loan, and (3) independent initiation by the Director of the National Bureau of Standards of research of interest to the District. Dr. H. T. Wensel, former Chief of the District's Research Control Section, and several technical assistants and consultants served with the District on this temporary loan basis.

During 1946, $225,000 was transferred to the Bureau, and over the full length of District's existence a total of more than $1,000,000 had been made available to it on this informal basis. There had been no responsibility for detailed accounting of these funds and District knowledge of specific expenditures and of the results of the actual work done was very meager.

Division Activities Directed toward Clarifying NBS Status.

General. At the request of the Division, the Bureau submitted a detailed survey of actual research being currently carried on at the Bureau facilities. Following review by the Technical Branch, it

was recommended to the District Engineer in January of 1946 that the various activities be continued, and that the directive authorizing them be of sufficient flexibility to permit maximum efficient effort, but that nonetheless regular periodic progress reports and final summaries at the completion of each project should be submitted to the District.

Policy Meeting. After investigating the anticipated requirements of the various other District research installations for work to be done by the Bureau during the forthcoming fiscal year 1947, the Deputy Director, Dr. E. A. Fidler, visited Dr. F. B. Kahler on April 29, 1946 and reached an agreement regarding future policy. It was decided that (a) the Bureau's assistance in loaning technical personnel to the District in consultant and other capacities and (b) performance of tests, analyses, and special research requested by District research installations should continue. However, the previous authorization directing the MSD Director to initiate voluntarily certain research projects for the District requiring unallocated District funds was cancelled. Thereafter, all such proposed work, it was agreed, would first be submitted to the District for review and authorization and would be approved by the Commanding General only after favorable recommendation of the Advisory Committee on Research and Development. It was further agreed that technical progress and final reports would be submitted as previously recommended. Thenceforth, all MSD work for the District was to be coordinated through the Research Division, with the exception that special work for the Madison Square Area would be handled by the Bureau directly, as in the past.

The Director's request for a supplementary allotment of $100,000 to continue work for the remainder of fiscal 1946 was approved, and it was agreed that a program detailing proposed activities for fiscal 1947 would be submitted shortly. These arrangements were confirmed in a letter from the District Engineer to Dr. E. U. Condon, Director, National Bureau of Standards, on 13 May 1946.

The position of Madison Square Area in the picture was clarified on June 4, 1946, in a letter from Dr. Fidler to the Madison Square Area Engineer requesting that the Division be advised of all work performed at National Bureau of Standards for Madison Square Area, so that one central District agency would be completely informed on overall National Bureau of Standards activities. Direct contact between the two installations, however, was to continue as before.

Approval of the Fiscal 1947 NBS Program. The $600,000 research budget and program submitted by Dr. Condon on 3 May 1945 for fiscal 1947, beginning July 1, 1946, was reviewed by the District and by the Advisory Committee at its June 15 meeting and many modifications were recommended. Dr. Condon's earlier request (February 21, 1946) for construction of a special uranium-graphite pile at the Bureau was indefinitely deferred pending further investigation, while additional justification was recommended for various itemized projects suggested by the Bureau for study in 1947. Among these new items had been intensive studies of the thermodynamics of heavy water and an expansion of the mass spectrograph studies.' On July 16 Dr. Condon was sent a condensed list of the Projects of most direct interest to the District,

and on July 22, Dr. Mohler replied with a revised estimate for these specified projects amounting to $446,184. A supplementary program of $100,000 was also submitted for research on establishment of neutron standards, a project strongly supported by the Division's Isotopes Branch.

After decision by the Washington Office that only $325,000 would be made available for the Bureau, the District Engineer advised Dr. Condon on September 4 that (1) the general scope of the Bureau's program was approved, (2) the total expenditures would be limited to this figure, and that (3) work was to be undertaken only on a priority basis. The assignment of priorities to the various projects had earlier been undertaken by the Division on August 30. This letter agreement served as the basis for authorizing National Bureau of Standards research for the District during fiscal 1947.

Nature of Fiscal 1947 MED Program. Under the approved 1947 budget the Bureau continued principally as a service contractor, undertaking such routine assays, analyses, and special research problems as were required by the various Project installations, including:

(a) Spectrochemical, chemical, mass spectrometric analyses.

(b) Special analytical service for the Union Mines and Development Company.

(c) Special analytical work involved in design and operation of proposed heavy water piles.

Research activities of a non-routine nature were:

(a) Fundamental studies in thermodynamics for improvement of production operations of the gaseous diffusion and electromagnetic operating plants at Clinton Engineer Works.

(b) Fundamental research on spectra of the uranium atom and related subjects.

Proposed Supplemental NRS Research for Clinton Laboratories. On July 19, and during the months following, Dr. E. P. Wigner proposed various different research projects to the Division which he felt should be officially undertaken for the District by National Bureau of Standards. On November 1, Dr. Kohler summarized these proposed activities unofficially sponsored by Dr. Wigner and requested District approval and funds for the work. Division investigation revealed, however, that most of these programs were already being conducted at other District installations, and upon being informed of this fact, Dr. Wigner withdrew his support of the National Bureau of Standards proposal.

University of California.

General. Under Contract W-7405-eng-48 the University of California, Berkeley, has been engaged in the following activities:

(a) Development, design, and construction of new apparatus for acceleration of nuclear particles, including the 184" cyclotron, the linear accelerator, the synchrotron, and related equipment. (See Chapter IX).

(b) Nuclear Chemistry:

(1) Properties of heavy elements.

(2) Properties of metals, refractories, and other pile materials at high temperatures.

(3) Research on the TTA solvent extraction process for separating plutonium from uranium.

(4) Isotope separation studies.

(c) Nuclear Physics: Cloud chamber studies of nuclear reactions.

(d) Medical and Health: Effects on animals and man of radiation, fission products, special materials, etc., and therapeutic measures.

As previously noted, the research program originally placed under Research Division jurisdiction at its formation were those supervised only by the X-10 Research Operations group. On November 28, 1945, the California Area Engineer was informed that, for administrative purposes, the District Engineer had directed that the work at the Berkeley Radiation Laboratory previously supervised by the Y-12 Unit Chief would henceforth be reported through the Research Division. The California Area Office was specifically placed under the jurisdiction of the Research Division, although it was still to remain in consultant capacity to the Y-12 Office and to continue to transmit copies of its applicable reports direct to Y-12.

Specific Research Division Action. At the request of the Security Division, the Technical Branch made a detailed technical survey of District facilities and activities at the University of California,

summarizing its conclusions in a report on July 16, 1946. These suggestions were incorporated into a memorandum of recommendations covering the safeguarding of facilities and classification of California activities, which was jointly presented to the District Engineer's Office by the Directors, Research and Security Divisions on August 5, 1946.

At the same time, the Technical Branch extensively reviewed the objectives and progress of the separate California research projects, recommending continuation, with certain modifications, of current investigations, the methods for administrating them, and the installation's publication and reporting practices.

General Electric Research Activities.

Prior to General Electric's Contract for Plutonium Research and Operation. At the time of the establishment of the Research Division on October 15, 1945, the District had no current research and development contract with the General Electric Company. General Electric had assisted the District on several other minor contracts at an earlier date, however, and was anxious to conduct research in nuclear science under Project sponsorship, especially in the field of power application.

On May 15, 1946, the District entered into Contract No. W-31-109-eng-32 with General Electric authorizing the latter to operate the Hanford Engineer Works and to conduct extensive research in various phases of nuclear science at Hanford and Schenectady. On this same day

the District Engineer and his technical staff, including the Deputy Director of the Research Division, met with the top-ranking General Electric executives in Schenectady to discuss the District's research program and to establish liaison channels through which General Electric research and development effort could be integrated with other District work. The tentatively proposed program of General Electric research was also reviewed in detail. Actual operation of Hanford Engineer Works by General Electric was not scheduled to begin until September, 1946, and considerable preliminary work was necessary before actual research could get under way. During the remaining months of 1946 the Research Division helped General Electric chiefly in establishing channels of communication adequate to security regulations and in assisting in the training of the company's research personnel.

Division Activities. The Division arranged for selected General Electric scientists and executives to attend the June 17-19, 1946 Project Information and Laboratory Directors' Meetings and arranged for visits through Clinton Laboratories. (See Chapter VI, "Interchange of Information"). On June 28 distribution to General Electric was approved for regular progress reports from Clinton Laboratories, Argonne National Laboratory, and other District research installations. During the next few months the Division's library and editorial services were put at the service of the General Electric Company for accumulation of special bibliographies of technical information concerning special materials, equipment, etc., of interest to its proposed research program.

On September 13, General Electric submitted a list of leading nuclear scientists whom it wished to invite to form an Advisory Subcommittee on Atomic Power for the benefit of General Electric research. Following review by the Division's Technical, Operations, and Declassification and Publication Branches, it was recommended that the Committee be established providing no dual compensation was paid for services rendered to these scientists already under consultant contract with the District. On September 17 the District Engineer approved the plan. The success was emphasized several weeks later when Dr. E. P. Wigner, Director of Clinton Laboratories, requested and received approval for establishment of a second Advisory Committee on Atomic Power to advise his installation on similar problems.

In the fall of 1946 arrangements were completed to transfer key General Electric scientific personnel to Clinton Laboratories to participate in the forthcoming training program and to become familiar with pile science and technology. The question of establishing adequate communication channels between the General Electric Group at Clinton Engineer Works and the group undertaking District research at the Schenectady parent laboratory was temporarily solved by the Research Division on September 19, when arrangements were made for all information from Clinton Engineer Works to be channeled through Mr. E. A. Wilms, General Electric Vice-President. On November 1, after proper security clearances had been obtained, the Division advised General Electric of the institution of permanent communication channels through Mr. D. F. Streib, stationed at Clinton Engineer Works, and Mr. B. F. Prentice at

Schenectady. It was agreed that all information transmitted between the two sites should pass only through these two men.

Review of the 1947 Program. During the first half of fiscal year 1947, ending December 31, 1946, District research undertaken by the General Electric Company was chiefly in the planning stage. The objectives of the program have been three-fold:

(a) Research and development for continued and improved operation of the Hanford production processes:

(1) Maintenance of existing piles.

(2) Provisions for emergency replacement of existing piles.

(3) Development of pilot plant facilities for the Redox solvent extraction process. (See Chapter VII "Chemical Separation of Pile Products")

(4) Manufacture of plutonium metal and related problems.

(b) Research in new problems:

(1) Improvements of plutonium pile design and construction.

(2) Design, construction, and operation of a reasonance pile for research purposes. (See "The Pile Program").

(3) Chemical control and analysis of materials to be used in future piles, including study of irradiation effects on such materials.

(c) Development of nuclear propulsion for naval applications in collaboration with the Navy Bureau of Ships. (See "Liaison with Military Agencies", Chapter X).

By November 27, 1947, the proposed General Electric research program was still mainly in the planning stage and had not received detailed formal approval. On this date the Division was requested by Col. K. D. Fields to obtain more specific information regarding the Navy ship propulsion program for review and approval by the District Engineer. By year's end, General Electric and its Navy liaison staff had not completed preparation of this information.

Evergreen.

General Background. Canadian research on atomic energy was originally conducted by the National Research Council of Canada, at the joint British and Canadian Laboratory in Montreal and later at the Chalk River Laboratory, Chalk River, Ontario. The main effort has been directed toward research, development, construction, and operation of the "Zeep", or Zero Energy Experimental Pile, composed of uranium and heavy water, and the NRX or uranium-heavy water pilot plant pile. The latter, presently still in the design stage, will produce approximately ten grams of plutonium and three grams of U^{233} per day. Research on separation processes for recovery of these materials is also being carried on at Chalk River.

At the time of the establishment of the Research Division, information on the District's pile operations at Clinton Laboratories and at Argonne was being furnished to the Canadians at Chalk River, as well as considerable amounts of special materials, including heavy water and natural uranium. Interchange of information, visits, and other liaison were governed by rules prescribed on July 13, 1944 by the Commanding General. The District established an Area Office at Chalk River, designated

as "Evergreen", and assigned both a special scientific representative and a liaison officer to control American-Canadian activities. Liaison between Evergreen and the District was maintained through the Chicago Area Engineer and the latter was responsible for the interchange of all information between the District and Evergreen, either in writing or through visits.

Research Division Jurisdiction. At a meeting in Washington on February 15, attended by representatives from the Division, the Washington Office, and by the District's Liaison Officer and Technical Representative at Evergreen, Colonel A. W. Nielsen and Dr. G. L. Weil, respectively, it was agreed that the Chicago Area's responsibilities regarding Evergreen interchange of information and materials would be transferred to the Research Division on March 15, 1946. Responsibility for actual supervision, it was concluded, would be placed with the Division's Operations Branch. The files on Evergreen activities at Chicago and in Washington would be transferred to the Division's central files, where all future records would also be stored.

In April, 1946, the Evergreen visitor records files were transferred to Oak Ridge from Chicago and since that time have been kept up-to-date by the Research Division.

To secure patent protection for the District, District Circular Letter (Legal 44-4) issued in April, 1944, had required that a report of all visits for the various areas be submitted periodically to the OSRD Patent Advisor's Office. Accordingly, on April 24, 1946, Evergreen was requested to submit a report before the 10th of each month covering all

visits for the preceding month. These reports have been forwarded monthly by the Division to the Patent Advisor beginning with April, 1946. Further details on actual visit procedure policy for the District, with modifications regarding Evergreen, will be found in Chapter VI, "Interchange of Information."

The Division began receiving, reviewing, and filing weekly reports from Dr. Weil, the District's Technical Representative at Evergreen, on June 22, 1946, and on July 6, the first weekly reports were received from Colonel A. W. Nielsen, District Liaison Officer at Evergreen. They have been periodically reviewed and forwarded to the Washington Office with comments, since that date.

Medical Research Programs.

General. The District's research and development activities in medical aspects of biology and health-physics during 1946 followed the suggestion of the Advisory Committee at its March 8-9 meeting that a reasonable research program "be supported on the basis of need for medical and legal protection." Medical research programs have been under the direct administrative supervision of the District's Medical Division. Several Research Division contractors, however, have pursued projects in this field in addition to undertaking non-medical research, namely: Argonne, University of California, Columbia University, and Clinton Laboratories. Such projects were reviewed by both Divisions, although technical supervision was carried on by the Medical Division alone.

Review of Medical and Training Programs: It was general policy for the Research Division to review and submit recommendations to the

Medical Division regarding proposed medical research programs contemplated by the latter. On May 31, 1946, for instance, Western Reserve University's informal proposal to undertake a District-supported investigation of thorium toxicity was studied by the Operations Branch and received unfavorable comment. It was suggested the program receive further consideration at the next meeting of the District's Medical Advisory Committee.

The Director of the Research Division subsequently attended the next meeting of the Medical Advisory Committee held on September 5-6, 1946. This group, headed by Dr. S. L. Warren, former Medical Division Director, had been appointed to advise the District on medico-biological research and safety and health-physics programs, and to encourage further activity in these fields. Subsequently, the recommendations of the September committee meeting were reviewed by the Director, at the request of the Deputy District Engineer. In general, the scope of District medical research activities and the Committee's recommendations received Division approval.

Clinton Laboratories embarked on an extensive research program with many medical implications when Dr. Alexander Hollaender was loaned by the U. S. Institute of Public Health in October, 1946, to direct the Laboratories' newly instituted Biology Division. On December 4, Dr. E. P. Wigner, Clinton Laboratories Director of Research, submitted Dr. Hollaender's program outlining the proposed research activities of the new group. At the same time the Laboratories forwarded proposals for undertaking an extensive health-physics training program and establishing a Health-Physics Advisory Committee for the District. The several

proposals were reviewed and forwarded with comments and recommendations to the Medical Division for review at the forthcoming Medical Advisory Committee meeting on December 6, 1946. It was felt that the biology program was quite imposing and would require careful review and coordination with other District research activities. In the case of the training program, it was generally felt that intensive educational courses of this nature, involving declassified material, should be undertaken by universities, hospitals, and other non-Project institutions.

A similar program drafted by the Medical Division, suggesting training by the District of physicians, health physicists, biologists, and medical and/or physics aides, was reviewed by the Division on October 30 at the request of the District Engineer's Office. In general, recommendations were similar to those submitted regarding the Clinton Laboratories proposal. It was felt that any such training program should be broad and general in nature and that further definite considerations should be withheld pending review of the whole question of District-supported training activities by the Atomic Energy Commission from a national standpoint.

Medical Research Security Control: At the request of the District Engineer's office the Division reviewed a procedure proposed by the Medical Division for control of medical research reports. After informal discussion of the proposal with various research laboratory directors, it was recommended on November 12 that, so far as the Division was concerned, it involved an inconvenient procedure and that it

should not be applied to Division research contractors. It was felt such stringent, routine control methods would not be suitable for Division contractors' reports.

Chapter III

Program for Administration of Contracts

General. Following establishment of the Research Division, the Operations Branch assumed administrative control of all current research and development contracts and of the specific programs and budgets under which research operations were being conducted during the current fiscal year 1946, ending June 30, 1946. Operations Branch responsibilities involved continual review of contractor progress to insure satisfactory performance of the scientific and technical undertakings for which the respective laboratories were obligated. Under regular contract stipulations, the contractor submitted periodic monthly progress reports and final technical summaries of all major projects upon completion. The Operations Branch also received, reviewed, and submitted recommendations to the District Engineer's Office concerning requests from research contractors for modification in program or budget provisions, such as requests for increased personnel, new construction, etc. Such individual requests were approved by the Branch wherever established District policy already authorized such action, or were refused where they proved unjustified. Cases involving either new policy determination or a modification in policy already established were forwarded to the District Office with comments and recommendations. In all such dealings between the District and the contractor the Operations Branch served as the District Engineer's staff advisory office, basing its suggestions on its familiarity with overall research activities, and seeking uniform policy and coordination of effort.

In addition to determining current status and performance of contractor research obligations, the Research Division also undertook a positive supervisory program of reviewing all associated contractor activities. Among these responsibilities were supervision of administrative functions, such as periodic preparation of budgets, future programs, special reports, etc., and resolution of administrative problems as they arose, including wage and salary problems, security restrictions, visits, and control of interchange of classified and declassified Project information. The Division also controlled contractor requests for special research materials and radiation detection instruments, making allocations according to a distribution policy determined by consideration of overall District interests. A final responsibility was the encouragement of training and educational programs in nuclear science among project contractor employees.

With the exception of the control of visits and interchange of information, all of the above responsibilities were supervised by the Division's Operations Branch. The present chapter deals with general administrative responsibilities involving Project research contractors. The chapters immediately following cover the programs for control and coordination of special materials, radiation detection instrument production and allocation, information interchange and encouragement of training programs.

Contracts.

General. District research and development activities have been carried on by operating agencies under several types of agreements.

in the case of new developments, by letter contracts written in anticipation of a formal contract to follow. An exception has been the National Bureau of Standards, which, as a government agency, carried on authorized District research by letter agreement supported by funds transferred from the District to the Department of Commerce.

In the case of every District research contractor, authorization of research has been dependent upon prior negotiation of a contract, approval by the District of a program submitted by the contractor detailing the specific activities to be undertaken, and approval by the District of the contractor's budget for the approved research item. Administration of the contract has been the responsibility of the Operations Branch. Control over performance has been maintained by review of monthly progress reports, quarterly budget reviews, and final reports, according to the provisions of the specific agreement.

Division Activities.

Liaison with Contracts Section. Physical preparation of the contracts and their custody have been the responsibility of the District's Contracts and Legal Sections and auxiliary administrative offices. On November 26, 1945, shortly after the Division was organized, the Contracts Section was requested to route all contractual action pertaining to research and development work to the Research Division, through the District Engineer's Executive Officer, for review and recording. It was intended that the Division would initiate and recommend for approval all contracts and their supplements, modifications, and renewals relating to District research

laboratories and programs, consultants, special services or other activities of a research and development nature. Since that date the Division has (1) reviewed and approved requests for extensions, as in the case of a contract with Princeton for analytical services (Feb. 15, 1946); (2) assisted the other District administrative offices in their contacts with Division contractors on administrative matters, as in the case of the Victoreen Company (February 7, 1946) and MIT (March 22, 1946); (3) reviewed and approved initiation of new contracts, as in the case of the contract with Professor G. L. Kehl, Columbia, for investigation of physical properties of heat-treated alloys, and continuation of other work begun by him at Los Alamos (March 21, 1946); (4) recommended proper delegation of authority by the Administrative Division for technical supervision of contracted activities (July 26, 1946); (5) provided technical personnel to serve as duly authorized representatives of the District Contracting Officer with authority to take action and make such decisions as are required by that officer, as in case of the District's consultant contract with Dr. R. F. Bacher, formerly at Cornell (April 10, 1946); (6) notified the Administrative Division when authority should be revoked or issued delegating Division personnel as authorized representatives of the contracting officer; (7) maintained close liaison in a technical advisory capacity between scientific agencies or institutions which intend to negotiate a research contract and the District Contracts Office, as in case of negotiations (May 28, 1946) with the Victoreen Instrument Company, in which case, a second, supplementary, District research program that had developed during mid-negotiations was incorporated into the final contract through

Division activity, saving duplication of effort; (8) maintained a file record of current and completed research and development contracts and subcontracts for the District covering contracting institutions and individual consultants; (9) reviewed and accepted performance following termination of a contract, as in the case of the University of Michigan's activities under a service contract to the District for use of its cyclotron. The Division reviewed this work and advised the contractor, on July 23, 1946, through the Chicago Area Engineer, for the District Engineer, that the work had been performed satisfactorily and no further action or information was necessary with regard to completion of the agreement.

Consultants. Because of the complex nature of the District's scientific activities, and the security restrictions requiring compartmentalization of knowledge, it was necessary to initiate numerous consultant contracts with individual scientists. This development became of increasing importance following the war as top-ranking scientists left District facilities to undertake other work, but agreed to continue to advise and assist the District in a consulting capacity. A large number of these consultanting contracts were also a result of the establishment of the Division's Declassification and Publication Program and are described in the volume of history devoted to that activity.

Consultant services to the District were two-fold in nature, either a direct service to District personnel (as in the case of the Declassification Program) or a service to contractor scientists. Whom

the question arose on March 6, 1946, as to whether the latter category should be handled by subcontracts the Division recommended, to the contrary, that all consultants be handled in a uniform manner by prime contracts with the District, to provide a more complete control of the consultant program.

The Division also reviewed and submitted numerous recommendations to the District Engineer regarding the selection of District consultants, and in many cases also determined their availability and their willingness to serve. The requests from various contracting operators of research facilities for special consultant services were forwarded to the Division by the respective area engineers, reviewed by the Division, and then forwarded to the Washington Office for approval with recommendations and comments. Various administrative problems involved in dealings with consultants were also reviewed by the Division, as in the case of reimbursement of off-Project scientific personnel who had no formal agreements with the District, but whose presence was required by the District for a short time - a time so brief, in fact, that no permanent contract was suitable. In such cases, arrangements were made to reimburse the "consultants" for the advisory visit by issuing an "Invitation to Travel" to cover the "expenses" of their journey.

Reports. The question occasionally arose regarding disposition of classified District reports and other information following termination of consultant or operating contracts. Generally, District policy required that all classified Project-developed information in the

Contractor's possession be returned following termination of his contract. At the request of the Washington Office, however, the retention of classified District information at Princeton University by Drs. Wigner, Smyth, and Wheeler was investigated, and it was recommended that they be permitted to retain the reports providing they were in safekeeping in accordance with security restrictions. It was felt that they should keep such reports as were needed, but that the District should try to regain all information not essential to their work. This exception to regular District policy was eliminated a few months later when Professor Wheeler and Smyth were given consultant contracts with the District and Dr. Wigner became a full-time employee at Clinton Laboratories.

A somewhat similar situation arose in the case of District reports retained by the du Pont Co. following termination on September 1, 1946, of their responsibility for HEW operation. Effective August 31, the Division ceased distribution of all regular classified information to the du Pont Co., arranging that transmittal be directed to the General Electric Company instead. The next problem was obtaining the old reports previously sent the former organization. The du Pont Company refused to return the data in question, claiming that it was prepared carefully to safeguard them. At year's end a policy decision on the question was being awaited from the Washington Office.

Standard Contract for University Assistance. At the March meeting of the Advisory Committee on Research and Development, a general policy was agreed upon to govern District-supported research undertaken by

universities and private laboratories (see Chapter VII), and it was further suggested that the policy should be incorporated into a standard master contract applicable to future research programs of this nature. In general, it was felt that every possible effort should be made to free non-Project academic institutions from the stringent accounting, fiscal and other contractual controls normally required of private industry contracts, in accordance with standard business procedure, and which the latter class was usually already organized to comply with.

A meeting was arranged in Chicago by the Research Division on April 26, 1946, between the Director of the Administrative Division, Mr. E. Diamond of the District Legal Section, and the business managers of Columbia University, University of Chicago and the University of California, to discuss formulation of a uniform peace-time contractual policy to govern agreements involving the District and universities, and to develop a master contract applicable to any university. As the result of this conference a tentative form of contract was drafted by the District for possible use in partial subsidization by the District or its successor of fundamental research at universities or private laboratories. Copies of the proposed draft, which provided the benefits of a grant and eliminated many difficulties involved in the usual form of government contract, were distributed to the members of the Advisory Committee on Research and Development at their June 15 Meeting. At that time the District Engineer requested that the provisions be reviewed and

that comments be submitted at a later date regarding general form, limitation of funds allocated, fixed percentage of total sum allowable for overhead, and percentage allowable for new construction.

Late in July, the Division obtained substantial agreement from the Committee regarding the general form of the proposed contract, although numerous and conflicting modifications were recommended in certain details. The suggested changes were forwarded to the District's Administrative Branch for review and consolidation into a second draft, and no subsequent important action was taken on the matter during the remainder of the year.

Security. The initiation of new contractual activities has generally been accompanied by increased security problems, and the Division's responsibilities were to advise the Security Division of all such developments. Thus the approval of construction of additional facilities at Iowa State College, Ames, involved the question as to what degree the architect-engineer could be informed of the purpose of the new building to assist him in his planning and design. On October 30, 1946, the Division advised the Security Division, at the latter's request, of the extent of data which could properly be made available.

Reprints Purchases. Various contractors introduced the question of establishing standard District policy regarding the proper number of reprints of articles from scientific journals which might be purchased by contractors at Government expense for distribution to their technical

personnel. The Division recommended on July 30, 1946, that the number should be the same as that usually ordered by the contractor for his normal research activities, and this suggestion was supported by the Manhattan Project Editorial Board at its August 13-14 meeting. At Colonel Haywood's request the matter was reviewed by the Administrative Division, which recommended on September 23 that statements be obtained from the various contractors regarding their policy in this respect. On November 6, Colonel Haywood requested that the Division obtain such statements from the various contractors, review and consolidate them, and forward them to him with recommendations, for his final decision. Pursuant to this request, the Division asked the Personnel Division to contact the respective installations, through the appropriate Area Engineers, and obtain these statements. As of December 31, 1946, the statements had not all been received and a definite policy was still unerystallized.

Hiring Policy. On December 4, 1945, the Division reviewed and approved the Monsanto Company request to hire scientific personnel available at Los Alamos for staffing X-10, providing such transfer had the approval of the Laboratory Director at Los Alamos.

Subsequently, District policy regarding acquisition of technical and scientific personnel has been determined by the general principles recommended by the Advisory Committee on Research and Development at its June 15 meeting. It was felt the most serious limitation to the conduct of work in the field of nuclear energy was the manpower

shortage. Further, it was agreed that personnel requirements at the various laboratories should be balanced according to the importance of the programs undertaken. It was recommended that changes in personnel within the Project be made through channels and that the laboratory directors themselves get together to resolve the problem.

Part-time Employment. District Circular Letter (Res. Control 47-2) dated October 16, 1946 stated the policy prohibiting employment of individuals, except consultant, on District work on a part-time basis, except for individual cases fully justified and approved by the Deputy District Engineer. Under this ruling the Research Division was made responsible for employment of all contractor-personnel on a part-time basis. During the remainder of the year reports and justifications covering part-time employees at the various research and development installations were received and reviewed by the Division, and authorizations permitting the exceptions were forwarded for the Deputy District Engineer in all justified cases.

Contractor Wage Policy

Wage Policy Committee. On November 19, 1946, the District Engineer appointed a Wage Policy Committee of various scientists and contractor-management officials "to recommend wage policy and wage structures for various classes of scientific personnel required for atomic energy research and development." The question of raising district wage and salary scales in accordance with the rising costs of post-war living

was unavoidable, and it was felt that the desired modifications should reflect over-all District policy. Professor F. W. Loomis, University of Illinois, was appointed Chairman of the Committee which also numbered Dr. John Tate, University of Minnesota, Dr. J. C. Stearns, Dean of Faculties, Washington University, St. Louis, Mr. W. B. Harrell, Business Manager, University of Chicago, Mr. Robert M. Underhill, Secretary and Treasurer, University of California, and Major H. A. Fidler, Deputy Director of the Research Division, (non-voting member and secretary). The chief objective of the Wage Policy Committee was the preparation of statistics and authoritative data regarding current wage scales and policy throughout the various District research and development installations, to assist the District Engineer in further review of the problem and to consider possible policy modifications.

The Committee met subsequently on December 10, 1945, in New York, and January 8-9, 1946 and February 25, 1946 in Chicago. Following the December meeting, it was felt that the Laboratory Directors at Chicago, Clinton Laboratories, and Los Alamos should take part in the exploratory discussions and accordingly they were asked to attend the January meeting. At the final February meeting the results of the January discussion were reviewed, and a final report summarizing Committee recommendations was outlined. This was subsequently prepared in complete form and presented to the District Engineer for consideration following final individual approval by the Committee members on March 22, 1946.

The Research Division, through the Deputy Director, Dr. Fidler, represented the District Engineer in his absence in all relations between

the Wage Policy Committee and the District, arranging for the meetings, and preparing preliminary agenda. The mechanics of drafting and securing Committee approval for the final recommendations were also handled by Dr. Fidler.

Committee Recommendations. In general, it was felt that present salary scales for professional personnel at the various District laboratories were reasonable. A proposed scale was recommended, however, for organizations not following a wage policy commensurate with that generally observed. Other recommendations related to (1) standardising labor-relations policies to include adequate vacations, automatic salary increases, hazard pay, etc., and (2) changes in policy peculiar to the District which would strengthen employee-morale, such as publication of results, reduced compartmentalization, increased frequency of information meetings, assurance of permanent tenure, etc.

On May 31, 1946, the various Committe members were advised that the report had been reviewed and forwarded by the District Engineer to higher authority for approval.

The Division, at the request of the District Engineer's office, also reviewed the organizational status of the various area offices, insofar as administration of research activities was concerned. On October 18, for instance, the organization of the Chicago Area Office was studied, and numerous recommendations and suggested changes forwarded to the District's Information and Procedures Division.

CHAPTER IV

Control of Special Materials

General. The Research Division was delegated responsibility for coordination and control of all special materials produced, possessed, transferred, or otherwise handled or utilized by District research and development installations. It received, reviewed, approved, allocated, and arranged for procurement of non-fissionable materials and materials of a fissionable or otherwise highly classified nature. Final authorization was obtained from Washington for the last-named categories, but all other administrative activities involved in their procurement, transfer, including current accountability, were delegated to the Division. Actual administrative control of special materials was undertaken by the Special Materials Section of the Operations Branch. Certain categories, however, particularly those of a highly classified or hazardous nature, were also followed personally by the Director. During 1946, responsibility for many of these latter items was gradually transferred from the Director to the Special Materials Section, insofar as changing security restrictions, increased production schedules, and other considerations made such action desirable.

Special materials under Research Division jurisdiction may be divided into the following general categories:

1. Fissionable materials (U^{235}, U^{233}, and Pu^{239}).

2. Fertile materials for fissionable material production, including naturally occurring U^{238} and thorium.

3. Neutron moderators such as graphite, beryllium, heavy water, etc.

4. Neutron absorbers, such as boron-10, cadmium, etc.

5. Special sources of alpha, beta, gamma, and neutron radiation.

6. Miscellaneous materials for special research purposes, including the transuranic elements (curium, americium, neptunium, plutonium), fluorocarbons, etc.

Fissionable Materials.

General. The three important fissionable materials were Pu^{239}, U^{235}, and U^{233}. The first two were normally produced and utilized in routine District operations. Division responsibility for their control was restricted only to procurement and use by research installations which necessitated removal of the materials from routine production channels. Uranium 233 was entirely under Division jurisdiction, since Project production of this material had not progressed beyond the laboratory stage at the end of 1946.

Research Division responsibilities regarding fissionable materials comprised:

a. Establishing general safety and security rules for transfer and handling of the materials.

b. Ascertaining adequacy of safety and security provisions in all specific cases.

c. Coordinating activities in criticality experiments to include close scrutiny of procedures and results.

d. Maintaining accountability records of the material in possession of installations under Division jurisdiction.

e. Allocation and distribution of special materials to research

laboratories, according to specific authorization of the Washington Office.

The Division's responsibility in the last category consisted of routine review of requests and the preparation of recommendations and comments for the Washington Office regarding availability, justification of need, and other pertinent considerations. Division activities concerning the other four responsibilities are described below.

Transfer.

General. Regular control of the District's fissionable materials was logically a production and shipping problem under the supervision of the District Operations Division, in accordance with established procedure for such operations. Two major problems involved in this general subject, however, concerned the Research Division. The first was the determination of critical amounts of fissionable materials under various conditions, a problem essentially experimental in nature and hence closely supervised by the Division. The second problem involved establishing procedures governing the transfer of fissionable materials outside regular production channels. Such transfers were almost entirely for research and development purposes, and involved many special problems of shipping, hazards, storage, etc., distinct from those encountered in a routine transfer of production quantities in accordance with standard operation procedures.

Transfers Outside Routine Production Channels. Peacetime District research activity saw an increasing number of requests for transfers of significant amounts of fissionable materials to research installations. During the war, all but very small quantities had gone into weapons and weapon research, and each individual request diverting these materials from such

production objectives had received intensive scrutiny. On May 23, 1946, the Deputy District Engineer requested the Directors of the Research and Security Divisions to review the general problem and to submit recommendations regarding security and safety during transfer of such materials consigned to research and other installations outside routine production channels. Following discussions between the two Divisions, joint recommendations were submitted to the District Engineer's Office on May 31. At the request of the Washington Office, a final letter was prepared by the Division on July 26 which summarized the recommendations of May 31, and which became standard District policy after receiving approval from the Commanding General on August 5, 1946. This document, entitled "Security and Safety of Top Secret Material Consigned to Installations Outside the Routine Production Channels", received confidential District-wide circulation and afterwards continued unmodified as the governing procedure for all such transfers during the rest of 1946.

In accordance with the procedure established on August 5, top secret, enriched material would be consigned to installations outside routine production channels only by specific authority of the Commanding General, and on condition that the receiving installation complied in all respects with specific safety and security measures approved by the District Engineer.

The Directors of the Research and Security Divisions were instructed to collaborate with the requesting contractor and the Area Engineer at his site in preparation of a step-by-step detailed procedure covering the safety and security measures to be taken during transfer and use of the desired

material. Approval of the transfer would be based on compliance with this authorized procedure. The Director of Research was further instructed in the August letter to coordinate all transactions pertaining to the proposed transfer, to ascertain from the District Security Offices that appropriate security measures had been taken, and to determine by inspection that adequate safety and health precautions were in effect. The various responsibilities of the Security Division, Area Engineer, and contractor utilizing the material were also specified in this document. Integration and review of all these various responsibilities was specifically delegated to the Division.

Under this letter, the Research Division was also ordered to establish a committee of qualified physicists to study the criticality problems involved in non-routine, top secret transfers of materials. The relation of this problem to the overall "criticality" problem is treated separately below.

Modifications in Policy. The August 5 procedure did not gain the full assent of District scientists, particularly since the same stringent policy covered both appreciable and negligible amounts of top secret materials. On October 30, 1946, Drs. Seaborg and Hamilton, of the University of California Radiation Laboratory, with the concurrence of Dr. E. O. Lawrence, the Director, recommended modifications which would subject transfer of small amounts of these materials to less involved procedures. The California request was forwarded to the Washington Office by the Division on November 12, with a proposed modification which reduced the stringency of the August 5 procedure appreciably. Under the new plan all request for

such transfers would continue to be reviewed as before by the Research and Security Divisions, and approval would be obtained from Washington. However, in the case of quantities well below the amount necessary to begin a chain reaction, even under the most extreme conditions, a joint memorandum would be written to the files stating this fact and both the detailed step-by-step procedure and the review by a criticality committee would be omitted. Whenever the amount involved in the proposed transfer was greater than critical, the detailed provisions of the August 8 letter were to remain in force. The Deputy District Engineer was authorized by Washington Headquarters to place the above modified procedure for transfer of small quantities into effect on November 16, 1946.

A more general relaxation in the stringency of the August 8 regulations governing transfer of top secret materials was requested by Clinton Laboratories on November 27. No further action was taken in this direction, however, during the rest of the year.

No effort is made here to discuss in detail the numerous transfers of top secret material which the Research Division reviewed and for which it recommended authorization in accordance with the August 8 instructions. In general, the majority of transfers involved amounts of not more than a few grams. More spectacular quantities were involved when 470 grams of enriched uranium oxide, containing around 300 grams of the fissionable isotope, were transferred from CEW to Battelle for rolling operations in November, 1946, and later returned to Clinton Laboratories for testing. Plans were also made during the year to transfer 100 grams of plutonium from HEW to Berkeley for extraction of americium and other rare transuranic elements. Approval of

the latter project was recommended by the Division after careful review, but at the year's end authorization from Washinton had not yet been obtained.

Incidental Problems.

Detection. An incidental problem involving transfer of fissionable materials was development of a means for the detection of small amounts being carried out through production area gates, either inadvertently or intentionally. The District Engineer requested the Division to develop a simple method for detecting Y-12 enriched uranium in the unauthorized possession of employees. The problem was discussed with Dr. W. H. Zinn, Laboratory Director at Chicago, who suggested "tagging" Y-12 product with minute amounts of radioactive cobalt 60, an intense source of gamma radiation, and using radiation instruments at the Area gates to detect its presence and give the alarm. The Division obtained the interest of Y-12, which considered the method feasible; subsequently, arrangements were made to supply Y-12 with a small amount of the cobalt isotope from Chicago, and also for the latter installation to develop appropriate radiation detection instruments.

Shipping. At the request of the Security and Operations Departments, the Research Division on several occasions (July 3, August 16-19, September 17-19) reviewed proposed plans for shipping containers for plutonium and uranium 235 and submitted recommendations and suggested design changes. Chief considerations were protection from possible chain reaction, as well as general physical adequacy of proposed plans. Review was delegated to both the Technical and Operations Branch.

Disaster Plans. At the request of the Security Division, several proposed procedures to be followed in case of a shipping disaster involving

fissionable or radioactive materials were reviewed. Proposed plans covering disaster in railroad car No. 89378 carrying either plutonium or uranium 235 were studied on September 19, 1946 and a similar procedure prepared by the HEW Area for plutonium was reviewed on October 28. In the latter case, the Technical Branch also prepared a plan for HEW to cover a parallel disaster involving uranium 235. (Further disaster plan activities involving the Instrument Production Section are described in Chapter V.)

Hazards.

Criticality Determinations.

General. In August, 1944, the District Engineer designated the Director as his personal representative to follow developments relating to special hazards problems at Y-12. The problem of various types of hazards involved in handling fissionable materials continued to be his responsibility following institution of the Research Division the next year. Chief among the important subjects given careful study was the accurate determination of criticality of uranium of different degrees of enrichment in the 235 isotope under varying conditions. Such information was essential to elimination of hazards at production plants, research installations, or wherever else fissionable materials might be present.

Los Alamos Criticality Experiments. During the fall of 1945, as the efficiency of the K-25 gaseous diffusion process improved, the extent of enrichment of production quantities of the material delivered to Y-12 for further separation continued to increase. Since the critical quantity decreases with increasing enrichment, the need for establishing accurate data to govern hazards precautions at both Y-12 and K-25 became increas-

ingly imperative. Inasmuch as previous criticality experiments had been conducted only at Los Alamos, it was necessary (1) to undertake further immediate investigations at that site, and (2) to arrange for training CEW personnel so that future experiments might be carried on at Oak Ridge. Accordingly, an agreement had been reached after war's end between the Commanding General and Dr. J. R. Oppenheimer to undertake a series of criticality experiments at Los Alamos to determine necessary data for establishing hazards prevention for the CEW production areas. Following the organization of the Research Division, the Director was delegated the responsibility of putting this agreement into effect. After obtaining Los Alamos' assent on October 31, 1945, for initiation of a program, the Division then proceeded to make arrangements for the actual conduct of the proposed experiments by qualified CEW production personnel.

Owing to the increasing importance of K-25 activities in the District's uranium isotopes separation program, Carbide and Carbon Chemicals Corporation scientific personnel assumed initial responsibility for undertaking the proposed criticality program. To gain important preliminary information, the Division arranged for Carbide scientists to visit the Chicago Metallurgical Laboratory on January 11, 1946 to discuss fundamental aspects of the subject.

On January 24, K-25 management submitted a summary of the proposed experiments to be undertaken at Los Alamos on U^{235} enriched material of 30% and 80-90% purity. The work was to be undertaken by K-25 personnel under supervision of more experienced Los Alamos scientists. After completion, it was felt that the K-25 group would be sufficiently trained in criticality techniques to carry out further necessary experiments at CEW. Arrangements

were made for Dr. C. E. Cook of K-25 to visit Site Y February 6-9 and discuss the proposal with Los Alamos laboratory personnel. On February 20, the Division obtained formal approval from the District Engineer and Dr. N. E. Bradbury, Laboratory Director of Los Alamos, to proceed with the experiments, and plans were made to begin the work at Los Alamos early in March.

The preliminary preparations for the experiments were the subject of numerous round-table conferences at K-25 in which the Director and the Division's Technical Branch were represented, as well as Y-12 scientific personnel. On February 20, 1946 the Y-12 management requested that a special hazards experimental program, involving criticality and related safety problems be mutually instituted for CEW by the three contractors, including the Monsanto Chemical Company and the District. Later, on February 28, Y-12 formally requested that it be represented in the K-25 group planning to undertake the experiments at Los Alamos. The Y-12 request was approved and arrangements were made for five K-25 scientists and one from Y-12 to visit Los Alamos and conduct the proposed experiments there. The visiting group kept weekly reports of its activities, beginning March 16 and ending April 25, which summarized current progress.

Meanwhile the Y-12 proposal for a general CEW hazards program, in which the District and the various contractors might participate, was reviewed and approved, and on March 14 Clinton Laboratories was informed of the proposed critical experiments and asked to participate. It was planned that the CEW criticality work would begin after return of the CEW group from Los Alamos.

By May 1 the group from Los Alamos had returned, after which a cooperative program was initiated by K-25, Y-12, and X-10 to carry out further

criticality studies at CEW. Weekly progress reports covering the Oak Ridge activities began with Series No. 1, Report No. 8 on May 10, 1946, continuing the earlier reports from Los Alamos, and ending on September 14, 1946. Series 2 of the CEW weekly reports began with September 21, 1946.

On May 13 the Division arranged for Dr. Beck to present a summary of the Los Alamos criticality experiment results to special hazards groups from the three CEW operating areas. Subsequently, "Special Hazards Information for Supervisory Personnel at K-25", a report based on criticality and other related safety precautions, was reviewed by the Division for distribution to properly cleared persons on June 18.

CEW Criticality Experiments.

K-25. Following return of the CEW scientists from Los Alamos, plans were initiated for continuing further experiments by this trained group at Oak Ridge. On August 5, 1946, Dr. Clifford Beck submitted a procedure for carrying out these additional studies entitled, "Description of Proposed Criticality Determination of Mock-up UF_6 at 50% and 60% Isotopic Concentration of U^{235}". It was proposed to conduct the work in the F-05 Pereleve Building in the S-50 Area, adjoining K-25. Since Dr. Beck's proposal did not cover step-by-step security and safety precautions in the detail required by General Groves' August 5 letter covering transfer of fissionable materials outside of production channels, the Division arranged to discuss the problem with him on September 12, at which time a supplement to his original proposal was prepared. The final procedure was reviewed by Drs. A. H. Snell and E. Greuling of Clinton Laboratories, and, following their approval, authorization was obtained from the District Engineer to carry out the experiments. At

this time, however, Colonel Nichols stated that no more criticality experiments would be undertaken at that location after the approved series was completed because of the proximity of the S-50 Area to K-25. Following the close of the experiments, S-50 was turned over to the NEPA program in the autumn of 1946 and no further criticality experiments were planned to be undertaken at that location.

Arrangements were made for K-25 personnel to undertake a series of experiments at X-10 during the period from October 5 to November 10, under the direction of Dr. C. P. Baker of Los Alamos, to obtain additional preliminary data on criticality experiment investigations. Following these studies, Dr. Clifford Beck prepared a program on November 12 proposing a series of further criticality investigations for K-25. The Division arranged conferences between Dr. Beck and the District Engineer on November 24 at which the K-25 proposal was approved. During the rest of the year Dr. Beck's group continued planning activities in connection with these investigations, making visits to Los Alamos to study techniques, etc., and preparing a step-by-step proposal covering the actual experiments.

Y-12. The Y-12 supervisors were concurrently eager to carry out a series of criticality experiments at Oak Ridge somewhat different in nature from the K-25 work and of more direct interest to its particular operating conditions. Whereas the K-25 program involved the approach to criticality of masses of solid dry materials, the Tennessee Eastman Corporation at Y-12 proposed a series of experiments on water solutions of enriched uranium which would define the chain reaction hazards connected with numerous Y-12 production problems and operations procedures. Since Dr. Beck's group at K-25 was more familiar with tests of this nature, the Division requested the Carbide and Carbon Chemicals

Corporation on June 28 to assist Y-12 in preparation of a proposal describing the program and the planned security precautions, in accordance with District regulations governing handling and transfer of top secret material outside regular production channels. On August 28, Dr. Beck submitted such a proposal entitled, "Description of Proposed Criticality Experiments on Solutions of Uranium Compounds", in which it was proposed that essentially the same S-50 facilities and K-25 personnel be used for the work as were then initiating the K-25 series of similar solid material experiments. On September 18, at the time the District Engineer approved the K-25 program, he prohibited initiation of any further criticality experiments at any CEW production area, thereby restricting all future activities, including the proposed Y-12 program, either to Clinton Laboratories or some other location than Y-12 or K-25.

On the basis of the above instructions, the Research Division investigated the possibility of undertaking the Y-12 solution experiments at Clinton Laboratories. This installation, however, was itself actively interested in criticality experiments and was contemplating a program directed entirely toward its own experimental problems. On September 28, the Director and scientists from K-25 and Y-12 visited Clinton Laboratories to discuss the matter with Monsanto research personnel. Subsequently, on October 14, 1946, Dr. Wigner, Director of the Laboratories, advised the Division that there was no space available at the Laboratory for the Y-12 studies, indicating that Monsanto planned to approach the District at a later date regarding construction of a special building adequate for this type of experiment. Inasmuch as the comprehensive preparation of a step-by-step procedure covering the Y-12 work program, in accordance with General Groves' letter of August 5, required

information indicating the space and location to be utilized, all further consideration of the Y-12 program was held in abeyance during the rest of the year pending settlement of that question. On October 28 the Division sent the Director of the Operations Division a status report of the Y-12 program, summarizing the situation and requesting that the Operations Division re-examine the purpose of the experiments and determine the necessity for their being undertaken. Inasmuch as Clinton Laboratories could not provide space for the Y-12 work, it was suggested that the Operations Division provide adequate space for such of the experiments as it felt advisable.

Following discussion of the matter between the Operations Division and the District Engineer, it was decided by the latter on November 4 that all further experiments of this nature should be performed in the vicinity of X-10, and that consideration would be given to construction of a special building in Bethel Valley near Clinton Laboratories, to serve for all CEW criticality experiments and to be supervised by the Monsanto Company. The Operations Officer at Clinton Laboratories was requested by the Division on November 15 to approach the Monsanto Company regarding preparation of plans for such a building. At year's end no definite proposal had been forthcoming in this respect from the Laboratories.

Clinton Laboratories. Meanwhile Clinton Laboratories was also undertaking an active program itself in criticality determinations to obtain information essential to design of the proposed high-flux, "heterogeneous" pile. During the summer of 1948 a program of unified experiments had been carried out to test a proposed design for the new reactor under conditions involving

heavy water as coolant, moderator, and reflector. Subsequently, however, interest shifted from this design to another utilizing ordinary water as coolant and moderator, and beryllium as tamper. Further criticality studies were necessary for this altered design. On September 24 the Division forwarded a copy of Dr. Beck's approved procedure for the K-25 experiments with UF_6 at S-50, to guide Clinton Laboratories in preparation of a similar step-by-step procedure, in accordance with General Groves' letter of August 5. Subsequently, a conference was arranged between Monsanto research personnel and the Division on October 18 at which the latter explained the reasons for the stringent, detailed procedure demanded. It was agreed by the Division on this occasion that, following approval of a step-by-step procedure, subsequent day-to-day modification could be made as conditions warranted, providing the District Operations Officer were kept advised at all times. Subsequently, arrangements were made by the Division for Clinton Laboratories scientists to visit S-50 and study the procedures and techniques being used by the K-25 group there. By December 31, 1946, the District had not received a step-by-step procedure of the proposed criticality experiments from Clinton Laboratories.

Disposal of Contaminated Wastes.

Committee on Disposal. The Director of the Division was a member of the District's Committee on Disposal which was appointed in 1946 to review the District's overall policies on disposal of material, scrap, and other waste containing radioactive matter. The committee met on July 1, 1946 and on December 2 to consider waste disposal procedures and to investigate the overall problem. At this session a Subcommittee on Waste Disposal

was appointed, including the Director of the Research Division, to investigate the matter more extensively and submit recommendations. The Subcommittee recommended in December that the existing Committee on Disposal be supplanted by a more effective organization, headed by the District's Medical Director, to establish firm rules and procedures to prevent exposure of humans and possible contamination of the country's metal resources through a continual recycling of contaminated scrap.

Overall Policy Study. As a result of the December 2 meeting, the Operations and Research Divisions agreed mutually to undertake an investigation of current waste-disposal procedures and problems at the respective research and production sites. On December 9 the Division's Operations Branch contacted the various research and development installations, requesting a report on past activities, present status, and foreseeable future problems relating to disposal of contaminated materials, wastes, scrap, equipment, etc.

On December 16, 1946, sufficiently detailed preliminary information had been received from District research installations to indicate that a diversity of procedures existed and that a general overall policy determination was desirable to standardize and coordinate waste-disposal problems. By year's end further information was being awaited from the various research and development installations, and Research Division activities in this respect were being closely coordinated with the Operations Division, which was reviewing similar procedures in effect at its various production areas.

Monitoring of Waste Scrap. The Division rendered the District special services in the matter of monitoring contaminated equipment at CEW with

Instrument Production Branch equipment and personnel. Further details will be found in Chapter V.

Accountability of Top Secret Materials. Under the provisions of General Groves' letter of August 5, 1946, which had been prepared by the Division to govern transfers of a non-routine nature, all persons or agencies authorized to transfer top secret materials were required to maintain complete accountability at all times. On September 18, the Operations Division requested the Research Division to have all its research and development installations submit monthly accountability reports on fissionable materials possessed, received, or transferred. It was arranged for the first report to be submitted before October 15 covering the August and September period. Subsequently, these reports were received by the Division, consolidated, and forwarded to the Operations Division on or before the 15th of the month following that for which the report was made.

Under the November 14 supplement to General Groves' August 6 letter governing transfer of fissionable materials - a modification which permitted freer transfer of sub-critical quantities - the Research Division was requested to submit monthly accountability reports to the Washington Office covering transfers and other handling of all top secret materials under Division control. Monthly reports were being distributed to both the Production and Washington Offices at year's end. In the case of uranium 235 in natural uranium, plant inventories and accountability records are dependent upon the accuracy of determination of the abundance ratio of U^{235} to U^{238} in normal uranium. On March 20, the Plant Operations Division reported that the accuracy of accepted figures establishing this ratio had been questioned, and

requested that the Division investigate the matter and initiate laboratory investigation, if necessary. The Division arranged a conference between scientists from the three CEW operations areas. At this meeting it was agreed to conduct independent analyses at all three areas to check mass-spectrograph results. Authorization of the program was issued by the Division on April 8, 1946 and by year's end the subject was still under consideration.

Fertile Materials: Thorium and Uranium

General. Important "fertile" materials for producing fissionable materials in pile-reactors are Uranium^{238} and Thorium^{232}. The former isotope is the major constituent of normal uranium and its control has always been a production responsibility under the Plant Operations Branch. Thorium^{232} which is the lone naturally occurring thorium isotope, is the "fertile" material for production of fissionable U^{233}, but no use of it has progressed beyond the experimental stage by the end of 1946, and consequently, thorium control remained a Research Division responsibility.

There have been no outstanding difficulties experienced in developing thorium for pile use, and relatively little research activity has been expended on the element. While none of the war-time piles were intended to produce U^{233}, most contemplated reactors are presently being designed to permit utilization of either thorium or uranium. Consequently, development of thorium technology has been chiefly a matter of obtaining satisfactory production line material and developing adequate fabrication methods.

Thorium. The sole producer of the metal for District use was Iowa State College, where facilities were available for maximum production of approxi-

mately 1,000 pounds per month. Actual production during 1946, however, was limited to 8300 pounds because of reduced demand and the limited supply of highly purified metallic calcium necessary for reduction of thorium fluoride to thorium metal.

The approved program authorizing new construction at Iowa State College to increase beryllium production also included provisions for expansion of thorium production facilities to 2,000 pounds per month. It was estimated that these facilities would be in operation by January, 1947.

At the request of the District Engineer, the Division determined the estimated thorium requirements of the District for 1947-1948 and summarized them in a report on November 4, 1946. On the basis of these figures, it was recommended that no additional facilities be provided for thorium production. Although the still uncrystallized Brookhaven pile program and the possible initiation of a large scale program for U^{233} production were omitted from these estimates, it was pointed out that further planning for either of these projects would necessitate review of the District's thorium production program. In contrast to beryllium production methods, thorium process techniques were in a more advanced state, and procurement and fabrication problems were far less difficult. Preliminary investigation of additional thorium production facilities, however, was recommended to anticipate any large scale District requirements. The Madison Square Area was instructed to undertake this study on December 4, 1946, following approval of the above recommendations by the District Engineer.

The possibility of thorium beneficiation by therma-vacuum distillation was investigated by the Division during the summer of 1946 when the War Assets

Administration informed the District that Government ferro-silicon reduction plants and equipment designed for magnesium production were available on surplus. On September 16, the District informed Washington that at least six months' exploratory research would be required to evaluate such a process, and that it should be undertaken at Iowa State, if at all. On December 4, Washington reported that the WAA would be unable to withhold disposition of the plants for such a period. Under these conditions, the Division concurred with the Washington Office that no further action should be taken.

Moderating Materials

Heavy Water and Beryllium. Moderating materials are low atomic weight elements, or appropriate compounds containing them, which slow down fission neutrons to thermal energies in piles. District production piles were designed to use graphite for this purpose, and during the existence of the Division, control of this material has been mainly a Plant Operations problem, although some research has been devoted to improving its properties and determining the effects of radiation on its structure. Beryllium and heavy water, however, received serious consideration in plans for future District experimental and production piles and their procurement has been a major Research Division responsibility.

Heavy Water.

General. Heavy water was produced on the Project for the purpose of providing a moderator in thermal piles. It was actually used in one experimental unit at Argonne and two in Canada but never in large-scale production piles. Although its use continued to receive further consideration, by the end of 1946 it was not planned to use heavy water in any reactors

currently proposed for construction.

At the time the Research Division was established, all District heavy water production in the U. S. had ceased, the only facilities in operation being those of the Consolidated Mining and Smelting Company at Trail, British Columbia. Production continued at an average of 1100 pounds per month, and a stockpile of around 20,000 pounds of uncommitted material had been accumulated by the District at CEW by the end of 1946. It was realized that if the enriched uranium available to the District for experimental pile research were to be suddenly diverted to military or other purposes, use of heavy water in future piles would receive immediate reconsideration. Consequently, maintenance of an emergency stockpile of adequate quantity was imperative.

At the time of its organization in October, 1946, the Research Division assumed administration of the District's heavy water program, along with its control of other special materials. Its subsequent activities may be divided generally into the following categories:

(1) Administrative Supervision of U. S. Production Facilities. During the war quantities of heavy water were produced by the du Pont Company at Morgantown Ordnance Works, the Wabash River Ordnance Works, and the Alabama Ordnance Works. These plants fed an intermediate product of approximately 30% D_2O enrichment into a finishing plant at Morgantown. All had been placed in standby by October, 1946 and were maintained in standby through December, 1946. The Division supervised their upkeep and attended to the routine administrative details.

(2) Administrative Supervision of Heavy Water Production at Trail, and Routine Allocation of Final Product to the Various Areas, as Requested, or to CEW Storage. As these activities followed regular policy for allocation of

special materials, they are not considered here. The history of the District's responsibilities for both Canadian and U. S. facilities for heavy water production will be found in the appropriate volumes of the Manhattan District History, prepared by the Research Division.

(3) Evaluation of New Alternative Methods of Heavy Water Production to Those Utilized at Canadian and American Plants.

(4) Determination of Policy Regarding Distribution of Heavy Water to Off-Project Requesters.

Only the last two items involved policy consideration of more than routine interest to the Division and are considered here.

The Akerlof-Mellon Institute Proposal. Heavy water production at Trail, Canada, involved concentration of the material from regular water by a combination of the chemical exchange and electrolytic processes. The District's U. S. heavy water facilities employed a water distillation process with a final electrolytic finishing operation.

In January, 1946, the Division heard indirectly from the Mellon Institute for Industrial Research at Pittsburgh that several industrial concerns in that region were planning to manufacture large quantities of oxygen by several possible methods, one of which proposed electrolysis of alkali hydroxides at high pressures with heavy water as a possible by-product. The Mellon Institute, chosen to evaluate the various contemplated processes, believed that the electrolysis method would be most suitable if the hydrogen by-product could be utilized for heavy water production. An Operations Branch representative visited the Mellon Institute with Dr. H. C. Urey on January 28, 1946, to discuss the matter with Dr. G. C. Akerlof. While the whole

project was still in an unerystallized stage at this time, the Division concluded that the Mellon Institute's proposed electrolytic process should be sympathetically reviewed by competent District scientists who could possibly incorporate into the Aberlef process the numerous refinements and technological improvements developed secretly by the District.

On February 5, the Division obtained Aberlef's consent to an evaluation of the proposal by Dr. J. O. Maloney, of the University of Kansas, and a report was forwarded to Dr. Maloney by the Koppers Company on September 16. The former's evaluation had not been received as of December 31, 1946, but inasmuch as the proposal submitted by the Koppers Company was found to involve hydrogen gas production from coke oven gas, rather than the electrolysis of alkali hydroxides at high pressure originally proposed by Dr. Aberlef, further clarification of the matter was necessary.

Off-Project Distribution. During the fall of 1946, the Division was approached by various scientists recommending release of a limited amount of heavy water to off-Project research facilities for fundamental investigations in nuclear and biological research. On November 7, the Division recommended to Washington that 25 kilograms of material, approximately 0.35% of the current uncommitted supply in the District stockpile, be made available to off-Project requesters. It was suggested that distribution be accomplished through the isotope request and allocation channels and that sales be made by an appropriate commercial concern at a price sufficient that no cost to the Government would be involved in production and distribution. As of year's end no further action had been taken by the District, pending consideration of the entire problem by the AEC.

Beryllium. Deuterium oxide, or heavy water, presented relatively few operations problems, and in the normal liquid state is readily suitable for production of fissionable materials. On the other hand, both beryllium and beryllium oxide presented serious difficulties in both purification and fabrication. At the same time, however, other properties made them outstanding moderator materials, particularly at high temperatures.

To provide good performance, beryllium must be exceptionally free from all impurities such as boron, cadmium, and other elements which have high absorption cross-section values for neutrons. Elimination of these contaminants had been difficult because analytical methods were not sufficiently precise to measure the offending impurities accurately. Whereas suitability of normal materials could be readily determined by physical and chemical tests, beryllium for pile use required a third series of specifications involving functional tests in a low energy pile for determination of overall neutron absorption. A great deal of District effort during 1946 was devoted to establishing simple and definite specifications which private industrial producers could meet. At year's end this objective had not been successfully achieved. The distinctive advantages and undesirable properties of both the pure metal and the oxide subjected them both to intensive evaluation by District laboratories. Although it is only the beryllium atom which is sought as the effective moderating material, its refractory properties in combination as the oxide make it superior to the metal at high temperatures. In the case of the Daniels pile, the operating temperature contemplated for the reactor itself was low enough to permit use of the metal also. Difficulties in obtaining the refined element in sufficient purity, however,

induced serious consideration of the oxide. At year's end the matter was still in a state of uncertainty and intensive research was being pursued on both forms of beryllium.

District research on beryllium was distributed among Argonne, Clinton Laboratories, Iowa State College, Battelle Memorial Institute, Massachusetts Institute of Technology and the National Bureau of Standards. Fundamental studies in moderators were being considered at Argonne in close conjunction with Clinton Laboratories, where planning and design of the power and heterogeneous piles were going on. Argonne was also developing various fabricating techniques for beryllium metal, including casting, rolling, extruding, etc. Similar supplementary studies of this nature were undertaken at MIT and BMI, including forging, vacuum welding and powder metallurgy. Battelle and MIT were also investigating other problems including effects of irradiation and corrosion on beryllium and the thermal conductivity of the metal and its oxide. Methods for producing very pure metal and metal salts were developed at Iowa State and MIT. Possible alloys of beryllium with uranium, aluminum, and other pile construction materials were also being explored by Battelle.

Meanwhile, it was essential to procure metal and oxide to carry out fundamental measurements and to obtain the basic data required for an accurate engineering design.

Beryllium Procurement and Research. Two successive meetings were sponsored by the District in 1946 to review the current status of the beryllium program. Major problems were the procurement of material and setting specifications. On May 14-18, representatives from the Research Division, MED, Los Alamos,

X-10, NBS, Chicago, Iowa State, MIT, California, and the Brush Beryllium, Clifton Products and Revere Copper and Brass concerns met at Battelle Memorial Institute to discuss mutual problems concerning beryllium. General procurement problems and more effective coordination of activities were explored informally at this time, and tentative estimates were set regarding amounts of the metal and oxide needed for future research and development activities.

On October 3, a second meeting was called by the District at Oak Ridge to review progress since May and revise estimated procurement needs on a more realistic basis. Emphasis was placed more specifically on immediate District procurement problems, and attendance was limited to representatives from the Division, MSA, Clinton Laboratories, Chicago, and Iowa State College.

It was agreed that 8000 pounds of high purity material should be procured and allocated to Argonne and Clinton Laboratories for determination of diffusion length, age experiments, and other essential research. Of the first 3000 pounds delivered to Argonne by year's end, a yield of only 1200 pounds of suitable metal was obtained in the form of machined bricks. Upon completion of the Argonne experiments it was intended that the acceptable material would be utilized either in the Clinton Laboratories experimental pile, or in other research studies.

It was also agreed that MSA would undertake primary responsibilities for procurement of beryllium metal and oxide, assisted by specifications analyses undertaken at Argonne. At this time, Clinton Laboratories held contracts with the Norton and AC Spark Plug Companies for fabrication work. Since all procurement responsibility was to be vested in MSA, the latter was delegated to arrange with the Monsanto Company for a resolution of the

problem of divided responsibility.

Clinton Laboratories' original estimate of 70,000 pounds of beryllium oxide for immediate research and development needs was reduced to 10,000 pounds and it was agreed that fabrication would be undertaken at the Laboratories, with 10% of the material to be allocated to Argonne for tests and other investigations. The remainder would be used for the proposed Clinton Laboratories pile. In the case of both oxide and metal, efforts would be made to procure "the highest purity attainable". Any materials declared unsuitable because of nuclear properties, along with scrap from machining, could be used for other District purposes, including study of basic physical, chemical, ceramic, and metallurgical properties, and fabrication of crucibles and other ceramic containers. The District requirements for beryllium and beryllium oxide established at the October 3 meeting in Oak Ridge were reported to the District Engineer by the Division, with recommendation that they be approved. Approval was forthcoming on October 11, 1948.

On October 10, the Division also recommended that the beryllium production program under Dr. H. F. Spedding at Iowa State College be expanded to pilot plant stage to produce the pure metal at a rate of 1000 pounds per month. New proposed construction involved a building of 500,000-600,000 cubic feet to house the production facilities. On October 11, the District Engineer approved the Iowa expansion, placing technical supervision of the project under the Division, with MSA delegated to supervise the administrative aspects of the procurement. Schedules estimated present and future production rates as follows:

Production in Lbs. Per Month

Supplier	Present	Anticipated - Date
Brush Beryllium Company	1000	1500 - Feb '47
Beryllium Corporation	None	800 - Mar '47
Clifton Products, Inc.	None	150*
Iowa State College	None**	200*** Jan '48

*Flake Metal. Can be furnished at any time.
**Except small amounts for experimental purposes.
***Can be increased to 1000 pounds per month in an emergency.

The increase in production capacity for the Brush Beryllium Company and the Beryllium Corporation noted above was dependent upon the installation of new equipment, and it was anticipated that this equipment would be in operation by the time indicated. It was not planned to utilize the Clifton Products material because at its present stage of refinement would require additional fabrication. The Iowa State College facilities were planned to be operated at a production rate of 200 pounds of metal per month. Thus the planned production would be 2300 pounds per month beginning in March, 1947 and 2500 pounds of metal per month beginning January, 1948.

Present research requirements for commercial grades of beryllium oxide, which are currently being filled by Clifton Products Company were 500 pounds per month as of December, 1946. These requirements were exclusive of 10,000 pounds of high purity oxide under procurement from the Brush Beryllium Company for test purposes for the Daniels power pile. The first samples delivered under this procurement were not satisfactory, and an investigation was initiated of new samples furnished by this company and by the Clifton Products Company. Depending on which of these samples is satisfactory, it was anticipated that the requirement of high purity oxide might be met by the supply of

10,000 pounds from Clifton Products in three months; or all from Clifton Products in four months.

Based on an estimated total requirement of 40,000 pounds of high purity beryllium oxide for the Daniels pile, it was anticipated that the additional 30,000 pounds might be procured in a minimum of nine months or a maximum of twelve months after the completion of the present orders without the installation of additional facilities. This would be in addition to the commercial grades being furnished. An additional producer which made laboratory quantities of high-purity beryllium oxide was the Beryllium Corporation. Large-scale production at this plant, however, could not be undertaken without the installation of additional equipment.

In view of the above, and anticipating the possibility that a number of reactors might be placed in operation simultaneously, it was planned to maintain production of beryllium metal at the maximum rate (2300 pounds per month during March-December of 1947 and 2500 pounds per month thereafter) until a reasonable stockpile of high-purity material had been built up. For the oxide, production would continue for the commercial grades at the present rate, and for the high-purity material at a maximum rate of acceptable material to meet the demands. In any event, it was expected that all of the requirements could be met within one year from the date of establishment of firm requirements.

Neutron Absorbing Materials

Boron 10.

General. Materials having high cross-sections for neutron absorption were important in both District research and production operations. Of

the various substances characterized by this special property, including isotopes of cadmium, certain rare earths, and boron, the last-named element proved of greatest concern to the District research and development installations during 1946. During the war, the District undertook production of boron enriched in the B-10 isotope to fulfill a requirement of the Los Alamos Laboratory for the crystalline element at an isotopic concentration 95% B^{10}. A secondary use of the material is the filling of proportional counter tubes for neutron detecting instruments. By virtue of the high absorption cross-section of the material for neutrons, emitting readily detectable alpha particles, the sensitivity of these instruments is increased many fold.

Shutdown of Production Plants. B^{10} production was undertaken in two successive steps by the Standard Oil Company at Whiting, Indiana, and by the American Cyanamid Company at Stamford, Connecticut. The former facility enriched the B^{10} content of the element in an organic-fluoride complex, and subsequent reduction to the crystalline material was carried out in Connecticut. The question of deciding when and how to shut down the two plants was delegated by the District Engineer to the Research Division in January, 1946. After extensive discussion of boron^{10} needs with the major research installation, it was determined that a 200 kgm. stockpile would be ample to take care of District needs for the next ten years. Accordingly, it was recommended to the District Engineer on January 28 that the Whiting plant be shut down as soon as possible and the equipment salvaged. Authorization was forthcoming the following day, and on February 4 the District formally instructed Standard Oil to take this action. Following a visit of Division personnel to the facility, several possible methods for proceeding with shutdown procedure were suggested. It was

recommended by the Division on February 8 that the plant be maintained in standby condition until the Civilian Commission destined to replace the District could review the program. The current contract (W-7418-eng-41) was extended to July 31, 1947 with an amendment for maintenance in standby condition at an annual cost of $6,000 a year.

Subsequently, on March 8, the Madison Square Area recommended that the American Cyanamid Plant at Stamford be shut down and maintained in standby condition. The American Cyanamid Company, however, was anxious to dismantle the facility completely. Following review of the situation by the Division, it was recommended on May 22 that negotiations be entered into with Cyanamid to extend the existing contract and maintain the plant in standby for a six months period, at which time the District would authorize dismantling or removal to another location. This action was approved by the District on June 10. Production ceased June 30, 1946 and the six-month standby period began July 1. Dismantling of the plant began January 1, 1947.

Shutdown of both plants involved the disposition of in-process material and wastes. The Whiting plant in particular presented a problem in the latter respect. The District recommended and obtained authorization from the District Engineer's Office on April 3 for dumping 3000 gallons of waste, containing the boron trifluoride, dimethyl ether complex, into a nearby canal adjoining Lake Michigan after no buyers had been located by the District for the material. On April 3 and again on August 2 it was recommended by the Division that disposal be authorized for 2170 gallons of similar material still remaining, either by dumping or some other method. Transfer of the material was made to the Navy on September 21.

Some of the unprocessed material after shutdown was processed to the final crystalline form and some to the solid boron fluoride-calcium fluoride complex. As of December 31, 1946, the District possessed approximately 500 pounds of the element containing 95% B^{10}, and approximately 775 pounds of $CaF_2.BF_3$ complex containing 5-6 pounds B^{10}. Most of the crystalline boron was stored at Los Alamos, but a small amount (approximately 65 pounds) and all of the complex were retained at Clinton Laboratories.

Allocation to Off-Project Requestors. Numerous request were received during 1946 from off-Project agencies for small quantities of boron-10 for instrument use. On July 19, the Division reviewed the supply and demand situation and recommended limited distribution of a small quantity of boron fluoride calcium fluoride complex to off-Project agencies. Subsequently the Division contacted the Monsanto Company and obtained the consent of the Clinton Laboratories organization to undertake distribution of the material. According to calculations made by the Operations Branch on June 18 the unit cost of boron^{10}, based on capital investment exclusive of research, on over-all production and production costs, and on 15% distribution of overhead, was about $320 per pound of calcium fluoride complex. On the basis of these figures, it was recommended to Washington on October 3 that around 25 pounds of the complex (1.6-1.7 pounds B^{10}) be distributed annually to off-Project requestors at a price (exclusive of handling, packing, etc.) of 70¢/gm., thereby involving no expense to the Government. In order to conserve the material, it was suggested that a single laboratory, either Victoreen Instrument Company or Clinton Laboratories, be authorized to undertake the filling of all tubes required by non-Project requestors. It was estimated that the proposed amount would fill approximately 1000-2000 counter tubes.

On December 30, 1946, the Washington Office authorized the Division to arrange for filling counter tubes from off-Project agencies by District installations and contractors, providing the instruments would be used for work of interest to the District. Distribution was limited to two pounds of B^{10} per year at the recommended cost of $0.70 per gram but allocation to non-Project installations for uses of no interest to the District was specifically prohibited.

Special Sources of Radiation

General. An important category of materials consisted of sources of controllable radiation, particularly the more penetrating beta and gamma rays, both for fundamental experiments and practical application in calibration of radiation detection instruments. Sources consisted of either (1) radioactive elements themselves, such as radium, Co^{60}, or La-140, or (2) combination radioelement-target mixtures which furnished controllable secondary emissions of importance, such as radium-beryllium or polonium-beryllium sources of neutrons. It must be emphasized that these materials were not limited to these uses only, but were also required for other important District purposes.

Polonium.

General. Polonium, a nearly pure alpha emitter, may be obtained naturally by extraction from radiolead, with which it is associated in small quantities, and Po-210 may also be obtained artificially by the irradiation of metallic bismuth in piles.

When mixed with beryllium, polonium alphas produce a steady, supply of neutrons from the beryllium target. The fact that practically no gamma rays are present has many important advantages, making polonium-beryllium sources more desirable than radium-beryllium in cases where gamma ray interference

is undesirable. Fundamental studies on neutrons at differing velocities may be readily carried out by the introduction of boron^{10} and other modifying barriers. Calibration of badge meters and other instruments designed to record or indicate neutron activity depends on the availability of polonium sources, and they serve many other important functions.

Major problems which confronted the District at the time the Research Division was established, and in which the latter subsequently played a major role, were the construction of new facilities for continued polonium production, and the evaluation of substitute materials.

New Production Facilities. During the war, polonium production was carried on at Dayton, Ohio, by the Monsanto Company. Difficulties of production, mainly of a "safety hazards" rather than operational nature, made it desirable to build new facilities to continue supplying the constant demand from other Project installations. Inasmuch as Monsanto activities for the District were concentrated at Clinton Engineer Works, the question of locating the new plant at Oak Ridge rather than at Dayton received serious consideration. The advantage of an isolated site on a government reservation over continued location in a populated area was obvious, particularly in view of the highly classified nature of the work and the hazardous production and waste disposal problems it involved.

After thorough review of the entire problem and extensive discussion with Clinton Laboratories scientists, the Division concluded that despite these advantages it was desirable that the proposed new facility be constructed on an appropriate site near Dayton rather than at Clinton Engineer Works. The danger of radioactive contamination of Clinton Engineer

Works research activities by polonium operations and the permanent research activities of the Monsanto Company in its Dayton Laboratories were the chief reasons for this decision. On May 28, 1946, the District Engineer approved this decision, and final authorization was forthcoming from the Commanding General on July 2, 1946. Preliminary plans had already been prepared by the Monsanto Company for the new plant, and, on July 19, 1946, after discussion between Dr. T. S. Chapman, Chief of the Operations Branch of the Division, and the Deputy District Engineer, the last-named authorized the Monsanto Company to proceed with final design for construction of the proposed facility.

On August 28, 1946, the Research Division submitted a comprehensive report to the District Engineer summarizing the current status of the polonium production program, and proposing a schedule for future production based on current and anticipated needs. It was also recommended that a research program be initiated to investigate the numerous problems involved in the production and utilization of the material. On this same date the District Engineer approved the initiation of a production schedule at the existing Dayton facilities of at least three millicuries per month, with remaining effort to be directed toward research for improvement of production methods. At the conclusion of this program, Dayton production was to be increased as soon as possible to eight millicuries per month. At this time the District Engineer transferred administrative supervision of Dayton operations from the Research Division to the Operations Division, establishing an Area Engineer at Dayton to undertake direct supervision of the activities there. Meanwhile the research and development activities being undertaken by Monsanto scientists at Dayton under the direction of

Dr. M. M. Haring remained under the jurisdiction of the Research Division, functioning through the Dayton Area Office. Subsequent construction and production activity since August, 1946, have been the responsibility of the District Operations Division.

Extraction of Naturally-Occurring Polonium. Prior to August 28, the Division had administered all Dayton production and operations activities, arranging for procuring additional warehouse storage space when requested (May 17, 1946) and reviewing production schedules. On March 28 at the request of the District Engineer, the Division submitted a study of the desirability of acquiring an emergency stockpile of radioactive lead oxide for extraction of polonium in the event that any unexpected development might shut off the irradiation of bismuth in the HEW piles. Lead dioxide supplies were available to the District from its uranium refinery contractors. On this date it was recommended that no additional oxide be added to the current District stockpile because of the enormous expense involved in putting the alternative oxide process into production and the uncertainty that the resulting extracted polonium would be of sufficient purity. It was known that in an emergency the Clinton and Argonne piles could serve as alternate sources of irradiated material. Therefore it was recommended that a six-months stockpile of irradiated bismuth slugs be maintained at HEW for emergency needs as a stop-gap until the Clinton Engineer Works and Argonne piles could get into production.

On July 10 the Los Alamos Laboratory suggested that polonium be recovered at Dayton from scrap and other waste materials at Los Alamos. The Operations Branch investigated this possibility and concluded that recovery

operations could be handled by the Dayton installation. On July 29 Dr. Haring, Director of the Dayton Laboratory, outlined general considerations which would be involved in the initiation of any such undertaking. No operation of this nature was begun during the remaining month that Dayton operations continued under Research Division supervision.

The unique neutron-emission properties of polonium-beryllium made it a popular source material for neutron measurements and calibration of neutron radiation detection instruments. Various research installations requested these sources at an accelerating rate during 1946. The Operations Branch coordinated all such requests, reviewing the specifications, shipping procedures and related details, and authorizing their fulfillment by the Dayton facility.

Inevitable, off-Project agencies and individuals requested the polonium and polonium-beryllium sources for fundamental research. Under District declassification and security policies, no material could be authorized for release to such requestors. On September 18, 1946, the Deputy Chief, Declassification and Publications Branch, proposed a change in declassification policy which would permit release of small quantities of the much-sought material to off-Project agencies, according to a discreet and carefully-controlled procedure. It was felt that such action would reveal the District's intense interest in the material to a lesser degree than current policy which had completely frozen all research activity or interchange of information on the subject. As a corollary to this tight security restriction, all information regarding the District's research and production activities at Dayton was maintained at a highly restricted level; consequently, no declassification or

publications of technical reports by the Dayton scientific staff was permitted. On the other hand, incidental investigations carried on at other District research sites on polonium had been declassified and published, after all reference to the District's interest in the material had been deleted. This anomalous situation, together with the question of discreet off-Project distribution of the material, were two problems which had yet to be resolved at the end of 1946. A research program on neutron counting was proposed by Dr. Kmauss of the Dayton group, utilizing the techniques and knowledge developed in current laboratory activities. The proposal was reviewed by the Division and a recommendation was forwarded to the Director of Operations on December 4, 1946, that the program be undertaken by the District and that it be coordinated with other Commission research activities.

Radio-Lanthanum (Rala). Radio-lanthanum is a 40-hour half-life fission product obtained from normal uranium after pile irradiation of between 40 and 60 days. The 12-day half-life Barium isotope on disintegration produces the radio-lanthanum daughter which is useful as an intense source of gamma radiation. District utilization of the material has been centered almost entirely at Los Alamos, while production was carried on at Clinton Laboratories.

Because of the operating difficulties involved in rala production, Clinton Laboratories desired a long-range production schedule for planning purposes, and at the Division's request Dr. Bradbury at Los Alamos submitted his requirements for the remainder of 1946 on February 28. For the six months period July-December, inclusive, it was requested that one shipment of 1500-2000 curies be made every two months. Subsequently, on September 17, Clinton Laboratories requested 1947 requirement estimates, and requirements were increased

by Los Alamos to approximately 1500 curies per month.

If irradiation in the Hanford piles and existing chemical separations equipment for Rala were used, it was further estimated that District production could be increased to 7500 curies per month, and that by making additions to existing separations equipment production of Hanford irradiated material could be raised to as much as 15000 curies per month.

Tritium:(Hydrogen-3)

General: Tritium is produced by irradiation of lithium fluoride whereby the neutron-alpha reaction on Lithium-6 forms helium and tritium. District consumption of the material in 1945 was limited to Edgewood Arsenal/Los Alamos which manifested an increasing demand for it. At the time of the establishment of the Research Division tritium production was centered at the Clinton Laboratories pile, but the growing use of the material made it advisable to consider production at the Hanford piles. On November 18, 1945, the Research Division called a meeting of Clinton Laboratories and Los Alamos scientists, officials from the duPont Company, then operating HEW, and District representatives to discuss the feasibility of transferring tritium production facilities to Hanford. It was agreed that such production could probably be undertaken readily in the HEW piles by replacing regular lead-cadmium "poison" slugs with lithium fluoride capsules. These poison slugs are strategically inserted to flatten the neutron distribution curve across the pile, permitting the unit to operate at higher overall power without an undesirable increase in operating temperature. Lithium fluoride may be readily substituted for this purpose, since it has the desirable neutron-absorbing properties of the lead-cadmium alloy and at the same time produces tritium. The duPont Company agreed to test and

appraise lithium fluoride slugs prepared at Los Alamos and at Clinton Laboratories and to irradiate those which met requirements. These arrangements proved satisfactory and during 1946 District tritium production was concentrated at Hanford.

Production Schedule: The Division maintained close supervision of current and anticipated demand and supply schedules for the material. Argonne Laboratory accomplished successful preparation of lithium fluoride slugs at a rate which it is estimated can readily average 25 per week, yielding approximately 250 ml. of tritium, or around 10 ml. per can. Processing at Hanford involved a 50-day irradiation period and a 15-day cooling period. Consequently after a processing delay of two months at the beginning, Hanford space should readily permit a regular production of 1000 ml. per month.

Meanwhile a small amount of tritium continued to be produced at the Clinton pile. On October 18, 1946, upon Monsanto's request that tritium production there be discontinued, approval was granted by the Division for the District Engineer on October 24. Los Alamos demands were reviewed at this time and it was determined that after an initial requirement of 1000 ml. had been met, monthly needs would approximate 500 ml. a month, or approximately the amount readily available at a 25 can per week production schedule.

Tritium Research at Other Sites: For some time other District research installations have been eager to obtain tritium for fundamental research studies. Since it was evident that Hanford production could readily provide an excess of the material beyond Los Alamos needs, consideration of modification in current District policy limiting tritium supply to Los Alamos appeared warranted. The Argonne National Laboratory on November 5 submitted a well-planned program proposing fundamental measurements on the nuclear, physical, and

chemical properties of tritium, while the University of California, the National Bureau of Standards, and Clinton Laboratories had also expressed a desire to conduct studies with it. Following a comprehensive review of the problem, including future anticipated supply and demand at Los Alamos, the Division recommended to the Washington Office on December 11, 1946, that current District policy be modified to permit the initiation of a coordinated program at other research installations involving fundamental research with H^3, and that excess material be made available for this purpose. From a security standpoint it was felt such a policy would deemphasize the District's interest in this important material more effectively than the present policy under which all use is frozen for Los Alamos. No further action was taken by the District during the remaining weeks of 1946.

Policy Governing HEW Irradiation of Special Materials. The demand for rala, tritium, polonium, and other artificially-produced radioisotopes in appreciable quantities after war's end resulted in the utilization of an increasing portion of the HEW piles for irradiating special materials for research and development installations. At the time the Division was established such requests were handled individually by the District Office, and subsequently by the Director of Research, who personally contacted the HEW operating contractor and obtained the latter's consent to perform each separate irradiation. As a result of the increasing number of these requests, the Division's Operations Branch recommended to the Washington Office on February 1, 1946, that clearly defined channels of communication be established between duPont and the Research Division to expedite processing of the requests. In view of the large volume of requests originating from Chicago, it was suggested that contact between that area and Hanford be conducted directly by the Area

Engineer and the du Pont Company. Requests from all other District facilities were to be coordinated through the Research Division's Operations Branch. Approval for this arrangement was obtained from du Pont on February 25, and the policy was placed in effect on March 6.

Subsequently, the Division took an active part in standardizing and coordinating special irradiations request procedures. On May 10, 1946, the Director arranged for the Hanford Area Office to prepare a fortnightly status report on NRX irradiations of miscellaneous items forwarded through the Research Division, and such reports have been submitted intermittently since that agreement. Shortly afterwards, (July 24, 1946) a standardized request form was prepared for District use in connection with special irradiation services.

A comprehensive procedure governing special irradiations in the NRX piles was submitted by the Hanford Area Engineer on September 9, 1946, incorporating the experience of the preceding months. Following review by the Division, approval was obtained from the Deputy District Engineer on October 21. By this time, Hanford operations had been assumed by the General Electric Company. Under the provisions of the new procedure, coordination of all requests was delegated to the Research Division's Operations Branch, subject to subsequent General Electric approval, and providing that such services did not interfere with regularly scheduled polonium and plutonium production at Hanford. Minor details of the procedure were revised on October 29, by the Division and standardized specifications for samples and shipping forms were prepared respectively on November 8 and December 31.

Major provisions governing the procedure for processing special Hanford irradiations in effect at year's end were as follows:

All requests for special irradiations by any project were to be made to the District Engineer, Attention: Director, Research Division. If approved by the District, these requests were then to be forwarded to the Area Engineer at Hanford. The Hanford Area Engineer would then secure the approval or disapproval of the Works Manager at Hanford who was empowered to act for the General Electric Company on this matter. If approved, the Area Engineer would notify the installation making the request to ship the material to Hanford together with any pertinent details concerning the shipment. If disapproved the request would be returned to the District with reasons for disapproval.

Before formal request for a special irradiation was made, the requestor was instructed to communicate directly with the Superintendent of the Technical Department of the General Electric Company at Hanford to insure that the request was feasible, and that it was planned to provide for maximum convenience and minimum reactivity loss. Such matters as location in the pile, sample dimensions, heat and gas generation, choice of the particular chemical compound, shielding, and possibilities of contamination, chattering, corrosions, etc., frequently required discussion in more detail than that submitted on the initial request.

A statement was to be submitted covering the urgency and importance of each irradiation request, to assist the Division in assigning priorities. Based on information submitted, priorities were to be assigned to special irradiations in the following manner.

(1) Priority A would take priority over all other material awaiting irradiation and would be charged into the piles as soon as practicable after receipt. If a number of priority A irradiations were on hand, they would

be charged in the order in which received unless other instructions were issued by the District.

(2) Priority B would be charged into the piles in the order in which received and only when there was no priority A material on hand awaiting irradiation.

(3) Priority C will be charged only when it was definitely known that irradiation capacity would not be needed for future A or B priorities and the capacity would otherwise be unused.

Because of the necessity for overall scheduling of pile operations to obtain maximum efficiency in the use of available reactivity, it was necessary at times to deviate from the system of priorities, i.e., it might be possible to combine a number of special irradiations in the same tube, or to insert some of them in tubes filled with regular metal. Deviation from priorities established, however, would be held to a minimum.

Other than its regular plutonium production, radiations at Hanford were chiefly for production of polonium and tritium, as described above. A third material obtained in a similar manner was radioactive carbon 14. This material can be made by irradiation of either calcium or ammonium nitrate and was produced satisfactorily in experimental quantities from both source materials by neutron irradiation in the Clinton pile. On January 10, 1946, at a District research conference at Chicago, Dr. W. H. Zinn, Director of Argonne, presented a proposal for producing C^{14} from beryllium nitride irradiation in the Hanford piles. It was proposed that MIT should prepare the nitride and that pelleting and canning of the slugs would be undertaken at Chicago. Neutron irradiation of beryllium samples

was subsequently undertaken at Hanford, and on October 18, when Clinton Laboratories requested authority to discontinue tritium production in the Clinton Engineer Works pile, it was also requested that production of C^{14} by the two nitrate methods also be permitted to close. On October 24, cessation of the ammonium nitrate method was authorized, together with tritium production. But it was requested that C^{14} production from calcium nitrate be continued since the success of the beryllium nitride method at HEW had not been definitely established at that time.

Among the other numerous isotopes obtained by the Division for various research and development installations following neutron irradiation at HEW were: high specific activity P^{32} for Clinton Laboratories, calcium^{41} and 45, potassium^{40}, iron^{59} and ^{55}, thallium ^{204}, neptunium^{237}, plutonium^{237}, uranium^{233} and ^{236}, thorium^{230}, and protoactinium^{231}.

Other Special Materials. As an incidental responsibility, the Division also furnished technical advice, on request, regarding procurement, disposition, and requirements for other special materials. In June, 1946, for instance, future project requirements for nylon film were surveyed at the request of the duPont Company, and on other occasions project needs for nylon yarn, and Saran plastic film. During that same month the District's Redistribution and Salvage Division requested advice regarding proper disposition of 497,000 pounds of potassium bifluoride being stored in Wilmington, Delaware. District needs for the material were reviewed by the Technical Branch and it was recommended on June 10 that it be disposed of as surplus property. On other occasions the Division located sources and arranged to supply District research installations with fluorocarbons, trichloroacrylyl chloride, cobaltic fluoride, etc.

Chapter V

Radiation Detection Instruments

Organization of the Instrument Production Section

Project wartime requirements for large quantities of unique and classified radiation detection instruments necessitated that the various major laboratories make their own provisions individually for procurement of most of the new equipment necessary for both research and production operations. Development of radiation detection instruments for the Plutonium Project was mainly centered at Chicago, which maintained liaison with subsidiary instrument groups at Clinton Laboratories and Hanford. District coordination of these Plutonium Project instrument needs prior to formation of the Research Division was undertaken by the X-10 Research Operations Group, which also assisted informally in taking care of Y-12 instrument needs. K-25 radiation detection instrument development was centered at SAM Laboratories in New York.

When the X-10 Research Operations Group was incorporated into the new Research Division on October 15, 1945, its instrument coordinating office came with it. Subsequently, as additional District research operations were brought under the Branch's jurisdiction and it evolved into the Operations Branch, its instrument-coordination activities were broadened. In the larger sense, however, these activities had been chiefly maintenance of records and control of disposition. Upon special request, the Instrument Section also provided special Project information, as in the case of the Metallurgical Laboratory inquiry of October 26, 1945, concerning the availability of technical data on vacuum tubes for electronic equipment developed by the National Defense Research Council of Canada.

Following the war, the various research facilities brought increasing pressure upon the District Office for establishment of a centralized facility to undertake a positive program of coordination and control for manufacture, procurement, and allocation of all radiation detection instruments and special electronic equipment and components required by the District. Typical of this Project interest was Dr. N. F. Ramsey's suggestion from Los Alamos in September, 1945, that a central electronics and nuclear physics equipment laboratory be established to improve design of existing equipment, to serve as consultant to both Project and off-Project scientific laboratories, and to arrange for limited production and loans of the more useful types of scientific equipment developed by the District.

The problem became even more critical in the Spring of 1946 when the Chicago Metallurgical Laboratory decided that, following its reorganization as the Argonne National Laboratory on July 1, 1946, it would no longer undertake to supply other District sites with electronic radiation detection instruments. Because of the superior quality and cheaper cost of Chicago instruments over those designed and produced at SAM and other laboratories, peace-time District activities had seen an increasing demand from other installations throughout the Project for instruments manufactured by the "Met Lab" Instrument Section. On March 24, 1946, Dr. Daniels advised the District of this major development in instrument production policy.

On April 16, 1946, the Division was represented at a meeting of District Army and contractor technical personnel at Chicago to discuss the problem of future procurement and production of electronic equipment peculiar to the District, especially those models designed for radiation detection. While

certain scientists supported the establishment of a special District production department to manufacture the more intricate and delicate models, it was agreed that Government policy favored the farming out of all declassified types to private industry. Since many of the instruments and their components required highly skilled and specialized knowledge to take them from the Project laboratories and place them into industrial plant production, it was further agreed that the best interests of the District would be served only by a centralized Instrument Production Section which would maintain close liaison with private industry to check specifications, blue prints, and the instruments themselves, and to assure that prescribed sensitivity, accuracy, and other features of the laboratory-developed models were incorporated into mass production models.

During the next several months, with the assistance of the Metallurgical Laboratory, the Division undertook the organization of an instrument production program to supplant discontinued Chicago production. At the April meeting, it had been agreed that a comprehensive survey should be conducted to determine the advisability of having private industrial firms produce "Met Lab" instruments. On May 22 Dr. Daniels submitted Part I of a "Feasibility Report" prepared by his instrument development group which expanded the conclusions of a preliminary survey requested by the Research Division on April 10. A list of standardized instruments suggested for industrial production was included, together with proposed responsibilities which it was felt the Instrument Production Section should assume. Subsequently, on August 13, the District received Part II of the Feasibility Report, com-

prising a highly confidential summary of the capabilities of various instrument concerns for manufacturing radiation detection equipment.

In June, 1946, the Instrument Production Section of the Operations Branch, Research Division, was established with Lt. L. B. Rasmussen as Chief, to coordinate the new District instrument program.

Instrument Production Section Functions

Control of all District Radiation Detection Instrument Procurement.

The primary function of the Instrument Production Section was to act as a central clearing house, controlling all procurement and transfers of radiation detection instruments within the District. On August 27, 1946, Circular Letter (Research Control 47-1) from the District Engineer's Office instructed all area engineers to transmit requisitions for all radiation detection instruments, special electronic equipment, and component parts used in conjunction with radiation detection instruments to the Section for coordination and consolidation.

Under this authorization the Section could obtain for the District the advantages to be gained from mass purchases. It could ascertain that District orders were placed with qualified manufacturers and that, where required, adequate priorities could be established in the best interests of the District. Where necessary, it could review requests in the light of new or anticipated improvements and suggest procurement of alternative or more desirable equipment. To effect the authorized control, the Section prepared standardized request forms and established a filing system to maintain up-to-date records of present and anticipated District radiation in-

strument needs.

Declassification of Instruments. All Project radiation detection instruments were originally classified, and declassification had to be effected before designs and descriptive prints and specifications could be turned over to private industry for manufacture under governmental licenses. According to declassification policy, all instruments and other scientific equipment were declassified only in conjunction with a document which described them and in cases where their declassification was specifically requested. (See History of the Declassification and Publication Program). On June 25, 1946, the Declassification Branch declassified the first ten District radiation detection instruments. Others subsequently were declassified and referred to the Instrument Production Section for negotiation of licensing agreements. In all cases, declassification was made with the provision that the motivation for development of the instrument and its applications in District activities would not be divulged. Eventually, it was expected that declassification could be obtained for all Project-developed scientific instruments.

On June 28, after review of the status of equipment which was still classified, the Isotopes Branch called to the attention of the Instrument Production Section a list of instruments whose declassification and licensing for industrial manufacture would be of great value to the isotopes distribution program by providing radiation hazard protection to off-Project requesters. Close liaison was maintained by the Section with both the Isotopes and Declassification Branches to achieve an effective program for production and allocation of District-developed instrumentation in the best interests of the District's research and development policy.

Patent Clearance and Licensing. During the spring of 1946, the Division held extended discussions with the Office of the OSRD Patent Advisor to effect mutally agreeable procedures for placing fabrication of declassified, Project-developed radiation detection instruments with competent industrial firms under reciprocal licensing arrangements which would adequately protect the Government's patent interests. On July 23 the Patent Advisor submitted the procedure to be used in attaining this end. Specifically, the IPS was instructed to provide comprehensive lists of all declassified instruments and allied equipment intended to be manufactured by industry, and lists of all organizations which possessed adequate personnel and facilities to produce them. The Section was also requested to determine the willingness of such concerns to enter into reciprocal cross-licensing agreements with the government whereby the manufacturers would grant non-exclusive, royalty-free licenses to the Government on any developments they might make, or on any patents which they presently possessed which would be applicable to the specific declassified instruments or equipment released for licensing. After these lists were drawn up, invitations were later issued by the District to reputable firms which wished to enter into such licensing agreements. Recommendations concerning the invitees, review of bids, and allocation of orders were administered by the Section in conjunction with the Administrative Division and the Patent Advisor's Office. The Section reviewed contract terms and served as the Government's contract representative on all contracts negotiated by the District for radiation detection instrument manufacture. Finally, it conducted the "follow-up", serving in a liaison

capacity between the various District installations and industrial manufacturers.

Expediting, Procurement, and Other Services. The Section established and maintained a warehouse at Oak Ridge for storage of new and surplus radiation detection equipment and the more critical component parts. It arranged for instrument engineers to inspect the new models as they came off industrial production lines, conducted inspections and performance tests of new models in its own Oak Ridge laboratory and arranged for tests to be conducted, where desirable, at the laboratories of contracting operators at the X-10, K-25 and Y-12 areas at Clinton Engineer Works.

At year's end, the Section was acquiring a complete library of catalogues and other technical literature from radiation detection and related electronic manufacturing firms. It also served as an advisory office for the dissemination of declassified information informally to Project and off-Project agencies. Extensive plans had already been formulated for preparation of an illustrated District catalogue and periodic information bulletins for distribution to interested Project and other government installations.

Other incidental responsibilities carried out by the Section during 1946 were to furnish incidental instrument service and advice, and to act as a clearing house for dissemination of instrument information. In October, for instance, the Section arranged to obtain radiation-sensitive film and film badges for the Ohio River Division Engineer, Corps of Engineers, for protection of employees against gamma radiation from metascopes at the

Scioto Ordnance Works. That same month classified radiation detection instruments and two radiation sources were obtained and delivered by the Section to West Point, and personnel there were instructed in their operation.

Administration of Victoreen Contract. The chief of the Section, as Government contracting officer, administered the two District contracts with the Victoreen Instrument Company for research, development, and production of radiation detection instruments and components. Under Contract W-31-109-eng-49, Victoreen agreed to conduct studies and experimental investigations pertinent to design and development of radiation detection equipment, as instructed by the District. As occasion arose, the Section authorized the specific initiation of such activity. On September 1, instructions were given to undertake investigations to improve design of a low-voltage Geiger tube, and various other studies were requested at later dates. To expedite this work, the Section arranged to furnish Victoreen with all pertinent District literature and technical reports developed at Chicago or other research facilities, and established liaison between Victoreen and these installations, where necessary. Under the contract, Victoreen also performed calibration studies, made repairs and adjustments, and reconditioned electronic instruments.

Under a second contract, W-31-109-eng-64, Victoreen was authorized to use Government facilities at Plant No. 2, Cleveland, to produce Victoreen "VX" type vacuum tubes in quantities required by the District. Review of all activities in this respect, including determination of production quantities and allocation of the tubes, was coordinated under the administrative jurisdiction of the Section.

Purchases from District Employees. The specialized nature of many radiation detection instruments, requiring highly technical "know-how" for satisfactory construction, the scarcity of trained technicians to build them, and numerous other factors made fabrication of District-developed instruments in production quantities a difficult problem. Many mechanics and engineers who worked for the District had offered to help out by fabricating instruments and components in off-hours, and during the war emergency such assistance had been welcomed. Several of these full-time employees were also officers of electronic instrument manufacturing companies which were anxious to submit bids in competition with other firms. District policy had to determine (1) whether the District should issue invitations to bid to firms whose employees were also hourly-rate employees of the District, and (2) whether the District should continue to purchase instruments and components from its full-time employees who fabricated the equipment in off-hours.

Discussions between the Section and the District Administrative Division resulted in a mutually agreeable decision that, in the absence of a specific District directive, purchase orders, contracts or invitations to bid would not be extended by the District to companies operated by its employees. As of year's end, the Instrument Production Section was still investigating the second problem, and policy governing off-hour activities of Project hourly employees had not been crystallized.

Cross-Roads Operation. Radiation detection was a major problem in the Navy's Cross-Roads Operation in the summer of 1946, and the District was called upon to furnish personnel and technical advice to assist in this phase of the project.

1. Remote Air-Sampling Project. In March, 1946, the Division had been requested by the Washington Office to assist the Army Air Corps in making radiation determinations of air samples taken from various points on the earth's surface following the Cross-Roads explosion. Specifications regarding the proper sampling devices to be used were obtained from Los Alamos, and arrangements were made with the California Radiation Laboratory to process the samples and conduct the radiation determinations after delivery by Air Corps personnel.

2. Instrument Production Liaison. Procurement of radiation detection instruments for the Navy was expedited by the Division's Instrument Section, and later by the Instrument Production Section. In May, 1946, for instance, the high percentage of failures in X-263 portable counter tubes destined for Cross-Roads use resulted in investigation and subsequent resolution of the problem by the Section. In all, some 500 radiation detection instruments and 50,000 film badges were procured for the Bikini tests by the Instrument Production Section.

Navy Liaison. The fall of 1946 saw continued and increasing liaison between the Instrument Production Section and the Navy for Operation Cross-Roads cleanup and the organization of Navy radiological safety training programs. Under the provisions of directives of Joint Task Force One, it was agreed that the District would furnish necessary radiation detection instrumentation and advice to Navy scientific personnel and that all Navy radiation detection requirements would be coordinated through the Section. Under this policy, the District was enabled to maintain close control over Navy requests for loan of special equipment, and on November 26 the Section

pointed out that certain Navy requests for loan of equipment (in this case, gas masks and canisters) were outside the scope of the agreement obligating the District to assist the Navy in loan of radiation detection equipment. At this time, the Section recommended allocation by the Navy to the District of funds against which future orders for equipment should be charged. Arrangements were also made for the Navy to assign a representative in the Section to assist in coordinating Navy training program requests, and to become familiar with procurement and allocation problems. On December 1, 1948, Lt. Morris F. Murphy joined the Section to carry out these duties.

Chapter VI

Interchange of Information

General Introduction. Information of a scientific or technical nature interchanged between District research installations falls into two categories. Visits and direct correspondence between individuals accounted for a great deal of information on subjects of immediate interest. The vast amount of technical information developed by District laboratories, however, was incorporated into formal reports which became a part of permanent Project records. Since such documents contain much significant data of interest to research activities being pursued at other laboratories, it was the Division's responsibility to receive, review, file, and maintain custody over all such data, and to organize a positive program for dissemination of copies to Project laboratories, after establishing (1) that the information was required in carrying out the laboratory's investigations, and (2) that no information was contained in the document which the particular recipient was not authorized to receive. The first part of this chapter, immediately following, is concerned with Research Division policy governing the establishment and operation of a positive program for dissemination of technical reports to contractor laboratories.

Other features of the District's program for interchange of technical and scientific information discussed further on in this chapter are the various publications prepared by the Division and circulated to Project laboratories, the information meetings, visits, and other contacts arranged for transfer of classified information, and the numerous advisory

activities of the Division's Technical Branch in furnishing information on particular subjects of interest to other District and contractor offices and laboratories.

Reports Control Policy.

General. Under regular contract provisions, research and development contractors were obligated to submit monthly progress or "P" reports and also final reports upon termination of the contract. Regular progress reports of these installations under Research Division jurisdiction were forwarded to the Operations Branch for review. Filing, recording, and distribution of the data were undertaken by the Division's Records Branch (later Information Branch).

Policy outlining submission of final contractor's reports summarizing major activities completed under the contract had been promulgated by the District in District Circular Letter (Research Control 46-1) of September 13, 1945. Responsibility for obtaining such final reports was placed with the contracting officer, who was instructed to forward the report to the District's Research Control Section. After incorporation of that Section into the Research Division, the latter assumed this responsibility, acting as custodian of the information and distributing the reports, upon request, to authorized District personnel.

At this time, the only positive program within the District for dissemination of technical information to research sites was being conducted by the Chicago Metallurgical Laboratory. During the war, the various laboratories participating in the Plutonium Project had found it necessary to establish a central facility for receipt, reproduction,

and distribution of classified information relating to new developments in nuclear science. At Chicago, an aggressive and well-organized office had been instituted to carry out these functions, including both indexing and the preparation and circularization of abstracts and title lists of all new documents received from Plutonium Project installations.

When the Division was established, it was planned to expand the reports-custodian responsibilities of the old Research Control Section so that it might undertake a Project-wide program for indexing and distributing technical information along procedures similar to those used at Chicago. It was planned not only to assimilate the Chicago program, but to modify and expand the system into one comprehensive enough to satisfy the needs of the other District laboratories. It was realized that such a program should encourage not only the dissemination of classified information to authorized facilities but also the interchange of newly-developed declassified information. Since plans were already under way for organization of a declassification and publication program, it was realized that the new Division Information Branch would also have an increasing volume of declassified material to index and distribute.

A third responsibility, in addition to the dissemination of both classified and declassified documents, was the procurement from various research facilities of copies of all technical reports not on file in the District Office, and to establish a central library containing all technical and scientific information developed on the Project.

The assumption of these three new responsibilities by the Division involved the organization of a more comprehensive program for information interchange than that originally undertaken by the Reports Sub-section of the old Research Control Section. The latter had been previously concerned with the receipt and custody of technical reports and the circulation of the documents to authorized laboratories by positive distribution and upon request. It was now intended to replace this wartime function with an aggressive, well-intergrated program for furthering nuclear science research by the dissemination of technical information to the maximum degree authorized by considerations of security and the best interests of the nation.

Establishment of the Information Branch. With these objectives in mind, members of the Division's technical and records-control staffs prepared plans on February 8, 1946 for organizing a Division office to handle, reproduce where necessary, and distribute all Project reports and other scientific and technical information on a District-wide basis. Subsequently, at its March 8-9 meeting, the Advisory Committee on Research and Development recommended that the Project set up central facilities having information on all current technical developments, and providing for positive dissemination of such information to interested and properly authorized District personnel. It was further agreed that policy governing distribution of such information should be in accord with existing security policies.

The Division renamed its Records Branch the Information Branch and obtained an experienced librarian and administrator to organize an

office prepared to pursue an active information distribution policy. Subsequently, with the acquisition of library, clerical, bibliographical, and scientific review sections, it initiated a comprehensive program for review, integration, filing and distribution of all technical information developed within the District or of interest to its major objectives.

Subsequent Report Distribution Policy.

Acquisition of Project Files and Records. The new Branch initiated a program at once to obtain copies of all back reports of a technical nature missing from its files. In March, 1946, Branch personnel undertook an inspection of Washington Headquarters' records files and subsequently copies of all British and Canadian reports were transferred to its Oak Ridge vaults. Later in September, Information Branch personnel inspected the 3000-odd reports at Y-12 contained in the "Nichols file," and after determining that the Branch library possessed copies of all the documents, the Division arranged for its transfer to Madison Square Area for reference use by that office.

Indexing of Reports. During the war, the Metallurgical Project had been unique among District facilities in that it established and maintained at Chicago and its other important laboratories, a subject index file of all technical reports and documents received at the Chicago Office. Index cards for separate documents were prepared under all applicable subject categories and were then distributed to Washington, Oak Ridge, and Los Alamos for reference use.

A second outstanding feature of the Chicago system was the distribution of reports according to standardized subject category lists.

These are to be clearly distinguished from the index category lists which were intended only to assist in identification of each report under the pertinent technical subjects to which it referred. Far less detailed than the latter were the subject category lists, which were established for the purpose of effecting distribution of technical documents automatically to appropriate and authorized laboratories. It was intended that each installation would classify each of its reports under one of these categories. Upon receipt by the "Met Lab" Information Branch the report was reproduced and distribution of the proper number of copies was made automatically. These category distribution lists were constantly reviewed by the Technical Branch, which authorized changes from time to time as required.

In its original February report the Division's technical and records-control staff had recommended the establishment of a comprehensive procedure for control and dissemination of all District technical and scientific information along lines incorporating the indexing and standard distribution list features of the Plutonium Project system. A positive program in this respect did not get under way, however, until August 15, 1946, when the Division's Information Branch took over all Chicago indexing and report-distribution activities, including the large Metallurgical Laboratory library of Project technical documents. During the remainder of the year the Branch continued the Chicago services and initiated a District-wide program based on these already operating procedures.

The Information Branch's indexing activities were two-fold. The Chicago file of District reports included a vast volume of documents which had not been indexed, and which required careful review and processing. At the same time the Branch was currently receiving reports from various research and development sites which required the same attention. Despite a scarcity of technical personnel, the Branch carried on a program including both indexing of current reports and a slow but gradual processing of back-files. Index cards were reproduced and prepared for distribution to the various installations depending upon the specific nature of the investigations being undertaken in the laboratories and their relation to the information contained in the particular document indexed as determined by the Technical Branch. By year's end actual distribution of the cards to research contractor facilities had not yet been initiated.

Revision and expansion of original Chicago standard distribution categories to include all District research and development activities required considerable study by the Division Technical Branch. The proposed lists were drawn up and distributed to the various installations on October 30 to see if the proposed categories and number of copies suggested would satisfy their needs. At year's end comments were still being obtained from contractors and area offices, and institution of the proposed lists had not yet been approved.

Coordination of District Report Activities. Prior to the institution of a centralized program, primary distribution of Project reports

had been mainly handled by the areas at which they originated, insofar as security compartmentalisation permitted such interchange, while supplementary distribution was authorised by the Technical Branch. Consequently, considerable "education" was necessary, and numerous policy decisions had to be made in order to evolve a well coordinated program. The Technical Branch, because of its familiarity with the programs of the various research installations, assisted the Information Branch in the encouragement and education of Project areas in the utilisation of a central control office to expedite interchange of technical documents.

The divided responsibility policy which subjected certain District research installations to supervision by the Madison Square Area Office and others to supervision by the Division, for instance, resulted in the latter's being left frequently uninformed regarding current progress and final results of research and development conducted under Madison Square Area auspices. Dr. D. J. Pflaum investigated the situation on July 15 during a visit to New York, and resolved several misunderstandings, arranging for current relay of contractors reports to Division Information Branch files upon their receipt by the Madison Square Area Office.

The general area responsibilities of area offices regarding distribution of all District reports were outlined in a letter to the Madison Square Area Engineer on November 27, 1946, which defined the relation of the Information Branch to overall District report distribution procedures, as follows:

(1) The respective Area Engineers (in this instance, Madison

Square Area) were instructed to screen all other District installation reports requested by, and received for transmittal to their contractors, so that no unauthorized disclosures might be made. Exceptions to this were reports originating outside the United States or from Los Alamos. Specific authorization must have been received from the Research Division for distribution of all reports in either of these categories.

(2) For administrative reasons, Madison Square Area was instructed to send the Division a copy of each letter of transmittal covering distribution of reports made by that office, and specifically identifying each item. In this way, a complete overall record of District-wide report distribution could be kept by the Information Branch.

On another occasion, the question of the frequency at which progress reports should be submitted by District contractors was broached by the Chicago Area Engineer, who wished to substitute quarterly "P" reports for those presently being submitted each month. After review, the Division concluded that these documents provided the principal means whereby the District maintained legal and technical control over current contractors' activities, and that in many recent instances the information reported incidentally in this manner had necessitated rapid and positive action by the District in its administrative supervisory capacity. Consequently, the request was disapproved on August 13, 1946.

Distribution of Los Alamos Reports. Information Branch distribution of information from Hanford, Los Alamos and to foreign nationals, was

handled differently from procedures governing regular dissemination of data to and from District laboratories. In the latter case, requests were made directly to the Information Branch on the basis of its periodicals reporting new additions to its report files, and distribution was made directly by the branch to the requester after review by the Technical Branch. The necessity of prohibiting Los Alamos production and technological data from unauthorized distribution, however, required that Los Alamos reports be given special scrutiny by the Technical Branch before distribution, and Washington Headquarters approval for each document was required. Policy governing interchange of information between the United States and foreign nationals was established at high diplomatic levels and such interchange also required Washington authorization.

The Information Branch maintained a complete and current file, approved by the Washington Office, of all Los Alamos reports which do not contain weapon or production information. Title lists of these reports were circulated in its periodicals, in the same manner as other District classified titles. Requests for Los Alamos reports, however, were first reviewed by the Technical Branch to determine that the document contained information of interest to the requestor, that it did not contain information for which he was unauthorized, and that no production or weapon information might by error have been included. If these conditions were satisfied, authorization to distribute was requested of the Washington Office.

Distribution of Hanford Title Lists. Hanford Engineer Works prepared lists periodically of all reports issued at that installation, including

both technical and administrative data. From this list only reports of a technical and scientific nature were forwarded to the Information Branch for processing, in conformance with policy followed at other District sites. Frequently, however, the lists themselves contained titles of documents of interest to certain other Project offices, and the Branch received requests for copies. But because of the possibility of production or other highly classified HEW information being released through the title lists, no authorization was forthcoming from Washington approving their regular distribution during 1946. The Division's Technical Branch, after studying the matter, recommended, however, that approval be given for their regular dissemination according to an authorized distribution roster after the individual title lists had been first carefully reviewed by the technical staff.

Distribution of British and Canadian Reports. The policy governing transmittal of classified information to the District from Canada and the British was established at high diplomatic levels and consequently has always been directly controlled by the Washington Office. No distribution of classified reports from either nation has been made without specific authorization from Washington Headquarters.

The policy governing transmittal of District information and reports to these nations, however, has been of a different nature. Prior to enactment of the Atomic Energy Act on August 1, 1946, transfer of all classified District information to the British was made by the Washington Office. Release of classified District information to the Canadian

scientists at Montreal (later Chalk River) until August 1, 1946, was made by the District according to the provisions of the agreement approved by the Commanding General, dated July 15, 1946, and entitled, "Interchange of Information between the Montreal Group and Various Groups in the United States." Prior to March 15, 1946, administrative supervision of Evergreen was maintained by the Chicago Area Engineer and positive distribution of classified District information to Canada was carried out in accordance with the provisions of the 1944 agreement. After March 15, when supervision of Evergreen was delegated to the Research Division, the latter continued the same policy. Following enactment of the Atomic Energy Act, however, all positive distribution of Classified information to Canada ceased, as well as that authorized through Washington to the British. During the remainder of the year no classified information was distributed by the Division to either nation.

It should be pointed out that the act had no effect on importation of information on atomic energy into the country, and that receipt and distribution of Canadian and English information continued after its enactment.

Typical of classified information requested by Evergreen but withheld after August 1 were reports and other technical data on shielding required for, and radiation intensity levels around the Clinton pile, samples of black oxide enriched in U^{235}, and I^{131} and other radioisotopes regularly distributed to American off-Project requestors. Similar information and materials were requested by the British, but approval was postponed by the District pending review of the entire matter by the Atomic Energy Commission after January 1, 1947.

Distribution of Reports to Government Military and Civilian Agencies. General District policy required approval by the Washington Office for transmittal of all District classified reports to military or other Government agencies, and all reports relating to information requested by such agencies were forwarded to Headquarters for review and possible transmittal to the requestors.

The active association of the District with military groups such as the Navy (Ship Propulsion Program) and the AAF (NEPA) required the establishment of routine channels for regular distribution of minutes of meetings, progress reports, quarterly reviews, etc. Proposed distribution lists for such information were approved by the Washington Office and became regular operating functions of the research program. Division activities in this respect are discussed in Chapter X, "Program for Assisting Other Military Agencies in Atomic Energy Research."

Other Information Branch Activities.

Publications.

List of Declassified Documents. (Formerly Documents Declassified) This is a restricted bi-monthly periodical prepared by the Branch for distribution to project installations in accordance with an authorized distribution list. Divided into three parts, Part I contained declassified documents which were voluntarily submitted by both Project and non-Project authors but for which the Government had no publication rights, since they were not prepared under contract. For further information, Project scientists were referred to the authors themselves. Part II consisted of declassified documents which had been prepared under

Government contract, and which the Government had the right to reproduce and disseminate. Subsequently, however, many of these articles were intended for publication in national scientific journals. Part III contained declassified documents being withheld, at the discretion of the District and with author consent, pending publication in the MPTS.

The first issue of this periodical was prepared on July 15, 1946, and at that time was designated Documents Declassified, Vol. I, No. 1. First release was made following approval on September 26. The issue was declassified and listing of the documents therein constituted notice of declassification.

The appearance of this periodical subsequently presented several problems. It developed that certain of the documents had been submitted by Los Alamos for declassification after deletions of classified material had first been made by Los Alamos scientists, without the knowledge of the Declassification Branch. Consequently, Documents Declassified listed titles of reports containing deleted and undeleted materials depending upon whether the report was obtained at Los Alamos or from the Division. On October 31, 1946, a District Circular Letter (Research Control 47-3) was circulated to all recipients of Documents Declassified informing them of this confusion. All subsequent issues of this publication were issued under the new title, List of Declassified Documents, and contained a prefatory paragraph stating that the listing constituted authority for declassification only of such portions of the documents listed therein as had been processed by the Declassification and Publication Branch, and

documents of the same title containing information not declassified remained in their previous classified status.

In the past it had been the custom both at Los Alamos and at the Metallurgical Laboratory to distribute copies of declassified documents and information listings of new declassified titles to Project "alumni," to keep them advised of recent scientific developments. Los Alamos, in particular, wished to distribute the List of Documents Declassified in the same manner. The Division issued instructions on September 30, prohibiting such activity and suggesting that all non-Project requestors be referred to the Office of Technical Services for procurement of copies, according to regular Government policy governing public dissemination of Government-developed technical information. The Office of Technical Services, Department of Commerce, was designated by Presidential order as the sole agency responsible for release to the public of all Government technical and scientific information. Further details concerning its relationship to District information dissemination activities will be found in the volume covering the history of the declassification and publication program.

Release of Declassified Documents. This is a publicity release issued at infrequent intervals, containing up-to-date lists of all declassified documents forwarded to the Office of Technical Services. The first issue appeared on December 10, 1946, and regularly contained articles appearing in part two of List of Declassified Documents, providing they had been previously published, or that the intended publication date was known. With the inauguration of this Release, the List

of Declassified Documents was reclassified "Restricted" to keep all other titles on the list from gaining unauthorized circulation. These latter comprised Group I and certain titles in Group II for which either no permission for publication had been obtained from the author, or where publication was not desired, and those in Group III destined for publication only in the Manhattan Project Technical Service. This policy of restricting publication of titles of declassified documents was necessary in order to protect the Government's position in the case of documents entrusted to it for declassification and Project circulation but which the authors did not wish to be considered ready for general publication. The first issue of the List of Declassified Documents containing such titles got into the hands of the editors of the Chicago Bulletin of Atomic Scientists on September 30, for instance, and was printed in its entirety without District permission.

The immediate incentive for issuing "Public Release No. 1" resulted from a conference of the Division representatives with Dr. E. P. Wigner of Clinton Laboratories and members of his staff who protested vigorously against the expense and time-consuming effort involved in getting declassified, Project-developed, technical information to the public and to off-Project scientists through the Office of Technical Services. These gentlemen felt that the District should distribute the Project-restricted List of Declassified Documents free to non-Project personnel. At this conference it was agreed to investigate the feasibility of such an undertaking. By year's end no such policy had been initiated, but the distribution of the "Public Release" to leading popular scientific and technical

journals and popular science information outlets was attaining this objective to some degree.

Atomic Energy in Foreign Countries. This was a monthly annotated unclassified bibliography prepared by the Information Branch and distributed throughout the Project according to an approved list. It contained information obtained by review of numerous foreign documents listed geographically. The first issue was distributed on July 1, 1946.

Guide to Published Research on Atomic Energy. This was a monthly containing abstracts and annotations from leading technical journals and books in English and foreign languages, and classified according to subject. The first issue was distributed on November 15, 1946.

Reports Added to the Research Division Library. This was a bi-monthly title list of all reports received by the Branch during the preceding period. Distribution was made to major District research installations beginning July 15, 1946.

It should be noted here that distribution was begun for the above five publications as of the date of their first issue. Following their reproduction, release was withheld pending final authorization from Washington, and actual distribution did not begin until some months after the original issue date.

Bibliographies and Translations. The Information Branch, in conjunction with its translating and technical publication review activities, provided special services for (1) translating documents, and (2) preparation of special bibliographies on scientific subjects, as requested.

Library and Library Services. The Branch maintained a technical library of standard books and journals of fundamental science, plus a rather complete collection of published technical information on "atomic energy." It encouraged contacts with other District and contractors' library and technical information offices, assisting in standardising and coordinating policies and expediting interchange of information.

Office of Scientific Research and Development S-1 Contracts. Under terms of an agreement reached between Dr. Vannevar Bush, Director of the Office of Scientific Research and Development, and Major General Groves, all Office of Scientific Research and Development S-1 contractors were brought under the Division's declassification, publication, and interchange of information programs for disposition of their contracts, reports, and other data relating to the S-1 program. The Office of Scientific Research and Development notified its former S-1 contractors in Administrative Circular No. 2.03, Supplement No. 1, on June 29, 1946, that all classified technical and scientific information would be declassified through the Research Division. On July 19, 1946, the Washington Office further delegated the Division's Information Branch to handle all administrative work involved in disposition of all records related to these contracts. Subsequently, on July 22, all S-1 contractors were requested by the Declassification Branch to submit all records and other data to its office for declassification. The Technical Branch assisted in establishing contacts with all contractors and other individuals involved and requested either the return of all records not submitted for declassification, or a formal certification that they had been

destroyed. After the Office of Scientific Research and Development records had been cleared each case was closed and the individuals or contracting agent informed of this fact, with the added request that he advise the District of any related documents on the subject which might subsequently come to his attention. By year's end, there were numerous cases still unclosed.

Advisory Activities of the Technical Branch.

General. The Technical Branch of the Division provided considerable technical information to Project installations requested either by District Area offices or contractor personnel. Due to the extensive ramifications of District programs, the Technical Branch's chemists, physicists and engineers could not be expected to provide immediate answers to all questions. Rather, they maintained surveillance of Project scientific research activities to enable them to know where to obtain the desired information, if inspection of District report files did not suffice. In general, the Technical Branch concerned itself with problems of a fundamental scientific nature. Special matters dealing with instruments, radioisotopes, etc., were properly referred to the other Division Branches, while information concerning administration of established research operations was forthcoming from the Operations Branch staff. The Information Branch staffed the library of published technical information and assisted in locating any data readily obtainable from its indexed files. However, it did not undertake to disseminate requested information which did not consist of already published material. All requests for special information involving further study and synthesis, or special interpretation of

technical data, were referred to the Technical Branch.

The Technical Branch's advisory functions with respect to scientific problems, consequently, were broken down as follows:

Relations with Information Branch. As has been indicated, the Technical Branch participated at great length in Information Branch activities, reviewing and advising in all matters of a technical or scientific nature. In accordance with policy established on July 8, 1946, all declassified documents forwarded by the Declassification and Publication Branch to the Information Branch for reproduction and distribution were routed through the Technical Branch for review. The latter assumed responsibility for determining "where" and "how many" copies were to be distributed. The documents themselves were routed to the appropriate members of the Branch for review, according to a physical procedure standarized and summarized on October 30, 1946. In addition to undertaking this physical processing of all newly declassified documents, the Technical Branch maintained a constant review of report distribution procedures to assure that maximum effectiveness was achieved. Thus, the improvements in the system suggested by Clinton Laboratories in the summer of 1946 were reviewed by the Branch and the most readily applicable features of their proposal were recommended to the Information Branch on August 7.

Declassification and Publication Program. The Technical Branch served in an advisory capacity to the Declassification Branch in the determination of problems of a special technical nature involving questions of classification status. In this respect it also was represented on District

committees appointed to consider the possibility of unauthorized release of classified information in trials and legal proceedings. On various occasions it was called upon to give technical opinions on documents submitted for declassification, such as photographs (May 27, 1946), scientific papers on health, etc. (May 9, June 7, June 28, etc.). It also reviewed the proposed Declassification Guide on May 16, 1946, and proposed several important changes governing release of information.

A recurring problem which involved both technical information and declassification policies was the matter of determining whether the District was obtaining all the information to which it was entitled concerning scientific developments at its many research projects. A contractor might be dilatory in keeping the District informed concerning the results of its overall activities, for instance, even though his individual scientists were planning to have declassified and to publish separate articles based on these hitherto unreported activities. On June 26, 1946, the Publication Section proposed that the Technical Branch review all papers intended for declassification and subsequent publication and determine that the District had received complete, detailed information on the contents of the paper. Such detailed information would have to have first been submitted to the District before the individual paper based on the work could be declassified and returned to the author for publication.

The procedure was initiated, and the Declassification and Publication Branch regularly withheld all declassified documents during the next

several months until the Technical Branch had indicated that the information therein contained was available for project use as a research report in the Information Branch Library. On October 24, however, the latter Branch notified Declassification and Publication that the policy would be discontinued, since such information would be available generally following publication of the documents in most instances, and that special reproduction of unpublished documents could be undertaken by the Information Branch were otherwise found necessary.

A second problem was the District's rights to publication of technical information developed by contractors. In certain instances, contractors submitted rough-and-ready reports to the District which they were the first to admit were not adequate for formal publication, but which never were subsequently rewritten for publication by their scientific personnel, because of transfers, contract terminations and other reasons. While District contracts provided for such reports, no publication rights were retained under them. Frequently the highly complex nature of the work restricted authoritative preparation of Project-developed data to an individual scientist. On the other hand, the public welfare required publication and dissemination of all significant declassified information as expeditiously as possible. No solution to this problem had been effected at year's end.

Preparation of Special Reports.

For District Office. In its advisory capacity to the District Engineer, the Division was frequently called up to supply special information of a scientific nature. The preparation of these reports was a

major responsibility of the Technical Branch. Data were obtained from study of Information Branch Library files, from general scientific literature, and from special contacts and correspondence with key Project or non-Project scientists. Like other scientific information provided by the Division's Technical Branch, the reports were prepared at the request of District offices, contractor personnel, or special off-Project requesters. Among subjects covered by Technical Branch reports prepared for the District Office were estimates of the District's future research requirements for helium, lists of cyclotrons in existence in the USA, survey of Canadian pile construction plans, availability of beryllium, summaries of new District research activities including Nepa, etc., reviews of availability of protoactinium and other rare elements, current and anticipated research programs in nuclear science being conducted by major United States universities, and many others.

At the request of the District Personnel Division, a roster of leading Project scientific personnel, key non-scientific research contractor personnel, and key Government personnel was prepared on May 15, 1946. On another occasion biographies of top Project scientists were compiled for the Washington Office, subsequently being revised and brought up to date in November, 1946.

For Contractor Personnel. Surveys were conducted by the Technical Branch and special information was obtained for research contractors in much the same manner as for the District Office. When, on June 13, the K-25 operations office inquired regarding application of

sound-radar to detection of accumulations of uranium deposits on the interior of K-25 cascade equipment, arrangements were made by the Division for the Carbide and Carbon Chemicals Corporation to refer the problem to an off-Project scientist, and proper clearance and a consultant contract were obtained. Earlier, in January, 1946, copies of German documents relating to construction of a centrifuge for uranium isotope separation were referred to the Division by the Washington Office for evaluation. The Technical Branch arranged for a competent specialist to evaluate them and subsequently distributed the latter's conclusions to interested contractor research personnel for their information.

The organization and establishment of authorized channels for temporary interchange of specific information between research contractor personnel was also regular Division responsibility closely followed by its technical staff. On February 1, 1946, when the Y-12 area requested permission to follow a series of experiments being undertaken at Clinton Laboratories on isotope separation, so that results might be coordinated with Y-12's own activity in this field, the Division determined and approved lists of personnel at both sites authorized to discuss the problem, and outlined the procedure to be followed in interchange of correspondence and scheduling of conferences between the two groups. Specific subjects, such as production data, which were prohibited from discussions were listed.

On another occasion the Y-12 area requested special technical advice regarding existence and availability of instruments for ether-air mixture

measurements. The Technical Branch investigated the matter, referred the request to an appropriate District contractor (Mallinkrodt Chemical Co., St. Louis) and provided Y-12 with the information desired on October 7, 1946. At other times, the Technical Branch prepared special surveys on a diversity of subjects, such as obtaining information for Y-12 on the availability of special X-ray diffraction data, or providing the Berkeley Radiation Laboratory with information on CEW barytes concrete for pile shielding, etc. Where possible, the Division arranged for research contractors to go directly to the best informed project source for any given request for information. In such cases the Division expedited the formalities of clearance, consultant contract, etc., and served as the "middle-man" only when security considerations necessitated.

For Off-Project Requests. Policy and activities covering release of declassified or unclassified Project information to off-Project requestors is treated farther on (Chapter XIV). No classified information was released to off-Project persons or agencies except through and with the approval of the Washington Office. Answers to questions from the Senate Committee on Atomic Energy, for instance, were prepared by the Director in a brief on November 25, 1945. Some months later, following appointment of the Atomic Energy Commission, special summaries of Division activities and matters awaiting policy decisions were prepared in August, 1946, and many subsequent reports were submitted as the time approached for transfer of District facilities to the Atomic Energy Commission.

Patent Review. The Division's relations with the Patent Advisor were so extensive and diversified that no effort has been made to review them here. In general, all Division activities involved in the release to the public of information developed on the Project involved the Advisor's office, although declassification, publication, licensing instrument-manufacturers, lending or donating Project equipment to off-Project scientific institutions, or many other motives might have been the primary purpose. The patent aspects of each of these activities are accordingly treated in conjunction with the appropriate subject.

A continuing function of the Division, however, separate from the above programs, was the technical review of patent applications brought to its attention by the Office of the Patent Advisor. This activity was undertaken by the Technical Branch, which conducted the review with two objectives in mind. First, "Did the application contain any novel ideas or combinations of ideas in a novel form unknown to and of interest to the District?" Second, "Had the idea or invention being applied for already been previously developed by the District, so that consequently patent rights had accrued already to the Government?" The Patent Advisor was informed of the District's interest in each application submitted for review.

Project Information Meetings.

General Information Meetings. During the war, the Metallurgical or Plutonium Project had instituted periodic classified information meetings attended by prime research contractor personnel for the purpose

of discussing matters of policy and special technical problems concerning design, construction and operation of nuclear reactors and related matters. Representatives were selected at the discretion of the contractors' laboratory or technical directors, and younger scientists were given an opportunity to present papers on recent experiments which security considerations prevented from gaining public circulation. In general, the sessions served the two-fold purpose of bolstering Project morale against the isolation of necessary compartmentalization and also provided for informal discussion of mutual technical problems. Until June, 1945, the information meetings were held each month. After that date quarterly sessions were inaugurated. As the various meetings progressed, both the biology and metallurgical groups participated less actively in these sessions, since each faced numerous special problems of little general interest to the physics and chemistry sessions. Consequently the meetings tended to emphasize more and more the major physics and chemistry problems of the District, while the biology and metallurgical groups supplemented the general meetings with incidental information conferences held among their own scientific members.

Following the establishment of the Research Division and the gradual loosening of intra-Project compartmentalization barriers, the quarterly Plutonium Project meetings were supplanted by District General Information Meetings to which representatives from all research and development laboratories were invited. The first of these sessions was held on March 18-20 at Oak Ridge, at which numerous papers were presented under the following general topics: Metallurgy, Symposium on Ion Exchange, Physics, Chemistry, and Piles.

A second General Information Meeting was held at Chicago on June 17-19, which Los Alamos representatives attended for the first time. No records or minutes of this meeting are contained in the Division files.

The third General Information Meeting was held at Oak Ridge on October 15-16, 1946, and the Division took an active part in assisting Clinton Laboratories to arrange for the sessions. In addition to regular District laboratories, the Monsanto Company was anxious to have the Bureau of Standards, the Monsanto-Dayton Laboratory, the U. S. Public Health Service, the new Brookhaven National Laboratory, K-25, Y-12, and the General Electric Company represented. The District's scientific representative in Canada, Hanford scientists, and the Project medical-biology group at the University of Rochester were also invited by the Division. Laboratories regularly represented were Chicago, Battelle, Massachusetts Institute of Technology, Columbia, Iowa State, Los Alamos, the University of California, and Clinton Laboratories. Consequently, the October session was actually the first information meeting in which broad Project participation was attained. In addition to the regular fields of piles, metallurgy, physics, and chemistry, numerous papers were also presented under the general subjects of health and biology, special instruments and their use, and radioisotopes.

An important question raised and discussed at the October meeting was the general content of the papers to be presented at future sessions.

The purpose of the gatherings was to effect the greatest possible interchange of information regarding recent classified developments at the respective laboratories in the various fields of nuclear science. It was decided at that time that every effort should be made to avoid presentation of declassifiable papers, since they subsequently could be made available through regular scientific publications, and that, generally, no material relating to weapons or production figures would be presented. The more detailed conclusions agreed upon at the meeting were incorporated into a letter to the Division from Dr. N. E. Bradbury, Los Alamos, on October 24, 1946, and served as the basis for planning future meetings.

A second problem presented by General Information Meetings was the number of representatives to be authorized from each installation. While the maximum interchange of information was desired, the continued increased attendance suggested that the quarterly or semi-annual sessions might develop into costly and unwieldy conventions unless regulated by standard business and professional practices governing attendance of scientific personnel at such conferences. In general, the Laboratories themselves desired the maximum freedom in determing their respective quotas. On the other hand, limited conference facilities at the various sites had to be considered. The Division gave the subject considerable thought, and discussed it with the Laboratory Directors. It was planned to explore it more thoroughly early in 1947 at the next scheduled Laboratory Directors meeting.

Laboratory Directors' Meetings. Unlike the General Information Meetings, the District had not scheduled regular periodic meetings of Laboratory Directors, chiefly by reason of compartmentalization requirements. Frequent conferences on major problems, of course, had been

arranged between the technical heads of various laboratories engaged in similar problems, but no regular policy was established in this respect. After the war, however, and during the District's interim period of peace time responsibility for operation of the Project, it was felt that periodic meetings of the Laboratory Directors should be held during which their respective program could be presented and discussed from the point of view of over-all District Policy, in order to coordinate current and immediately anticipated research activities. These sessions would permit the Directors to express their views on future Project policies and also permit the District itself to provide background on its own established policies.

On October 16-17, 1945, the first of these meetings was held in Chicago, at which time the District's general information interchange program was discussed. It was agreed that future similar conferences on Laboratory Directors were desirable and that they should dovetail as far as possible with the Program for General Information Meetings. During 1946, three Laboratory Directors' Meetings were held, on April 15-16, June 17-18, and October 14-16, coincident with the three General Information Meetings held on these dates. The Division noted and earmarked for the agenda of these meetings all matters which it was felt should be presented to the Directors for further consideration. Participation in the Laboratory Directors' Meetings was limited more drastically than the General Information Meetings, both numerically and geographically. Generally, only the Directors and their division heads attended, while representation at first was limited to the laboratories pursuing the most

extensive fundamental research program, i.e., Clinton Laboratories, Chicago, Iowa State, the University of California, and Los Alamos. Control laboratories for production processes (e.g., Monsanto-Dayton) and the sites limited to metallurgical problems (MIT, BMI) or general nuclear research (Columbia, NBS) did not attend. Subsequently, attendance at Laboratory Directors Meetings expanded in a fashion paralleling that of the General Information Meetings.

Other Meetings. It was District policy to hold special meetings of key scientific personnel to review specific problems and to determine further action, as the necessity arose. Among these meetings frequently sponsored and generally attended by Division representatives were the sessions on the tritium production program, November 15, 1945, and the futuner pile construction program on the same date. The Division also occasionally participated in special health and medical meetings called by the Medical Division, particularly where research was planned, but such activity was incidental, and is not considered in further detail in this history.

Special meetings on District research problems in the field of metallurgy were called on May 14-15 and later on October 3, 1946. Emphasis on both occasions was placed on beryllium problems and the results of those sessions are accordingly treated in Chapter IV . In general, these two meetings served to supplement the various papers and discussions devoted to metallurgical problems at the General Information Meetings.

A unique meeting was arranged by the Division on November 4, 1946, to coordinate District materials research activities with those undertaken

by the AAF Materiel Command Laboratory at Dayton, Ohio. At the suggestion of the Director of that agency, scientists and engineers from the Division and Clinton Laboratories met with Dayton technical personnel to discuss their respective research programs in materials, particularly projects being conducted at academic institutions, so that no duplication of effort would result. It was agreed to interchange reports and other special information on ceramics and refractory materials of mutual interest to the District's pile program and to the AAF engineering and scientific research activities.

Division Responsibilities Regarding Research Meetings. Generally, the Division assumed the following responsibilities in connection with meetings of Project scientific personnel called to discuss research and development problems and activities.

Attendance. It approved the choice of dates, locations, number of representatives in attendance, qualifications of representatives, etc., and arranged for passes, clearance, quarters, etc., through the Area Engineer at the location of the scheduled meeting place, or making arrangements itself in the case of meetings at Oak Ridge. The Division also arranged to have its representatives in attendance.

Subject Matter. The Division reviewed and approved the proposed agenda, including subjects, data to be presented, controversial subjects to be considered, etc., and assisted where necessary in providing the necessary clerical facilities for reproducing agenda, issuing letters of invitation, etc.

Results. The Division arranged for minutes to be taken, either by its own representatives or by others authorized for that purpose by the conferees, and prepared summaries of the important actions and decisions. It advised the District Engineer of any results of interest to his office arising from the meetings, and distributed minutes and summaries to appropriate interested Project personnel.

Visits.

General. By authority of the Commanding General, in his directive to the District Engineer dated May 10, 1946, the general rule was promulgated that all persons wishing to visit any District installation where they were not regularly employed, and who might have access to "secret" or "top secret" information, must first be cleared by the Washington Office. Exceptions to this rule (as indicated by District Circular Letter MI 46-13, dated May 24, 1946) were employees and consultants on work of no more comprehensive nature than their original assignment, and employees who regularly visited the installation in the course of their normal duties. The provisions of these directives were subsequently modified by District Circular Letter MI46-13, Supplement I, June 12, 1946, which permitted the Area Engineers at the two respective sites to approve the visit of a Project employee from one installation to the second site where the visit was necessary for the proper transaction of business. Exceptions to this ruling were visits to Site Y, which still required approval by the Washington Office. Visits of all non-Project employees to any District site still continued to require Washington

approval. These regulations governed all visits on the Project during the rest of the year.

The above instructions, however, failed to take care of visits to three District research and development installations of direct interest to the Division: (1) Clinton Laboratories, which possessed no "Area Engineer," (2) the Evergreen Office in Canada, and (3) various research programs at Iowa State, Battelle Memorial Institute, Massachusetts Institute of Technology, and the National Bureau of Standards, which also possessed no "Area Engineers." The first and third instances, while similar, were not identical. The Research Division Operations Branch was designated to administer the latter laboratories in the absence of an Area Engineer and as such possessed authority to arrange visits. Clinton Laboratories, however, was supervised by an Operations Officer responsible directly to the District Engineer's Executive Officer, but not delegated an Area Engineer's authority for visitor approval. The Research Division was delegated to approve visits requested by the X-10 Operations Officer, for the District Engineer. Thus, the Division arranged visits to District research and development laboratories through three separate channels, in addition to standard District policy placing authority for visits under the respective area engineer.

It should be pointed out that obtaining administrative clearance was a two-fold operation, involving approval of both the security and the proper administrative offices. In the case of all visits for which Division approval was required, standard procedure was to obtain security clearance, establish justification for the proposed visit from the standpoint of approved District research and development policy, and finally to

approve issuance of the nessary visitor's pass.

In general, the principle justifying Research Division approval of visits of either Project or non-Project scientific personnel was the statement of the host laboratory director that the visitor could contribute to a definite and specific problem arising in an authorized laboratory activity.

Clinton Laboratories. The ambiguous policy governing authorisation of visits to and from Clinton Laboratories had existed prior to District policy established June 12. In an effort to clarify the respective responsibilities of the Division and the X-10 Operations Officer, the former prepared a procedure for obtaining administrative clearance to and from the Laboratories which was submitted to the District Executive Officer on February 12, 1946, and approved by him. The subsequent overall District policy prescribed by the successive clarifying supplements did not materially alter the channels established by the Division's proposed procedure. It operated as follows:

1. All visits of a purely administrative nature, where the acquisition of technical information was only incidental, were to be approved by the X-10 Operations Officer.

2. In cases where the visit was primarily for the exchange of Classified technical or scientific information, and the visitor was a District employee, authorization would come from the Research Division.

3. Cases identical with (2) but involving a non-Project employee (other than consultant) would require approval by the District Engineer.

The larger portion of Research Division activity in coordinating Clinton Laboratories visits, however, was in connection with the various supplementary programs developed there during 1946 in addition to Monsanto's regularly scheduled research projects. Initiation of the Nepa program, the assignment of Office of Naval Research and Naval Bureau of Ships scientists to Clinton Engineer Works, the various Information Meetings, the visits of special committees to review pile programs, criticality experiments, etc., involved considerable administrative effort. Such activity could have proceeded smoothly and according to the above policy were it not for the fact that last-minute notice of proposed visits, failure to notify the Division at all, or failure to have arranged with the contractor-hosts to receive the visitors, and other similar difficulties made the physical mechanism for obtaining visits often creak and groan.

Evergreen. After the Division took over jurisdiction of Evergreen from the Chicago Area on March 15, 1946, it attempted to maintain an effective control over visits to and from the installation. All such visits, however, were subject to final approval by the Washington Office. No established procedure was ever set up indicating the Division's responsibility in this respect. However, the Division made an effort to maintain a complete information file regarding all visits involving Evergreen. All requests received for visits to or from the site were forwarded to Washington for approval and most requests made directly to the Washington Office were referred to the Division for evaluation.

On April 16, 1946, the Division submitted a revised procedure to supplant current policy governing visits to and from Canada, and other foreign installations as well. The proposal channeled all requests for visits through the Research Division to the Washington Office. Revisions were suggested by Washington on July 11, and a revised procedure, essentially that originally submitted, was again forwarded to Headquarters on December 16. By year's end no further District action had been taken.

District Circular Letter (Legal 44-4) dated April, 1944, required that all visits within the Project be reported to the Office of the Patent Advisor for patent protection. In March, 1946, the Division arranged to continue the Chicago Area Engineer's monthly report to the Patent Advisor of all visits by Evergreen personnel to District installations. Subsequently, in May, the Division instructed Evergreen to include in its monthly report all visits to Evergreen, whether District, non-Project Americans, foreign nationals or whomsoever. Beginning in June, these monthly reports of all Evergreen visits were submitted to the Patent Advisor through the District Control Section, which combined them with all other reports of visits into one comprehensive monthly summary.

Operations Branch Installations. Routine administrative clearance for visits to and from Iowa State College, Massachusetts Institute of Technology, Battelle Memorial Institute and the National Bureau of Standards was originally supervised by the Operations Branch. By December 31, 1946, however, the Iowa facility had been placed under an Area Engineer and administration of Massachusetts Institute of Technology had been assigned to Madison Square Area. Battelle Memorial Institute and National Bureau of Standards visit control and approval continued under the Branch's jurisdiction during the rest of the year.

Chapter VII

Advisory Committee on Research and Development

Introduction. The preceding chapters have been primarily concerned with Research Division administration and control of research-contractor programs. The following pages of the history will be devoted to the Division's activities in connection with overall, District-wide research programs.

It should be quite clear by now that during the war emergency unavoidable security restrictions had prevented the formulation of a comprehensive, carefully-considered Project research and development policy under which current activities could be coordinated, and in terms of which future programs could be projected and foreseen. Not only was there a crying need for physical coordination of the separate contractor programs, but future planning necessitated the determination of broad objectives and comprehensive programs possible only after blanket review of current activities.

The Division's first objective had been to integrate the administration of the separate contractor operations, and its initial efforts were devoted to streamlining the physical research mechanism. At the same time it was evident that such physical consolidation was not enough, and that broad policy decisions had to be made on many pressing research questions in order to continue current programs with greatest effectiveness and to plan future work so that the nation would remain in the forefront of international nuclear science research.

It was for these reasons that early in 1946 the Commanding General appointed the Advisory Committee on Research and Development, composed

of leading American nuclear scientists, to assist in determining the general policies under which future Project activities should be coordinated. The Committee met in March and in June, 1946, to recommend action on the major problems involved in District research, and during the year the Division was concerned in large measure with effecting these Committee recommendations which met with subsequent District approval. The general research principles established by the Committee served as the "frame of reference" defining the broad philosophy for furthering nuclear science research which guided Division activities during the remainder of the year. Any history of these respective District programs should properly be prefaced by a review of Advisory Committee activities.

Evolution of the Committee. In June of 1945, some months prior to the establishment of the Research Division, the District Engineer appointed an advisory committee composed of Dr. A. H. Compton and Dr. C. A. Thomas to advise and assist in coordination of the research and development activities of the X-10 Project. It was proposed that this group, known as the "Metallurgical Steering Committee," would meet on the third Tuesday of each month to review the past results and future programs of the various laboratories comprising the Project, and to correlate them with overall policy and objectives. The first meeting was held on July 24, 1945, and the second on August 21. The third meeting fell on November 9, 1945, and was attended by members of the newly formed Research Division. Since the X-10 Research Operations office had been incorporated into the Division and other research installations pursuing research unrelated to the Plutonium Project would shortly come under Division jurisdiction, expansion of the committee's

membership and aims was discussed in detail at this time, but no definite action was taken.

Shortly after the beginning of 1946, however, the X-10 Advisory Committee or "Metallurgical Steering Committee," was replaced by the General Advisory Committee on Research and Development. It was intended that the new group would meet every 60-90 days and would serve as an interim agency to advise the Commanding General and his staff on continuation of Project's research activities, to serve the interests of national welfare and national security, and to insure an uninterrupted advance in nuclear science research during the transition period until a civilian agency had been appointed to assume Manhattan District responsibilities. The Committee members appointed by General Groves comprised Dr. R. F. Bacher, Dr. J. A. Wheeler, Dr. R. C. Tolman, Dr. W. K. Lewis and Lt. Col. J. R. Ruhoff, as well as Drs. Thomas and Compton of the X-10 Research Group. The District Engineer served as non-voting chairman, and the Director of the Research Division as non-voting secretary. At the request of the District Engineer, the Research Division prepared an agenda of topics awaiting District approval, for consideration by this committee at its initial meeting, March 8-9, 1946.

March 8-9, 1946 Meeting. The initial meeting was concerned chiefly with formulating the broad, general policies under which research and development should be pursued by the District during the remaining months of its tenure. The chief topics considered were:

(a) General policy for contracting for research and development with universities and private laboratories.

(b) General policy for conducting research and development in national laboratories established by the District.

(c) Continuation of current programs being undertaken for the District by universities and other private scientific institutions.

(d) General policy for a District-supported health program.

Policy for Universities and Private Laboratories. Having agreed that the District should expand its current research activities for the fiscal year 1946 to include a larger number of qualified agencies, the Committee recommended that this expansion be aimed toward the following objectives. Further history of each item will be found in the appropriate chapter of this history:

(a) Research and development in the production of fissionable materials. (Chapter IV).

(b) Research and development in the production of useful power. (Chapter VIII).

(c) Training of personnel in all branches of study associated with the field of nucleonics. (Chapter XIII).

(d) Encouragement of fundamental research in nuclear science. In general, it was felt that District research and development work undertaken for this purpose by universities and private laboratories should be fundamental and unclassified in nature (See Chapter XIII). The general conditions circumscribing such effort would be as follows:

(1) Eligibility. Any qualified university or private laboratory might participate in such District-supported work, providing its program had been previously approved by the Committee. Programs would be reviewed on the basis of funds available, priority of research acti[illegible] objectives,

and adequacy of personnel and facilities planning to undertake it.

(2) Government Request: The District on its own initiative might invite qualified institutions to undertake such work.

(3) Financial. The extent of subsidization should be:

(a) Not exceeding dollar-for-dollar support of operating costs (salaries, supplies, items of equipment, etc.) for work done at the initiative of the private agency.

(b) Total cost should be assumed by government for work undertaken specifically at its own request.

(4) Contract. The type of contract between the government and university or private laboratory should be in the nature of a grant where possible. The university or private laboratory should prepare a budget upon which the contract would be based and should submit a quarterly report on the status of budget and program.

(5) Security. There should be a contract clause providing for proper disposition of discoveries which might affect the national welfare or which might have direct military application. Further development of such discoveries could subsequently be undertaken at the private agency on a classified basis, or at a government laboratory where such classified work normally would be undertaken. In the former case, such classified work should be done on a voluntary basis. The universities and other private agencies would be under moral obligation to report all such discoveries to the District for review. Other security requirements, should be in accord with existing District policies.

(6) Health and Insurance. The District would assume no responsibilities for this matter in the case of research undertaken at the request of the private institutions and supported by District assistance. The District would assume total responsibility for health and insurance matters on research undertaken at its own request, provided mutual agreement had been reached that the work was hazardous.

The National Laboratories. In general, fundamental research undertaken at District-supported national laboratories, in contrast to that carried on at various universities and private institutions under the provisions directly above, should be of an unclassified nature requiring the use of piles, accelerators, and other equipment of too great cost for a university or private laboratory to underwrite.

Costs of all permanent facilities, permanent staff, administration, and all work done at government request would be paid by the District. Any qualified university or private institution would be permitted to participate in utilizing national laboratory equipment and facilities, in cooperation with other participating institutions, insofar as such facilities were available. Cost of such work, unless of principal interest to the government, would be borne by the private agency. (More detailed consideration of the national laboratories program and the Advisory Committee's activities in this respect, will be found in Chapter XII.)

Other District Research. The Committee further agreed that semi-works, pilot plants, development, and improvement of full-scale production processes and other experimental and development work associated with commercial exploitation or industrial skills should be carried on at District facilities

such as Clinton Engineer Works or the Hanford 300 Area. Work of a hazardous nature from medical or legal aspects should also be undertaken at more remotely situated District installations.

Extent of District Research Expenditures. It was felt that the total budget for research and development for the fiscal year 1947, ending June 30, 1947, should be in the order of $30,000,000 to $40,000,000, dependent on the available manpower, and as near the latter figure as possible.

Other Decisions at the March Advisory Committee Meeting. Other decisions at the March meeting not directly relating to the District's policy regarding research programs, and treated more extensively in other places were:

a. The isotope distribution program (See Chapter XI).

b. The District's medical and health program (See Chapter II).

c. Policy regarding dissemination of technical and scientific information to District research and development installations (See Chapter VI).

d. Government patent rights.

June 15, 1946, Meeting. At the Committee's second meeting, on June 15, the following general subjects were considered:

a. Research for new methods of isotope separation (Chapter IX).

b. General policy regarding construction of additional high-energy accelerators. (See Chapter IX).

c. Procurement of Personnel (See Chapter III).

d. Establishment of the national laboratories (See Chapter XII).

e. The Pile program, including current and proposed projects in this field (See Chapter VIII).

f. Form of contract for partial subsidization by the government for work in the atomic energy field (See Chapter III).

g. Review of specific programs submitted by various universities, either currently under contract with the District or under no contractual obligations, for assistance in new research undertakings (See Chapter XIII).

Future Meetings. The meeting of the Advisory Committee tentatively scheduled for August 2-3, 1946, was postponed on July 13 due to the District Engineer's presence at the Crossroads Operation. On October 1, 1946, the Division recommended to the District Engineer that no more Advisory Committee meetings be held pending transfer of District activities to the newly appointed Atomic Energy Commission, and this policy remained in effect throughout the rest of the District's existence.

Research Division Activities re Advisory Committee. It was the Research Division's responsibility to carry out all administrative activities necessary for the effective and efficient functioning of the Advisory Committee. The Division prepared extensive documented agenda for the meeting, arranged for the dates, meeting quarters and other essential details. As non-voting Secretary, the Director drafted and obtained Committee approval for the minutes. While the Committee was advisory in nature, such of its recommendations as received approval by the District Engineer were carried out by the Division in accordance with the spirit and intention of the meetings at which they were determined. The Division kept the District Engineer advised regarding all Advisory Committee Activities, and periodically reported the status of those recommendations which the District had subsequently approved and undertaken to place into effect.

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Chapter VIII

The Pile-Reactor Program

Introduction. The following two chapters are devoted to major District research programs emphasizing the further development and improvement of processes and equipment which have become significant features of District production technology. The present chapter discusses the history of the pile program, including plans for construction of new reactors and improvements in the chemical separation and recovery of pile fission products -- both features of former "Plutonium Project" research activities. Chapter IX, immediately following, is concerned with methods of isotope separation and production, and includes District policy governing development and construction of high-energy accelerators.

The District's Research Program for Pile-Reactors.

Experimental Pile Status, October 15, 1946. At the time the Research Division was organized the District's pile facilities consisted of the three production piles and the small-scale Sigma pile at Hanford, the Clinton Laboratories' graphite, air-cooled pile, the Los Alamos "water boiler", and the graphite and heavy water piles at Argonne. A zero power graphite pile originally constructed in the University of Chicago West Stands had been dismantled. Thus, the Clinton Laboratories and the Argonne piles were the chief facilities available for experimental research and development, together with such portions of the Hanford piles as could be provided for experimental purposes without restricting the plutonium production program.

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At a policy council meeting of various District Research Laboratory Directors held in Chicago October 16-17, 1945, it was decided that an informal planning conference should be held on November 15 for evaluation of the various proposed new pile construction programs. The November meeting was attended by the Research Division Director, who reported agreement among the Laboratory Directors that the preferred order of construction for future piles should be:

a. The Daniels, gas-cooled, "power" pile intended to demonstrate the application of atomic energy to power generation.

b. The Clinton Laboratories, high-flux, "heterogeneous" pile designed to provide neutrons over a wide energy range for research studies.

c. The Zinn, "fast neutron" pile.

It was recommended that no more emphasis should be placed on any individual aspect of the pile program at this time, but that all three projects should be pursued with vigor until the numerous preliminary problems involved in completion of each had been investigated and, where possible, resolved.

The problem of final location of the Daniels Power Pile was also explored by the District Engineer and Dr. Farrington Daniels at this time, but no final decision was reached.

Major Phases of the 1946 Pile Program. Major District research activities during 1946 were devoted to furthering these three new piles, the power pile, the heterogeneous pile, and the fast neutron pile. Priority of effort has been that originally established, the

power pile program receiving the greatest emphasis and reaching the highest stage of development by year's end. The District's activities in all three programs are treated separately below:[1]

1. Proposals for District construction of several other new types of pile-reactors were considered during 1946, namely:

a. An air-cooled, graphite, experimental pile for Brookhaven National Laboratory, essentially a modified and improved version of the Clinton Laboratories air-cooled, slow neutron pile.

b. An experimental pilot-plant pile to serve as the prote-type for a later full-scale, high-power, high temperature power pile. This pile will be built by General Electric at Schenectady.

c. A fast neutron, low-power, mercury-cooled experimental pile at Los Alamos.

Detailed descriptions of all current and proposed District piles are included in Dr. W. H. Zinn's summary "Reactors," included in the "Report on Research and Development" prepared for the Atomic Energy Commission on February 1, 1947.

The Power Pile Program.

Background. In the early part of 1944 a small group of scientists at the University of Chicago's Metallurgical Laboratory began to hold frequent informal meetings to discuss the application of nuclear energy for other uses. Of particular interest was the utilization of atomic energy for the generation of power. The group included Drs. S. K. Allison, E. P. Wigner, Leo Szilard, H. C. Vernon, Frederick Seitz, P. Morrison, Gale Young, E. C. Creutz, J. Franck, William W. Watson, Charles M. Cooper, Thorfin F. Hogness, Albert Weinberg, L. A. Ohlinger, Enrico Fermi, and others who came in from time to time to express their ideas. The general scope of this administrative history will not permit discussion of the numerous proposals and suggestions considered regarding the utilization of atomic energy in power piles. Following his arrival at the Metallurgical Laboratory in September, 1944, Dr. Farrington Daniels had conceived the idea of a high-temperature pile using beryllium oxide as a moderating material. After detailed discussions of the proposition by other scientists of the Chicago group, it was decided to be the most feasible program considered up to that time. During the remainder of the fall of 1944 and the early part of 1945 frequent informal conferences were held between Dr. Daniels and Drs. Wigner, Hogness, and Compton of the Chicago Project on the subject, and on frequent visits to Chicago the District Engineer had talked with Dr. Daniels and encouraged the development of a power pile.

In April, 1945, the District's budget for research and development at the Metallurgical Laboratory was modified to include a provision for the expenditure of approximately $20,000 in the Chemistry Division for power pile research work. Soon afterwards, in July, 1945, a "Power Pile" section was organized within the Metallurgical Laboratory's Chemistry Division, and the first actual experimental work was begun on problems relating to the construction of a chain-reacting pile to be operated at a high temperature. Dr. J. E. Willard, then at Hanford Engineer Works, was brought to Chicago to take charge of this section.

During the fall of 1945 several conferences were held among Colonel K. D. Nichols, Major General L. R. Groves, and Dr. Daniels (who at that time was still Director of the Metallurgical Laboratory) concerning the scope of the problems that were being encountered in the proposed high-temperature pile. Colonel Nichols felt that the problem was getting too big for the Metallurgical Laboratory, and that, since the pile was intended primarily for power purposes, its development should be the responsibility of an industrial organization rather than a research group. At the same time Colonel Nichols was opposed to the negotiation of additional subcontracts by the Metallurgical Laboratory. Although he believed that a power pile should be built as soon as possible, he felt that the project should be undertaken at Oak Ridge. It was, therefore, decided that the Monsanto Chemical Company (operators of Clinton Laboratories at Oak Ridge) should be approached regarding the undertaking of a contract for the design and development of the power pile program. In January, 1946, the Monsanto Chemical Company sent four representatives to Chicago

to confer with Dr. Daniels. After a careful study of the plans, Dr. C. A. Thomas, Vice President of Monsanto Chemical Company, agreed that his company would undertake the job.

Advisory Committee Review. A history of previous developments regarding completion of the power pile program was presented by the District to the Advisory Committee for Research and Development at its March 8-9, 1946 Meeting. The Committee at that time recommended that further design of the proposed pile should proceed on the assumption that it would be built and operated by the Monsanto Company at Clinton Laboratories. Actual design and construction would be undertaken by Monsanto in cooperation with Dr. Daniels and Metallurgical Laboratory personnel, and other interested agencies including the General Electric Company, Westinghouse, the Navy, and possibly other research institutions such as Massachusetts Institute of Technology.

Authorization and Organization of the Oak Ridge Power Pile Program. On April 11, 1946, a meeting was attended in New York by Dr. Daniels, Dr. J. H. Lum, Dr. C. R. McCullough, who had been appointed Director of the Power Pile Division that was to be located at Oak Ridge, various industrial executives and engineers from the General Electric Company, Westinghouse Electric Company, and the Allis-Chalmers Manufacturing Co., and representatives of the Army and Navy. At this conference the respective organizations agreed to participate in a cooperative program at Oak Ridge, to be established as soon as possible, and the Monsanto Chemical Company formally accepted responsibility for the design, construction, and operation of the power pile.

On May 16, 1946, the Division prepared a letter from the District Engineer to Dr. C. A. Thomas of the Monsanto Company confirming the agreements reached previously at various meetings and conversations and directing Monsanto to proceed as rapidly as possible with the design, construction, and operation of an experimental, high-temperature power pile, on pilot plant scale, according to the Daniels design. Monsanto was also authorized to undertake the study of the long-range aspects of power applications of atomic energy. These directives were to be carried out in connection with its existing contract and without substantial interference with current Clinton Laboratories programs. In this regard, Monsanto was authorized to obtain assistance from Chicago, leading industrial concerns in power and related fields, universities, technical institutions, and interested branches of the Army and Navy, and, further, to organize a working group of qualified personnel within the framework of the Clinton Laboratories organization. In May, 1946, Dr. McCullough began to negotiate with the various companies for the loan of engineers and scientists, on a "leave of absence" basis, for the design work on the proposed pile. A few weeks later, special courses in nuclear physics and mathematics were initiated at Clinton Laboratories for some of these men. Particular emphasis was given to the calculations involved in power-pile design. Meanwhile, experimental work was being continued at the University of Chicago under Dr. C. G. Simpson. Dr. Daniels joined the group at Oak Ridge in July, 1946, as a consultant, and at the beginning of the school year (in the autumn of '46) he began dividing his time equally between Oak Ridge and the University of Wisconsin, spending alternate weeks at each place.

Following formal authorization of the power pile project in May, it had become a regular part of the Clinton Laboratories research program, and the Division's administrative activities regarding it will be found included with the history of other Clinton Laboratories' functions in Chapter II. Procuring personnel for the new program continued to present a definite problem, and the Advisory Committee on Research and Development recommended at its June 15 meeting that the new, proposed Brookhaven National Laboratory be approached regarding the loan of physicists and other technical personnel to Clinton Laboratories to assist in the power pile program and at the same time gain valuable experience. In accordance with this suggestion the Division approached the new laboratory's planning committee on July 1 regarding such a loan. Brookhaven, however, had not progressed sufficiently beyond the preliminary organization stage during 1946 to render appreciable assistance to the power pile program in this respect.

Despite this handicap, by November, 1946, plans and experimental work were far enough advanced that a formal preliminary report could be prepared covering all phases of the design, construction and operation of the power pile.

Research Division Activities. The Research Division coordinated the research program for this work with the exception of the "Power Generation System". Special problems were assigned to those research contractors which had the manpower and equipment best suited to handle that particular part in the overall program. For instance, analytical problems were given to the National Bureau of Standards; metallurgical problems were given to Battelle Memorial Institute, Massachusetts Institute of Technology and others; methods of material purification and production were given to

Iowa State College, the University of Chicago, and others, etc. Each contractor submitted a monthly progress report on the program which was being conducted at its installation. At the conclusion of any particular phase a technical report was written to cover the experimental work. Therefore, the monthly progress reports and the technical reports issued by each of the contractor installations give a full account of all power pile research.

Factors Concerning Power Pile Development.

General. The size, shape, and overall consideration of a power pile were approached mainly from the theoretical standpoint; however, experience gained from the operation of chain-reacting piles was of considerable aid to the group connected with these particular factors. This portion of the program has been carried on for the most part at the Argonne National Laboratory.

Fuel. The consideration of the type of fuel for operation of the power pile was a factor of particular importance. Under the present limitations the fuel had to be U^{235}, and the manner in which the material was to be incorporated into the pile required much research. Rather than using the customary normal uranium as fuel it appeared to be better to utilize enriched U^{235}, either alloyed or dispersed in one of a number of other possible materials. The size, shape, metallurgical composition, and physical and chemical characteristics of the fuel components were all vitally important factors to be considered. This problem has been a closely coordinated, cooperative investigation involving the Argonne National Laboratory, Battelle Memorial Institute, Massachusetts

Institute of Technology, the Norton Company, and the National Carbon Company.

Moderators and Reflectors. Moderators and reflectors are materials which slow fission neutrons to thermal velocity and lessen their escape from the pile. These components will probably determine the final size, operating characteristics and efficiency of the power pile more than any other factor. The moderators and reflectors first considered were carbon, light water, heavy water, beryllium oxide, and beryllium metal. The physical and chemical characteristics of all the moderators considered caused the first three to be ruled out. The final choice will probably lie between the last two mentioned materials. The research program on this phase at the close of this history was being conducted at Iowa State College, Hanford Engineer Works, Argonne National Laboratory, Massachusetts Institute of Technology, Brush Beryllium Corporation, Clifton Products Company, Beryllium Corporation, A. O. Sparkplug Company, and the Norton Company.

Shielding. Radiations given off from a chain-reacting pile require the use of shielding to safeguard the lives and health of the operators. Metallic lead and aggregate concrete of required thicknesses had been adequate for most shielding requirements and hitherto very little attention had been given to the development of other lighter shielding. Battelle Memorial Institute was authorized to embark upon a research program to produce concrete containing a high percentage of finely divided metallic iron. Early results of these investigations indicated some promise for this aggregate as a shielding material, but work was not far enough advanced by December, 1946 for any definite

evaluations to be made.

Coolant. The selection of a primary coolant for removal of the heat generated by the high temperature pile was a major problem, although the relative advantages of several suitable materials had been known for some time. After the specific operating conditions of the Daniels' Pile had been determined, helium was chosen for this purpose.

Power Generation Components. Development of this phase of the program was not under the primary jurisdiction of the Manhattan District. The overall program was approved by the District for execution by the Monsanto Chemical Company, but it was felt that the cooperating industrial concerns were the best suited and the most capable for selecting and developing this system. The conditions under which the system was to operate were given to the cooperating industrial group and several designs for various pieces of equipment were subsequently submitted by the following companies to serve as the basis for further design evaluations.

(a) Boiler designs were submitted by Babcock and Wilcox, Foster-Wheeler Corporation, and Combustion Engineering Corporation.

(b) Designs for a number of pieces of auxiliary equipment were submitted by the following companies: Frederick Flader, Incorporated, American Blower Co., Allis-Chalmers Manufacturing Company, Buffalo Forge Company, Delaval Steam Turbine Company, Westinghouse Electric Company, and Spencer Turbine Company.

The steam turbine-generator equipment will probably be supplied by the Navy.

Chemical Processing. Continuous operation of a power pile requires constant charging with fresh fuel and discharging, at the same time, of the spent uranium. A period of radioactive decay is then necessary before chemical processing to recover the U-235 isotope and the fission products from the discharged fuel can be accomplished. Final designs of equipment for chemical processing of the spent material will be based on investigations undertaken during 1946 at the Argonne National Laboratory, University of California Radiation Laboratory, Hanford Engineer Works, and Clinton Laboratories.

The Clinton Laboratories Heterogeneous Pile Program. On May 6, 1946, the District Engineer appointed a Pile Review Committee to meet on May 27, 1946, at Oak Ridge and review the Clinton Laboratories proposal for proceeding with construction of a "heterogeneous" or high-flux experimental pile at Oak Ridge. The outstanding feature of the proposed unit was the fact it would supply a wider energy range of neutrons than any hitherto considered. Members of the Committee were Dr. Ray Jeffries of the General Electric Company, Dr. Hood Worthington of the du Pont Company, Dr. W. H. Zinn, Dr. John Wheeler of Princeton, and Dr. W. K. Lewis of Massachusetts Institute of Technology. On May 17 the Division sent a preliminary report describing the pile to the Committee members, and arranged for the May 27 meeting at Clinton Engineer Works.

The objectives of the Pile Review Committee as stated by the District Engineer at the May session, were to:

a. Explore and determine the technical feasibility of the proposed pile.

b. Recommend whether or not to build the pile and when.

c. Determine its advantages compared with other proposed experimental piles.

d. Outlined the general organization required to carry out its design, construction and operation.

e. Evaluate safety, health, and other hazards involved.

f. Review current status of available research and engineering data necessary to complete the project.

g. Estimate concentrations and amounts of special materials necessary for completion and suggest methods for maintaining accountability.

The Review Committee conferred with Clinton Laboratories scientists and agreed that the proposed pile was technically feasible, advising that its construction be authorized at once.

At the subsequent June 15 meeting of the Advisory Committee on Research and Development, the proposal was once again considered on the basis of the Pile Review Committee's decision and the latter's conclusions were seconded. It was agreed, however, that the relative "safe" or "dangerous" hazards involved in its construction marked it as a "borderline" case.

Despite the Advisory Committee's recommendation in June that engineering design be initiated at once on the heterogeneous pile, no appreciable advance was made in this respect during the remainder of 1946. Instead, Clinton Laboratories' work on this reactor was directed toward making changes in the experimental, preliminary design to incorporate new ideas derived from subsequent fundamental research and

particularly from conclusions developed at Argonne. No authorization for inauguration of construction engineering design was forthcoming from the District.

The Zinn Fast Neutron Pile: The Zinn Fast Neutron Pile is intended primarily to furnish fundamental, experimental data on "breeding" and "conversion" of fissionable materials. The Program was revised by the Advisory Committee on Research and Development at its March 8-9, 1946 meeting at which time it was recommended that work on the project be continued at Chicago under the supervision of Dr. Zinn and that ultimate construction of the unit be undertaken at Chicago if possible. Following completion of the preliminary design, it was felt that the proposed construction program should then be reviewed by a special committee to determine feasibility and to consider the legal and health problems presented by location of the pile in Chicago. Dr. Zinn was requested by the Division to compile data on design and construction of his pile for consideration at the June 15 Advisory Committee Meeting, and the information he submitted was included in the agenda of the meeting. No further action was taken either by the Committee or the District, however. Subsequent activity on this score was limited to completion of preliminary design data for the proposed unit. Approval for initiation of final construction and engineering design had not been authorized by the District by December 31.

Proposed General Pile Review Committee: On October 1, 1946, when the Research Division recommended to the District Engineer that no more meetings of the Advisory Committee be held until the Atomic Energy

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Commission had taken over District activities, several suggestions regarding the experimental pile program were also submitted. After briefly summarizing the status of the major proposed pile projects, the Director recommended appointment of a general Pile Review Committee, to begin functioning as soon as possible and to make a thorough review of the Zinn Fast Neutron Pile, the Daniels' Power Pile, and the Clinton Laboratories High-Flux, Heterogeneous Pile in the light of national needs, availability of personnel, special materials, and other pertinent considerations. At this time a list of recommended scientists and engineers was submitted whose qualifications made them eligible for membership on such a committee. Having approved this suggestion in principle, the District Engineer apprised the recently appointed Atomic Energy Commission members in November regarding establishment of such review group. The Commission requested no definite action be taken until it had been able to review the matter more thoroughly.

Bational Bureau of Standards Rejected Requests for Piles.

On February 21, 1946, Dr. E. U. Condon, Director of the National Bureau of Standards, requested the District Engineer to authorize District construction of a uranium-graphite pile at the Bureau. The request was reviewed by the Advisory Committee at its June 15, 1946, meeting and recommendation made that it be disapproved because of the current manpower shortage. It was felt, however, that construction of the facility for the Bureau would be of considerable value and that it should be provided at some future date.

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Chemical Recovery of Pile Fission Products:

General. Despite the success of the Hanford method for separating plutonium from fission products after pile exposure, research has continued at various installations on alternative methods. Of these processes, the greatest emphasis has been placed on solvent extraction, utilizing either the "Redox" (reduction-oxidation method) or the "TTA" (chelate method).

The "TTA" and "Redox" Solvent Extraction Processes: Solvent extraction of plutonium from uranium and pile fission products by "TTA", a ketone which complexes with plutonium by selective chelation, has been confined to laboratory-scale investigations at the University of California and at Chalk River, Ontario. A higher stage of development has been reached by the "Redox" process which was carried through the experimental stages at the Metallurgical Laboratory in Chicago and subsequently was expanded to semi-works scale (1/100 full plant) in the University of Chicago West Stands. The du Pont Company during 1945 had also experimented with the process in its Hanford Laboratories.

On March 23, 1946, the Division reviewed the results of both Hanford and Chicago studies and recommended to the District Engineer that a tenth-scale "Redox" pilot plant be installed at Hanford to provide design data at higher radiation levels for future separation and metal-recovery units. The reasons for locating the project at Hanford rather than at Oak Ridge, where plutonium production pilot plant scale work had hitherto been concentrated, were: (a) the anticipated continuation of plutonium production at Hanford Engineer Works, (b) the need to

recover large amounts of uranium from stored wastes, and (c) in order that planning for large-scale processes at Hanford Engineer Works might be considered simultaneously with pilot-plant design. Other considerations supporting further "Redox" activity at the time were the need for establishing an alternative extraction process for the precipitation method in current use in order to provide against any emergency which might make the latter inoperable; the necessity for acquainting other scientists with valuable process "know-how" before the anticipated disbanding of the Redox group at Chicago had occurred; and the unquestioned superiority of the redox process over the regular Hanford separation.

The process takes advantage of the fact that under controlled conditions certain water-immiscible organic solvents such as hexone, upon intimate contact with the aqueous nitrate solution containing uranium, plutonium, and fission products, will extract preferentially the first two materials leaving most of the fission products behind in the aqueous layer. Separation of plutonium from uranium can subsequently be brought about by taking advantage of the fact that under controlled reducing or oxidizing conditions, plutonium is rendered very insoluble in hexone whereas the uranium remains unaltered and is extracted efficiently in the hexone layer.

When the General Electric Company assumed responsibility for Hanford operations on September 1, 1946, its contract obligated it to develop pilot plant facilities for the redox process. On September 27 General Electric advised the Division that it planned to take over the complete redox program at Hanford Engineer Works, following establishment

of a comprehensive research project schedule. On October 4, after contacting the redox group at Hanford, it further reported that both experimental and pilot-plant development could be undertaken at Hanford Engineer Works within the next six months providing sufficient skilled manpower could be obtained.

Chapter IX

Programs for High-Energy Accelerator Construction and Isotope Separation Research

General. Besides the pile reactor program, the two other outstanding District technological programs involved construction of high-energy accelerators for fundamental nuclear research, and investigations in improvement of methods for isotope separation, particularly of uranium. The following two sections discuss the Division's activities in each of these programs.

The District's Research Program for High-Energy Accelerators.

General Policy. The District's policy with respect to support of future, high-energy particle accelerator research and development was guided by recommendations made at the initial meeting of the Advisory Committee for Research and Development, March 8-9, 1946. In discussing continuation of the University of California's research activities, it was recommended that an important condition to such continued District support should be the University of California's assistance to other American universities and scientific institutions in design of accelerating equipment.

Government policy regarding support of high-energy accelerating equipment construction was again reviewed by the Advisory Committee at the June 15 Meeting. It was generally agreed, in reply to a direct query from the District Engineer, that a need existed in the United States for District subsidization of accelerator construction at private universities in addition to any equipment of this nature which might be installed at the District's proposed national laboratories. Drs. Bacher

and Wheeler were delegated to prepare a list of institutions capable of supporting a high-energy accelerator program. It was proposed that the top ten universities from this roster would then be contacted informally by the District regarding their future plans for research in this field.

The present section is limited to District policy respecting subsidization of accelerators in U. S. universities. Plans for installation of this equipment at Brookhaven and Argonne, at District expense, are discussed in detail in the respective reviews of these programs (See Chapters XII and II, respectively). While various accelerators are planned for Argonne, the only equipment approved for installation at that facility during 1946 was a Van de Graaff accelerator. At year's end, Brookhaven's accelerator program was still in the planning stage.

Review of University Programs. Professors Wheeler and Bacher prepared a list of universities to be investigated and subsequently the Research Division was requested by the Washington Office to contact the respective institutions regarding their present and proposed accelerating equipment and also their current and future plans for undertaking nuclear physics research. The Technical Branch completed a survey of the field and the results were forwarded to Washington by the Division Chief on September 5, 1946.

On October 14, Colonel Fields requested the Division to submit comments regarding general policy to be followed in Government support of accelerator programs at universities and private scientific institutions. The several points suggested by the Division Technical Branch

were sent to Washington by the Chief on October 31, 1946, were:

(a) The diverse programs of the separate government organizations supporting accelerator construction programs at various universities and scientific institutions, and that of the Navy in particular, should be coordinated under one Government agency, preferably the Atomic Energy Commission. Except for the University of California, it was observed that practically all new cyclotron construction in the United States was currently being supported by the Navy.

(b) The government should make every effort, where practicable, to decentralize its accelerator-support program, making such equipment available to areas where it is not now available. Under this regionalization of support, it was pointed out that the equipment would serve in training a wide geographical distribution of future nuclear scientists and technicians.

(c) Mammoth accelerating machines should be limited in number and located preferably at national laboratories in metropolitan areas within reach of a large number of capable scientists, rather than merely at a strong university not readily accessible to other scientific institutions.

(d) Grants-in-aid should be the preferred type of financial assistance, since the universities would be readily able to spend funds in this category in accordance with their normal accounting procedures without extensive government fiscal control.

Dr. E. M. MacMillan prepared a comprehensive review of present and proposed District-supported accelerators which was included in the Division's "Report on Research and Development" submitted to the Atomic Energy Commission in February, 1947.

Isotope Separation Processes:

Gaseous Diffusion (K-25) and Electromagnetic (K-12) Processes: During the war, fundamental research on the gaseous diffusion process was carried out under the supervision of the Columbia University group in New York at the SAM Laboratory, and at Carbide & Carbon and other associated laboratories. Following establishment of the Research Division very little research on this process was sponsored by the District in 1946, other than that conducted directly by the operating contractor at K-25. An exception was the research carried on by the National Bureau of Standards, to provide fundamental thermodynamic data for improvement of production operations of the gaseous diffusion and electromagnetic operating plants.

Research and development on the electromagnetic separation of isotopes of uranium by the calutron developed at the University of California followed much the same pattern as that for the gaseous diffusion process. Except for the National Bureau of Standards thermodynamic studies, most work since the war has been conducted at K-12. Since the calutron is a mass spectrograph designed for large-scale isotope separation, however, improvement of electromagnetic methods for separation of isotopes at Berkeley was essentially a part of the District's overall accelerator program.

The general philosophy followed by the District during 1946 on research in isotope separation methods was clearly stated by the Advisory Committee on Research and Development at its June 15, 1946, meeting. While no specific recommendations were made on the proportion of effort which should be placed on development of new separation methods, it was agreed in principle that effort should be placed on research and development in the general field of uranium isotope separation, and whenever a method was developed to a point where its relative merit could be determined, it should either be dropped or pursued further with increased effort.

Thermal Diffusion Separation at Oakmont (S-50): The Clinton Engineer Works S-50 Plant for uranium isotope separation by thermal diffusion was shut down in September, 1945, prior to the establishment of the Research Division. About a year later, at the request of the Navy, Dr. B. J. Pflaum of the Technical Branch visited the S-50 Pilot Plant at the Philadelphia Navy Yard on October 17, 1946, to inspect the facility, evaluate its worth, and make recommendations regarding its disposal. It was recommended that unless the Carbide & Carbon Company planned to operate the CMI S-50 plant in the future, and desired to utilize the Philadelphia pilot plant equipment, that the latter be jettisoned as the cheapest means of immediate disposal consistent with security.

Ionic Centrifuge Separation Methods (Westinghouse Electric Company). War-time research conducted by Dr. Joseph Slepian at the University of California and later at the Westinghouse Research Laboratory, Pittsburgh, on isotope separation by a modified magnetron known as the "ionic centrifuge" is described in the Smyth Report, Pars. 11.29 and 11.30.

Slepian's project aimed at the practical development of a electromagnetic device comprising an ion source operating in a highly evacuated magnetic field. Following the decision of the District late in 1942 to use the "calutron" method of electromagnetic isotope separation, Dr. Slepian returned to the Westinghouse Research Laboratories from Berkeley and independently undertook further development of his ionic centrifuge. In 1943 he requested permission to obtain special materials from the District which were essential to this effort, and the Army agreed to supply them free provided it was kept informed of any significant developments. The District also provided free analytical services for his various sample runs. The work, as summarized by Dr. Slepian in a letter to the District on December 21, 1945, was covered by no formal contract, the District's only contribution being the furnishing of materials, analyses and obtaining desired draft deferments. Inasmuch as the analytical chemists who had previously performed Slepian's analyses in New York had been subsequently moved to Clinton Engineer Works, the Division on January 3, 1946 authorized the X-12 Area to furnish him the desired services.

In view of the loose verbal agreement existing between Slepian and the District, it was desirable that the value of his program be determined and that it be either discontinued completely or that a definite, formal relationship be established. Accordingly, Dr. Slepian was requested to review his activities to date. Following his reply on April 19, 1946, it was decided to have one or more competent chemists study his program more intensively and evaluate its worth to the District.

During the month several months the District unsuccessfully attempted to have Drs. R. L. Thornton of the University of California and L. T. Reinbridge of Harvard visit Slagdem and review his activities. Finally, in September it was arranged that Dr. Robert Wilson of Harvard would evaluate the work on the basis of Slagdem's summary "The Ionic Centrifuge," which he had submitted. On October 7, Professor Wilson advised the Division that the program had not progressed sufficiently for any definite decision to be made regarding its success and that further experimentation was the only answer to the problem.

On November 15, Dr. McDaniel of the Technical Branch visited the Nottingham Research Laboratories to discuss the matter with Slagdem. It was recommended that the program be continued and that the District continue its policy of supplying the necessary analytical services, providing that it in turn was informed of the results of his activities. On December 30, 1946, the Division prepared a formal letter of agreement from the District Engineer confirming the original verbal agreement of 1943 and enumerating the mutual services to be performed.

Other Ionic Separation Research Projects. During 1946 the District sponsored five additional research projects involving uranium isotope separation, one at Iowa State College and four at the National Bureau of Standards. Details of the Iowa investigations of isotope separation by an electrolytic process will be found on page 10, Chapter II. The four NBS projects, involving separation by photochemical reduction, chemical interchange of tetravalent uranium ion, counter-current electromigration, and counter-current molecular distillation, are treated on page . All four

National Bureau of Standards studies were given low priority rating by the Division, as a result of which on November 26, 1946, the Bureau advised the District that limitation of funds necessitated that all further effort on the projects be undertaken at the Bureau's expense and discretion.

Chapter X

Program for Assisting Other Military Agencies in Nuclear Science

Research.

General. The possibilities of the application of atomic energy to power generation have long attracted the interest of the Army Air Forces and the Navy. Following war's end, positive steps were taken by the District to assist both of these agencies in their research efforts to develop atomic power generators for ships and aircraft.

The Navy's program was coordinated with plans for General Electric research at Schenectady and was still largely in the development stage at the end of 1946. Meanwhile, arrangements had been made to provide the Naval research staff with necessary classified technical information to orient them in the various technical activities at Oak Ridge.

The Army Air Forces program crystallized into the establishment at Oak Ridge of the NEPA Project for the undertaking of a positive program in engineering research and development in the application of nuclear energy to aircraft propulsion.

District Research Liaison with the Navy.

Over-all District Liaison. On October 3-4, 1945, shortly before the establishment of the Research Division, representatives of the Naval Research Laboratory visited the Chicago Metallurgical Laboratory ~~to initiate preliminary discussions with the District in anticipation of the institution of Navy research program in nuclear science to be undertaken in conjunction with the District and its civilian successor.~~ Emphasis was to be placed by the Navy on development of power. Exploratory discussions were held with the Chicago Area Engineer regarding transmission of reports

and other information to the Navy (scientific officers) and possible assignment of Navy personnel to the District for training purposes, but no definite decisions were made at that time.

The extent to which the District would support research and development activities in the field of application of atomic energy to ship propulsion for the Navy was discussed a few months later by the newly-appointed Advisory Committee on Research and Development at its initial March 8-9, 1946 meeting. At this time it was agreed that the District would undertake such work until specific legislation had been passed to the contrary.

During 1946 numerous Navy Department officers were assigned to various District sites, including Lt. Commander H. A. Jackson to the General Electric Ship Propulsion Program at Schenectady, and Captain H. G. Rickover and (a staff of) Naval officers to Oak Ridge. Several civilian scientists from the Bureau of Ships and the Naval Research Laboratory were also assigned to Clinton Laboratories for training purposes. Meanwhile certain high-ranking officers in the Navy Department in Washington were cleared by the District to receive information and reports on atomic energy.

The Navy-General Electric Ship Propulsion Program. Prior to August, 1946, the Navy had approached the General Electric Company regarding a research program on atomic energy for ship propulsion. General Electric expressed interest in such a program, but, before a Navy contract could be negotiated, this concern had been awarded a contract by the Manhattan District for the operation of the Hanford Engineer Works and for undertaking a broad research program at Schenectady, New York. The terms of this contract prompted the Navy to propose a cooperative program with both the General Electric Company and the Manhattan District. On August 19, 1946,

the Acting Chief of the Bureau of Ships wrote to General Groves stating the general terms of the proposal. General Groves felt that the program was desirable and that it could be conducted at Schenectady under the Hanford contract. The proposed cooperative program was approved in August, 1946, and it was agreed that the Manhattan District or the Atomic Energy Commission would finance the program for the fiscal year 1947. This arrangement was to be reviewed before July 1, 1947, to determine if other arrangements would be desirable. (The Navy also requested that several Naval officers and civilian engineers of the Navy Department be assigned to Oak Ridge to acquire certain information which was necessary for the furtherance of the program. This request was also approved and part of the group has been assigned to Oak Ridge since December, 1946.)

(8)

(9) PP. > (10) <

(Research Division Liaison.) On November 14-15, 1946, Dr. H. H. Roth visited the Office of Naval Research Planning Division in Washington to discuss the Navy's current interest in nuclear science. His trip revealed the existence of a well-rounded program of fundamental nuclear science research being supported by the Navy at numerous American universities and scientific institutions. Except for the University of California, practically all new cyclotron construction in the United States, it was found, was being supported exclusively by the Navy. It was felt that all proposed District (and Atomic Energy Commission) research should be coordinated with the Navy to avoid duplication of effort. Finally, to further the government's overall atomic energy program, it was recommended that the District initiate an aggressive policy to supply the Navy with currently declassified information and to establish channels for speedy dissemination of all classified information to properly authorized Navy personnel.

~~A few weeks later, in December, a more positive program for~~ (11)
~~expediting liaison between the District and the Navy was in evidence.~~
The Navy had assigned a Bureau of Ships officer to the Research Division Instrument Production Section for training and coordination of Navy radiation detection instrument requirements, and the Division was formulating a definite procedure for expeditious transmittal of classified and declassified District scientific information through the Washington Office to the Navy.

For some time, the Office of Naval Research had maintained a representative in the Operations Division, Captain H. G. Rickover, to maintain liaison between the Navy scientific and engineering staffs and the District. At the request of the Director of Operations, the Division also established channels whereby classified District information could be interchanged between Captain Rickover and the Office of Naval Research. (12)
A list of Navy off-Project personnel to whom the reports of the Navy representatives at Oak Ridge were to be distributed was prepared and authorized by the District Office in Washington. Individual reports intended for off-Project distribution were to be forwarded to the Division for review by its technical staff, together with the authorized distribution list. The Division then forwarded the reports, with recommendations to the Washington Office; if final approval was given there, the latter arranged for transfer to the Navy. In individual cases, distribution could be requested and approved for extra persons in addition to those requested on the standard, authorized distribution lists. Clearance for such additional Navy personnel was carried out in Washington. (13)

The Nepa Program (Nuclear Energy for Propulsion of Aircraft)

General Background. For several years prior to the establishment of the Research Division, the Army Air Forces had desired to investigate the use of atomic energy for aircraft propulsion. Following war's end, several airplane manufacturers approached the Army Air Forces with proposals for experimental work on such an application. The prerequisite to such an undertaking, however, was the willingness of the Manhattan District to make available the fundamental restricted information and special equipment and facilities necessary for research in this new area of atomic science. An agreement was reached between the District and the Army Air Forces whereby the former would make available necessary information providing this information were funneled through a single organization representing the overall AAF program so that centralized security control could be maintained.

To satisfy this requirement, the AAF chose the Fairchild Engine and Airplane Corporation as prime contractor in the program for development of atomic energy for aircraft propulsion. The Fairchild Corporation, in turn, set up a new Division, designated NEPA, composed of its own technical staff and representatives of numerous other interested engine manufacturers. It is the NEPA Division which has undertaken the operating responsibilities for training aeronautical engineers and scientists in nucleonics and for the development of atomic energy propelled aircraft on a non-profit, cost-reimbursement contract. Under this arrangement, the AAF agreed to authorize no changes in established NEPA policy governing interchange of technical information, allocation of

research contracts, modification of current research projects or any other activity involving nuclear science research and development without prior approval from the District. The District, on the other hand, assumed responsibility for scrutiny of all NEPA research activities to assure optimum coordination with operations, objectives, procedures, and other established policies of the national atomic energy program.

It was decided that NEPA headquarters should be located at Oak Ridge, where effective coordination of the program could be achieved with the Monsanto Chemical Company's pile program at Clinton Laboratories, and particularly its power pile project. It was originally intended that a limited number of NEPA employees would be placed on the Monsanto payroll to work on the power pile, in order to assist in that project and also to gain fundamental pile science training. Eventually, it was hoped, these trained experts could return to their respective aircraft concerns and stimulate further research in a new and highly specialized field. At year's end, however, no such arrangement had been effected.

Late in July, NEPA representatives visited Oak Ridge for preliminary, unofficial inspection of the facilities, and on August 7, 1946, the District Engineer reached an agreement with Major General Curtis E. LeMay, Deputy Chief of Staff for Research and Development, Army Air Forces, whereby the District would assist the NEPA program to the extent permitted by security considerations and the best interests of the nation.

Research Division Relation to NEPA. Since interchange of information was essential to furthering the NEPA program, representatives of the Research Division met on September 6, 1946, with Colonel Marsden of the District Engineer's staff, Colonel D. J. Keirn from the Washington Liaison Office, who supervised liaison between the District and other military agencies, and Major D. J. Grant of the Army Air Forces. The Division's responsibility in the matter was to control all information exchanged between NEPA and the District. The purpose of the meeting was to establish an adequate method for such interchange.

It was agreed that Major Grant, who had been assigned to Oak Ridge as resident representative for the AAF in the NEPA Program, would receive all NEPA information for outside transmittal. After review, it would then be cleared through the Research Division before distribution to a restricted list of receiving personnel approved by the District's Washington headquarters. The Research Division was to keep an extra copy of all reports and other transmitted information in its files, and was to act as the liaison agency between NEPA and Colonel Keirn's military liaison group in Washington. Mr. R. D. Cross, Chief of the Engineering Section in the Division's Technical Branch was delegated the responsibility for coordination and control of Research Division relations with NEPA.

The question of the specific categories of restricted District information which were to be made available to the NEPA group was not resolved until September 10, at which time the Washington Office defined this as classified information relating to "production of power by atomic energy, including basic chemistry, physics, engineering, and health; theory of construction and actual operation of experimental piles."

and all applicable declassified reports. Information on "production piles, chemical separations, production of fissionable materials, and weapons," however, was specifically excluded. The results of the September 5 conference and the decision regarding information interchange were incorporated into an official letter from the Deputy District Engineer to Major Grunt on September 27 formally notifying him of policy and channels to be observed in all MEPA activity.

The Division's subsequent activities have been the control of MEPA information interchange in accordance with the above policy. On October 18, Major Grunt submitted the first proposed distribution of MEPA progress reports to various interested government agencies, including the AAF and key Fairchild personnel. Approval for the list was forthcoming from Washington in a letter dated November 14, in which the Division was requested to coordinate all security activities with the Security Division and to ascertain that the latter had completed all security investigation before any actual distribution of MEPA information to the listed parties was effected. The Division subsequently served the Security Division in an advisory capacity on all security matters regarding MEPA.

Clearance of Clinton Laboratories personnel, including the X-10 Operations Officer and Navy and Air Corps personnel stationed at that site, was authorized by the Division on October 28, and all contact between the MEPA group at Oak Ridge and the Monsanto-Clinton Laboratories research personnel was directed to be channeled through the X-10 Operations Officer and the AAF Officer in Charge, Major Grunt.

Subsequently, the Division reviewed and obtained authorization from the District Engineer's office for modification which proved necessary in both the specific categories of information to be made available to NEPA and the persons to whom it could be distributed. Thus, changes authorized in information categories were modified on October 30 to include data on scientific equipment and on the Clinton pile, and revised distribution lists.

A comprehensive listing of personnel from participating NEPA industries and the AAF to be cleared for access to restricted District information was prepared by the Division on November 18 after extensive conferences with the NEPA organization. It was intended that this more complete list should supplant current distribution lists restricted to only key personnel and should permit access to Clinton Laboratories for conferences on approved subjects. The list was reviewed by the Security Division and approved December 11, 1946. Meanwhile on November 19, the Research and Security Divisions formulated a procedure to be followed by NEPA in initiation of requests for issuance of security clearances to future new employees and consultants. At this time it was agreed that all contact between NEPA and other District offices would be channeled through the Research Division.

A further Division responsibility during 1946 was the review of a tremendous volume of District technical and scientific reports to determine those which contained information of interest to program personnel and to assure further that no unauthorized, classified data was transmitted. The Division obtained approval from the District Engineer in November for several AAF officers attached to Clinton Laboratories to

assist temporarily in this project, and on November 22 a conference was held between Division and NEPA representatives to establish the procedures for undertaking such review. Additional Division responsibilities have been the periodic review of regular NEPA monthly status reports for distribution to authorized personnel and the authorization of visits of Nepa personnel to other restricted District installations.

On December 2, 1946, the regular distribution of Nepa reports to participating companies was approved, providing the report itself had first met with approval from Washington. Reports of a purely administrative nature, containing no technical information, were authorized for direct distribution to the approved list of recipient member companies without referral to Washington for review. On December 3, the first NEPA status report, covering activities through October 31, was approved, and a week later the status report ending November 30 was authorized for distribution.

Part of the Nepa research program consisted of a subcontract with Frederic Flader, Inc., for research on the effects of radiation on electronic equipment, in order to obtain information essential for the design of nuclear power plants for pilotless aircraft and missiles. In order to complete this study, Nepa requested permission for certain Flader research personnel to discuss the proposed research with Argonne National Laboratory scientists. Following District refusal of the desired permission the Division arranged with Dr. H. L. Hall at Argonne to undertake a small fraction of the program on December 6. On December 20 NEPA formally requested District authorization for Frederic Flader, Inc., to

undertake an elaborate, detailed series of investigations at Argonne, in cooperation with Dr. Hall's group and utilizing Argonne facilities. On December 30 the Division advised the Chicago Area Engineer of the request and asked him to discuss the matter with Argonne personnel and submit his recommendations. At year's end the District was still reviewing the proposal and no decision had as yet been reached.

The concerns participating in the Napa program which were authorized to receive "member company reports" on December 16, 1946, were: Allison Division, General Motors Corporation; Continental Aviation and Engine Corporation; Frederic Flader, Inc.; General Electric Company; Lycoming Division, the Aviation Corporation; Manasco Manufacturing Co.; National Advisory Committee for Aeronautics; Northrop Aircraft, Inc.; United Aircraft Corporation; Westinghouse Electric Corporation; Wright Aeronautical Corporation; and Fairchild executives.

Chapter XI

Isotope Production and Distribution Program

Establishment of Program

Organization of the Research Branch. During the closing months of the war, as major production emphasis in the Plutonium Project was gradually shifted from laboratory and pilot plant development activities to full-scale operation of the Hanford piles, many District scientists began to turn their attention to the application of the pile facilities to peacetime research problems. In particular they looked forward to the production of useful radioisotopes at low cost and in large quantities, a development which would contribute greatly to the advance of medical, agricultural, biological, industrial and many other aspects of scientific research. In informal contacts with Project scientists, the District's medical and operations officers had frequently discussed the desirability of initiating such a program after the District's military objective had been successfully achieved. Peacetime production of radioisotopes was of particular interest to scientists at Chicago and at the Clinton Laboratories where the principles of pile theory and operating techniques had been carried through the experimental laboratory and pilot plant stages.

At the time the Research Division was formed, the establishment of a program for production and nation-wide distribution of radioisotopes was prominent on the agenda of activities which it planned to organize and place into operation. When Dr. F. C. Ashervald of the Los Alamos Scientific Laboratory was approached in December regarding

transfer to the Division's staff, one of the important factors in his decision to join the Division was the contemplated isotopes distribution program. A few months earlier the National Academy of Sciences had appointed Dr. Aebersold a member of the Committee on Growth of the Medical Division, National Research Council, to assist in the encouragement of peace-time research utilizing radioisotopes from piles. From his conversations with National Research Council members, Clinton Laboratories scientists, and members of the District Engineer's advisory technical and medical staffs, Dr. Aebersold was intimately aware of the problems and objectives involved in organizing an effective nation-wide distribution program of these District-produced materials.

When, on January 3, 1946, Clinton Laboratories submitted to the District the first comprehensive specific proposal for national distribution of radioisotopes, the recommendations met with sympathetic District attention. Prepared by the Radioisotopes Committee at Clinton Laboratories and addressed to the Director of the District Medical Division, the proposal outlined a detailed step-by-step procedure for carrying out the suggested program. Meanwhile the District obtained the six-months' loan of Dr. Aebersold from the University of California to establish and operate a distribution program along the lines indicated by Clinton Laboratories, and the Isotopes Branch was officially established as a unit of the Research Division on February 1, 1946. Dr. Aebersold's six-month loan terminated August 1, 1946, on which date he was released from the University of California's employ and placed with the District as a Civil Service employee to continue his former duties.

Interim Advisory Committee. On February 26, the Commanding General requested Dr. F. B. Jewett, President, National Academy of Sciences, to recommend nominations for an "Interim Advisory Committee on Isotope Distribution Policy," to assist in formulating a feasible procedure based on the Clinton Laboratories' suggestions. A ten-man committee of scientists was appointed from the names recommended, two each from the fields of physics, chemistry, biology, medicine, and applied science, and Dr. Ackerwald was made Secretary. Shortly afterwards, the District's Advisory Committee on Research and Development, at its March 8-9, 1946, meeting reviewed District plans for setting up an isotopes production and distribution policy, approved the general objectives of such a program, and recommended that distribution be made at a cost based on direct operating expenses only. Specific steps in the procedure were agreed upon at the Interim Advisory Committee's first meeting on April 20 in Washington, and recommendations were submitted to the Commanding General in a letter from the Committee Chairman on May 1, 1946. On May 22 General Groves issued instructions to follow the recommended procedure, and in compliance the District Engineer authorized the Monsanto Company on May 24 to set up an organization and facilities at Clinton Laboratories to effectuate the program, including the preparation of production and distribution cost schedules. Dr. C. A. Thomas formally entered into agreement with the District for Monsanto on June 4, 1946 to operate the service. The recommendations of the Interim Advisory Committee specifically called for:

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(a) Appointment of a Sub-Committee on Allocation and Distribution, to be nominated by the Interim Committee and appointed by the District, to advise on the purpose and value of requests and the qualifications of the requester.

(b) Appointment of a Sub-Committee on Human Applications to review and vote or approve any request intended for use on humans.

(c) Making isotopes available to individuals only through qualified institutions.

(d) Making reasonable charges not greater than "out-of-pocket" costs to the District.

(e) Allocation according to use, as determined by the following priorities:

1. Publishable researches in the fundamental sciences.
2. Human therapeutic applications, and publishable researches requiring larger samples than in (1).
3. Educational and training purposes.
4. Publishable researches in applied sciences.
5. All other uses.

Organization of Procedures.

(a) Sub-Committee on Allocation and Distribution: A four-man Committee on Allocation and Distribution composed of K. T. Bainbridge (Chairman), J. W. Kennedy, J. G. Hamilton and P. C. Aebersold (Secretary) was appointed by the District and held its initial meeting in Chicago on June 18. Production arrangements submitted by Clinton Laboratories

were approved as a good starting basis for testing the market. A uniform grading system was adopted to provide a basis for assigning priorities to each request within the five general priority groupings established by the Interim Advisory Committee. Requests for radioisotopes other than for therapy and diagnosis in humans were to be weighted as follows:

1.	Problem	0 to 10	
2.	Facilities	0 to 10	
3.	Quantity	P/R	P = amount available R = amount requested
4.	Class: Fundamental science	10	
	Educational	3	
	Applied Science	2	
	Others (not commercial)	1	
	Commercial	0	

Details were worked out for the mechanism of routing and handling requests referred to the sub-committee for an evaluation of allocation priority. All requests would be received and recorded by the Division's Isotopes Branch, which would coordinate and expedite the program and function as the integrating liaison link between Clinton Laboratories and the various advisory groups.

(b) Sub-Committee on Human Applications. A four-man Sub-Committee on Human Applications was appointed by the Interim Committee consisting of A. H. Dowdy (Chairman), G. Failla, H. L. Friedell and P.C. Aebersold (Secretary). At the initial Sub-Committee Meeting in Oak Ridge on June 28, 1946, it was reaffirmed that the group's primary responsibility would be review and approval of all requests for radioisotopes to be used on human beings. Other objectives were to determine the overall production effort to be placed on isotopes destined for therapeutic

and diagnostic applications and to recommend the amount of currently available materials to be allocated for these uses. The isotopes considered to be of most immediate significance for such uses were: I^{131}, P^{32}, Sr^{89}, Sr^{90}, Co^{60}, and Na^{24}. The Committee also unanimously endorsed the following recommendations: (1) A representative, Nation-wide list of accredited medical schools, hospitals, and clinics prepared to receive radioisotopes should be chosen, (2) each selected hospital, medical school, and clinic should be invited to appoint a local committee, composed of a chairman and other members as they should desire, to pass upon all requests originating from their institutions; (3) all isotope requests to the Isotopes Branch of the Research Division of the Manhattan District for human use for their particular institution should be initiated by the local chairman, (4) the Sub-Committee should advise the selected institutions to have the membership of their local committees include (a) a physician well versed in the physiology and pathology of the blood forming organs (b) a physician well versed in metabolism and metabolic disorders (c) a competent biophysicist, radiologist or radiochemist qualified in the techniques of radioisotopes.

(c) Federal Food, Drug, and Cosmetic Act. The Federal Food, Drug, and Cosmetic Act places definite restrictions on the use of a material for investigation involving humans or animals. Such uses define a material as a "new drug". The procedures set up by the Isotopes Branch for controlling the use of radioactive materials in the therapy, diagnosis and study of disease were submitted to Dr. Ernest Q. King, Acting Medical Director, Food and Drug Commission, on June 3, 1946.

[redacted]

Several suggestions were made by him to insure compliance with the Act and subsequently on August 2, 1946, P. B. Dunbar, Commissioner of Food and Drugs, gave final approval to forms and affidavits proposed by the Isotopes Branch for permitting the use of radioelements in tracer studies in fundamental physiology, in the causes of abnormal conditions in human beings, and in fundamental biology or similar investigations in animals and human beings.

(d) Determination of Prices. On May 3 the Director, Mr. A. V. Peterson of the Division and Dr. Aebersold met with Clinton Laboratories personnel and Monsanto officials of the home office in St. Louis to make legal and administrative arrangements for undertaking the distribution program. It was agreed that the materials would be sold at "reasonable" prices based on "out-of-pocket" costs. Subsequently, on June 22, 1946, the Monsanto Company submitted cost estimates from which the Isotopes Branch approved a price list which received official District approval on June 26, 1946. The estimates presented "out-of-pocket" costs, excluding depreciation and amortization of research and development expenses, and were computed according to standard business procedures within the limits of accuracy of the basic technical data available. It was realized at this time that the estimates were in many instances based on anticipated operating costs and would be subject to considerable variations as more production experience was obtained. It was agreed, consequently, that a general review of all costs would be made within six months, and prices adjusted in the light of actual experience and established inequities.

Official Announcement of the Program. Public announcement of the distribution program was made by Washington Headquarters in a brief article, "Availability of Radioactive Isotopes," which appeared in the June 14, 1946, issue of Science (Vol. 103, pp. 697-705). The release culminated the preceding four months' activity of the Isotopes Branch, the Clinton Laboratories, and all others concerned, in evolving, organizing, and establishing the physical mechanism for effecting the distribution program. A total of about one hundred isotopes were listed and details regarding their production, procurement, allocation and distribution were outlined. At this time, the Isotopes Branch also distributed reprints of the Science announcements to various scientific journals in pertinent fields for concurrent publication.

Initial Distribution. Although shipments of some isotopes could have been made shortly after the announcement was released, a period of eight weeks was permitted to elapse in order that all immediately interested requestors could make formal application. By this means, the small initial quantities could be most effectively distributed. On August 2, 1946, representatives of the Barnard Free Skin and Cancer Hospital, St. Louis, were given the first peacetime product of the Clinton Pile. At a brief ceremony, the Deputy District Engineer delivered to them a pea-sized unit of Carbon-14 to be used to "tag" component parts of cancer-producing molecules.

Functioning of the Program.

General. During the rest of 1946, 304 requests for radioisotopes of 45 separate elements were received by the District, and shipments had been completed on 125, representing a sales value of $29,797.47.

Despite the eagerness of scientists throughout the nation to obtain the materials, the comparatively small number of units allotted to requesters during these initial months of operation was due directly to the lack of trained personnel and radiation-detecting instruments in non-Project medical and scientific institutions. The Research Division undertook to alleviate this situation through its medical training and instrument production programs described in Chapters III and V.

Although District radioisotope distribution was chiefly planned to utilize the experimental production facilities of the Clinton Pile, irradiations of special materials in the Argonne pile were also coordinated with the Clinton program and radioisotope research at both sites was closely followed by the Isotopes Branch. Wherever production operations at Hanford permitted, these facilities were utilized for the production of the isotopes in greatest demand (C^{14}, P^{32}, Fe^{55}, Fe^{59}, and I^{131}). By year's end, however, Hanford participation in the program was not yet great. During the remainder of 1946, as the program progressed and new experience was obtained, continued review of Monsanto distribution activities was maintained by the Isotopes Branch, and numerous modifications in policy and procedure resulted.

Transportation Problems. Until the official announcement on June 14 of the availability of radioactive isotopes for national distribution, it was not definitely understood how such materials could be shipped in interstate commerce. Questions continued to arise almost daily because of the lack of specific rules and regulations. Shipments were made possible only through the cooperation of national and local express company and air line officials. The transportation of induced

radioactive materials was a new problem for the carriers which were generally unacquainted with the properties of the materials. The Railway Express Company, however, had prepared rules as early as May 1, 1939, covering the transportation of radium. Mr. H. A. Campbell, Chief Inspector, Bureau of Explosives, Association of American Railroads, informed the Isotopes Branch on June 14 that in his opinion the labels, marking and packing as prescribed for radium should apply to the transportation of radioactive material. On the basis of this opinion arrangements were made for the acceptance of shipments from Clinton Laboratories. The airlines, through the Civil Aeronautics Board, quickly established emergency rules effective June 6, 1946, to allow air transportation of radioactive materials until such time as more complete rules could be formulated. Not all airlines consented to accept shipments. All lines serving Knoxville, however, agreed to carry such materials when consigned by Clinton Laboratories. As of December 31, 1946, tariffs were still inadequate, and Mr. Campbell at the request of the Interstate Commerce Commission was endeavoring to write regulations to govern the transportation of all radioactive materials by rail. Mr. Homer S. Young of the Air Transport Association, Washington, D. C., was preparing a similar proposal for approval of the CAB to regulate shipment by air.

Price Revision. On July 24 the Deputy District Engineer announced that the radioisotopes prices approved July 26 would remain unchanged for a six-months period, after which time they would be reviewed on the basis of audit of costs, and recommended revisions would be submitted to the Commanding General. The Monsanto Company concurred in this decision and agreed to submit a revised price list to become

effective January 1, 1947. At this time the Division also requested Clinton Laboratories to initiate a careful audit record of all costs involved in the program to serve as the basis for anticipated revisions. During the next few months several cases where price adjustments were indicated were noted by the Division. On August 16, for instance, the Isotopes Branch pointed out that C^{14} was quoted at a price three or four times higher than was actually justified. On November 18 the Monsanto Company submitted a revised price list to which supplements were appended on December 6. In this the price of C^{14} was reduced from $367 per millicurie to $50, and other minor adjustments in both directions were also recommended. As of December 31, 1946, approval of the revised list was being withheld by the District pending review by the Atomic Energy Commission. Actual operation of the program during the preceding five months had shown that total costs were not being entirely recovered on the basis of the June prices. The Atomic Energy Act of 1946, however, clearly stated that radioactive products could be distributed by the Government either with or without charge. The question of whether or not to continue the current policy of partial subsidy of the radioisotopes program was clearly a matter to be determined by the new Commission.

Sub-lot Distribution. Shortly after initiation of the program, several requests were submitted for sub-lot quantities of the higher priced isotopes. After considerable discussion between the Isotopes Branch and the Monsanto Company, it was mutually agreed to establish sub-lot costs for the more popular higher priced samples of materials at an activity of 1/10 the regular unit. On October 28 the Division requested Clinton

Laboratories to prepare a supplementary cost estimate list for sub-lots to be issued as an appendix to the current price list. At year's end, preparation of the supplement was still being undertaken by the Monsanto Company.

Short Half-life Isotopes. At the August 13 meeting it had been agreed further consideration should be given to the matter of reduced charges for continued periodic shipments to a requestor of short half-life radioisotopes, which through their transient nature could not be purchased in large quantities and stored until ready for use by the requestor. On August 15, the Washington Office approved preparation of a proposal by which the regular $25 handling charge for isotope shipments would be applied only to first shipments in the case of short half-life materials (less than one month), and that subsequent shipments to the same approved requestor would cost only $10 for handling, over a period of from three to six months. Such a proposal was prepared and submitted by the Division to Washington on August 30. The Monsanto Company's consent was obtained on September 3, and approval from the Commanding General was forthcoming on September 16 authorizing the Deputy District Engineer to carry out the proposed handling charge revision. Subsequently, the Division obtained specific approval for institution of the policy in the case of fractions of standard units for Ca^{45}, Co^{60}, Ag^{108}, Ag^{110}, and various others, and incorporated them into the revised list of November 15, 1946.

Isotope Distribution to Government Civilian & Military Agencies. For security and other reasons, the Washington Office delegated the Division on August 2 to investigate a procedure for handling requests from Government, civilian, and military agencies for radioisotopes without

reference to the Sub-Committee on Allocations. On August 15 the sion sent to Washington a proposed procedure for handling all cl fied and non-classified requests from Government agencies accord the following categories:

(a) Government agencies not connected with Project:

1. Non-military (Veterans Administration, Depart Agriculture, etc.)

2. Military (Army Chemical Warfare, Medical Corp

(b) Non-Government agencies under military contract.

The procedure was approved by the Washington Office on August 30 the provision that all requests from non-military Government age military agencies, and from non-Government agencies on military would be routed to the Isotopes Branch through the Washington Of Technical Staff.

Foreign Distribution of Isotopes. Contemplated distri of isotopes to the Chalk River Project in Canada was abruptly pu by the passage of the Atomic Energy Act on August1, which necessi reconsideration of all District relations with foreign nations. tive approval of distribution of these materials to both the Can and British was made by the Commanding General on October 15, and cial approval was formally made on October 24. Actual procedures such transfer, and actual transfer of the requested radioactive had not been accomplished, however, by year's end.

Project Distribution of Isotopes. Allocation of radio isotopes to Project research and development laboratories for ex investigations in connection with their regular operations was m

the Operations Branch, and such Project needs held priority over routine off-Project requests. Project allocations were reviewed by the Isotopes Branch, however, so that both on and off-Project needs could be coordinated.

Following announcement of the off-Project isotope distribution program in June, 1946, placing a money value on these materials, it became advisable to institute accounting procedures for Project stocks of isotopes similar to those utilized for off-Project distribution. Hitherto transfer had been covered by routine shipping records. Accordingly, the Operations Branch advised all research and development installations under its jurisdiction, on July 29, that all isotopes produced, distributed, or consumed at each site should be accounted for as accountable District property, in accordance with regular procedures.

The University of California Radiation Laboratory at Berkeley was unique in that it maintained standing orders with Clinton Laboratories for regular, monthly shipments of radioisotopes. On October 5 it was notified by the Division that henceforth all such requests would hereafter have to be submitted each month, to bring it into line with policy governing allocations of these materials to other Project research laboratories.

Stable Isotopes. Stable isotopes were produced in small quantities by the District in the experimental equipment at the Radiation Laboratory and at X-12. Shortly after joining the Division in February, Dr. Aebersold investigated the current X-12 stable isotope production program and reviewed the desirability of continuing it at the existing level of effort. On April 3 he recommended continuation of

pilot-plant production at current production rates to enable accumulation of sufficient data for practical determination of costs and capabilities of production equipment. At the insistence of the Tennessee Eastman Corporation, however, and in order to devote prime attention to U^{235} production, only one production run of any one element was authorized at Y-12, in accordance with provisions of the operating contract.

The Isotopes Branch's recommendations were seconded on August 5 by Dr. E. P. Wigner of Clinton Laboratories, who requested that more emphasis be placed on production of a variety of stable isotopes for research purposes in contrast to the effort being devoted to improving uranium separation processes at Y-12. Following a review of the stable isotope program, the Division informed Dr. Wigner on September 13 that a positive program had been initiated at Y-12 for stable isotope production, that specific experimental equipment had been allocated for production of the materials, and that arrangements were being made to issue permanent passes for the scientific personnel from Y-12 engaged in the program to visit X-10 and interchange information. The priority of remaining elements to be run on the program was determined by the District on the basis of recommendations made by Project laboratories in collaboration with technicians at Y-12. At year's end, the separation program was still in progress, and distribution was being made to Clinton Laboratories and Argonne for mass assignment determination, and measurement of properties. Current accounting practices were merely to transfer the materials on shipping names, with no cost-control procedures.

On October 16, the Division reported to the Washington Office that an immediate need existed for establishing prices involved in production and distribution of these substances to Project installations, particularly to effect a greater appreciation of the expense involved and a more careful accountability for them after receipt. Earlier the Y-12 Operations Office had recommended a procedure for price determination based on incorporating the entire cost of a production run to the price of the most salable isotope obtained during the run. If the entire current demand were for only one of the separated products, the entire cost would be carried by that particular product. This procedure appeared inadvisable to the Division, however, since anticipated varying demands for these new products would result in frequent changes in prices. Instead it was recommended that prices be established on the presumption that all products would be equally marketable and that costs of runs should be divided equally between them.

On December 4 the Washington Office stated that present District practices would be continued and that stable isotope distribution would be made without charge to those project installations which could make most effective use of them. Allocation of the materials was placed under jurisdiction of the Deputy District Engineer. Production beyond that necessary for current approved research activities was prohibited except by prior approval from the Commanding General. In the case of all such exceptions, total production costs would be borne by the installation initiating the request.

No distribution of stable isotopes has been made to off-Project requesters, nor have recommendations on this subject been submitted by the Division.

CHAPTER XII

Establishment of the National Laboratories.

General. With its military mission completed at war's end, the Manhattan District found itself faced with the problem of providing some effective arrangement for continuation of Government-supported research and development programs in nuclear science during the interim period before a peacetime civilian agency could be established to sponsor and control such activities. During the war, research on separation methods for uranium isotopes had been chiefly conducted by academic or industrial contractors at private facilities. In the case of the Plutonium Project, however, the District established and supported a comprehensive research program at Chicago, known as the Metallurgical Project, and supervised by the University of Chicago as operating contractor, which involved the construction and maintenance of various District laboratories and other facilities. Among these, for instance, were the two piles in the Argonne Forest Preserve and other facilities constructed on University of Chicago property on the South Side, all of which possessed important potential peacetime uses for nuclear science research.

In order to reorganize, consolidate, and redirect these various Chicago projects toward permanent peacetime research in nuclear science, it was desirable that the activities in the area be transferred eventually from the University of Chicago campus to one main site where they could be established as a centralized research institution. Such an undertaking, it was realized, required the preparation of a comprehensive and well-integrated research program, the design, construction, and operation of adequate facilities, and the organization of a permanent scientific staff. The District felt strongly

that any such Government-sponsored activity should be shared by the many universities and scientific institutions in the surrounding area; moreover, the short-term loan of key technical personnel from such agencies to the new laboratory, on a rotating basis, would assist in assembling a competent scientific staff and would also serve to train scientists in the new techniques of nuclear chemistry, physics, and engineering. Finally, it was desirable that the installation of elaborate scientific equipment and the formulation of research programs at the proposed Government-supported institutions be integrated with the scientific resources and activities of the neighboring universities.

A month or so after plans were promulgated for establishing the new District laboratory in the Chicago area, a number of universities in the northeast which had contributed in an important way to Manhattan Project research activities approached the District regarding the establishment of a similar Government-supported nuclear science laboratory in the New York metropolitan region, to implement the nuclear science activities at Harvard, M. I. T., Yale, Princeton, Columbia and other nearby universities, such as the proposed Chicago laboratory was intended to serve academic and private laboratories in the north central United States. This second proposal came as a direct consequence of the District's earlier decision to establish a peacetime laboratory in or near Chicago.

The general problem of supporting national laboratories, and specifically the establishment of the two in the north central and northeastern United States, was presented by the District to its Advisory Committee on Research and Development in March, 1946. At that time it was generally agreed that the District should undertake the establishment of national laboratories in various

desirable regions of the United States to supplement District-supported research and development work being undertaken under contract by universities and private laboratories. Further, the latter agencies should be permitted to participate in the national laboratories' programs, in cooperation with all such scientific institutions in the area. Specifically, the proposed plans for establishing the Argonne and the Northeastern (since re-named Brookhaven) National Laboratories were approved.

Ultimately, it was intended that all national laboratories should be operated in the same manner. Representatives of the various participating universities of the region would join in a formal mutual association with a Board of Directors, which would be prepared to plan and operate the facility for the Government, subject to its approval, as a contractor. In the case of Argonne National Laboratory, however, this arrangement was not possible during 1946. The new proposed Laboratory was to replace the old Metallurgical Project, which had been successfully operated by the University of Chicago. During the transition from the old organization to the establishment and effective functioning of the new mutually cooperative Argonne arrangement, it was imperative that current and contemplated District research programs be continued without interruption. Inasmuch as the whole matter of outside university participation, with its resulting security and related problems, was still experimental, it was decided to continue the University of Chicago for the time being as the prime operating contractor for Argonne. A second reason for this action was the fact that, except for the pile facilities at Argonne, most other buildings on the project belonged to the University of Chicago, or were located on campus property. However, despite the University's primary responsibility

as contractor, the Council of Participating Universities for Operation of Argonne, composed of 25 universities in the north central area, has served an important function in advising the District regarding the planning and staffing of Argonne National Laboratory since it came into existence on July 1, 1946.

Meanwhile, the organization of Brookhaven National Laboratory, in the northeast, followed a somewhat different pattern. Here, the establishment of a new research facility involved no continuation of previous District activities. It was possible to "start from scratch," and the ultimate objective was reached in a more direct fashion. Representatives of the nine interested universities formally organized Associated Universities, Inc., a corporation prepared to undertake the contract for planning, establishment, and operation of the District's Brookhaven National Laboratory on the site of Camp Upton, Long Island. Subsequent to its incorporation in July, 1946, this concern prepared a program for the organization and operation of the new facility, in conjunction with the District, and negotiated a contract. By the end of 1946, the close of this history, negotiations for approval of the proposed contract, and formulation of the research program to be pursued under it were essentially complete, although formal approval was being withheld pending assumption of Manhattan District activities by the new Atomic Energy Commission.

At the Advisory Committee meeting in March, 1946, it had been agreed in general terms that establishment of national laboratories in other regions of the United States should be encouraged, but that no definite action should be taken by the District until a definite joint proposal had been made by the institutions which were interested in participating. At the close of this

history, December 31, 1946, three universities in Southern California had presented a very general and preliminary proposal for establishing a government-supported nuclear science laboratory in their neighborhood, but there had not been sufficient time for detailed consideration of the proposal by the District.

The Argonne National Laboratory.

Status of Metallurgical Project after V-J Day. At War's end, in the summer of 1945, the physical organization of the Metallurgical Project at Chicago was that generally described in Chapters 6, 7, and 8 of the Smyth Report. Within the confines of the Project itself, headed by Dr. A. H. Compton, were the Metallurgical Laboratory, under Dr. Farrington Daniels, the Argonne Laboratory, under Dr. W. H. Zinn, and various other technical divisions and auxiliary administrative sections. The contract under which the Project was being operated for the current fiscal year 1946 was written to terminate on June 30, 1946, and it was considered desirable by both the District and University of Chicago, the operating contractor, that a definite plan be formulated before this date for continuation of Government-supported research and development activities in nuclear science in Manhattan District facilities at Chicago on a permanent peacetime basis. Included among the various factors pressing for early resolution of the problem were:

(1) The University of Chicago's desire to recover its classrooms, laboratories, and other regular facilities, and teaching staff, being used for Project work.

(2) The fact that Dr. Compton, Project Director, was to leave shortly to assume his new duties as Chancellor of Washington University, St. Louis.

(3) Some definite plans for the future had to be formulated to maintain the highly trained scientific and technical personnel collected at Chicago who were being lured away by offers of positions in teaching and industry.

Plans for Reorganization of the Metallurgical Project. At a meeting of Major General L. R. Groves with Dr. Farrington Daniels and various other Metallurgical Project officials in Washington on September 20, 1945, it was decided to effect the following reorganization of the Project after Dr. Compton's departure on October 1, 1945:

(1) The Metallurgical Laboratory would replace the Metallurgical Project in the administration of District research activities until termination of the 1946 fiscal year on June 30, 1946.

(2) Dr. Daniels would continue as Director of the Metallurgical Laboratory, with increased responsibilities as a result of the assimilation of Project activities by the Laboratory, and would report directly to the District's Chicago Area Engineer (Reference 1).

(3) The Argonne Laboratory would be made, for administrative purposes, a division of the Metallurgical Laboratory.

Initial Interest of Neighboring Universities.

Non-District Sponsored. Meanwhile, on September 28, 1945, Chancellor Robert M. Hutchins of the University of Chicago independently called a conference of eight mideastern colleges to discuss possible cooperation by the neighboring universities in the joint utilization of the Argonne piles and other related facilities operated by the University of Chicago. The representatives attending the meeting all were or had been Manhattan District scientists. General problems involved in academic participation in the nuclear

science program at the University of Chicago were explored, and the difficulties of security restrictions were discussed at length. (Reference 2).

District Sponsored. Shortly afterwards, the District took an active part in establishing a plan whereby neighboring north central universities might participate in Government-supported nuclear science activities at Chicago. Following informal discussions between Dr. A. H. Compton and Colonel K. D. Nichols, the latter appointed Dr. Compton chairman of a committee of representatives of several leading midwestern universities to investigate the general question of mutual participation in the Metallurgical Laboratory program to the extent permitted by security and other national interests. The immediate purposes of the committee as indicated in Colonel Nichols' letter to Dr. Compton of November 19, 1943 were, generally, to recommend a plan for continued operation of the District's research facilities at Argonne by means of a cooperative arrangement between the Government and various neighboring midwestern universities, and to achieve the following specific objectives:

a. Initiation of new programs and continuation of current research and development activities in nuclear science at the District's permanent facilities in Chicago.

b. Establishment of programs designed to train scientific personnel in the techniques, theory, and applications of nuclear science.

c. Making the unique equipment and facilities at Argonne available on a widespread basis to qualified outside institutions interested in pursuing research programs related to this field.

d. Staffing the laboratory with competent academic personnel from these outside institutions on a rotating basis.

Committee members appointed by Colonel Nichols in addition to Dr. Compton were Dr. R. A. Gustavson, Vice President of the University of Chicago, Dr. F. H. Spedding, Iowa State College; Dr. Farrington Daniels, University of Wisconsin; Dr. F. W. Loomis, University of Illinois; Dr. John T. Tate, University of Minnesota; Dr. O. H. Eshbach, Northwestern University; and Major E. J. Bloch, U. S. Corps of Engineers, Committee Secretary and non-voting member.

Establishment of Advisory Committee on Argonne. This group, officially designated as the Advisory Committee on Operation of Argonne Laboratory, met at the University of Chicago on December 2, 1946. It was recommended at that time that the laboratory be continued as a regional Government-supported facility, intended primarily to serve research institutions in the north central United States and to undertake a research program of fundamental and applied nuclear science designed to supplement related programs at associated institutions in that area. The immediate operation of Argonne, it was felt, should be continued for the time being under the current contractual arrangement between the Manhattan District and the University of Chicago. However, a regional advisory council should be established to review the Laboratory's operation, and the ultimate objective should be the formation of an operating corporation, consisting of representatives from leading north central research institutions, to supervise administration of the Argonne National Laboratory for the Government. To effect this it was recommended that an advisory council be immediately organized of representatives of 24 neighboring north central universities to operate Argonne in conjunction with the present contractor, the University of Chicago. This regional advisory council should then elect an executive board of seven members to act for the council and eventually to serve

as a board of directors of the corporate entity which would later assume full responsibility for operation of Argonne Laboratory. Finally, it was recommended that activities at Argonne should include both classified and unclassified nuclear research, that no scientific compartmentation of information or of work should exist, and that participation in all laboratory activities would be on a voluntary basis and subject at all times to proper security regulations (Reference 3). It was proposed under this plan that all present Metallurgical Laboratory activities should be eventually removed from the University of Chicago campus and consolidated at the Argonne Laboratory site some twenty miles southeast of the city.

District Authorization for the New Laboratory. A plan was subsequently submitted to the District Engineer by Dr. Daniels on February 21, 1946, which outlined the specific procedure for transfer of Metallurgical Laboratory activities to the proposed new Argonne National Laboratory in accordance with the broad objectives recommended by the Advisory Council (Reference 4). Under the proposed Daniels plan, Metallurgical Laboratory activities would terminate with the current 1946 contract on June 30, 1946, and the assets and facilities would be transferred to the new laboratory proposed by the Advisory Committee. In the meantime it was also suggested that research activities necessarily confined to buildings on the University of Chicago campus as the time should be gradually transferred to the new institution during the next few years as fast as conveniently possible. Specific proposals for expansion and continuation at Argonne of the Metallurgical Laboratory's current research activities were also outlined in Dr. Daniel's proposal. A few days later the District approved development of a definite program for establishment of a north central national

laboratory at Argonne along the lines recommended by the Advisory Committee and according to the procedure suggested by Dr. Daniels. (Reference 8). At the March 8-9 meeting of the Manhattan Project Advisory Committee on Research and Development, the proposed District program with respect to the establishment of the new national laboratory was approved. In general, the Advisory Committee felt strongly that plans for establishing national regional laboratories for research in nuclear science should be supported by the Government in cooperation with the various neighboring universities and research institutions in particular regions. The broad outlines of organization should follow those proposed in the case of Argonne, with a board of directors chosen from the participating institutions in each area to cooperate with the Manhattan District in determining the program to be undertaken by the various regional laboratories. Each laboratory should be administered by a financially responsible agency acceptable to both the District and the participating institutions. In the case of the new Argonne Laboratory, specific approval was given to the District's general plans and the proposed organization.

Establishment of the Council of Participating Universities. Shortly afterwards, Colonel Nichols invited the 26 midwestern universities recommended by the Advisory Council on December 5, 1945, to send representatives to the initial meeting of the Council of Participating Universities for Operation of Argonne, scheduled for April 5 and 6, 1946. At this conference, the cooperating institutions elected a board of governors of seven scientists, comprising those originally appointed by Colonel Nichols in November, to effect the establishment of Argonne National Laboratory. This group met the following day to outline specific programs for the organization of Argonne for the approval of the District. It was agreed to recommend continuation of the University of Chicago

as contractor for the fiscal year 1947. In general it was felt that research which could be done effectively at the laboratories of the associated institutions should not be undertaken at Argonne. The latter's efforts should be chiefly devoted to full-scale projects in nuclear science for which the associated universities were not equipped. (See Reference 6).

Board of Governors. The executive activities of the Council of Participating Universities were carried on by the Board of Governors, which met at appropriate intervals after its establishment to effect the final mechanism for transfer of Metallurgical Laboratory activities to the new Argonne National Laboratory. (Reference 9). At separate meetings on May 6, June 5, and October 7, it considered specifically:

(1) Selection of a laboratory director to replace Dr. Farrington Daniels, who planned to leave the Chicago Area when the Metallurgical Laboratory expired on June 30.

(2) Preparation of a formal plan of organization and statement of operating policy agreeable to the Council, the University of Chicago, and the District.

(3) Formal approval of the Argonne research program and budget for fiscal year 1947.

(4) Determination of the role of the University of Chicago as the operating contractor.

(5) Selection of a permanent site.

Selection of a Director. Dr. W. H. Zinn, Director of Activities at the Argonne National Laboratory under the Metallurgical Project, was selected on May 6, 1946, to head the new national laboratory upon its establishment on July 1, and he continued in this role through December 31, 1946.

Preparation of a Plan of Organization. Instead of indicating the functions of the participating university group by a series of by-laws, it was decided to specify the responsibilities in a formal plan of organization and statement of operating policy indicating the interrelated functions of the associated universities, the Laboratory, the operating contractor, and the Manhattan District. Such a plan was prepared by the University of Chicago's legal counsel, based on principles outlined by the Board of Governors, and including revisions recommended by the District. At the Board's June 6 meeting the plan was unanimously approved and met with the consent of the full council. (Reference 7). To achieve the objectives of the plan, the full Council of Participating Universities held an official organization meeting on June 6 and elected a new Board of Governors to function for the current year. Dr. John Tate was elected chairman of the Council, and Dr. Norman Hilberry secretary. The new Governors themselves elected Dr. Daniels as their Chairman, Dr. John Tate as Vice Chairman, and Dr. Norman Hilberry, as Secretary, pro tem. On July 1, 1946, the Argonne National Laboratory officially came into being upon termination of the Metallurgical Laboratory, under the terms of the approved plan of organization and statement of policy which governed its activities through December 31, 1946, and the close of this history.

Argonne Research Program and Budget. The Research program and proposed budget for operation of Argonne National Laboratory during the fiscal year 1947 was approved by the Board of Governors at its June meeting and it was agreed at that time to continue the plans originally intended for 1947 research under the old Metallurgical Laboratory, with a budget of $7,800,000. In general, the broad research objectives of the participating university

group, as stated and approved by the Board of Governors, are to pursue research and development in nuclear science to the extent warranted by available manpower and in accordance with the Government's over all program of nuclear science research. Continued research in both chain-reacting piles and the acceleration of nuclear particles has been emphasized. In this latter respect, the Board of Governors recommended approval of the laboratory's request for construction of a high potential Van de Graff generator. The District subsequently referred this request to the Advisory Committee on Research and Development, and authorized construction and installation of the equipment following the latter's approval. At the Board of Governors meeting on October 7, 1946, a review of the extent to which members of the staffs of the participating institutions had taken an active part in Argonne research programs since its formal establishment on July 1 showed that the original objectives were being gradually attained. The "Summary Report on the Progress of the Program of Cooperation to Argonne and Participating Institutions since June," presented at this time, indicated some twenty scientists and consultants from the cooperating universities had already contributed to research work currently under investigation. (Reference 10). At this meeting Dr. Zinn also presented a list of research problems currently being investigated at Argonne, together with a program for the scientific and technical projects contemplated for the rest of fiscal year 1947. A more comprehensive and detailed account of the work of this installation will be found in the appropriate volumes of the District History devoted to Argonne National Laboratory research.

Role of the University of Chicago as Operating Contractor. An important

phase in the development of the Argonne National Laboratory was the crystallization of the University of Chicago's legal and administrative position as operating contractor for the joint association of the District and its advisory group of participating universities. As operator of the Metallurgical Project, and the Metallurgical Laboratory which subsequently replaced it, the University's responsibilities had been solely to the District. Although it is intended ultimately that Argonne shall be operated directly by an agency representing the participating universities, it was felt that, until what was essentially a new and experimental effort in establishing a Government laboratory had been achieved, the University of Chicago should continue as the responsible operating contractor. Under this arrangement both the choice of an operator and the proposed program of research would be subject to the approval of the participating university group. However, final approval of the Laboratory's program and budget and of the performance of the operating agency would lie in the hands of the Manhattan District. In order to clarify the University of Chicago's contractual status under this arrangement various conferences were held between the University and the District. The terms of the agreement reached at these conferences and concurred in by the Board of Governors were, briefly, that while the University would maintain close working relations with representatives of the Government and the participating institutions, it would also, as operating contractor, assume full responsibility for determining the business policies under which the Laboratory was to operate. The formulation of the research program would be prepared by the Laboratory staff in conjunction with the staffs of the participating universities, subject to District approval. The University, however, assumed full

responsibility and authority for seeing that its procedures for attaining objectives were properly implemented. In this connection it was agreed by all parties concerned that the University of Chicago's academic staff would not be preferred over the other cooperating universities in the mutual use of Argonne facilities. (Reference 8).

Permanent Site for Argonne.

Negotiations with Cook County Forest Preserve. During the war, in 1942, the Cook County Forest Preserve leased to the District approximately 1000 acres of its holdings in the Palos Hills Section, some twenty miles southwest of Chicago, for construction of the Argonne research facilities, including experimental piles. In the autumn of 1945, when plans were being formulated to transfer all District research activities of the University of Chicago to Argonne and to integrate them under the proposed national laboratory, negotiations were opened with the Forest Preserve authorities for permanent acquisition of the Argonne acreage. In conversation with the University of Chicago the District concluded that at least 45 acres of the Preserve property, comprising the land presently used together with sufficient added acreage for expansion purposes, should be acquired by purchase or long-term lease. Subsequent discussion with Forest Preserve officials, however, disclosed that the land would only be made available to the District on a 10-year lease at the very longest, and that no permanent acquisition or loan of the property was possible. At the Board of Governors meeting on April 5-6, 1946, it was unanimously agreed that every effort should be made to continue operations at the proposed laboratory at the Argonne site as long as possible, particularly in view of its convenient location to metropolitan Chicago. By June, despite

further negotiations with the Forest Preserve Officials, it seemed apparent that permanent tenure of the Argonne property was unlikely and that other alternatives must be seriously considered. The District Engineer reported at this time that the War Department and Congress desired that surplus Government-owned property be used for the new site unless there were imperative reasons established to the contrary. A subcommittee, consisting of Dr. Daniels, Dr. Rabbach, and Dr. Gustavson, was appointed to survey all Government-owned surplus property within a 150-mile radius of Chicago. Meanwhile the District resumed its efforts to acquire a portion of the Forest Preserve for permanent use, this time at a higher level. These negotiations culminated in an exchange of letters between the Secretary of War and Cook County Forest Preserve officials which definitely precluded the possibility of using the property for a permanent site. A 10-year lease was subsequently arranged between the District and the park board, during the summer of 1946, for the 45-acre area presently occupied by Argonne facilities. Meanwhile, attention was turned toward acquisition of other land for a permanent residence.

Selection of a New Site. It was essential for continued effective operation of Argonne and permanent retention of its highly trained technical personnel that a definite site be obtained and new facilities constructed as soon as possible. Early plans for the establishment of the new laboratory called for construction of numerous additional structures of a permanent nature to provide space for the proposed nuclear research projects contemplated by the District. Dr. Farrington Daniels' "Proposed Program for the National Nucleonics Laboratory at Argonne," of February 21, 1946, and the Chicago Area

Engineer's "Report on Availability of Utilities and Services Required for Expansion of the Argonne Project," of May 1, 1946, described the general [illegible] preliminary considerations necessary to initiation of the proposed Argonne which building program. With these in mind, the Gustavson-Hilberry-Daniels subcommittee surveyed all Government-owned war surplus plants within a 100-mile of the radius of Chicago during the summer months and reported at the October 7, 1946, Board of Governors meeting that nothing of a satisfactory nature had been found. After further discussion the Board of Governors unanimously agreed that the new permanent site should be located in the Chicago area within a few minutes drive of the present laboratory. Dr. W. H. Zinn then proposed a site, highly recommended by his Laboratory staff, located on the Des Plaines River near the present facilities and comprising some 4000 acres. After a tour of inspection the Board of Governors unanimously recommended that the War Department obtain this area as the permanent location for the Argonne National Laboratory. District approval of the proposed site was still pending on December 31, 1946. [illegible] rinceton were formulating plans for a similar

Selection of National Laboratories in Clinton Laboratories. The question of Clinton Laboratories position in the District's program for establishing National Laboratories was clearly stated by the Director, Research Division, on February 4, 1946. The present suitability of Clinton Laboratories for the unclassified, general research problems intended at the new facilities was pointed out. Rather, it was felt that the Laboratories would be continued for the study and development of new types of atomic energy plants under strict security limitations [illegible] met with members of the group on February 3 to discuss

Brookhaven National Laboratory.

Initiation of Program. Following the end of the war a number of educational, scientific, medical, and engineering institutions in the New York region, which had been interested in wartime developments in nuclear science, became concerned with the need in the northeastern area of the United States for certain of the large and expensive equipment necessary for further research in this field, such as chain-reacting piles, betatrons, cyclotrons, and other high energy accelerators. Specifically, it was felt the Government should support a nuclear science research laboratory in the area in which the various institutions could participate, similar to the proposed Argonne National Laboratory in the north central region.

On the 14th of January, 1946, Dean G. B. Pegram of Columbia took the initiative in inviting representatives from twenty-eight institutions in the New York area to meet at Columbia on January 16, and explore the situation in greater detail (See Reference 11). At the very same time, Dean H. S. Taylor and Professor H. D. Smyth of Princeton were formulating plans for a similar gathering to be held at their own university. The two separate efforts were consolidated at the Columbia meeting, and it was decided to request the establishment of such a laboratory by the District in the northeast. (See Reference 12). Dean Pegram informed General Groves of this decision in a letter, dated January 19, 1946, which enumerated the obvious advantages to be derived from the establishment of such a centrally located facility (See Reference 13). In reply to this letter General Groves designated Colonel K. D. Nichols (then Brigadier General) to meet with members of the group on February 8 to discuss

the plan more extensively. At this conference three main points were brought out:

(1) The District was seriously considering the proposal.

(2) The laboratory should not be "regional" but "national". However, it was agreed the preeminent resources of the New York region in scientific personnel and other respects, made that area a particularly advantageous location.

(3) The whole case would be much strengthened if it were backed by Universities from Baltimore to Cambridge rather than these concentrated merely in the New York area. This was particularly true since M.I.T. had already approached the District for support of a laboratory to be set up in the vicinity of Cambridge.

Following this conference Dean Pegram conferred with President Compton at M.I.T., who was quite willing to join with the other universities in their cooperative efforts for a central laboratory. Meanwhile, the support of Harvard and Johns Hopkins was also obtained. Leading scientists of the nine more prominent universities of this group (Columbia, Cornell, Harvard, Johns Hopkins, M.I.T., Princeton, Pennsylvania, Rochester, and Yale) met on March 2 and decided to transmit a second letter to General Groves reemphasizing the proposal and indicating the broadened support it had received from a more widely distributed number of northeastern universities. The other New York institutions which had originally supported the proposal were informed of the combined action of the nine initiatory universities in a memorandum circularized to all parties concerned on March 5 summarizing the developments to date. It was felt both by the District and the nine university representatives that the initial planning arrangements for the venture should be concentrated in the hands of a few leading institutions rather than among the many which had fir

met informally (See Reference 14). Consequently, further planning was carried on by the representatives of the nine institutions for which Dean Pegram had written the March 3 letter to General Groves. There was no intention, however, of limiting cooperation between the proposed laboratory and the other smaller institutions. The activities of the group of nine universities were intended merely to expedite planning and establishing the new facility (See Reference 11).

District Approval. At the first meeting in Washington of the Project Advisory Committee on Research and Development on March 8-9, 1946, the general proposals contained in Dean Pegram's March 3 letter were reviewed. Professor H. D. Smyth was chosen by the Initiatory Group to represent it at this conference, and Professor Zacharias of M. I. T. and Dean Pegram also participated in the discussion. It was agreed by the Advisory Committee and Colonel Nichols that the establishment of a northeastern laboratory should be a part of the District's broad program for support of nation-wide nuclear research and development activities. More specifically, it was agreed that the nine cooperating universities, with the assistance of the District, should be authorized to proceed with preliminary plans and organization of the northeastern laboratory in accordance with the general objectives outlined in Dean Pegram's proposal (See Reference 12).

The Initiatory Universities' Planning Committee. Following Advisory Committee approval of plans for establishing a northeastern national laboratory, the District requested Dean Pegram's group to submit a detailed proposal for establishing and operating the project and to organize a legally responsible corporation or other representative and mutual association of the universities

prepared to undertake the operation. Since the previous conferences of interested institutions had been entirely informal in nature, Dean Pegram, in a letter of March 19, formally requested the presidents of the nine participating universities to designate two representatives, preferably one scientist and one administrative official, to represent the respective institutions at a formal organizational conference on March 28 (See Reference 17). On this date the representatives met in New York and set up the "Initiatory University Group" to cooperate with the District in planning the project. At this meeting a Planning Committee was appointed consisting of one representative from each of the nine universities. This body served as the executive committee guiding the Group's activities during the interim period to formal incorporation as Associated Universities, Inc., in July, 1946. It met frequently with District representatives during the next several months, and reported its actions at the less frequent gatherings of the larger general Group. The Planning Committee was composed entirely of scientists, while the larger Group comprised both scientists and responsible officers and business managers of the universities. Dr. L. A. DuBridge, Columbia, headed the Planning Committee from its inception until May 18, 1946, at which time he was replaced by Dr. R. F. Bacher, Cornell. During the four month period from March, 1946, to final incorporation of the Group in July, the Planning Committee met with District representatives on eight different occasions. The larger general Group of university representatives, however, met only twice, on April 16 and June 1, to review and approve Planning Committee actions. Following incorporation, the responsibilities of the corporation were legally assumed by a Board of Trustees and by the latter's duly elected officers and executive committee. One of the

first acts of the new Corporate Trustees, however, was to confirm and continue the responsibilities of the Planning Committee and its various operating subcommittees on site, contract, nuclear machines, etc. During the rest of 1946 these groups continued to meet and prepare plans for establishing, organizing, and operating the northeastern laboratory (See References 15 to 19, inclusive).

In the subsequent numerous conferences between the Manhattan District and the cooperating universities leading to the establishment of the Northeastern (later Brookhaven) National Laboratory, the District was represented in all actions, except final decisions of important policy, by the Area Engineer, Madison Square Area, Colonel C. W. Beeler, or by authorized members of his staff.

Planning Committee Objectives. At its first meeting on March 30, 1946, the Planning Committee outlined the major preliminary objectives which were to be attained, with District approval, before the new laboratory could begin functioning effectively. These objectives were (1) establishment of a responsible corporate organization prepared to operate the new laboratory as the District's approved contracting agent, (2) negotiation of a mutually agreeable contract, (3) selection of a satisfactory site adequate to the laboratory's needs, (4) formulation of an approved program of scientific research and development, and (5) acquisition of a technical and administrative organization prepared to carry out the proposed research work. To effect each of these broad aims, various subcommittees were appointed to make recommendations on site location, form of contract, personnel policies, and installation of electronuclear machines and "pile" reactors, etc.

Formation of the Corporation. In Dean Pegram's original proposal of March 3, 1946, the need had been emphasized for delegation of the operating responsibilities of the new northeastern United States laboratory to a strong contracting agency prepared to organize and support a permanent and qualified organization of scientific and administrative personnel. In view of (1) the desire of the various northeastern universities to support the program effectively, (2) the established corporate position of the institutions themselves, and (3) the practical and successful experience of both officers and scientists of the respective universities in undertaking numerous research war contracts, the District had a strong incentive for delegating operation of the proposed laboratory to the associated group.

Choice of Form of Organization. At the March 30 Planning Committee meeting, Professor H. D. Smyth of Princeton was chose Chairman of the Subcommittee on Contracts, and his group was requested to consider the various possibilities for organization of a contracting body; namely (1) operation of the laboratory by a single university as at the Argonne National Laboratory, (2) formation of a mutual non-profit association, (3) or formation of a new corporation representing the nine associated universities (See reference 30). At the group meeting of the Initiatory Universities on April 15 and 16 1946, it was decided that organization of an individual corporation to serve as the responsible operating contractor would provide the most suitable arrangement. Provisions in the by-laws of the corporate charter would maintain the body as the cooperative association engaged in a mutual venture, an identity which the various universities desired to retain. It was

originally planned that each university, individually, would serve as one of the incorporators underwriting the program by an amount ranging from about $25,000 to $100,000. To effect these general objectives and prepare articles of incorporation, the New York legal firm of Milbank, Tweed, Hope, Hadley, and McCloy was retained as the Group's legal counsel.

Incorporation of Associated Universities. As the result of extended conferences between District representatives and the Planning Committee, the final articles of incorporation provided that: (a) individual representatives of the universities, including faculty members or officers, would serve as the individual incorporating members of the corporation, rather than the various university corporations, and (b) each of the associated universities would underwrite the corporation by $25,000. Since a definite site had not been decided upon at the date of incorporation, Associated Universities, Inc., was first incorporated under the laws of the State of New Jersey on July 8, 1946, with Princeton, New Jersey, as its official place of business (See references 16, 17 and 20). About this time, however, Camp Upton, Long Island, was selected as the location of the new laboratory, and it was therefore considered advisable to have the Group incorporated under the laws of the state in which it would transact its business. Accordingly, incorporation of Associated Universities, Inc., under the Education Law of the State of New York was completed on July 18, 1946, (See reference 21). As a New York corporation, the incorporating trustees elected additional trustees to form a total board of nineteen members, including the president, who serves ex-officio. An executive

committee and officers were also elected, with Edward Reynolds, vice President of Harvard, as Corporation President, Joseph Campbell, Columbia University, as Treasurer, and T. I. Parkinson, Jr., an associate of the firm of legal counsel, as Secretary (See Ref. 18 and 19). One of the important decisions at the first meeting of the corporation's Executive Committee, September 9, 1946, was to adopt the name "Brookhaven National Laboratory" for the corporation's research project to be established at the Camp Upton site, Brookhaven Township, Suffolk County, Long Island, New York.

Interim Financing of Associated Universities Prior to Formal Contractual Agreement. Inasmuch as no formal contract had been arranged between the Manhattan District and the Associated University Group by December 31, 1946, reimbursement for interim expenditures up to that date was arranged through Letter Contract W-31-109-eng-18, negotiated between the District and Columbia University, and separate in form and intent from the District's two other current contracts with Columbia for specific research and development programs in the field of nuclear science. On June 28, 1946, the Madison Square Area Engineer, as Contracting Officer for the District, entered into this letter contract with Columbia, authorizing the latter to furnish all necessary services for planning the proposed national laboratory. The contract was written for an estimated expenditure of $50,000, over a period of two months, ending September 1, in anticipation of a formal contract to be instituted shortly thereafter. Since no formal agreement was subsequently reached, it became necessary to extend the period of the agreement and to raise the ceiling of authorized expenditure. Five successive

supplements, written between July 17, 1946 and December 31, 1946, extended the period covered through January 31, 1947, and raised the limit of reimbursable expenditures to $200,000 for planning Brookhaven under terms of the letter contract. (See Ref. 22).

Contract Negotiations Prior to Incorporation of Associated Universities, Inc. Prior to incorporation, the District explored the question of a proposed contract with the Planning Committee, and the Madison Square Area submitted the initial draft of a suggested agreement on June 1, 1946, for review and discussion at the June 10, 1946 Planning Committee meeting. It was agreed at that time that further contract negotiations should be withheld pending organization of the formal corporation, since the general form and legal powers of the latter undertaking would be deciding factors in determining the nature of any contract entered into by the District.

Negotiation of a Contract Subsequent to Incorporation of the Associated Universities. By the articles of incorporation under both the New Jersey and New York laws, Associated Universities, Inc., was authorized to enter into contracts with agencies of the Government of the United States or others for establishment, support, and operation of laboratories and other facilities for research in the physical and biological sciences, including all aspects of nuclear science and its applications in engineering and other fields. Subsequently, various drafts of proposed contractual agreements were drawn to serve as the basis for extended negotiations between the District and the officers and Executive Committee of Associated Universities, Inc. A final contract agreeable in most particulars to both

the District and the Corporation was drawn up for the calendar year 1947, at $7,900,000, and was submitted to the District for final approval on December 17, 1946 (See Ref. 23). After approval by the District Engineer, Major General Leslie R. Groves informed Mr. David Lilienthal, who had been appointed Chairman of the Atomic Energy Commission by President H. S. Truman, that he planned to approve the proposed contract on December 27, 1946. However, since the Commission had not had sufficient time to consider the proposed agreement, and felt such review obligatory, Mr. Lilienthal decided to withhold Commission approval pending further consideration. Mr. Lilienthal, however, advised the Corporation on December 27, 1946, through its President, Mr. Reynolds, that it was the Commission's intent that the Laboratory should press ahead with its program, and that interim arrangements would be made to permit all the necessary work to proceed pending formal signing of a contract between the two parties.

Site Requirements. The general features desired by the university group in the location of the proposed laboratory had been breifly indicated in Dean Pegram's letter to General Groves of March 3, 1946 (See Ref. 11): "It does seem entirely possible, however, to find a site so located that a man could leave his university after work one day, travel either in the evening or at night, spend the next day at the nuclear laboratory, and return to his own university the next evening or night; for instance, a site within a relatively short automobile ride of one of the stops of the Pennsylvania or New Haven Railroads between Washington and Boston." These general requirements were narrowed down by the Planning Committee at its March 30 meeting to a

location "as near as possible to New York City," not exceeding two hours commuting distance from Pennsylvania Station or Grand Central Station, and within easy range of a desirable residential area. Other consideration were adequate size, (at least a square mile) and satisfactory solution of problems of drainage and radiation from stack gases.

Inspection of Possible Sites.

Developed Areas. The Subcommittee on Site reported to the Planning Committee during the next several months its recommendations regarding the acceptability of a number of developed site areas which it had surveyed in the metropolitan region surrounding New York City. In view of the War Department's desire to utilize surplus war property where possible, the Manhattan District insisted that all surplus developed Army property be given full consideration in the discussions. This was agreeable, for developed acreage would allow a shorter interim construction period before the laboratory could be in operating condition, since the installation of many utilities and conveniences would have already been completed. With this consideration in mind and stimulated by District enthusiasm, the general interest of the Site Subcommittee shifted from undeveloped areas to several desirable War Department surplus property sites, including Fort Slocum, Fort Hancock, and Camp Upton in the adjacent New York area, and Fort Devens in Massachusetts. At the further suggestion of the District, it was agreed to have the Stone & Webster Engineering Corporation undertake feasibility surveys of several developed and undeveloped sites (See References 24 and 26). At the request of the Madison Square Area Engineer, the Initiatory University Group prepared and submitted an estimate of population,

facilities, services, power, water, and other factors which served as the basis for the Stone & Webster surveys (See Ref. 25). The New York District, Corps of Engineers, at the request of the Madison Square Area Engineer, also inspected the shore at Fort Hancock, New Jersey, to determine the need for shore protection and the type of protection required at this particular location (Reference 27).

Undeveloped Areas. Among the more important undeveloped sites considered were plots near Untermeyer Lake, Bear Lake in the Jersey Ramapo Mountains, the Lake Zoar area north of New York City, and the Millstone-Raritan area west of New Brunswick, New Jersey, but developed locations were favored instead because they were potentially more suitable for immediate utilization.

Selection of Camp Upton. By the June 17, 1946, meeting it was evident that Camp Upton was probably the most desirable site available in the region from War Department surplus, and the Planning Committee conducted an extensive inspection tour of the property on June 27. At the July 6, 1946, meeting the Committe voted to accept the Upton area and unanimously agreed to recommend it to the Corporation as the most suitable site for the new laboratory, on the belief that the advantages of a developed site more than outweighed the desirability of an undeveloped site, even though the latter might be more accessible or possess other incidental attractions. Of the various virgin areas considered, the Millstone, New Jersey, region along the Raritan River near New Burnswick was voted the most desirable. A few days later, at the first meeting of the Trustees of Associated Universities, Inc. (A New

Jersey corporation) the Planning Committee's recommendation that Camp Upton be acquired for the new laboratory was approved. The trustees of the New York Corporation approved this choice at their first meeting on July 30, 1946. Following this action, the Madison Square Area Engineer directed a request to the Secretary of War for assignment to the Manhattan District of the southern portion of Camp Upton, comprising 3725 acres of the Camp area, together with buildings and facilities; assignment was made to the District on August 21, 1946. The Planning Committee had also originally requested a right-of-way through the unassigned north portion of the Camp, comprising the target range, for construction of a pipe line necessary for contemplated chemical processing operations. The desired easement was refused by the War Department at the time the southern portion was transferred. A formal request for transfer to the District of the remaining 2434 acres of the reservation, including the target range, was made to the War Department by the Madison Square Area Engineer at the request of the Planning Committee, and transfer of this remaining area to the District was subsequently authorized by the Secretary of War.

Preparation of a Program. One of the first acts of the Initiatory University Planning Committee had been formation of the various subcommittees to consider the many problems involved in establishing the proposed laboratory. The recommendations of these groups were incorporated into a "Proposed Program for the New National Laboratory of Nuclear Science," approved by the Initiatory University Group meeting of June 1, 1946, and transmitted to the District for approval (Reference 28).

Shortly afterwards, the District presented the proposed program to the General Advisory Committee on Research and Development for review at its June 15, 1946, session in New York. It was recommended at that time that the tentative 1947 minimum budget for $12,400,000 be cut in half and the general program be cut down to a more realistic basis. The remaining months of 1946 were devoted to effecting a functioning organization prepared to formulate and submit to the District a realistic program in the light of available facilities, personnel, and other determining factors. Once the preliminary steps of effecting a corporation, negotiating a contract, and choosing a satisfactory site had been completed, the physical organization of an operating group and the preparation of its proposed program could be pursued with increased emphasis. Efforts in this respect had proceeded sufficiently far by October 30, 1946, for the Laboratory staff to submit a tentative outline of proposed Brookhaven plans, and to request approval of various modifications in administrative buildings and related incidental actions necessary to assist in their headquarters. By December 31, 1946, preparation of the official program describing proposed Brookhaven research activities was substantially complete, although official District approval had not yet been indicated.

Selection of Director and Staff. From its first meeting, the Planning Committee had given careful and detailed attention to the selection of a competent Director for the new Laboratory. After considerable discussion and review of numerous potential candidates, Dr. P. M. Morse, of the Massachusetts Institute of Technology, was selected by the Planning Committee

early in July, 1946, and approved by the Corporation at its July 10 meeting. District approval of Professor Morse as Director of Brookhaven Laboratory was directly forthcoming. Prior to his war activities, Dr. Morse had received his doctorate at Princeton and taught physics at Massachusetts Institute of Technology for 16 years, 12 of these as a full professor. In the late summer of 1946, the new Director began activating the major Brookhaven Laboratory departments, and by the end of October the skeleton staff included Professor Norman Ramsey of Columbia as acting head of the Physics Department, Dr. L. W. Nord, on leave from Massachusetts Institute of Technology, as head of the Pile Project, Professor M. S. Livingston, on leave from Massachusetts Institute of Technology, as head of the Cyclotron Project, and Professor J. G. Peter, on leave from Harvard University, as head of Architectural Planning and Plant Maintenance. Personnel, technical services, accounting, and other administrative and service offices had also been organized by this date (See Reference 19). Initial plans, reported by the Planning Committee's Subcommittee on Personnel, estimated a final Laboratory organization of approximately 1,000 (including around 400 members on the scientific staff) operating under a proposed annual budget of about $10,000,000. The technical personnel would consist of three broad categories: a permanent staff, a rotating group on leave from neighboring universities, of approximately one-to-three year tenure, and a floating group which would consist chiefly of summer workers and other short-term "visitors."

Proposed Research Activities. A major purpose for establishing Brookhaven National Laboratory in the northeastern region was to provide central facilities available to the neighboring scientific institutions for on

intensive program in nuclear science research. Here, it was planned, would be centralized and established the elaborate, expensive, and intricate scientific equipment and facilities necessary for such activities, including piles, cyclotrons, and various other items peculiar to the study of nuclear particles and fissionable materials. In general terms, such equipment may be divided into two general classifications: (1) piles or "reactors," and (2) electronuclear machines, including cyclotrons, synchrotrons, and other electrically-powered scientific equipment intended to accelerate bombarding nuclear particles. One of the first acts of the original Planning Committee, at its March 30 meeting, had been to appoint separate subcommittees to review and recommend action on each of these two subjects. Professor R. F. Bacher of Cornell headed the Subcommittee on Reactors, and Professor J. R. Zacharias, Columbia, headed the group on electronuclear machines (See Reference 31). It was essential, of course, that plans for the construction of such expensive and complex equipment at Brookhaven be closely integrated with other existing or planned facilities at the various other District research laboratories. During the organizational meetings of the Planning Committee in the spring and summer of 1946, the District Research Division arranged for conferences between representatives of the initiatory group and various District research scientists, for visits to District sites, and for exchange of information. The May 4, 1946, meeting of the Planning Committee was held at Oak Ridge, where members of the group inspected Clinton Laboratories and discussed problems of mutual interest with the latter staff. On June 17-19, members of the Committee met in Chicago, where they inspected the Argonne National Laboratory and attended the Project General Information Meeting and Laboratory

Directors' Meetings currently being held at the University. During the subsequent months, Dr. W. H. Zinn, Director of the Argonne National Laboratory, Dr. E. P. Wigner, Director of Clinton Laboratories, and various other Project scientific personnel provided information and suggestions leading to the preparation of a realistic research program including piles and electromuclear machines which would supplement existing District equipment and facilities, and make possible new programs of research in nuclear science. As was indicated in the most recent review of Brookhaven plans, on October 30, 1946, major Laboratory efforts during the remainder of the year were directed toward preparatory data preliminary to design and construction of such facilities, and toward preparing the elaborate and detailed program on the basis of which the District could authorize the future contractor to initiate the steps necessary to establish the new laboratory as an active, Government-supported, research facility (See Reference 29).

Proposed West Coast Laboratory.

General. In view of the Manhattan District's association with Pacific coast universities and scientific institutions during the War, it was inevitable that considerable interest would be shown in the establishment of a national laboratory in the West to supplement those planned for the north central and northeastern United States. The District had not only constructed research facilities at the University of California Radiation Laboratory at Berkeley, but included financial support for the new 184" cyclotron and the construction of additional District research facilities on the University campus. As a general policy governing the establishment of additional new

national laboratories, especially on the west coast, the Advisory Committee on Research and Development agreed at its March 8-9, 1946, meeting that development of a plan for such project should be definitely encouraged, but that no District action should be taken until a definite joint proposal had been received from the institutions interested in participating.

Preparation of a Proposal. Actual initiation of such a proposal did not begin until the arrival of Dr. L. A. DuBridge on the west coast as the new President of the California Institute of Technology. It will be remembered that Professor DuBridge had served until May 18, as the Chairman of the Initiatory University Group for Brookhaven, at which time his imminent departure for California resulted in his being replaced in that role by Professor Bacher of Cornell. In November, 1946, the District forwarded Dr. DuBridge detailed information on the procedure for organizing Argonne, to supplement his own personal experience with the initial establishment of Brookhaven. On December 30 the heads of the University of Southern California and U. C. L. A. met with President DuBridge and agreed to cooperate in carrying through plans for establishing a national nuclear science laboratory in the Southern California area. At this time a contract was proposed for $18,000 to cover further preliminary planning and engineering studies for the new laboratory. The plan was submitted to the District at year's end, December 31, 1946, and further action was withheld pending consideration by the new Commission (Reference 32).

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APPENDIX TO SECTION I

REFERENCES

Number	Title	Location
1.	Letter from Drs. R. G. Gustavson and Farrington Daniels to L. R. Groves, September 29, 1945, and reply from Groves to Gustavson, October 23, 1945	Research Div. Files
2.	Teletype from Chicago Area Engineer to District Engineer, November 8, 1945.	" " "
3.	"Plan for Continued Operation of Argonne Laboratory" submitted by the Advisory Council to Colonel Nichols, December 8, 1945.	" " "
4.	Plan for continued operation of Argonne Laboratory submitted by F. Daniels through the Chicago Area Engineer to the District Engineer, by teletype, February 21, 1946.	" " "
5.	Memo from Colonel Nichols to General Groves, February 21, 1946.	" " "
6.	Minutes of meetings of Advisory Council and Board of Governors, participating universities, April 5 and 6, 1946.	" " "
7.	"Plan of Organization and Statement of Operating Policy," appended to June 5 Minutes of Board of Governors' Meeting. (See 9 below.)	" " "
8.	Letter from Mr. W. B. Harrell, University of Chicago, to Colonel K. D. Nichols, March 7, 1946, and subsequent statements included in minutes referred to in (6) above.	" " "
9.	Minutes of Meetings of Board of Governors, May 6, 1946, June 5, 1946, October 7, 1946, and of Council June 6, 1946.	" " "
10.	"Progress of the Program of Cooperation Between the Argonne National Laboratory and Participating Institutions since June, 1946," appended to October 7, 1946, minutes.	" " "

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Number	Title	Location
11.	Letter from Dean G. B. Pegram to President J. C. Hinsey, Cornell Medical College, and others, dated 14 January 1946.	Research Div. Files
12.	Minutes of meeting of representatives of the New York Area, 16 January 1946.	" " "
13.	Letter from Dean G. B. Pegram to Major General L. R. Groves, 19 January 1946.	" " "
14.	Memorandum from Dean Pegram to fifteen northeastern institutions, dated 5 March 1946.	" " "
15.	Letter dated 5 March 1946, from Dean G. B. Pegram to Major General L. R. Groves.	" " "
16.	Minutes of the 8-9 March 1946 meeting of the General Advisory Committee on Research and Development.	" " "
17.	Letter from Dean G. B. Pegram to the presidents of the nine universities, dated 19 March 1946.	" " "
18.	Minutes of Planning Committee Meetings on the Initiatory University Group, dated:	" " "

30 March 1946	New York
15-16 April 1946	New York
3 May 1946	New York
4 May 1946	Oak Ridge
18 May 1946	New York
31 May 1946	New York
17-19 June 1946	Chicago
6 July 1946	New York

19.	Minutes of the Planning Committee of Associated Universities, Inc., dated 5 August 1946 - New York	" " "
20.	Minutes of the Initiatory University Group, dated 16 April 1946 and 1 June 1946, New York.	" " "
21.	Minutes of meeting of incorporating members of Associated Universities, Inc. (a New Jersey Corporation) dated 10 July 1946 (New York).	" " "
22.	Minutes of meeting of Board of Trustees of Associated Universities, Inc. (a New Jersey Corporation) dated 10 July 1946 (New York).	" " "

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Number	Title	Location
23.	Minutes of meeting of incorporating Trustees of Associated Universities, Inc., (a New York corporation) dated 30 July 1946 (New York).	Research Div. Files
24.	Minutes of meeting of Executive Committee of Associated Universities, Inc., (a New York corporation) dated 9 September 1946 (New York)	" " "
25.	By-laws and Certificate of Incorporation of Associated Universities, Inc. (a New Jersey corporation).	" " "
26.	Petition for Incorporation, supporting affidavit, and By-Laws of Associated Universities, Inc. (a New York corporation).	" " "
27.	Letter Contract No. W-31-109-eng-18 to Columbia University, dated June 28, 1946, and supplement Nos. 1-5, inclusive, dated 17 July 1946, 27 August 1946, 17 September 1946, 17 October 1946, and 17 December 1946, respectively.	" " "
28.	Proposed Contract No. W-49-060-eng-18, undated.	" " "
29.	Letter of A. C. Klein, Stone & Webster Engineering Corp., to the Madison Square Area Engineer, dated 9 July 1946.	" " "
30.	Letter of the Madison Square Area Engineer to Prof. L. A. DuBridge, dated 2 May 1946.	" " "
31.	Report of the Stone & Webster Engineering Corp. on Fort Hancock, Camp Upton and the Untermyer Lake Area, dated 3 July 1946.	" " "
32.	Letter from Colonel W. J. Ely, CE, Resident Member, Beach Erosion Board, Office of the Chief of Engineers to the Madison Square Area Engineer, dated 8 July 1946, subject: "Shore Protection at Proposed Installation, Fort Hancock, New Jersey."	" " "
33.	"Proposed Program for the New National Laboratory of Nuclear Science," dated 31 March 1946, with (5) appendices entitled "Reactor Designs," "Regional Laboratory Pile," "Electromuclear Machines," "Synchro-Cyclotron," "Tentative Budget".	" " "

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Number	Title	Locatio
34.	Memorandum from Dr. P. M. Morse to Colonel O. W. Beeler, dated 30 October 1946, "Preliminary Comments on Program for Brookhaven National Laboratory," with organization chart appended.	Research Divisio
35.	Minutes of Meeting of Subcommittee on Contract, 8 April 1946.	" "
36.	Minutes of Meeting of Subcommittee on Electronuclear Machines, 4 April 1946.	" "
37.	Letter of 31 December 1946 from Dr. L. A. DuBridge to the District, inclosing a document entitled "Preliminary Planning and Engineering Studies for a Proposed Nuclear Science Laboratory in Southern California."	" "

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Chapter XIII

Encouragement of Training and Education Programs in Nuclear Science.

General. At its initial meeting, the Advisory Committee on Research and Development had strongly supported in general terms a policy for positive training of District personnel in principles and techniques of nuclear science. It was realized such a program was essential to the continued progress of fundamental and applied science and would be of immeasurable benefit to the national welfare, particularly if an "atomic-bomb" war were to occur. The establishment of national laboratories, operating in conjunction with participating neighbor-universities and scientific institutions, was intended to assist in educating the nation's scientists in the new developments, instrumentation, principles, and techniques of a unique and still largely restricted area of science. But because of the highly classified nature of most of the Argonne projects and the paper planning stage of Brookhaven, little actual training and education of a positive nature was achieved at the national laboratories during 1946, except that necessary to the pursuit of immediate investigations.

It was consequently at the research contractors' laboratories, rather than at the national District laboratories, that the greatest opportunities were offered for training and education in nuclear science during 1946. The center of District activity in this respect was at Oak Ridge, where the Monsanto Chemical Company out-distanced all other contractors in its aggressive support of training and educational programs at Clinton Laboratories, the most "academic" of the three Clinton Engineer Works operating areas. The Oak Ridge

Institute of Nuclear Studies, the University of Tennessee's program of graduate studies (which was later taken over by the Institute), and the Clinton Laboratories training program were important features in the Clinton Engineer Works educational program.

In addition to supporting these activities, Clinton Laboratories also drew up plans for extensive educational and training programs in health-physics and biological medicine, to supplement the new Biology Division established at the Laboratories in the late autumn of 1946 under Dr. Alexander Hollaender of the U. S. Institute of Public Health. No approval for these programs was forthcoming from the District, however. Further details will be found under "Medical Programs" in Chapter II, "Research Contractor Programs."

A third feature of the District's educational and training program was the institution of research assistance grants-in-aid to American universities for the initiation of broad, fundamental investigations in nuclear science. During 1946 the only activity in this respect was the work at Columbia University under Dr. John Dunning which had originally been carried on under a typical contract but which was altered to an interim arrangement developing from the extensive research which Columbia had undertaken for the District during the war. Many similar requests for research assistance were received from other leading American universities during 1946, but no action was taken pending further consideration of the general problem by the Atomic Energy Commission. An additional aspect of the District's encouragement of educational activities was the use of Project research for academic Ph.D. theses. The following pages discuss these various features of the Division's efforts to encourage educational and training programs in nuclear science among Project

and non-Project laboratories.

The Oak Ridge Institute of Nuclear Studies.

General. Important factors at Clinton Engineer Works in securing and retaining trained scientific and technical personnel have been the unique and specialized research equipment and facilities, and the opportunities there for learning new, fundamental, scientific techniques and for working with highly skilled specialists in various fields of nuclear science. While such training has been informal and incidental to the primary objectives at Oak Ridge, there has been a general feeling that institution of formalized instruction of contractors' scientific personnel on a graduate level would assist in obtaining scarce technical manpower and would be of wide benefit to Project research activities. Of the three operating areas at Oak Ridge, Clinton Laboratories has devoted by far the greater part of its efforts to fundamental research, and consequently it was logical that the operating contractor, the Monsanto Chemical Company, would be more directly interested in such advanced training. In the fall of 1945, therefore, the Monsanto Company and the District arranged for the University of Tennessee to conduct graduate courses at Clinton Laboratories for the scientific personnel there. In an effort to make these educational opportunities available to Clinton Engineer Works scientists in general, and also to stimulate closer liaison between Oak Ridge activities and the research programs of neighboring universities, the University of Tennessee called a meeting of southeastern university representatives early in December, 1945. In addition to providing graduate courses at Oak Ridge, it was agreed at the meeting that neighboring

institutions should be parpared to participate in and to utilize wherever possible the special research facilities available in Oak Ridge, and that faculty members and students from these universities should serve as a desirable reservoir of both "rotating" and permanent manpower to help staff the District's laboratories. It was mainly because of its interest in the last-named objective that the District encouraged formation of a definite organization prepared to function as a liaison agency between Oak Ridge and neighboring universities. During 1946, with District sponsorship and approval, the group evolved into a corporation called the Oak Ridge Institute for Nuclear Studies, representing a growing number of associated southeastern universities, and intended eventually to function under a formal contract as an advisory agency, coordinating relations between the District and the various member institutions. At the close of this history, December 31, 1946, a preliminary contract for these services had been drafted and submitted by the Institute to the District. Further action was being held in abeyance pending review of the entire situation by the Atomic Energy Commission.

Preliminary Conference Sponsored by the University of Tennessee. On December 5, 1946, the University of Tennessee sponsored a "Conference on Research Opportunities in the Southeastern United States" at Knoxville to consider: (a) the potentialities at the Clinton Engineer Works for academic research graduate training, (b) mutual benefits to be derived from cooperation between the Government facilities located there and neighboring universities, and, (c) recommendations for future action. The District Engineer, members of his Research Division staff, executives from the District's local operating contractor organizations, numerous scientists from Oak Ridge, and members of

the faculties of twenty-odd southeastern universities attended the all-day session. At this time an Interim Committee was formed under the chairmanship of Professor W. G. Pollard, University of Tennessee, to draw up a definite program for further action. It was felt that representatives should be appointed from each of the cooperating institutions to meet at Oak Ridge as soon as possible to draft specific proposals for the program. In particular, it was emphasized that the Oak Ridge research facilities should be utilized for stimulating graduate work in nuclear science under the direction of the cooperating universities in the region (See Ref. 1).

The Oak Ridge Institute of Nuclear Studies. Professor Pollard arranged with the District for a conference of the various representatives to be held December 27-29, 1945, at Oak Ridge to formulate a definite program of action. Some fifty scientists met for this three-day series of discussions during which various committees were appointed. These conferred and prepared recommendations covering the several objectives desired. Scientists from the staff of the District Research Division cooperated with the visiting professors to form committees on Organization, Administration, Immediate Needs, Engineering, Medicine, etc. At the final session an Executive Committee was elected, with Professor Pollard as Chairman, to effect the recommendations of the several committees. Dr. P. W. McDaniel, Chief of the Research Division's Technical Branch, was chosen Secretary-Treasurer. He played an important role during the following months in coordinating the District's relations with the embryonic association. At this time, after considerable discussion, it was unanimously agreed to call the new organization "The Oak Ridge Institute of Nuclear Studies" (See Ref. 2).

The Institute and the Oak Ridge Programs for Graduate Study. In general, the Oak Ridge conference had been concerned with two separate and distinct subjects: (a) the long-range program for establishing the Institute itself, and (b) the immediate problem of providing graduate courses at Oak Ridge to resident scientific and technical personnel. The second of these two objectives was, and continued to be, of more direct interest to the District since it would assist in attracting and holding technical personnel at Clinton Engineer Works. Immediately after the general Oak Ridge meeting, the newly appointed Executive Committee convened and appointed a special committee on Graduate Education, headed by Professor K. L. Hertel of the University of Tennessee, to follow up a positive program for instituting courses at a graduate level at Oak Ridge under the auspices of the University of Tennessee. It was agreed that the problem would be best handled by this institution because of its proximity. Scientists from the three Clinton Engineer Works operating areas and members of the University of Tennessee faculty comprised the members of the Graduate Education Committee (See Ref. 3).

Establishment of the Graduate Program. Earlier, in the fall of 1945, the Monsanto Chemical Company, with District support, had arranged to provide graduate instruction for its scientific personnel by the University of Tennessee faculty on Clinton Laboratories' premises. At the January 5, 1946, meeting of the Graduate Education Committee, it was decided to supplement this program by conducting courses at each of the three Clinton Engineer Works operating areas. Classes were to be scheduled for both working and non-working hours, depending on the convenience of the various parties concerned. No employees, however, it was felt, should be paid for regular work hours spent in class. These

general proposals were approved by the District on January 31, 1946, subject to the individual approval of the separate contractors. Since they were essentially operating organizations, both the Carbide and Carbon Chemicals Corporation and the Tennessee Eastman Corporation found it undesirable to rearrange their schedules to permit employees to attend courses in their respective areas during regular working hours. The Monsanto Company, however, whose facilities at Clinton Laboratories were essentially for research and development, found it easy to participate in the program. Meanwhile, the University of Tennessee made arrangements for a schedule of graduate courses to be conducted at the Oak Ridge High School in order to serve the needs of all the other interested graduate students in the vicinity. This program opened at Oak Ridge concurrently with the University's regular spring quarter on March 18, with an initial enrollment of 166 students. Graduate courses continued to be held under this program during the remainder of 1946. The parallel graduate program being conducted for Monsanto employees at Oak Ridge also was continued under University of Tennessee sponsorship during the remainder of the year. The inauguration of the Clinton Laboratories Training Program in the fall of 1946, under the supervision of Dr. Frederick Seitz, however, has in a large measure supplanted the need for the University's special program in the Monsanto operating facilities. By December 31, 1946, most of the Oak Ridge graduate study was concentrated at the High School (See Ref. 4 and 5).

Long-Range Objectives of the Institute of Nuclear Studies. At the time of the establishment of the Executive Committee in December, that body was authorized by the university representatives to make all desirable arrangements

with the District and its operating contractors in the name of the new Institute. Following a series of meetings, the Executive Committee formally presented to the District on April 3, 1946, a summary of various functions which it was proposed that the Institute should perform. These were:

a. To serve as a coordinating liaison agency between the District and the Oak Ridge research laboratories for:

(1) Adequate scientific staffing of the laboratories

(2) Loan of individual university staff members to the laboratories for special technical problems

(3) Use of laboratory facilities at Oak Ridge for academic research sponsored by the universities.

b. To service and expedite requests by participating universities for Government assistance in the former's own research program by:

(1) Investigation and recommendation, in an advisory capacity, to the District;

(2) Investigation of existing proposed and possible facilities for such research among the participating universities; and

(3) Encouragement and assistance in negotiation of contracts between these institutions and the Government. (See Ref. 6).

District Approval of Objectives. The general objectives enumerated in this proposal and the specific procedures outlined by the Institute for obtaining them were formally approved by the District on April 12, 1946. Under this authorization the Institute was to inform the separate regional universities and such others as might later affiliate with the group of the nature of its activities and was also to notify them:

a. That all requests for clearances of scientists for access to classified information and for possible visits to Government laboratories would henceforth be screened through the Institute (except for cases which clearly did not concern it) for correlation, review, and recommendation for appropriate action by the District.

b. All participating universities should furnish the Institute with lists of their qualified scientists who in the future might desire to:

(1) Take leave of absence for full-time employment at Oak Ridge

(2) Accept continuous employment at Oak Ridge for short periods of time to conduct research at the request of the District.

(3) Accept a research position with a Government laboratory at Oak Ridge for the purpose of joining in the fundamental research program of the laboratory while continuing as an employee of the university with which they were affiliated

(4) Make use of the research facilities at Oak Ridge for experimental work not directly connected with the District research and development program but which could be carried out only at Oak Ridge facilities (See Ref. 7).

The general objectives of the Institute and a review of the Executive Committee's activities in pursuing them were contained in the "Report of the Executive Committee" circulated June 1, 1946, to the participating institutions. The nation at large was formally advised of the Institute's existence in a statement "A Nuclear Research Institute at Oak Ridge" prepared by the Committee and published in the June 14, 1946, issue of Science. During the next several

months the District arranged for the Executive Committee and other members of the Institute to visit the various laboratory facilities at Clinton Engineer Works so that they might be familiar with current and potential research programs of which the installation was capable.

Preparation of a Proposal. In order to function effectively, it was felt that the Oak Ridge Institute of Nuclear Studies should formalize its relationship to the Manhattan District by a contract definitely specifying the respective advisory and educational services which it would perform. Prior to the preparation of such a proposal, the Executive Committee was reorganized early in August, 1946, to reflect the Institute's primary educational purposes more clearly (See Ref. 8). The reorganized committee was composed of Dr. F. P. Graham, President of the University of North Carolina, Chairman; Prof. Paul M. Gross, Duke University; Dr. P. W. McDaniel, Chief, Technical Branch, Research Division, Manhattan District; Professor W. D. Funkhouser, University of Kentucky, representing the Conferences of Deans of the Southern Graduate Schools; Professor W. G. Pollard, University of Tennessee; and Professor F. G. Slack, Vanderbilt University. The specific functions to be undertaken by the Institute under District contract were presented to the District Engineer on August 7, 1946, in a "Proposal for an Oak Ridge Institute for Nuclear Studies" submitted by the newly organized Executive Committee. After careful review by the District Research Division, the proposal met with the general approval of the District Engineer and a meeting was held September 18, 1946, between Executive Committee representatives, Colonel Nichols, and members of his staff to discuss further action.

At this time the District agreed to subsidize future meetings of the new directing Board of Governors which was to be created under terms of the Proposal, and also to provide space and office facilities at Oak Ridge for the Institute's executive staff. It was reemphasized at this time that the chief benefit to the Manhattan District in establishing the Institute would be the assistance the latter would render in placing scientific personnel from the participating universities with the plants at Clinton Engineer Works. The benefits to the participating universities would be the use of the Oak Ridge facilities for training of their graduate students. The general agreement reached at the September 19, 1946, meeting was confirmed in a letter from Colonel Nichols to President Graham, the Chairman, on September 25, 1946.

Incorporation of the Institute. The August "Proposal" had indicated that the physical form of organization to be assumed by the Institute as a contracting agency would be as follows:

a. The participating universities would each be represented on a general Council by the respective executive heads of the institutions or their authorized representatives. Each representative would serve as the official channel between his university and the Institute

b. The Council would elect a Board of Governors with seven members, each to serve a term of five years. The Board's responsibility would be to carry out the objectives of the Institute, to approve its budget, program, and the administration of its contractual obligations and its obligations to participating institutions

e. The Board would elect an Executive Officer as a permanent full-time employee to establish headquarters at Oak Ridge and to carry out the program of the Institute as directed by the Board.

The Executive Committee proceeded with formal organization of plans, and a charter of incorporation was granted by the State of Tennessee on October 15, 1946. At the Committee's request, the District arranged for an organizational meeting of the Council at Oak Ridge on October 17. At this time by-laws were adopted and the members of the Institute and their Board of Directors were chosen. Since the work of the Executive Committee was now complete, its members resigned from active work at this time. President Graham was elected Chairman of the Board of Directors, thereby automatically becoming President of the Corporation. Other members of the new Board were Dr. Frederick Seitz, Carnegie Institute of Technology; Dean G. B. Pegram, Columbia University; Dean Ernest Goodpasture, Vanderbilt Medical School; Dr. F. M. Gross, Duke University; and Dr. W. G. Pollard. No further formal meetings of the Council or its directors were held during the remainder of 1946. Further activities were dependent upon the negotiations and completion of a contract between the Institute and the District (See Ref. 9).

Contract Negotiations. On October 31, 1946, Dr. Pollard, representing the Executive Committee, submitted to Colonel Nichols a draft of a contract between the District and the Institute, based on the original August Proposal as modified by Colonel Nichols' recommendations of September 18. It was felt that the draft should serve as the basis for further discussion leading to a final contract suitable to both parties. Since the transfer of District

activities from the War Department to the Atomic Energy Commission was impending, however, further action on the matter was accordingly postponed until the new civilian agency could review the entire program.

Research Division Activities. The Research Division represented the project in all organizational activities involved in establishing the group, and maintained liaison between the latter and the District Engineer's Office. Dr. F. W. McDaniel, Chief of the Technical Branch, served as organizer and officer of the preliminary planning group until its incorporation in October, at which time he resigned. Dr. McDaniel prepared speeches of welcome and letters of approval and other correspondence for District Officers, served as Secretary-Treasurer of the group, and arranged clearances, meeting facilities at Oak Ridge and other details necessary to the organizational activities. Drs. D. J. Pflaum and H. A. Fidler also assisted in these activities, serving respectively as members of the Planning Group Committee on Immediate Needs and Committee on Organization. On March 24, the policy was established that all visits relating to the Institute would be coordinated through the Division, and the Technical Branch carried out this responsibility. The Division also kept the District Office advised of Institute activities and organizational progress, arranging for conferences between the two when necessary and recommending District action in all related matters.

Clinton Laboratories Training Program.

Organization of the Program. The Clinton Laboratories Training School at Oak Ridge was the suggestion of Dr. E. P. Wigner, and was specifically approved by the District as an inducement to him to accept the position of Laboratory Director. Dr. Wigner was apparently not interested in the position

unless he could be assured of a competent laboratory staff and of the opportunity to devote part of his time at Clinton Laboratories to training and educational seminars in the new techniques and principles of nuclear science. The presence of Dr. Wigner and the opportunity to engage in this part-time study constituted sufficient inducement to obtain the loan of highly competent scientists from American universities and industry for continuation of Clinton Laboratories' research activities. While this was a somewhat unusual employment policy, the scarcity of technically trained manpower, the uncertain future of the nation's interim atomic energy program, the urgency of continuing the Clinton Laboratories research program, Dr. Wigner's distinguished position in the field of mathematical and nuclear physics, and numerous other factors justified authorization of the Training School. Not the least among these considerations was the District's conviction that a positive training program in the new principles and techniques of both theoretical and applied nuclear science was an essential feature of the nation's as yet unerystallized atomic energy program.

Prior to assuming Directorship of the Division, Lt. Col. Peterson had been active in the District's efforts to obtain Dr. Wigner as Laboratory Director to succeed Dr. M. D. Whitaker. In December, 1945, Division representatives met with Drs. Wigner and Whitaker in Chicago to work out an arrangement of this nature. At this time the former agreed to take the position providing he could devote about 10-12 hours a week to seminar and class instruction. The District agreed to this arrangement, but plans were subsequently cancelled in January of 1946 when it turned out that Princeton University, Wigner's current employer, would not permit him to leave until the following June, at the earliest.

Later on, Dr. Wigner accepted the Laboratory Directorship, to begin at the close of the Princeton academic year in June. Following his arrival, the question of inaugurating the training program was again brought up and it was agreed that the school would begin instruction in the Fall and continuing to June, 1947.

Insofar as the training aspects of the Program were concerned, it was felt that the nucleus of technical personnel, upon termination of the training studies would return to the parent organizations and in turn train other personnel. This plan was based on the highly improbable assumption that a considerable portion of project classified information would have been declassified by the end of the training period. At year's end, it was quite evident that no such possibility would materialize, and that the only actual techniques and principles which could be released publicly would be confined to practical operation of instruments, new theoretical concepts of an unclassified and fundamental nature, and other incidental information.

The original concept of the seminar had been that it would be limited to 25-30 people of post-Ph. D. grade, secured from non-Project sources on loan with the understanding that they would return to their parent organization upon completion of the nine-months period. It was felt that the calibre of their experience and ability would more than compensate for the 10-12 hours a week they spent in non-productive classroom seminars. The total number of trainees loaned from interested non-Project agencies was 37, which was consistent with the original figure. About 6 came from universities, two from the Navy, while practically all the rest were scientists from Westinghouse, Standard Oil, and other large industrial corporations. In addition to these 37, however,

about 240 other regular project employees "sat in" on the courses, at an individual average of around 4½ hours a week. Of the latter group, four-fifths were regular Clinton Laboratory personnel, while the rest were Navy, Manhattan District, CE & C, TEC or Nepa employees. Instead of confining "training activities" to only 10-12 hours a week, it further developed that such effort consumed around 60% of the trainee's regular work-week. For this service, "trainees" were paid at a rate equivalent to their normal compensation. At year's end it was becoming apparent that the School had evolved into an actually somewhat different from that originally anticipated.

Research Division Activities. The Division delegated ten from its scientific staff to attend the sessions on a rotating basis and also arranged for representatives from Nepa and other military agencies to be admitted, subject to Dr. Wigner's personal approval. The Navy Department indicated an interest in having a half-dozen of its technicians attend the seminars, and the Division conducted liaison between the two groups, but in the end only two from that branch of the armed forces participated.

Classified Research for Ph. D. Theses. Following war's end, and the return of many project junior scientists to graduate study, the latter requested permission to submit theses based on the valuable fundamental research they had pursued on the project under the supervision of many of the nation's leading scientists. All leading American universities require publication of graduate theses for higher academic degrees, however, a stipulation which conflicted with the security restrictions covering much fundamental project research activity. On March 27, 1946, the Los Alamos Laboratory submitted a proposal whereby employees desiring to use project

research as material for academic theses would have their papers submitted to a committee of project scientists who would read the paper, and in the event its contents were approved, would advise the applicant's university of its merit, keeping the title and specific contents of the work secret. This policy, satisfying both security and the university regulations, met with District approval, and on April 8, the Division approved the appointment of a special committee to read the specific thesis referred to in the case of the Los Alamos request of March 27.

Review of Proposed Programs Requesting Research Assistance.

General. During 1946 numerous proposals were received from University and private scientific institutions requesting District support, financially or otherwise, for research in nuclear science and associated fields. The type of aid sought ranged from requests for simple services and loan of special materials to proposals for District subsidization of large-scale projects involving considerable expenditure. At the initial Advisory Committee meeting on Research and Development on March 8-9, 1946, District policy regarding handling of such proposals had been outlined as described earlier in this chapter. Discussion of specific proposals, however, was limited at that time to review and recommended continuation of current programs at the University of California and Columbia University on individual projects which had already met with District approval.

Several new proposals from universities and private laboratories seeking financial support, which had been presented to the District during the interim period after the first Advisory Committee meeting, were included on the agenda for the June 15, 1946, session. At that time, however, the assistance program

was discussed only in the most general terms, and specific approval was given to no programs which were not to be conducted at already established District research facilities, either at Clinton Laboratories or the Argonne National Laboratory. In general the programs requesting District support involved construction of (1) experimental piles, (2) high energy accelerators, or (3) other incidental research projects of a general fundamental nature.

At the June meeting, the question of the propriety of Committee members making recommendations to the District regarding programs proposed by agencies with which they were associated was discussed. It was agreed that members would refrain from voting on programs of direct interest to themselves.

Research Division Policy. In the absence of instructions to the contrary, the Research Division acknowledged and filed all research assistance proposals received from universities and private laboratories, pending action on them by higher authority. In the summer of 1946, instructions were received from the Washington Office that no action on the proposals could be taken until Atomic Energy Commission policies had been formulated. Proposals received after this time were acknowledged in letters stating this situation and individuals from whom prior proposals had already been received were informed of this new policy decision. (The various proposals received during 1946 have been summarized briefly in the "Appendices" prepared as a supplement to the "Report on Research and Development" prepared for the Commission on February 1, 1947. Detailed briefs of the actual correspondence involved for all proposals are included in the more comprehensive summary prepared by the Division, "Research Assistance Proposals.")

The following programs were reviewed by the Division for feasibility and other considerations:

a. Columbia University program proposed by Dr. T. I. Taylor for isotopic separation by molecular distillation of liquid organic compounds, investigation of the possibility of economical extraction of uranium from sea water, and establishment at Columbia of a completely equipped analytical laboratory for nuclear and isotope research (all disapproved).

b. Johns Hopkins program for spectroscopic study of uranium compounds (recommended with important reservations).

Both of these programs were also reviewed by the Madison Square Area Engineer's staff, the respective recommendations having been included in the "Research Assistance Proposals" summary mentioned above. None of the other nine proposals were subjected to evaluation by the Division's technical staff, and were still awaiting further consideration by higher authority on December 31, 1946.

[redacted]

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REFERENCES

Number	Title	Location
1.	Minutes of Meeting of Southeastern Universities at Knoxville on December 5, 1945. "Research Opportunities in the Southeast."	Research Division Files
2.	Minutes of the Oak Ridge Conference, Oak Ridge Institute of Nuclear Studies, Dec. 27-29, 1945.	" " "
3.	Letter from Dr. W. G. Pollard to Col. K. D. Nichols, January 14, 1946.	" " "
4.	Memorandum from Dr. P. W. McDaniel to files, subject: Oak Ridge Institute for Nuclear Studies, February 6, 1946.	" " "
5.	Letter from Dr. W. G. Pollard to Col. E. E. Kirkpatrick, February 13, 1946.	" " "
6.	Letter from Dr. W. G. Pollard to Col. K. D. Nichols, April 3, 1946.	" " "
7.	Letter from Lt. Col. A. V. Peterson to Dr. W. G. Pollard, April 12, 1946.	" " "
8.	Letter from Dr. W. G. Pollard to Col. K. D. Nichols, August 7, 1946.	" " "
9.	Letter from Dr. W. G. Pollard to Col. K. D. Nichols, October 31, 1946, inclosing draft of proposed contract.	" " "

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CHAPTER XIV

Relations with Non-Project Agencies and the Public:

A Liaison with the Public Relations Office:

Although the District maintained a separate "Public Relations Office," the Research Division informally conducted an extensive inter-change of information with the public, answering many queries concerning matters of a complex and frequently remote, technical nature. Formal District press relations were conducted through official channels by the Public Relations Office, with the Division acting in an advisory capacity. Personal letters from the public requesting specific information were handled directly by the Division, however, whether they involved a ten-year old grammar school student's inquiries on atomic energy or a request of the president of a large corporation for release of special project materials to pursue industrial research.

In time a policy for handling such requests was evolved, and inquiries of a purely non-technical nature, such as the request on August 14, 1946, for a project publication on Hiroshima, were referred to the Public Relations Office. A request for general technical information, such as a list of technical books on atomic energy, would be referred to the Information Branch, which maintained a library on the subject, and all queries for information of a more complicated nature were referred to the Technical Branch for a study and preparation of an appropriate reply.

All news releases regarding District research and development activities, such as announcement of the District's interest in the new 184 inch Berkeley, California, cyclotron, on November 1, 1946, were first cleared with the Division. Frequently, serious changes were recommended, as in the case of a November 21, 1946, release concerning Clinton Laboratories which contained information on radium which District

Laboratories which contained information on radium which District research policy required should not be published.

The Division also assisted the District office from a scientific standpoint in its public (utterances on Technical subjects), in preparing a speech for the District Engineer on September 13, 1946, on Army atomic energy policy, for instance, and others on different occasions welcoming visiting committee members of the Oak Ridge Institute of Nuclear Studies.

Requests for Materials, Services, and Information, etc.

Requests from off-project agencies or individuals processed by the Division fell generally into four categories: information, special materials, scientific equipment, or special services. Naturally a large number of the requests for information were inquiries regarding the possibility of obtaining one or more of the other three, and served merely as a prelude to a specific request for purchase or loan of District materials, equipment, etc.

Off-project requests for materials, information, etc., were also divisible into those originating at government military or non-military agencies, and those from civilian agencies or individuals. During the Division's existence, no classified materials, equipment or other supplies were released to civilians, although they were given whatever unclassified information was readily available, or referred to the Office of Technical Services for data already released in District declassified reports. All contacts with government agencies were channelled through the Washington office. Available information was forwarded to that office

for final approval and transmission, and, in the case of requests for equipment, materials etc., the availability was determined for the information and action of the Washington office. No definite policy was established during most of 1946, however, regarding the Division's communication channels with the public. Replies to similar requests were prepared for the signature of the District Engineer, the Washington Technical Staff, the Commanding General, or the Director of the Research Division, depending usually upon whomever received the original inquiry. Finally, on November 18, the Madison Square Area Office was instructed that all requests for information, etc., from any non-project sources whatsoever, including both Government and non-Government agencies, should be processed through the Research Division for review and preparation of an appropriate reply which would issue from Washington. No overall-District policy, however, was established for this procedure.

Prior to establishment of the Research Division, off-Project requests to the District for special materials were forwarded to Dr. J. B. Conant's office, OSRD, Washington. After the Division took over the processing of the requests, the Madison Square Area office was directed on January 21, 1946, (and subsequently on January 28 and November 18), to forward all such requests to the Research Division. No formal District authorization for this policy ever received project-wide circularization, however, although the desirability of taking some such definite action was realized both by the Division and the Patent Adviser. Some central control of all District contacts with off-project agencies on technical and scientific matters involving possible inter-change of scientific information was

desirable to avoid patent and legal complications. No such policy had been established, however, by year's end.

The Division, in December 1946, began to keep a current status record of off-project requests for special materials and scientific equipment. Requests for information were so numerous and varied in nature, however, that no effort was made to handle them all in this fashion. During the period of this interim history the District prohibited release of its special materials or technical equipment to off-project, non-government requesters, so that all replies were negative. At the beginning of its career, the Division had obligated itself, in its refusals, to advise the requester of any subsequent policy changes which might modify the refusal. As it became evident that such modifications would be delayed, the Division ceased this mode of reply and after February 14, 1946, it merely acknowledged the requests. Subsequently on April 11, the Washington office instructed the Division to expedite in the most effective manner all official government requests to the District for anything whatsoever, including requests for visits, materials, information, etc., where possible.

Many requests for special materials, information, and related services were also initiated by private industry and other off-Project agencies, such as Navy, AAF, Chemical Warfare, etc. In such cases the requesters were advised to submit their requests to the Washington Office through the military agency for which the work had been initiated.

Examples of the various materials, scientific equipment, and special services requested during the Division's existence are given in Tab J of the summary, "Organization and Functions of the Research Division,"

prepared February 19, 1947.

Review of Off-Project Scientific Suggestions and Theories.

Legitimate. Numerous serious proposals by competent scientists were referred to the Division by the District Engineer's office for evaluation and recommended disposition and reply. Several proposals for isotope separation processes were reviewed and found to be of no interest; a proposal by Yale University for District support of a research program to investigate atomic propulsion of rockets was referred to the Washington Office for further consideration by more appropriate military agencies; improvements in cyclotron design, plutonium production, and various other suggestions were studied and determined to be of little value, frequently only after further details had been obtained from the original submitting source. On one occasion a new "expenential" theory of gravitation scheduled for presentation at Johns Hopkins graduate seminar was reviewed at the request of the Washington Office but proved to contain no information of District interest.

Whenever proposals were found to be significant they were forwarded to other District scientists for further study and information, as in the case of a number of reports of German technological developments in nuclear science which were referred to Clinton Laboratories personnel who might benefit from the knowledge reported. Other proposals were referred to more directly interested District offices, e.g., proposals for treating radiation sickness, which were sent to the Medical Division.

Ores and Source Materials. A special category of communications

directed to the Division's attention from off-Project sources involved information regarding alleged discovery and existence of ores and source materials containing radioactive constituents, particularly uranium. District policy, as established by District Bulletin MDMI-51 (October 8, 1943) was to refer all information of this nature to the Washington office. During its existence, a score of such communications were treated in this manner, and in more than one instance the individual prospector himself appeared at the Division office to discuss his discovery. At year's end, the District was arranging to transfer responsibility for evaluation of these claims to the Madison Square Area.

"Crack-Pot". The Division also received numerous proposals from the public of a "crack-pot" nature, suggesting ideas of no merit and generally submitted by individuals not competent to make original contributions to the advancement of nuclear science. The proposals were treated with consideration and the "inventor" received a reply thanking him for his interest and, where possible, indicating the specific reasons for the District's lack of interest in his idea.

Scientific Personnel and Committee Nominations. The Division not only suggested numerous qualified scientists for various District advisory committees but also advised the Washington office whom off-Project scientific agencies and organizations requested the Project to nominate scientists to their national committees. Recommendations were made at the request of the National Bureau of Standards concerning project members to serve as medical and health-physics representatives on its committee for standardizing X-ray and radium radiation protection regulations. On

another occasion the Division recommended scientists for membership on the National Research Council's Committee on Radioactivity Standards.

The Division also determined the qualifications and professional standing of scientists upon request, and prepared a comprehensive summary of biographic information covering the leading war-time Project scientists