# *CHANGING PATTERNS OF ADMINISTRATION*

## CHAPTER 14

So much had happened in the twelve months since July, 1949, that it was difficult to believe only a year had passed. The Hickenlooper investigation, the first Soviet detonation, the debate over speeding development of the thermonuclear weapon, the resignations of David E. Lilienthal and Lewis L. Strauss, the demands for more fissionable material and weapons, and the outbreak of war in Korea had all but transformed the world of atomic energy as Lilienthal and Carroll L. Wilson had visualized it in the summer of 1949.

The larger currents of change were clearly of significance in national and international affairs, but they also had profound impact on the Commission as an agency of the Federal Government. Changing requirements and new leadership brought new patterns in most aspects of the Commission's organization and administration. As important as any factor was the emergence of Gordon E. Dean, first as one who brought a fresh approach to administration, and then as heir apparent to Lilienthal as chairman.

The changes taking place, however, were too broad and far-reaching to be attributed to one individual. Some were parts of trends going back to 1947—for example, the interest of Congress in appropriations and in the management of the Commission's communities. Others, such as the Commission's labor and security policies, were already in a state of transition when Dean joined the Commission.

The summer of 1950, marking as it did the effective end of the Lilienthal era and the beginning of the Korean conflict, was a turning point in the Commission's administrative activities. Both labor and security policies soon reflected the growing demands of national defense, and the Dean

administrative style was at last to lead to effective cooperation between the Commission and Congress. In the rising tempo of change, new patterns of administration were emerging to replace the tentative solutions of the 1940's.

## THE EMERGENCE OF GORDON DEAN

President Truman's decision to appoint Dean to the Commission in May, 1949, had profoundly disappointed Lilienthal. Having never met Dean, he envisaged a brash young politician, perhaps a younger version of Brien McMahon, who had been Dean's law partner and chief sponsor. Lilienthal admitted that Dean might be as intelligent as any of his colleagues and that he might bring a needed new look to the Commission's deliberations. But Lilienthal could not forget the fact that McMahon's sponsorship was the principal reason for Dean's selection. It was in Lilienthal's words "a second —or third—rate appointment to a first-rate responsibility." [1]



The Commission, Lilienthal had explained to Truman, was as important as any body in the country, perhaps even in the world, and it deserved the very best people available. Since 1946 Lilienthal had maintained that there was something special, even unique, about the Commission's responsibilities that set it apart from other agencies of Government. Dean's appointment suggested to Lilienthal that "politics as usual" was replacing nonpartisan statesmanship as the hallmark of the Commission's leadership.

Lilienthal began to temper his disapproval of Dean after meeting him. Dean looked older than Lilienthal had imagined, "thoughtful, judicious, easy. No touch of the politico at all." Others soon discovered that Dean had more than a time-server's interest in the Commission. Dean, who had no technical background, read everything he could find on atomic energy, and he astutely observed the unfolding drama of the Hickenlooper investigation in the summer of 1949. Dean was certainly not the cigar-chewing political dilettante Lilienthal had feared.[2]

Dean's criticisms of the Lilienthal administration had first appeared in several Commission discussions in the summer and fall of 1949. In July Dean had questioned the strict legality of the Commission's procedures for exchanging technical information with the British and Canadians under the *modus vivendi* of 1948. He thought the Commission should discuss the subject with the Joint Committee to determine Congressional intent. He also agreed with Strauss that the Commission should reexamine the sweeping powers of the general manager, including the organizational arrangement that required the general counsel, the controller, and the secretary to report to the Commission through the general manager.[3]

In time Dean's misgivings seemed to settle on the division of responsibility between the Commissioners and the general manager. In August he questioned Carleton Shugg's decision, as deputy general manager, to award a

large construction contract without consulting the Commissioners. He complained when the staff prepared an agenda for a meeting of the General Advisory Committee and showed it to the Commissioners only the day before the meeting. In October he objected when Wilson, almost as an afterthought, asked the Commissioners to approve a $42-million construction project at Los Alamos.[4]

This last incident precipitated a general discussion of the Commissioners' role in making policy decisions. At Wilson's invitation Dean set down his views on the matters troubling him. He acknowledged the difficulty in trying to define precisely the division of responsibility between the Commissioners and the general manager, but he maintained that only the Commissioners could make such a decision. To get the ball rolling he ventured to compile his own list of those matters in which the Commissioners should participate directly. In the area of Congressional relations, he urged that the Commissioners take a more active role in preparing the budget, drafting legislation, and presenting the Commission's program to the Joint Committee. He agreed with Strauss that the Commissioners should have direct representation in State Department talks with the British and Canadians and that the Commission should tighten up the administration of security. In all the Commission's relationships with outside organizations, whether the Defense Department, the Military Liaison Committee, the White House, the General Advisory Committee, or the Combined Policy Committee, Dean favored more frequent meetings, more open discussions, better agendas, and more participation by the Commissioners. Internally he advocated direct involvement of the Commissioners in selecting key personnel, awarding major contracts, approving construction projects, reviewing production data, and establishing personnel policy. Dean found only two areas in which he thought Commission review was no longer necessary: the foreign distribution of radioisotopes, and visits under the technical cooperation program.[5]



Dean's concern increased in early November, 1949, when the Commission discussed the General Advisory Committee's recommendations against all-out development of a thermonuclear weapon. Dean thought that Lilienthal was determined to delegate the issue to the staff, while he and Smyth insisted that this was one question the Commissioners themselves would have to tackle. Only after some heated discussion did Dean convince his colleagues that they should prepare their own views for the President.

There was no opportunity to continue the discussion of the Commissioners' responsibilities until Strauss and Pike returned to Washington from speaking engagements, but Lilienthal made plans to set aside most of the week of November 21 for this purpose. The first opportunity came after the regular Commission meeting on November 23. During the meeting Lilienthal had received the news that Truman had accepted his resignation effective December 31. In announcing his decision Lilienthal explained that he wanted to be able to speak his mind fully as a private citizen about Congressional and

military restrictions on Commission activities. Dean and Lilienthal were clearly moving in opposite directions.[6]

The discussions actually began the following Monday, November 28. In executive session Dean apparently started off with the topics in his October 26 memorandum. He later recorded that Lilienthal and Pike reminded him that delegation of responsibility was necessary in an organization as large as the Commission. When Dean pursued the question of whether the Commissioners should retain any authority, Lilienthal, according to Dean, could suggest little more than public relations.[7]

The following day most of the talk revolved around the Commission's relations with the advisory committees and other organizations. With most of the division directors present, Lilienthal spoke with some feeling about the difficulties of making decisions when the advisory groups and the Joint Committee were "breathing down our necks." Dean responded at some length about what he saw as the realities of the situation. The Military Liaison Committee, in his opinion, was there to stay; it served a vital function in coordinating Commission activities with military needs. Dean admitted that he himself did not always agree with the General Advisory Committee, as the recent debates on the thermonuclear weapon indicated, but that disagreement did not suggest to him that the Commission should dispense with the judgments of eminent scientists. As for the Joint Committee, Dean believed the Commission should "learn to live with it." It seemed to him perfectly reasonable that some group representing the people of the nation should have an opportunity to get behind the security barrier.



Dean ended with the observation that the Commissioners, in talking about the other groups, were evading the central issue of their own responsibilities. This remark prompted Strauss and Smyth to reiterate some of their earlier suggestions of topics the Commissioners should consider. Lilienthal, growing impatient, "blew open" his feelings on the subject. The Commission's role, in his opinion, was hard to define because the basic organization had been wrong in the first place. He contended that the Commissioners had no function other than passing on the most general policy issues and handling public relations. Those tasks could be performed by a part-time Commission and a full-time single administrator. Lilienthal intended to advocate such a reorganization after he left office. To Dean, Lilienthal's suggestions were completely impractical. The American people would never agree to give so much power to one individual. The balanced views of men with different backgrounds were needed to resolve the life-and-death issues facing the Commission.[8]

Even two days of discussion had not settled the far-reaching questions Dean had raised, and neither Lilienthal nor Dean was in a position to press his colleagues to a decision. Although Lilienthal agreed to stay on as chairman until February 15, 1950, to advise the President on the thermonuclear weapon decision, Pike was in fact serving as acting chairman on most other

business. Dean was still a junior member of the team. Until the President could find a new chairman, there would be little chance of defining the role of the Commissioners.

## *INTERREGNUM*

Long before Lilienthal left office, newspaper columnists were speculating about the appointment of a new chairman. Robert Oppenheimer, Paul G. Hoffman, and Chester I. Barnard were the first names suggested. By February there were rumors that the President had offered the position to Charles Luckman, who had just resigned as president of Lever Brothers Company. Strauss himself was mentioned but his own resignation, effective April 15, and Lilienthal's departure on February 15 left the question wide open as the President named Pike to serve as acting chairman.[9]



In the following weeks Washington was full of rumors of Commission appointments. Truman apparently asked Gordon Gray, the retiring Secretary of the Army, to take the chairmanship, but Gray had already accepted the presidency of the University of North Carolina. Strauss suggested Admiral Paul F. Foster as his replacement, and Dean told McMahon that many people around the Commission favored Paul M. Gross, vice-president of Duke University and president of the Oak Ridge Institute of Nuclear Studies. James B. Conant, Arthur H. Compton, and Robert M. Hutchins were momentarily in the news as possibilities for chairman. Dean himself was a leading candidate with strong support from McMahon, Strauss, and Donald Dawson, Truman's assistant on personnel matters. James Reston told Dean on March 17 that with Gray definitely out of the picture Dean was moving up on the President's list. A few days later Reston was even more confident that he was on the right track when he could find no one to knock down his "hunch" that "Senator McMahon's candidate" would get the job. "For Lord's sake," Dean shot back over the telephone, "don't put it that way!" [10]

When Dawson suddenly departed for the vacation White House at Key West on March 20, the press corps was convinced that the announcement would come soon. It did, but it was the appointment only of a Commissioner, not the chairman. The nominee to complete Lilienthal's term was Thomas E. Murray, a New York industrialist. Born in 1891, Murray had received a degree in mechanical engineering from Yale, had been president of an engineering company, and at the time of his appointment was a director of the Chrysler Corporation and other industrial and financial organizations. Holder of more than 200 patents and a prominent Catholic layman, Murray was also interested in labor matters. Truman had selected him in 1946 as the impartial chairman of the United Mine Workers welfare and retirement fund. The Senate section of the Joint Committee acted quickly on Murray's nomination, and the full Senate confirmed Murray on March 31.[11]

As the first weeks of spring slipped by with no word from the White House on further appointments, Dean and his colleagues became more anxious. Under the compromise agreement which Senator Bourke B. Hickenlooper had devised in the summer of 1948, the terms of all the Commissioners would expire on June 30, 1950. It would then be necessary for the President to submit new nominations and to designate the number of years each nominee would serve in order to place the appointments on a five-year rotating schedule. Perhaps to minimize the opportunities for a political sideshow in the confirmation hearings, Truman did not send up the nominations until June 19. Pike got the four-year term, Dean three, Murray two, and Smyth one. As yet there was no nomination for the five-year term.[12]

Three days later McMahon told Dean that he was going to poll the senators on the Joint Committee on three of the nominees. Hickenlooper was "on fire" about Pike, and there was sure to be trouble. But McMahon hoped that he could avoid having any hearings at all. He thought hearings might revive some of the issues which Lilienthal had raised in recent articles about abolishing the Commission form of organization and ending the Government "monopoly" of atomic energy. True to his word, McMahon reported out the nominations of Dean, Murray, and Smyth on June 23. The Senate confirmed them on June 26.[13]



As Pike's term was running out in the last days of June, Smyth was getting angry. McMahon was doing nothing to secure action on the nomination and Dean had gone off on a trip to Berkeley. Finally at noon on June 28, Smyth telephoned McMahon. He had no intention of letting the Pike nomination die without a fight. Unless McMahon held a hearing on the nomination at once, Smyth would call a press conference and give his own views on the subject. That was enough for McMahon. The next afternoon the Senate members of the committee met to hear Smyth deliver a ringing testimonial to Pike's ability and integrity. Dean, just back from Berkeley, and Murray supported Smyth's statement, but none of the senators had any questions to ask. The entire hearing was over in thirty-five minutes.[14]

Whether Smyth had done Pike a favor in demanding the hearing was not entirely clear. William L. Borden called Dean the next day to report that the committee had voted against confirmation. Democrat Edwin C. Johnson had joined his Colorado colleague, Eugene D. Millikin, and the Republicans, Hickenlooper, William F. Knowland, and John W. Bricker, in the opposition. Only McMahon, Tom Connally, Millard E. Tydings, and Richard B. Russell voted for Pike. McMahon had called Truman and told him that there would be no chance to bring the question to the Senate floor before July 5. McMahon assured the President he would be ready to present the facts.

Dean was troubled about the course of events. Now that there was no hope of confirming Pike before his term expired, he could no longer serve as acting chairman. That fact might upset plans for the appropriation hearings. Furthermore, as senior member of the Commission, Dean was now in the

embarrassing position of being acting chairman. McMahon told him it was unlikely that the President would try to forestall the opposition to Pike by naming someone else as chairman. Anyway, McMahon guessed, Pike would probably be confirmed.[15]

Whatever the basis for his optimism, McMahon did not find it easy to prepare for Pike's defense on the Senate floor. The senators voting against the nomination in the Joint Committee had been careful to keep the reasons for their opposition off the official record. Not until the following day did Hickenlooper state on a "Meet the Press" broadcast that he opposed Pike for his failure to support Strauss and Dean on the thermonuclear weapon decision. That Pike had taken a positive attitude since the President's decision in January was beyond question, but McMahon told Dean privately that he thought Pike was vulnerable for his indecisive stance during the preceding months. The best McMahon could do was to ask Pike for letters justifying his
448 position on this and other points. Truman in his press conference on July 6 voiced his complete confidence in Pike, scoffed at charges against Pike on the thermonuclear weapon decision, and dismissed the opposition as "Republican party politics." [16]

The Senate debate on July 10, 1950, showed that the President was not far from the truth. Senator Johnson of Colorado was the only Democrat who spoke against the nomination, and his opposition, like Millikin's, was mainly on the grounds that Pike had advocated maximum efforts to procure uranium ore from foreign sources rather than from the Colorado Plateau. For Hickenlooper, however, the nomination represented the broader threat of perpetuating in the Commission the last traces of Lilienthal's influence. Hickenlooper described at some length Pike's role in the Cyril Smith incident in 1948, with all the implications that Pike had been helping the Lilienthal administration to subvert the provisions of the Atomic Energy Act restricting the foreign dissemination of technical data. Knowland added the charge that during seven months as acting chairman Pike had done nothing to find a replacement for Admiral John E. Gingrich as director of security. Millikin revived some of the charges leveled during the Joint Committee investigations of the previous year that the Commission had been lax in controlling security clearances and fellowships. Pike, as a member of the Commission, presumably bore some responsibility for these shortcomings.[17]

One final source of opposition to Pike was the concern that the President might name him chairman. Truman had dismissed this idea with the remark that he could have appointed Pike months earlier if he had intended to do so, but he refused to give the Senate any assurances. McMahon, who already knew that Truman would appoint Dean, did his best to assure his colleagues that Pike would not get the chairmanship. On the final vote, the Senate justified McMahon's optimism by confirming Pike's nomination 55–24. The next day Truman appointed Dean chairman. The interregnum was over.

By the time Dean became chairman he had already suggested the elements of a new administrative style. He could not hope, however, to escape the legacy of the Lilienthal era. He had inherited a living organization with established procedures and assumptions. Whether the question was one of appropriations or policies in the Commission's three communities, he would have to start from patterns of previous years in dealing with Congress and the Joint Committee.

## *CONGRESS AND THE BALANCE OF POWER*

James R. Newman, one of the principal authors of the Atomic Energy Act, called his creation a radical piece of legislation. It established an agency, he said, vested with "sweeping authority" and entrusted with "portentous responsibilities." During the first two years of its existence, the Commission had exercised its extraordinary powers almost in a vacuum. Behind the security barriers the Commission's staff and its contractors lived in a world of their own, a world unknown to most of the nation. The President caught only fleeting glimpses of this world and the Congress was almost totally excluded. The predilection of Congressional appropriation committees and even the Joint Committee for criticizing the Commission's housekeeping and administrative functions demonstrated the inability of the Legislative Branch to exert any effective influence in central policy decisions. The question was whether the exceptional demands of security and the presumably esoteric nature of nuclear technology required such a large displacement in the traditional balance of power in the American system.



Certainly Congress could not hold the Commission solely responsible for whatever imbalance existed. In 1947 Lilienthal had considered irresponsible the Joint Committee's refusal to accept classified information. Congressional hearings, whether before the appropriations committees or the Joint Committee itself, had centered on relatively peripheral administrative matters. There was little evidence that members of Congress wanted to probe the mysteries of the atom or the grim arena of nuclear weapons.

McMahon's appointment as chairman of the Joint Committee in the 81st Congress opened new possibilities for redressing the balance of power. William L. Borden, the committee's new executive director, set out to transform the committee into an effective instrument of policy. McMahon's demand for access to classified information marked the first step in this direction. A second was Borden's proposal in May, 1949, to amend the Act to give the committee power to authorize the Commission's annual appropriation.[18]

Before World War II Congress had customarily incorporated in or-

ganic legislation a blanket authorization for all funds to be appropriated under the basic act. Section 19 of the Atomic Energy Act was an example of this practice. Only the appropriations committee had authority to review the Commission's budgets, and those who were familiar with the Commission's activities always found something unreal about the annual appropriation hearings. Almost never coming to grips with the essential aspects of the Commission's budget, the appropriations committees frequently became enmeshed in almost irrelevant administrative questions, as the hearings on community affairs had demonstrated. Almost as often members of the Joint Committee had been forced to intercede in the cause of reason and understanding. The need for a better system was obvious to both sides.

Borden's idea was part of a new trend in legislative procedure. A requirement for specific authorization by a legislative committee would impose on agency budgets some expert review which the appropriations committees could not hope to provide. The device also gave the legislative committees an opportunity and an incentive to push for larger appropriations for the agencies and departments under their jurisdiction.



The Hickenlooper hearings on "incredible mismanagement" had hardly begun when, on July 7, 1949, McMahon and Congressman Carl T. Durham had introduced bills based on Borden's authorization proposal. Carefully both men disassociated their action from the Hickenlooper hearings. Their amendment, they explained, would permit the proper exercise of Congressional authority. No longer would the Commission be able to proceed on new projects costing millions of dollars without specific Congressional approval. Even so, the Commission would still have more discretion and authority than most Executive agencies. In McMahon's view, he and Durham were merely trying to maintain the system of checks and balances essential to democracy. As members of legislative committees usually did, McMahon and Durham had couched their argument in constitutional terms, but their real goal was greater power for the Joint Committee.[19]

It was not surprising that Lilienthal and his associates took a contrary position on the amendment. They argued that atomic energy posed complex, dynamic, and unpredictable problems. Handling these had required the Commission to exercise all the unusual powers granted by the Act. If these powers were transferred from the President and the Commission to Congress, the Commission would lose the flexibility needed to exploit technical advances in weapon development, to take emergency measures in nuclear accidents, and to keep production rates at the maximum possible levels. Furthermore, the Commissioners contended, no other large Government agency had to obtain Congressional authorization for all of its continuing activities; the most required was authorization for major construction projects. Satisfied for the moment, McMahon announced on July 15 that for the time being he would not press the issue.[20]

The appropriation bill which Truman signed on August 24, 1949,

however, contained further evidence of Congressional intention to abridge the Commission's power. Senator Joseph C. O'Mahoney's appropriations subcommittee had written into the bill a requirement for FBI investigation of applicants for Commission fellowships. The bill also restricted the Commission's authority to begin new construction projects if the estimated cost were not in the approved budget or exceeded the budgeted amount. Only if the director of the Bureau of the Budget sent a detailed justification for such a project to the appropriation committees of Congress could the Commission proceed with construction. The budget director would have to submit a similar justification whenever the estimated cost of any current project exceeded the budgeted cost by 15 per cent.

O'Mahoney explained to the Senate that the amendment was intended to prevent the Commission from changing its plans without notice to the President or Congress. He did not mean to single out the Commission by these provisions; they could apply equally well to other agencies. The subcommittee, O'Mahoney said, had drafted the proviso with the help of the Joint Committee and the Commission. Acknowledging this fact, McMahon countered that the version before the Senate was a vast improvement over the original proposal. Lilienthal too had accepted the proviso, but with some mental reservations. He feared that the amendment crippled the Commission's flexibility, and he agreed privately with McMahon that the language was too restrictive. In October, 1949, McMahon and Durham succeeded in amending the appropriation act so that it would not apply to technical and production facilities if the Commission certified that they were essential to the national security.[21]



The summer of 1949 had marked the low point of the Commission's relations with Congress. Lilienthal, scarred and enervated by the Hickenlooper inquiry, saw his attempts to satisfy Congressional committees as a harassing and futile experience. After Lilienthal's resignation, Pike fared better in his exchanges with the Joint Committee, but the spirit of accommodation seemed to stem largely from the understanding that he would not be chairman. Now Dean would have a chance to demonstrate his ability to work with the Legislative Branch.

## *COMMUNITIES: AN AMERICAN ANOMALY*

The nation's atomic energy program as the Commission inherited it in 1947 was in many respects an anomaly in American life. Bred in extraordinary scientific developments which few Americans tried to understand, isolated by security barriers, and protected by unprecedented national legislation, the Commission was, as one observer put it, "an island of socialism in the midst of a free enterprise economy." [22]

Of all the aspects of this anomaly, none were more striking than those manifested in the three "atomic cities" of Oak Ridge, Richland, and Los Alamos. Created by the Army during World War II, the three towns were completely owned and operated by the Commission. Everything from cemeteries and sidewalks to homes and grocery stores was Government property. In 1947 Oak Ridge and Los Alamos were still closed communities surrounded by patrolled security barriers. Even relatives of residents could not enter without a pass. Behind the fences the scientists, engineers, technicians, and laborers who manned the production plants and laboratories lived with their families in an isolated world of their own. The Army and then the Commission, through local management contractors, operated the bus systems, collected rents, delivered coal, repaired homes, manned the fire departments, operated the movie theaters, leased stores, and ran the schools. Never threatened by the crass forms of exploitation sometimes imposed on residents of "company towns," the inhabitants of the atomic cities were more nearly the privileged subjects of a beneficent, if not indulgent, ruler.



For the Commission, the communities were an unwelcome legacy. The towns, hastily established on a temporary wartime basis, possessed neither the buildings nor the organization necessary for permanent communities. They were expensive to operate, difficult to administer, and always vulnerable to criticism. As one observer remarked, Congressmen and others who would never have dared to raise questions about scientific aspects of the Commission's work considered themselves experts on local community problems. The quicker the Commission could divest itself of the communities, the better; but as long as the plants and laboratories at the three sites were vital to the national defense, the Commission would find it difficult to escape from its community responsibilities.

Much to his credit, Carroll Wilson recognized the complexities of community management from the start. Early in 1947 he obtained the services of Lyman S. Moore, an authority on municipal government and city manager of Portland, Oregon. Moore began at once to frame some of the questions the Commission would have to answer. Was it desirable to provide the towns with some sort of local democratic government in which the people themselves would determine the scope and quality of public services in terms of related needs and costs? If so, how would a democratic government operate in an environment in which security and defense requirements were paramount? What would be the ties between the communities and county and state governments? To what extent were subsidies needed to attract highly skilled scientific and technical personnel to these isolated areas? To answer these and other questions, Moore suggested that the Commission set up an advisory panel and hire several analysts with expert knowledge of housing, public financing, and municipal government to survey the Commission's communities.[23]

In the chaos of the confirmation hearings and the efforts to organize

the Washington staff in 1947 there was little time to apply Moore's recommendations. Virtually all actions on community matters occurred at the local level. The one exception was a general policy statement in which the Commission declared that "residents at field installations shall enjoy those facilities, services, and activities which are properly a part of American community life." There was no commitment to end Government ownership of the communities, but the Commission did encourage the people to join in making community policy to the extent that security and plant operations made possible.[24]

In April, 1948, the Commission hired Moore to make the survey which he had recommended more than a year before. Moore did not have time for an exhaustive study, but with J. Bion Philipson, an expert in home financing policy from the National Housing Agency, he did get some first-hand knowledge of the communities during two-day visits to each site. His report, reinforcing the Commission's policy statement of December, 1947, proposed that the long-range goal be "to achieve democratic control of a visible local government which provides responsible town management and efficient operations at minimum cost consistent with getting the job done." [25]



As first steps toward democracy in community management, Moore pointed to the need for uniform classification of accounts for all town activities, including housing, commercial operations, utilities, and government services. Only through a uniform accounting system and regular reports of costs and revenues could the Commission gather the information to formulate workable procedures. Moore thought it also important for the Commission to state as clearly as possible its fiscal policies for all aspects of town activities and to find ways to separate the landlord function from community management. Moore also expressed the hope that Oak Ridge might become an open community so that private ownership of land would be possible.

Although Wilson and the headquarters staff took little formal action on the Moore report, both Shugg at Hanford and John C. Franklin at Oak Ridge adopted its recommendations as guide lines. At Hanford, Shugg's problems were relatively simple. Richland had never been behind the security barrier; one contractor, General Electric, operated both the community and the production plants; and some community services, such as the school system, were established originally within the local county government. Residents of Richland showed little interest in self-government, largely for economic reasons; but there was real local interest in taking over commercial enterprises in Richland and even in home ownership. For Los Alamos, the Moore report was almost irrelevant. As long as the laboratory was in the middle of the community, there was no possibility of opening the town, and the absolute space limitations on the mesa made the expansion of housing almost impossible. In 1948 it seemed likely that Los Alamos would have to remain under complete Government control for the foreseeable future.[26]

Oak Ridge, as the largest and most diversified of the three towns, posed the greatest challenge in community operations. Fortunately for the people at Oak Ridge, Franklin had the breadth of vision to understand that community relations were one of the most important factors in the success of production operations. To supervise community activities, Franklin had excellent assistance in Fred W. Ford, a former city manager. Together they set out to accomplish the immediate goals set forth in the Moore report. Franklin hired an expert appraiser to put rents on a more equitable basis, established uniform accounting systems separate from the plant systems, and reorganized the community management staff to put all municipal functions under a city manager and real estate operations in a separate office. Completion of the Oak Ridge master plan provided a framework for municipal zoning laws. Franklin also hired consultants to study the feasibility of incorporating Oak Ridge, to estimate tax revenues, and to draft a model charter. Late in 1948 Franklin

organized a series of town meetings to discuss the incorporation studies. The Commission authorized the first sale of Government land at Oak Ridge in January, 1949, for church sites. On March 19, complete with ceremonies including Vice President Alben W. Barkley, Lilienthal, and movie star Marie McDonald, the guards took down the barriers to the city. Oak Ridge had taken the first step toward the goal of self-government.[27]

Despite these accomplishments, most of the features of a Government town were still evident at Oak Ridge and Richland. Some of these brought distinct advantages to the residents. The community services provided by the Commission were superior to those furnished in neighboring cities of comparable size. Rents were about 20 per cent lower and there were no property taxes in the Commission's towns. But the residents had no stake in the community and no financial incentive for establishing one. Government ownership and operation bred an insidious type of paternalism that sapped the initiative of the residents. The Commission faced the improbable task of inducing Americans to exercise their rights as free citizens.

Far more worrisome in the short run than public lethargy were the constant irritations inevitably generated by community operations. Franklin complained that, even with a management contractor to serve as a buffer between him and the people, he was continually besieged by irate housewives who complained about leaky faucets or uncollected garbage. In the absence of a free enterprise system, residents could readily demand services they did not pay for and object to rent increases stemming not from impersonal market conditions but from the "arbitrary" decisions of Government officials. Eventually the more outspoken citizens mailed their grievances to the Tennessee Congressional delegation in Washington, thus providing convenient ammunition for Senator Kenneth D. McKellar and other Lilienthal opponents to use against the Commission. Perhaps a typical example was Senator Hickenlooper's prolonged debate with the Commission during the 1949 investigation concerning the cost of garbage can enclosures at homes in Oak Ridge.[28]

The Hickenlooper investigation no doubt reminded Wilson of what he already knew well: that the Commission could never work too hard to free itself of the communities. He told the Commissioners in December, 1949, that he had been able to get community management on a sound administrative basis. Significant steps had been taken at Richland and Oak Ridge toward making the towns "normal" American communities, but he did not believe the Commission had really thought through the question of what "normality" would mean in these communities.

Some of the difficulties were apparent in a comprehensive report which Richard W. Cook, the new manager at Oak Ridge, sent to Washington in January, 1950. To create a permanent community and free enterprise in a true sense would require private ownership of real estate, but the Oak Ridge staff was convinced that sale of commercial properties would not be feasible until the town had been incorporated. To complete the vicious circle, incorporation would not be practical until private enterprise provided a broad enough tax base to meet at least some of the municipal costs. Even if the standards of municipal services at Oak Ridge were substantially reduced and a high municipal tax rate were established, there would still be a gap between revenues and costs, in terms of property evaluation, of almost $38 million. The low population density of the town, which resulted in unusually high costs for streets and utilities, and the demands of the residents for schools superior to those in nearby localities did not make cost reduction a promising solution.[29]



As an interim measure, Cook and the Oak Ridge staff proposed to grant long-term leases on land at Oak Ridge, for both commercial buildings and private homes. There was some hope that existing commercial structures could be sold if the prices were low enough to make it possible for the merchants to meet the high maintenance costs on the temporary buildings. Cook also had plans to place the building of additional homes at Oak Ridge in the hands of private developers. It was still not feasible, however, to sell homes, even to people directly engaged in Commission work, without resale restrictions. The shortage of housing and the continuing demand for homes resulting from the expansion of production facilities at Oak Ridge required ultimate control by the Commission. Another consideration was that Government ownership provided the only basis for typical ordinance controls over health, safety, sanitation, and zoning until the town was incorporated.

Beyond these practical matters there were important policy questions which the Commissioners raised in January, 1950. However desirable self-government and free enterprise were, the Commission could not let these aims interfere with the primary purpose of the communities. As Walter J. Williams suggested, the towns did not exist in their own right but only as they supported the Commission's essential activities. Wilson raised the question of whether incorporated towns could meet the housing needs of Commission and contractor personnel. Dean was concerned about the implicit assumption in

the Oak Ridge proposal that the town was to be a permanent community. Both he and Pike saw the difficulty of guaranteeing for ten or twenty years the operation of the production plants necessary to support the population of the town. Changing demands and obsolescence of existing plants could spell doom to a one-industry town. In short, the Commission did not intend to abandon its long-term goals for the communities, but it recognized the practical difficulties of removing the anomaly of Government control in the immediate future.[30]

## *COMMUNITIES AND CONGRESS*

Orderly withdrawal from community operations may have seemed a reasonable goal for the Commission in early 1950, but there was some reason to

believe that Congress might force precipitous action. Since the first full-scale appropriation hearings in 1948, the House subcommittee under Albert Thomas of Texas had shown a preoccupation for probing the complexities of community management. Most Congressmen thought they understood the operation of local governments. They could imagine a town of 33,000 people, the population of Oak Ridge, and they could envisage the services a town of that size would probably require. They admitted that the Commission had reduced the costs of community operations substantially over the years, but they still found it incredible that gross costs for operating Oak Ridge in fiscal year 1950 could exceed $12 million. Even harder to accept was the fact that the Roane-Anderson Company, the management contractor for the town, received an annual fee of $180,000 over and above all salaries and expenses. How many city managers, they asked, received such a princely fee for directing the services of a small municipality? [31]

After three years of hearings, Shugg, Williams, and Cook were growing weary of explaining that Roane-Anderson did far more than provide municipal services. The company served as landlord for almost 9,000 private homes and all the commercial buildings in the town and collected about $5 million per year in rents. In addition to providing the usual municipal services, the company maintained all the homes and commercial buildings, operated the steam plant and community warehouses, disposed of surplus Government property, maintained all Government vehicles and equipment, ran the taxi service, kept the grounds, and delivered coal. Subcontractors now performed many of these functions, but Roane-Anderson was still responsible for activities costing more than $14 million per year. In short, the company was far more than a city manager.

Williams had explained several times that the Turner Construction Company had created Roane-Anderson as a subsidiary in 1943 at the Army's request specifically for the purpose of operating Oak Ridge. During the peak of the wartime operation, the company had received a fee of $300,000 per

year. The Commission had since negotiated the fee down to $190,000 and then to $180,000. Gross costs were dropping steadily and Roane-Anderson employment had declined from 4,000 workers in July, 1948, to less than 1,400 in January, 1950, despite the growth of community operations required by the expansion of production plants at Oak Ridge. For achieving these economies, Williams maintained, the company deserved a management fee. Shugg insisted that the fee was modest, particularly if the portion paid for real estate services and other nonmunicipal functions were deducted. Of one thing Shugg was certain: The Commission could not reduce the costs of community operations either by running Oak Ridge directly with Government employees or by finding another contractor.

The repetition of these arguments seemed to have little effect on the committee. Congressman Albert Gore of Tennessee still thought both the reimbursable costs and the fee were too large. The same judgment applied to American Industrial Transit, Incorporated, which operated the bus system at Oak Ridge, and to the Zia Company, which provided all the community services at Los Alamos. Only the General Electric Company, which operated the Richland community, escaped criticism and presumably only because the company received an overhead allowance of $200,000 rather than a fee.



When the House hearings ended on February 22, 1950, there was little doubt that this time the committee would do more than complain about Commission performance. Thomas and Gore had made a point of inquiring about the impact of a statutory limitation on fees paid for community management. In a letter to Thomas, Wilson contended that such a limitation would force the Commission to operate the communities directly, at considerable additional cost to the Government. In defense of the $180,000 fee, Wilson showed that only $27,000, or 15 per cent of it, applied to the city management function. Despite these protestations, the committee report to the House on March 28 recommended a proviso that no part of the appropriation could be used for payment of a contractor "where the fee for community management is at a rate in excess of $90,000 per annum or for the operation of a transportation system where the fee is at a rate in excess of $45,000." The involved language was a technical device to circumvent the Congressional prohibition against using appropriation bills to accomplish substantive legislation, but the effect was clear enough. It would cut the community fees in half.[32]

Following the usual practice, the Commission carried its appeal to the Senate Committee on Appropriations and to the Joint Committee. Shugg told the senators the effect of the limitation would be damaging, particularly because the House committee meant the limitation to apply to the entire fee and not just to that portion paid for city management. A further complication was that all the community contracts would run until the end of 1950, but the limitation would take effect in June, thus forcing the Commission to repudiate valid contracts. Senator McMahon told O'Mahoney's committee that disrup-

tion of community operations at Oak Ridge and Los Alamos would slow the development of the thermonuclear weapon. Pike stressed the same theme before the Joint Committee on April 18. He assured the committee of the Commission's long-term interest in divesting itself of the communities. To speed up that process, Pike said the Commission was considering the appointment of a disinterested advisory panel to survey the possibility of making the three towns independent, self-governing communities.[33]

The idea of a survey panel took on added importance after May 5, when Congressman Chet Holifield, also a member of the Joint Committee, failed in his attempt to strike the fee limitation from the appropriation bill during House debate. Moore had already recommended several names for membership on the panel, and Pike checked these with McMahon a few days after the House acted. On May 17, the Commission approved the terms of reference for the committee. The panel was to devise a plan by which the
458 Commission could divest itself of the responsibility for operating the communities and to recommend the policies the Commission would have to adopt to carry out the plan. The panel would also be expected to point out any practical limitations on the Commission's ability to attain the goal and to evaluate the steps already taken.[34]

The House amendment was not the only pressure Congress was bringing to bear on the Commission's community policy. The Senate committee had listened to the Commission's arguments against the amendment, but gave no signs of favorable action in the weeks after the hearing. Then on May 28, in discussing the appropriation bill with O'Mahoney, Shugg learned that the senator was considering an additional amendment which would require the Commission to turn over all responsibility for the towns to the residents by June 30, 1951. Shugg pointed out the disastrous results such an amendment might have, but his statement did not seem to impress O'Mahoney.

The Commission's response to this challenge reflected something of the new style which Dean would bring to relations with Congress. Dean's first reaction was not to fight but to try to explain the situation and in a way that would not embarrass or perturb the legislators. He supported the idea of sending O'Mahoney a strong private letter pointing out the impossibility of acting so quickly on the complex problems involved in community divestiture. Dean could also gain support from McMahon and Borden, who would see in the proposal a threat to weapon production. Most of these discussions, however, were behind the scenes. When the Commissioners met with the Joint Committee on June 6, most of the discussion went to the effects of the House amendment. Dean vaguely referred to "some kind of rider that might attempt in this session to tell us to free ourselves of this town within the course of the fiscal year." Before the meeting ended, Senator Bricker had offered to discuss the community issue with O'Mahoney, and Dean had promised McMahon to establish the community panel and have a report for the Joint Committee by January, 1951.[35]

Within a week the threat of the O'Mahoney amendment had disappeared. On June 13 Wilson discussed the charter for the panel with Herbert Emmerich and Don K. Price, Jr., two experts on municipal government from the Public Administration Clearing House in Chicago. It no longer seemed wise to commit the Commission to divestiture as an immediate goal. Emmerich and Price agreed that the complexities of the situation recommended a cautious approach. Under the revised charter, the panel would seek a plan which would enable each of the three communities to contribute most effectively to the atomic energy program and suggest how, within that context, the Commission might grant greater local autonomy and reduce Government costs. The Commissioners readily accepted this approach and approved the formation of the panel under the chairmanship of Richard G. Scurry, whose law firm had represented the Dallas housing authority and many private real estate interests in that city for more than a decade.[36]



While Scurry was organizing his panel, Congress was at last taking final action on the 1951 appropriations bill. The report of the Senate Appropriations Committee on June 6 showed that the Commission's blandishments had not been in vain. The report not only omitted the O'Mahoney proposal but also deleted the House amendment. The committee, however, did call upon the Commission to discontinue "the present undemocratic method" of operating the communities and suggested that the Commission establish a definite timetable for eliminating the community management and transportation contracts. The final blow came when the Senate-House conference committee restored the House amendment, which became law on September 6, 1950. The Commission now had no choice but to apply the statutory limitation on fees paid to the three contractors. Congress had expressed its determination to end the American anomaly.[37]

## *LABOR: THE CREATIVE POSSIBILITIES*

In April, 1949, a month before Dean joined the Commission, President Truman had formally established the Atomic Energy Labor Relations Panel. Acting on the recommendations of the *ad hoc* group under William H. Davis, the President hoped that the new panel would stabilize labor relations in the Commission's plants and laboratories. Now it was up to Davis as chairman to carry out the principles for negotiation he had recommended to the Chief Executive. During the preceding year Davis and his *ad hoc* group had helped Lilienthal and his colleagues avoid the worst pitfalls in labor relations, but it remained to be seen whether the new panel could maintain the delicate structure of cooperation between the Commission, its contractors, and the unions under the pressures of successive expansions of production facilities.

Davis was fortunate to have the continuing services of Edwin E. Witte and Aaron Horvitz, who had been members of the temporary panel established in the aftermath of the Oak Ridge dispute in 1948. Davis himself, just a few months short of his seventieth birthday, was a man of unusual experience and ability. His discursive, conversational manner often concealed the shrewd and penetrating qualities of his mind. That same mind had led him to the conclusion that studied uncertainty in negotiations was a valuable ingredient in successful labor-management relations. With this approach both Witte and Horvitz agreed.

The new panel was a part-time group, empowered to step into such disputes as it chose to consider after all the usual conciliation methods had failed. Not only were the panel's procedures deliberately flexible, but Davis was always vague about the next steps he would take in any situation. If the parties could not reach a voluntary agreement, the panel could recommend a
460 settlement. During the following thirty days the parties could neither interrupt production nor modify the agreement in effect when the dispute began. The intent of the broadly defined steps was to keep labor and management from using the panel as a means of avoiding the normal bargaining processes. The principle of uncertainty would preserve what Davis called "the creative possibilities of responsible collective bargaining." [38]

If the panel were to work successfully, both management and labor would have to accept the role which Davis had proposed for it in his report to the President. Most important was the provision that there would be no interruption of production or services before, during, or thirty days after the panel assumed jurisdiction. The unions agreed, as did all the Commission's contractors, with two exceptions. Robert G. Sproul, president of the University of California, which operated the Los Alamos and Berkeley laboratories, was sympathetic to the panel's aims, but he doubted whether the university as an agency of the state government could accept any limitations on its authority without violating the state constitution. Oscar S. Smith, the Commission's director of labor relations, was reluctant to press the issue. Labor relations with the university were good, and from conversations with its representatives Smith was sure the university would maintain the *status quo* during a labor dispute.

The second contractor with qualms about the Davis formula was General Electric. The company was willing to accept the panel for Hanford disputes but not for those at the Knolls laboratory. Not only was the laboratory close to the company's huge plant at Schenectady, but the company was also still uneasy about its relationships with the union of the United Electrical Workers, which, in late 1949, was being expelled from the CIO on charges of communist domination. For Knolls, Smith also advised that the Commission move cautiously. He suspected that the company's hesitation would disappear after the panel had demonstrated its effectiveness.[39]

None of the Commission's sites were without labor difficulties, but Oak

Ridge continued to live up to its reputation as a trouble spot. Since the beginning of 1950 jurisdictional disputes had kept Oak Ridge on edge. On May 24, laborers employed by the Maxon Construction Company, contractor for the new gaseous-diffusion plants, walked off the job after a disagreement on wage differentials. Although local and national union leaders and the craft unions repudiated the walkout, the stoppage spread to the laboratory and the town. Richard W. Cook, the Commission's manager at Oak Ridge, considered the need for additional police. As a last resort Cook could have summoned the 82nd Airborne Division of the Third Army, but fortunately this proved unnecessary. The last of the laborers returned to work on May 31, when the Commission assured them that an arbitration panel would issue an award by June 12.[40]

A threat to plant operations at Oak Ridge followed hard upon the construction dispute. Late in May, Cook warned Walter J. Williams, the director of production in Washington, that operators of the K-25 gaseous-diffusion plant had voted to strike on June 8. The issues between the United Gas, Coke, and Chemical Workers (CIO) and Carbide included wages, benefits, and, as later negotiations revealed, better contract terms which AFL employees of the same contractor enjoyed at Oak Ridge National Laboratory. Donald B. Straus, secretary of the Davis panel, hurried to Oak Ridge and found the situation ominous. In Washington, Williams asked Cook to decide what he would do if the strikers put up road blocks. At Oak Ridge, Samuel R. Sapirie, Cook's deputy, met with Carbide officials to draft emergency plans for operating the plant. Carbide intended to use supervisory personnel to run the K-25 plant and shut down some of the ancillary operations. The chief worry was whether the supervisors could get through the picket lines. Again a strike was averted when the union and the company agreed to abide by panel procedures. Philip Murray, president of the CIO, lent his influence to keep negotiations going and the plant operating. By the middle of August, 1950, the parties had reached agreement on all but a few issues, and Davis expected the terms of the settlement to appear in a new contract.[41]



## *SECURITY—SINE QUA NON*

Among all the aspects of administration, none took more of Dean's time than did security. On the day he took office as Commissioner in May, 1949, his colleagues were deeply embroiled in a public dispute over security. Congressional voices were demanding an investigation of the Commission's practice of granting fellowships to scientists without security clearances. The day before, Commissioner Strauss and Admiral Gingrich, who had just resigned as director of security, had expressed to the Joint Committee a lack of confidence in the Commission's security program. Gingrich complained that

decentralization of administrative functions to the field offices had left him with little more than a staff function at headquarters; even there, he said, he did not control all the activities that seemed properly to belong to the director of security. Under the Commission's existing organization, he had been responsible to the general manager, not to the Commissioners. In the interests of efficiency, Gingrich suggested, Wilson had relegated security to a subordinate staff function.[42]

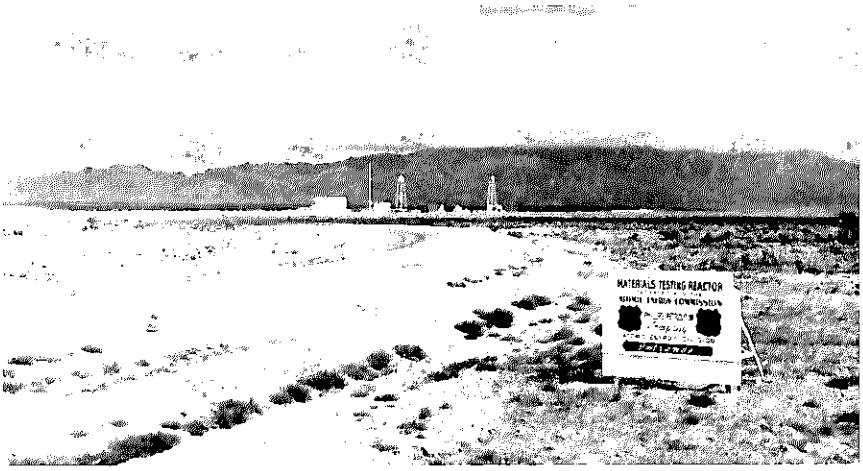
Strauss admitted that these views represented a minority opinion in the Commission. Both Lilienthal and Pike accepted Wilson's contention that true security lay more in "positive" achievements than in "negative" policing of personnel and plants. The failure to find a replacement for Gingrich during the spring and early summer of 1949 reflected the stalemate within the Commission. Presumably the two new Commissioners, Dean and Smyth, held the balance of power and would eventually determine whether the Lilienthal or the Strauss view of security would prevail.[43]



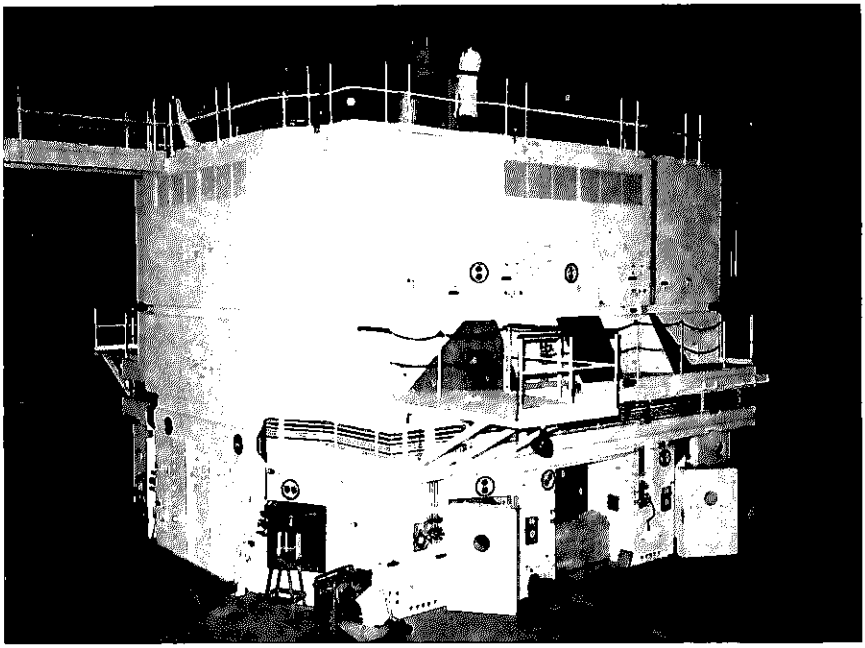
By July, Strauss must have gained some hope that Dean would eventually support his position. Just before Wilson had gone on vacation, Strauss had reopened the question of decentralization of security. Although Dean did not express himself formally on this matter, he took a firm position on Strauss's side that the existing language of the Act did not support the Commission's actions in exchanging technical information with the British and Canadians. Like Strauss, Dean showed an interest in administrative procedures and particularly in the functions of the general manager and the Commissioners. In September, Dean questioned Wilson's practice of making the final decision himself on security clearances for fellowship applicants rather than forwarding them to the Commission when the investigations revealed derogatory information. Perhaps in time Dean would enable Strauss to escape his lonely minority of one on security matters.[44]

Both Dean and Strauss had taken an active part in the search for a director of security during the summer. Finally, on September 12, when the latest of these efforts proved unsuccessful, Pike suggested that the Commission first define the organization and functions of the division before seeking a director. Having recently read a transcript of Gingrich's remarks before the Joint Committee, Pike thought some clarification would be helpful. Three days later Wilson suggested the appointment of an *ad hoc* panel both to study the Commission's security system and to recommend a director. The Commissioners accepted this idea and agreed to suggest members of the panel. One of those Dean recommended was John S. Bugas, a former FBI agent and since 1944 an industrial relations executive with the Ford Motor Company. Strauss also knew Bugas and offered to approach him.[45]

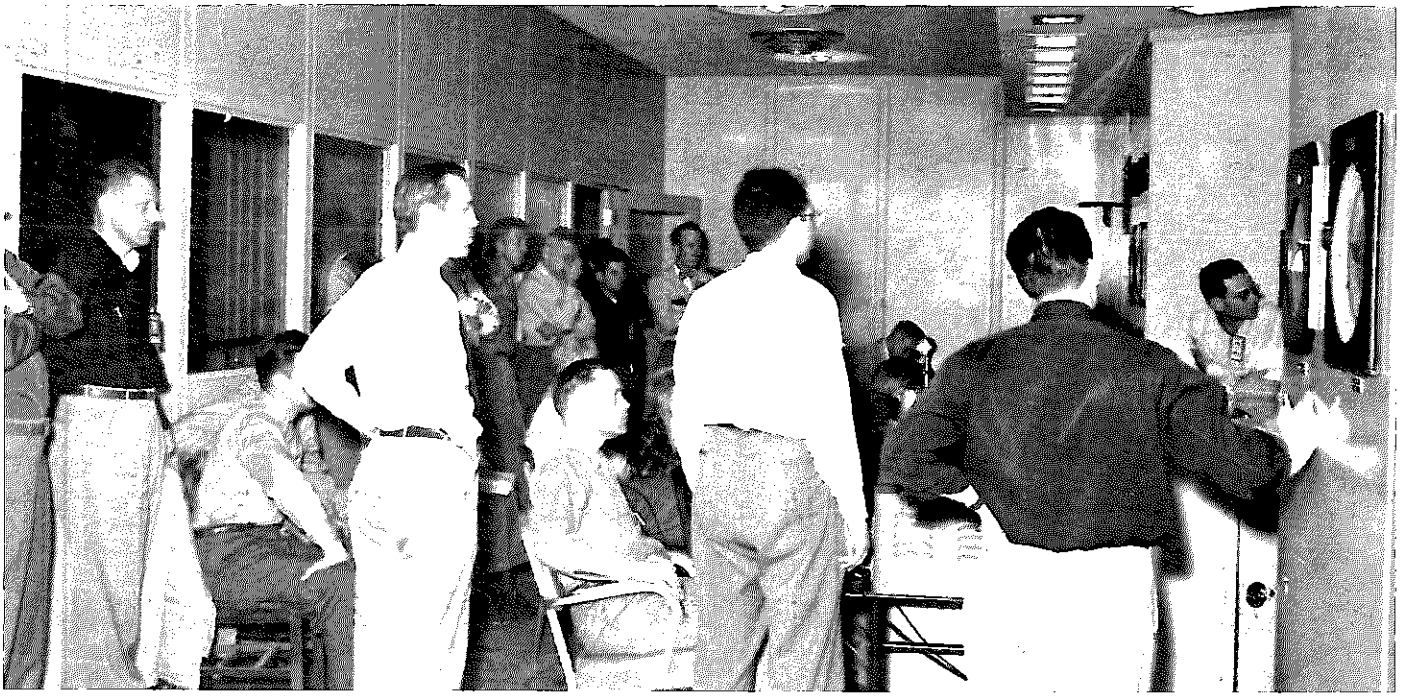
Strauss convinced Bugas to take the chairmanship, but it took several weeks to select the members of the panel: J. Arthur Mullen, a Detroit businessman, D. Luke Hopkins, a Baltimore financial executive, and Paul E. Klopsteg, scientist and engineer. Strauss, already planning to leave the Com-



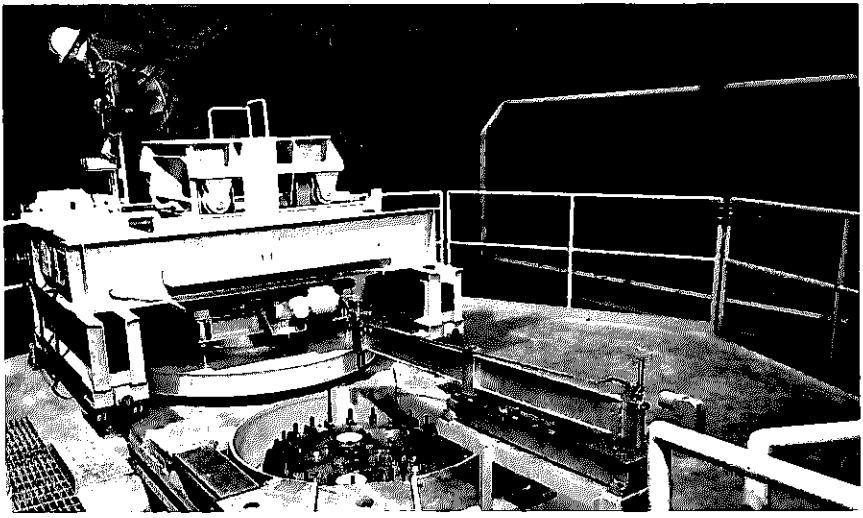

THE MATERIALS TESTING REACTOR FACILITY AT THE TIME OF COMPLETION, 1952 / The huge reactor building and supporting facilities are dwarfed by the vastness of the Idaho desert.



THE MATERIALS TESTING REACTOR, JUNE, 1952 / The reactor as it appeared about two months after criticality—still so new that the floor surrounding the reactor looks strangely vacant of experimental equipment.



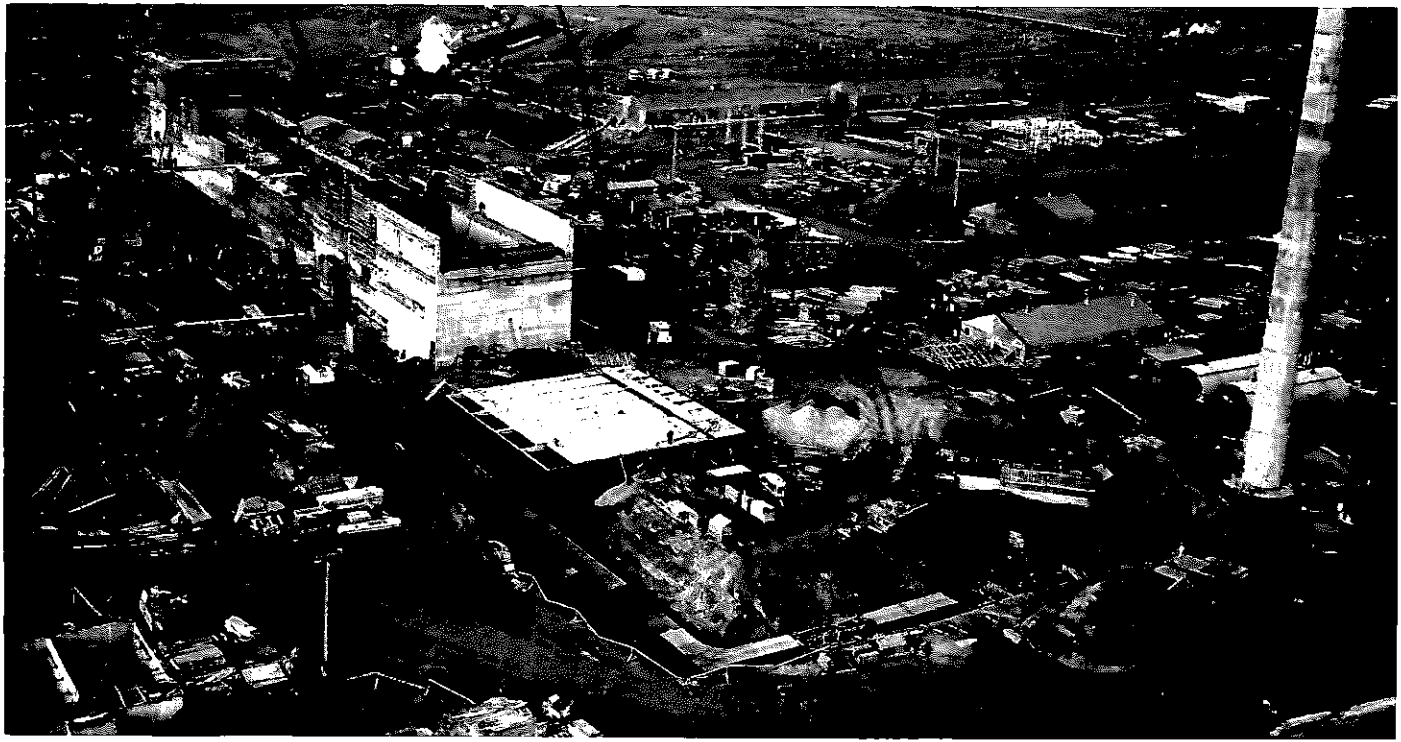
THE MATERIALS TESTING REACTOR REACHES CRITICALITY, MARCH 31, 1952 / The group is watching the reactor instrument board in the control room. Standing from left to right: Richard L. Doan of the Phillips Petroleum Company (with arms folded); J. Bion Phillipson, assistant manager of operations at Idaho for the Commission; Deslonde de Boisblanc, head of the Phillips instrument section; Steven Hanauer (in white shirt), Oak Ridge instrument technician; and Leonard E. Johnston (in dark shirt, near instrument panel), manager of Idaho operations. In the right background close to the instrument panel is Marvin M. Mann, leader of the Oak Ridge design group.



ARGONNE NATIONAL LABORATORY

MECHANISM FOR REMOVING FUEL ELEMENTS FROM THE EXPERIMENTAL BREEDER REACTOR / This photograph, taken just before full power operation in December, 1951, shows the small diameter of the reactor tank in comparison with the large amount of concrete shielding required. During removal the rod had to be shielded and kept in an inert atmosphere at all times.

LIGHT FROM THE ATOM, DECEMBER 27, 1951 / The reactor building illuminated by nuclear power from the Experimental Breeder Reactor.



THE REDOX PLANT TAKES SHAPE AT HANFORD / The long "canyon" of concrete cells would contain chemical equipment for recovering plutonium and uranium from slugs irradiated in the Hanford production reactors. The photograph was taken on December 1, 1950.

mission, made every effort to expedite the work of the panel. He offered the members assistance on administrative details and arranged with the Navy to have Gingrich flown from his new station in Hawaii for a meeting with the panel in San Francisco. Although Bugas and his associates did not begin their work until January, 1950, and had to visit all the Commission's major installations, they completed the report on April 6, nine days before Strauss left the Commission.[46]

From the opening paragraph the report showed that the panel construed its mandate broadly. Security, the panel contended, pervaded all functions of the Commission and was a "*sine qua non* of a successful achievement of the objectives which Congress had in mind in creating the Atomic Energy Act." Because safeguarding information often seemed to conflict with operational efficiency, the director of security had to be in a position to exercise the nicety of judgment required for sensible compromise. In the panel's opinion, the Commission's organization did not give the director this kind of independence. The panel thought the division had been downgraded and had lost prestige, partly because it lacked aggressive leadership and partly because top management failed to understand the importance of security.[47]



The Bugas panel could suggest dozens of administrative remedies, but its principal recommendation was that the Commission establish a new position for an assistant general manager. He would supervise all activities with security implications, including, in the panel's estimation, personnel, public and technical information, intelligence, classification and declassification, export control, and accountability of source and fissionable materials. For matters he deemed of sufficient importance, the assistant general manager should have direct access to the Commissioners.

Strauss was ready to accept the report without change. The division had been without a director for almost a year. To delay until new Commissioners were appointed to replace him and Lilienthal would require the Commission to go back over the same ground. Dean was inclined to agree with Strauss that the Commissioners should act on the report without waiting for a laborious review by the staff, but Pike and Smyth thought the issues were too large and far-reaching for quick decision. Although he would no longer be a member of the Commission when the report came back for final action, Strauss accepted the suggestion of staff review.[48]

Wilson was circumspect in his comments on the report. He tried to be positive despite his strong reservations about the wisdom of some of the recommendations. Many of the suggestions for better administration and coordination he could adopt at once, but the proposals for an assistant general manager aroused misgivings not only in Wilson but also in the staff.

General James McCormack thought there would be advantages in cutting down the number of people reporting to the general manager, but he wondered whether the Bugas proposal would give the impression that security

in the sense of secrecy and exclusion was more important than security by achievement. Both McCormack and Williams questioned the wisdom of permitting the assistant general manager to report directly to the Commissioners. The idea of putting the Commission's personnel and information activities under the assistant general manager seemed questionable, particularly if, as Williams predicted, the new official's security functions overshadowed his other responsibilities. Wilson shared most of the panel's suggestions, but he disagreed that the organizational change was the only alternative available.[49]

Wilson's report to the Commissioners on May 19, 1950, revealed that the Bugas panel had sharply spurred the staff to greater efforts in improving administrative procedures. Wilson was speeding completion of a comprehensive manual of security procedures. The manual would include new instructions for transferring and controlling classified documents, making security surveys, controlling visitors to Commission installations, clearing employees,

and fixing standards for physical security. Wilson also accepted Bugas's criticism that action on policy matters took too long. To coordinate action in the general manager's office, Wilson called on Thomas O. Jones, who had helped to set up the Commission's security operations in 1947. The staff itself was planning more frequent conferences for security personnel and considering the use of special panels to hammer out new procedures. To meet some of the complaints that inspections of the field offices were often ineffective and unreasonable, the division was developing a special training course for inspectors, revising inspection procedures, and making sure that the field offices took prompt action on findings. In the area of personnel security, the staff was almost ready to replace the "interim" procedures in use since 1948 for the personnel security review board. The staff was also considering the feasibility of the panel's recommendation for periodic reinvestigation of all Commission and contractor employees.[50]

The more fundamental issue of organization was the principal topic in the Commission's meeting with the panel on May 24. Responding to Wilson's written comments to the Commissioners, Bugas stressed the breadth of the panel's fact-finding efforts and the unanimity of its recommendations. Appointing an assistant general manager was not the only solution the panel had considered, but it had not found any other to recommend. Bugas said his group did not expect the assistant general manager to be an "exalted" director of security or a "super cop." He would be the general manager's assistant in every sense of that term, except for the right to go directly to the Commissioners, a right he would exercise rarely if ever. There were other ways of providing this kind of assistance in the general manager's office, but Bugas thought the prestige and authority of an assistant general manager would be valuable.

Wilson thought the panel had diagnosed the Commission's ailment but had not prescribed the proper remedy. Many of the shortcomings in adminis-

tration and communications Wilson attributed to the lack of a division director for more than a year. He thought the isolation of the security group from other headquarters divisions stemmed from Gingrich's tendency to treat his job as a temporary assignment. Adopting the panel's suggestion would probably leave the division without a leader for another year. Wilson thought the most pressing requirement was to find a director.[51]

In the absence of a decision by the Commissioners during the final hectic days of the interregnum, Wilson as an operating official had a distinct advantage over Bugas as head of an advisory committee. Wilson and Shugg devoted their energies toward finding a new director of security. The Commissioners found it hard to object to that effort, although Dean warned Wilson that he should check back with the Commission before taking any final action to make sure that he was not prejudicing organizational changes.[52]



The outcome reflected both Wilson's and Dean's efforts. Just a few days before Wilson resigned as general manager in August, 1950, the Commission agreed to appoint John A. Waters as director of security. Waters had just retired as a captain after thirty years' service in the Navy. As one of his friends described him, Waters was a "plugger," a steady worker with experience in security. Wilson's departure also opened the way to appointing an assistant general manager if Dean wished to do so. Although never cast in a formal Commission action, the decision was to recruit three such officials to assist the new general manager. One would cover the activities suggested by the Bugas panel; the second, the assistant general manager for research and development, would watch over research, biology and medicine, and reactor development; the third, the assistant general manager for manufacturing, would supervise raw materials procurement and fissionable materials production.[53]

Wisely the Commission refrained from announcing the new positions until there were men to fill them. As Williams remarked several years later, it was not easy to find qualified men to accept such broad responsibilities at the salaries the Commission could offer. By the end of 1952, the Commission had filled only the position dealing with manufacturing. Security was indeed a *sine qua non* in the Commission's organization, but the main recommendation of the Bugas panel would have to wait for a more propitious time.

## *THE DEAN ADMINISTRATION*

Even before Dean was appointed chairman, he had begun to lay the foundations for his administration. Late in June, 1950, he had asked Roy B. Snapp, the Commission's secretary, to compile a list of those decisions which the Commissioners had deferred until it was again appropriate to consider

long-range policy issues. Presumably with the confirmation of the four Commissioners and the naming of the chairman, that time would soon arrive. Snapp had the summary ready on July 12, the day after Dean became chairman; but the Commissioners deferred it until August, when Carroll Wilson expected to return from a well-deserved vacation.[54]

In the meantime, Dean had several new ideas to explore. One was to establish a series of committees consisting of a Commissioner, the general manager or his deputy, and perhaps the appropriate division director to make continuous evaluations of the Commission's most critical responsibilities. Dean thought the committees might well supplant the program council, which seemed to have outlived its usefulness. Dean was also eager to discuss various ways of streamlining the Commission's organization.[55]

Any changes in organization would depend heavily on Wilson's plans. In the closing days of his July vacation Wilson had stopped at Lilienthal's summer home at Martha's Vineyard. Wilson had followed with a growing feeling of disgust the Congressional attacks on Pike. Now Dean's appointment had convinced Wilson that he would have to resign. He simply had no confidence in the new chairman. Wilson had talked with Vannevar Bush, James B. Conant, and Hartley Rowe, and all of them agreed he should resign under the circumstances. Lilienthal added his support, but warned Wilson to act quickly before McMahon or the Joint Committee found some way to force him to resign under political pressure. Lilienthal was still upset by what he regarded as McMahon's attempt to control the agency by arranging Dean's appointment to the Commission in 1949. It was hard for Lilienthal to believe that Truman was happy about making Dean chairman, but he advised Wilson to say "as many nice things about the President as he could" in his letter of resignation so that the President's political foes would not use the letter against him.[56]



Back in Washington on Thursday, August 3, Wilson told Shugg of his intentions. Shugg advised against the resignation and especially against a candid disclosure of the reasons for it. But Wilson believed in being forthright. On Friday afternoon he read to the Commissioners a draft letter to the President. Although Dean could hardly be pleased, he took the news well and thanked Wilson for being frank and open. Pike tried without success to change Wilson's mind, and later in the afternoon Wilson went to the White House for an appointment Dean had arranged through Dawson. Wilson found Truman cordial and even interested that he was resigning over a matter of principle and not because he was tired of Government service.

The public did not learn of Wilson's action until August 8, when the White House released his brief letter and Truman's reply. From Wilson the press got the details. He did not have the degree of confidence in the chairman necessary to do an effective job. Furthermore in the preceding year he had seen a trend toward greater control of management by the Commissioners. In time he feared this would result in "a cumbersome, slow-moving

administrative machine." [57]

Wilson's action was understandable enough. Since the summer of 1949 Dean had been suggesting a variety of decisions in which he thought the Commissioners should be directly involved. These he had summed up in his memorandum of October 26. In the spring of 1950 Dean had supported an amendment to the Atomic Energy Act which would limit the general manager's term to three years. In June Dean had again raised the question of action on his October memorandum and, since becoming chairman, he had given reorganization much of his attention.

More surprising than Wilson's resignation was Dean's public reaction to it. Most men in Dean's position would not have been able to resist the temptation to strike back with a personal attack on his detractor, and Dean admitted that he was "sorely tempted." Instead he took the path of conciliation. In a press statement on August 8 and in an informal talk with the Washington staff the following day, Dean stressed Wilson's many contributions. Wilson's departure, Dean said, was entirely his own idea. There had been no clashes between them. In fact, Dean had scarcely seen Wilson since his appointment as chairman.



Turning to a larger perspective, Dean claimed that the agency had been "bedeviled" by controversy ever since he had joined the Commission. At times controversy was good, but Dean thought the Commission had encouraged too much of it by insisting that "we are always right" or by carrying "too many chips on our shoulders." Dean was not suggesting subservience to every pressure, whether it came from Congress, labor unions, universities, or industry. Rather he thought it was "an hour in the life of the Commission when we will have to do some selling—not by asserting our perfection, but by demonstrating our skill and our sincerity." [58]

Looking ahead to the future, Dean spoke with some feeling about the need for understanding. At the Commission level, there could be "no one-man show." The job was too big for one man, and the abilities and experiences of all five Commissioners were needed in making decisions. At the same time, the Commissioners could not know everything about the entire program. They had to trust the general manager and the staff. Dean still believed the Commissioners should know as much as was humanly possible about the program, but that did not mean management by the Commissioners. He admitted that relations with the advisory bodies were sometimes difficult, but the Commission had to realize that it needed help in making the important decisions it faced. If the Commission made sure that other groups in the Government understood the issues, there would be little danger of faulty advice or misguided opposition. The Commission, in other words, would try to work within the existing fabric of Government, to shed some of the trappings of isolation and superiority, and to become part of the American scene. Lilienthal had complained to Wilson that McMahon and Dean were trying to bring politics into the Commission. Dean probably would have

rejected that charge, but he might have admitted the reverse—that he hoped to bring the Commission into the American political system.

To complete his team Dean needed a fifth Commissioner to replace Strauss. Since leaving office in April, Strauss had suggested several candidates, the latest being T. Keith Glennan, president of Case Institute of Technology. Some of the Democratic Congressmen on the Joint Committee were urging the appointment of Joseph A. Volpe, Jr., the Commission's general counsel, but both the White House and the Pentagon preferred Glennan. A graduate in science at Yale in 1927, Glennan had spent fifteen years in the motion picture industry before becoming director of the Navy's underwater sound laboratory at Columbia University during World War II. Glennan had a solid business background, some experience in Government, and a great interest in the role of science and technology in modern industry.[59]



Glennan's confirmation on August 22, 1950, left Dean with only one major position to fill. He needed a general manager to replace Wilson. First it was necessary to scale down the status of the general manager. Two days after Wilson left office, McMahon raised with the Joint Committee the idea of revising the Atomic Energy Act to give the Commission rather than the President the authority to appoint the general manager. In reporting a bill to this effect in the Senate on August 30, McMahon declared that "the ultimate responsibility lies with the Commissioners, and they are held accountable accordingly." McMahon concluded that the Commissioners should have the power to select their own general manager.[60]

Even before the amendment became law on September 23, Dean and his fellow Commissioners were looking for a promising candidate. They wanted someone with extensive experience in business and industry. Above all, a man with a sound conservative background would help to scotch the charges Joseph R. McCarthy was making in the Senate that the Commission had ignored the communist leanings of many American scientists. Strauss, now back in the business world, could help in sounding out some of the large corporations for prospects. Robert LeBaron, chairman of the Military Liaison Committee and Assistant to the Secretary of Defense (Atomic Energy), offered the services of the Defense Department.

The choice quickly narrowed to Marion W. Boyer, a vice-president of the Esso Standard Oil Company. A graduate in chemical engineering from MIT, Boyer had spent virtually all of his professional career with Standard Oil. During World War II he had managed the huge refinery at Baton Rouge, Louisiana, one of the nation's largest producers of aviation gasoline and synthetic rubber. Anything but flamboyant, Boyer was a quiet, affable man who looked like a corporation executive. He had a reputation for knowing how to get the best efforts out of his staff without direct pressure. At forty-nine he was one of the most promising executives at the top of the Esso organization.[61]

When Boyer took office on November 1, 1950, Dean's new team was complete. The years of strife seemed over. Now Dean and his associates could put into practice the principles of administration which Dean had been formulating for more than a year. Evidences of the new style would show up most clearly in the Commission's relations with Congress and the Joint Committee. In other administrative areas, such as labor relations and security, the impact of the Korean conflict would be a dominant theme.

## *LABOR AND THE DEFENSE EFFORT*

By late 1950 the Davis panel had built an impressive record in labor negotiations. In sixteen months operating personnel had stopped work only three times, with minor effect. Two of these instances involved a contractor who had not accepted the *status quo* procedures set forth in the panel's charter.[62]



This enviable record did not mean, however, that the Commission's labor policies went unchallenged. At its annual convention in Chicago in November, 1950, the CIO called upon the President, Congress, and the Commission to stop contracting atomic energy work to private corporations. The delegates resolved that the Commission should adopt the Tennessee Valley Authority's system of direct Government operations. Only in this way, the union members argued, could there be genuine collective bargaining between a Government agency and free labor unions. Operation by private contractor gave management the advantage of a double standard. The contractor could claim that a shutdown would threaten the national security. Thus the company could continue to operate the plant at a profit while depriving labor of the right to strike. Adding to labor's concern was the recent announcement by the Monsanto Company of its intention to build a nuclear power plant, the first step, in the union's opinion, toward transferring atomic energy from public to private hands. Even Lilienthal since leaving the Commission had abandoned the TVA principle of direct operation to advocate turning the atom over to private industry.[63]

Perhaps some of the CIO resolution was rhetorical, but one charge was not. The CIO leadership challenged the "invite procedure," under which the Commission in certain instances made available to its contractors derogatory information about job applicants even though the information had nothing to do with loyalty. The CIO complaint arose from a case in late 1949 involving an employee of the Commission's Kansas City, Missouri, weapon plant, operated by the Bendix Aviation Company. The employee had been hired on probation while being cleared. The investigation had revealed character blemishes unconnected with loyalty. After examining the allegations and questioning two supervisors, Bendix had fired the man on the grounds that he

lacked the qualifications the company expected of its employees. The Commission's personnel security form had revealed to Bendix information on the employee's union activity. For the Commission's security investigation this was pertinent because at least one union—the Industrial Workers of the World—was on the Attorney General's subversive list. For the company, however, to collect information on union affiliation, except under specific collective bargaining procedures, was illegal under the Taft-Hartley Act. The CIO had brought the case before the National Labor Relations Board. The union accused Bendix of unfair labor practices and claimed that the man had been discharged for union activity.[64]

As a result of the incident the Commission had revised its forms so that they would reveal nothing to the contractor about an applicant's union background. The labor relations board absolved the company of the discrimination charges. Nonetheless, as Carroll Wilson had admitted at the time, the
470 Commission could improve some of its procedures. One of the deficiencies, which the union had pointed out, was that the employee had no access to the information which had brought about his dismissal. On the other hand, the company had the right to fire employees for reasons other than security. Otherwise the contractor might not be able to meet his obligations to the Government. Certainly the Commission could not disclose information it had received in confidence.

After many discussions with Commission personnel in the field offices, with contractors, union representatives, and officials of the National Labor Relations Board, the Commissioners in March, 1951, approved a codification of security policies for use in collective bargaining. There was no way of bringing all such proceedings into the open, but the Commission concluded that it would serve justice to clear for access to confidential information all parties to the proceedings, including a panel of trial examiners from the labor board, international union representatives, and the counsels of both parties if necessary.[65]

Although the Commission had an excellent record in avoiding work stoppages, Davis was concerned in late 1950 about the increasing number of cases calling for panel intervention. As a temporary expedient, the President appointed three additional members to the panel in November, 1950, but the real question was whether the panel was undermining the normal operation of collective bargaining procedures. Perhaps labor and management were coming to depend on the panel to resolve issues which they themselves should settle at the bargaining table. Davis believed strongly that harmony in labor relations had little value if it were achieved at the expense of free collective bargaining. He insisted that procedures be flexible and that the parties to disputes be left as much latitude as possible.[66]

The room to maneuver was narrowing as the nation moved deeper into the Korean conflict. On July 19, 1950, Truman on radio and television had called for an increase in defense production. After signing the Defense

Production Act, he told the nation from the White House on September 9 that the new legislation would give the Government power to meet defense needs. But the fight against inflation, the President said, involved everyone. The housewife should not hoard, the businessman raise prices, the laborer seek wage increases. He promised that under the new production act he would establish a wage stabilization board. When the Chinese Communists shattered hopes for an easy end to the Asian struggle, Truman proclaimed a national emergency in December, 1950. The wage stabilization board ran into difficulties early in 1951 when union representatives withdrew. As reconstituted, the board had responsibility only for disputes affecting the defense effort.[67]

The Davis panel had to proceed cautiously in handling the Commission's labor disputes so as to preserve what Davis called the "custody of the no-strike pledge" and yet not to encroach upon the functions of the stabilization board. With the expansion of the Commission's production capacity, the panel found the character of its work changing. Now the more dangerous disputes were in construction projects which, because of their importance to the defense effort, involved both the stabilization board and the panel. Davis and his group found themselves exploring wage settlements according to policies established by the board.



Among the labor troubles of the expansion period, those at the new Paducah, Kentucky, plant, mostly involving local disputes with craft unions, caused the most difficulty. In September, 1951, the Sheet Metal Workers' International Association (AFL) demanded an allowance to increase earnings above established area rates. When the demand spread to other crafts both at Paducah and at Dana, Indiana, Dean had to appeal publicly to William Green of the AFL and to the Paducah and Dana contractors to get the men back to their jobs. Davis noted, however, this was the first time that the Commission chairman had been forced to enter directly into a labor controversy since the summer of 1948, when Lilienthal had met with union leaders during the Oak Ridge dispute.[68]

By early 1952 Davis was beginning to think the panel had served its purpose. He had always considered it a temporary device, and it was now well into its third year of operation. Perhaps, he thought, he and the members should submit their resignations to the President. Smith, however, had other ideas. When the panel members met with the Commissioners in May, 1952, he remarked that in three years there had been only five minor work stoppages by operating personnel. No one knew what might have happened without the panel, but Smith doubted the Commission would have had as good a record. The Commission had not used the panel often in construction disputes, but where it had intervened, the work stoppages had ended quickly. In the seventeen months following June, 1949, the panel had taken part in thirty-three disputes. During the same period unions and contractors had negotiated or amended 102 agreements at Commission facilities. Thus 75 per cent of the negotiations took place without panel intervention. The Commissioners as-

sured Davis that they wanted the panel to continue.[69]

Davis was not sure, however, that the panel had met his own standards of success. The flexibility of operations and the use of informal personal contacts made it difficult to tabulate the panel's accomplishments. By the end of 1952 Davis and his associates thought they had avoided both the dangers of Government intervention and prolonged strikes. Collective bargaining practices at Commission sites were now scarcely different from those generally prevailing in American industry. Davis, it seemed, had succeeded in preserving the creative possibilites in labor negotiations, even in a time of national emergency.[70]

## *SECURITY—CONFLICTING PRESSURES*



Under Waters's direction, the division of security began in the summer of 1950 to effectuate most of the administrative reforms and improvements which the Bugas panel had proposed. In this respect the Commission's security forces would be better able to protect information and facilities vital to the national defense without unduly hampering operations. But new requirements were already offsetting the gains in security administration. In the months following the outbreak of war in Korea, the United States moved rapidly toward a war economy, with all the adjustments that process involved. If, as some Americans feared, the North Korean attack marked the opening of a general communist offensive against the West, it was all the more important to protect the remaining secrets of nuclear technology.

Clear evidence of a communist attack on the homefront was emerging as the Korean war began. On May 23, 1950, Federal authorities arrested Harry Gold, a young Philadelphia chemist, on charges of engaging in espionage for the Soviet Union. Gold's confession showed him to be a link between Klaus Fuchs, the convicted British scientist, and a Soviet spy ring. On June 17, newspaper headlines reported the arrest of David Greenglass, a former Army sergeant who had been a machinist at Los Alamos during World War II. Greenglass's confession led on August 17 to the indictment of his sister Ethel Rosenberg, her husband, Julius, and Anatoli A. Yakovlev, a Soviet consular official. Greenglass admitted that beginning in November, 1944, he had furnished information about the Los Alamos project and some technical information on atomic weapon design to his wife, Ruth, the Rosenbergs, and Gold. Fuchs's perfidy, then, was not an isolated instance of betrayal but part of an organized Soviet intelligence operation against the United States atomic energy project. The implications for the Commission's security program were obvious.[71]

The Korean War also increased pressures on the Commission from another direction. The deepening international crisis had sparked efforts to

expand the Commission's production facilities. By the summer of 1950, the Commission was well launched on new construction at Hanford and Oak Ridge and was contemplating still another expansion. The need for hundreds of technicians and thousands of construction workers imposed heavy burdens on the security clearance procedures required by the Atomic Energy Act. Demands were also developing within the military services for technical reports containing Restricted Data and for personnel trained in handling nuclear weapons. In short, the division of security was facing conflicting pressures. On the one hand, there was an obvious need for tight security controls; on the other, there were good arguments for more liberal criteria to permit ever larger numbers of personnel to take part in atomic energy activities.

An agreement with the National Military Establishment in 1947 had proved adequate for a time in controlling the dissemination of Restricted Data within the armed forces. In the place of the Commission's regular "Q" clearance, the services granted military and civilian personnel special "M" clearances for access to Restricted Data. The Commission had the right to review the M clearances granted in order to assure that the standards applied were comparable with those the Commission employed. In addition, the Commission permitted the services to give military and contractor personnel access to certain limited categories of Restricted Data without special clearance. As the military need for Restricted Data increased, however, the 1947 agreement became too cumbersome. By March, 1950, the Department of Defense had granted 30,000 M clearances and had 3,000 cases pending. M clearances took from nine to twelve months to complete, and the number required was increasing by 1,000 per month.[72]



A legal technicality in the Atomic Energy Act posed an additional, and potentially, much more troublesome problem. Section 10b provided that the Commission's contractors. as distinguished from Commission employees, could not grant access to Restricted Data to anyone who did not have a Q clearance. Apparently the provision was intended to apply to research and development activities and not to military personnel, but the precise language of the prohibition gave reason for caution. Both the Commission and the Department of Defense had interpreted the law literally, often at heavy cost to operating efficiency. In one instance, military officers going to Oak Ridge for a briefing on aircraft nuclear propulsion could not receive the information directly from the Air Force contractor. First the contractor had to give the facts to a Commission employee, who could then repeat them to the officers, all of whom had the M clearance giving access to Restricted Data within the Department of Defense. In another instance, Los Alamos scientists, as employees of a Commission contractor, could not give Restricted Data to military officers making preparations for the *Greenhouse* weapon tests because the officers had only M clearances.

Facing a real emergency in meeting the schedule for the *Greenhouse*

tests, the Commission gave Los Alamos special permission to grant access to the military personnel, but the general problem remained. Always leery of schemes for circumventing the law, Dean favored an amendment to the Act to make clear that Section 10b did not apply to personnel with appropriate military clearances. LeBaron showed little enthusiasm for amending the Act, particularly if the amendment covered only a specific difficulty. The Department, he wrote the Commission on September 18, 1950, was more concerned about the increasing difficulty of operating under the 1947 agreement. LeBaron proposed that the Department abolish the M clearance and grant access to Restricted Data under military security classifications. This change, LeBaron contended, would not require amending the Act, but he would not object if the Commission sought such an amendment.[73]

At least two aspects of LeBaron's proposal troubled the Commission. Abolishing the M clearance would do nothing to remove the statutory obstacle
474 in Section 10b. The division of security objected that LeBaron's idea would create a double standard, one for the Commission and one for the Department of Defense, a dubious arrangement for sound security administration. Volpe, however, predicted that the Attorney General would approve LeBaron's proposal. The best position the Commission could take was to accept the change, with the understanding that the Department of Defense would support the Commission's effort to amend Section 10b. An exchange of letters with Defense Secretary George C. Marshall in the fall of 1950 sealed the agreement.[74]

The next step was to decide what kind of amendment the Commission should support. Dean, again taking the direct approach, was willing to entertain the idea of striking the phrase "Restricted Data" from the Act altogether. As long as the Commission retained full authority over the classification and declassification of atomic energy data, he was not worried about the form of the amendment. Should abolishing the term "Restricted Data" prove too sweeping, McCormack suggested an amendment which would restrict the term to weapon and production data and would permit the Commission and the military services to handle all other material as ordinary defense information, protected by the Espionage Act of 1917. A third possibility was the Commission's original suggestion simply to permit Commission contractors to give Restricted Data to the military.[75]

Not yet reduced to statutory language was another idea drawn from the military security system. The armed forces had long followed the practice of establishing differing degrees of sensitivity for classified information and then establishing for each category the extent of security investigation required. Thus a person having access only to information of low sensitivity could be cleared by a simple check of personnel and police records. Those using information of high sensitivity might require a full background investigation such as that performed for the Commission by the FBI. The difficulty with Section 10b was that it lumped all Restricted Data together regardless of sensitivity. An employee needed the same clearance for drawings of buildings

as for weapon data. Just how the needed flexibility could be built into Section 10b was a question requiring more legal study.[76]

The Commissioners considered several of the more immediate solutions in the form of draft amendments during February, 1951. One would have authorized some exceptions to the prohibition of Section 10b in certain circumstances. Another would have permitted the Commission to remove information of low sensitivity from the Restricted Data category. A third embodied McCormack's proposal of limiting the definition of Restricted Data. The Commissioners' first reaction was to eliminate the Restricted Data category altogether, but Boyer and the staff convinced them that a lesser amendment was more likely to win Congressional approval. The amendment the Commissioners finally selected would permit the Commission to hire any individual, or to authorize any Commission employee or contractor to permit any individual to have access to Restricted Data, whenever the Secretary of Defense certified that the individual had been cleared for information of comparable security classification, or whenever access was limited to Restricted Data of the lowest classification.[77]



Hopes for the draft amendment were short-lived. Soon after the Commission sent the draft to the Bureau of the Budget, LeBaron registered the Department's disapproval. In LeBaron's opinion, the amendment continued the double standard to which the Commission had earlier objected. Furthermore, the idea of certifying clearances to the Commission suggested to LeBaron that the Department would be required to reaffirm the decision it had made in granting the clearance in the first place. Without support from Defense, the Commission would probably receive a cool reception from Congress. Another handicap was that, by careful management and hard work, most of the field offices had been able to keep pace with the increasing demand for clearances. It would be difficult to justify to a doubting Congressman that the existing provisions of the Act were still hampering Commission operations by the summer of 1951. The best argument for the amendment was that the heavy burden of clearance actions on the Commission's security groups and the FBI might inadvertently reduce the quality of investigations.

The solution, then, seemed to lie not in amending Section 10 but in somehow reducing the investigative load on the FBI. Dean, still favorable to the idea of abolishing the Restricted Data category, agreed to discuss with J. Edgar Hoover ways of reducing the FBI workload. The result was a variety of suggestions for transferring the burden of investigations for the Commission from the FBI to the Civil Service Commission.[78]

The Atomic Energy Commission had little direct part in the legislation introduced in Congress on August 30, 1951, to accomplish the transfer. In its original form the bill provided simply for assignment of all Commission investigations to the Civil Service Commission. Dean and his colleagues, however, wanted to reserve the right to designate certain sensitive positions for FBI clearance. Dean wrote Senator Tom Murray on October 17, that

under the new provision the Commission would require from the FBI only 35,000 of the 90,000 clearances that would be needed in fiscal year 1952. All Commission employees and certain contractor employees in especially sensitive positions would continue to be subject to FBI investigations. The bulk of the contractor clearances would be based on Civil Service findings. Murray had no trouble inserting the provision in the bill, which became law on April 5, 1952.[79]

The Commission had failed in its original effort to remove from Section 10b the language that prevented its contractors from giving Restricted Data to military personnel, but there had been some progress in reconciling the conflicting pressures of the Korean crisis. The abolition of the M clearance system had helped operations within the Department of Defense, and shifting some of the investigative burden to the Civil Service Commission would speed clearances. More fundamental changes in the Act would be the business of another day.



## *PLANNING FOR LOCAL DEMOCRACY*

The appropriation bill which became law in September, 1950, called upon the Commission to take positive steps toward democratic government and free enterprise in the three "atomic cities." Fortunately for the Commission, Richard Scurry had by that time formed his committee and was ready to begin an intensive study of the Commission's community operations. Joining him on the panel were Frederick M. Babcock, a housing finance consultant who had formerly been an official with the Federal Housing Authority; George E. Bean, city manager of Grand Rapids, Michigan; and George Gove, vice-president for housing projects of the Metropolitan Life Insurance Company. Composed of an experienced and capable group of men, the panel had full access to the extensive studies which the Commission's staff had completed during the preceding years. There was also ample occasion to talk with community experts at Oak Ridge and Richland, the two towns which would be the subject of the panel's first report. Thus the panel could observe the Commission's policies in action and follow closely the effects at Oak Ridge to develop a procedure for disposal of vacant land and buildings. When the Commission announced early in 1951 a general increase in rentals at the three sites to make them comparable with rates in the surrounding areas, the panel supported the action as a necessary first step toward eventual disposal of residential real estate.[80]

The Scurry panel had its own report in draft form by early April, 1951. A comprehensive document of 150 pages, the report reflected a professional mastery of vast amounts of legal and technical detail. The panel began with the assumption that the three communities were essential to the Commis-

sion's operations and that their continued existence either as Government towns or independent communities depended on attractive living conditions, good community facilities, reasonable living costs, and adequate housing. Incorporation and disposal of Government property at Oak Ridge and Richland would not only establish democratic institutions and the free enterprise system, but would also reduce Government costs, free Commission executives for other activities, and improve relations with workers at the sites. At the same time, the panel recognized that impressive obstacles stood in the way, among them financial requirements, inertia of the residents, loss of Commission control, and lower standards of service. An effective plan, in the panel's opinion, would have to take into account all the Commission's needs and suggest ways of removing all of the obstacles to acceptance of the goal by the residents.[81]

Scurry and his associates acknowledged the many steps the Commission had already taken toward incorporation and disposal, but they stressed the need for Commission initiative in stating intentions clearly, providing planning assistance, obtaining necessary legislation, and working with the residents. The controlling factors in the communities were so interrelated that it was difficult to know where to begin. As for the old question of whether incorporation or disposal of property should come first, the panel did not believe that the Commission could "coerce" the communities to incorporate by withholding property disposal. Disposal was the necessary first step, and the Commission would have to accept the risk that the residents might then fail to establish effective government through incorporation. The new city councils would need help from the Commission in estimating revenue sources and preparing budgets. The Commission would have to clarify what land, buildings, and equipment it was donating and what payments it would make to the communities in lieu of taxes. Commission help would also be necessary in drafting city codes and regulatory ordinances, determining personnel needs, and appraising property for tax purposes. The panel thought the city charters themselves should be left to the residents.



Not satisfied with providing merely the broad outlines of the plan, the Scurry panel added a compendium of precise, practical information on procedures. There was an excellent section on the necessary Federal and state legislation for incorporating the towns, for the disposal of real estate, for financing real estate sales through Federal agencies, and for financial assistance to the new cities. Another section analyzed the thorny question of determining the amount of Federal subsidy to be paid to the communities and the form of payment. The panel concluded from the analysis that both Oak Ridge and Richland should receive annual subsidies for schools and hospitals and that an annual cash subsidy on an agreed-upon declining scale might be necessary to secure prompt incorporation of Richland. Other sections included practical information on classifying real estate, adjusting rents, establishing sales prices, financing sales, drafting occupancy controls and charters,

and establishing municipal organization and finance.

Under continual pressure from Congress, Dean grew impatient as the summer of 1951 waned, but the report proved worth waiting for. The staff had made only a few editorial changes and updated a few sections in the April draft, and the Commissioners confined their comments to the announcement that would accompany the release of the report. They were not willing to commit themselves unalterably to incorporation and disposal until the residents of the communities had expressed their views on the report. There was no question, however, what the Commission's intentions were. Soon after publication of the report, the Commission would obtain appraisals of the property to be sold so that residents could determine their interest in purchasing homes. The Commission also offered to poll the residents for their views on incorporation and to support the necessary Federal legislation.[82]



Publication of the report set off a chain of events at both Oak Ridge and Richland. The town council at Oak Ridge organized a citizens' committee to study self-government and various civic and church groups organized meetings to discuss the panel's recommendations. Before the end of the year property boundary surveys were completed at Oak Ridge and nearing completion at Richland. The Commission arranged with the Bureau of Census to undertake public opinion surveys in the two communities, and appraisals began early in 1952. Results of the survey indicated a strong interest among Oak Ridge residents in purchasing homes. As 1952 ended, the Commission was completing plans for leasing vacant land at Oak Ridge and Richland for residential development.[83]

For Los Alamos the goal of self-government and private ownership was still far in the future. In a second report in June, 1952, the Scurry panel maintained the same ultimate objective for Los Alamos as for Oak Ridge and Richland, but the existing system of Government operation would have to continue at least until the laboratory could move its technical facilities out of the town. For all three communities the goal which Moore had set down five years earlier was not yet clearly in sight, but the Commission could now feel confident it was moving in the right direction.[84]

## *CONGRESS AND APPROPRIATIONS*

When Dean took the chairmanship, he recognized that one of his first tasks was to improve relationships with Congress. His personal connection with McMahon would help, but something more was needed. Was it always necessary, he asked Shugg, to be on the defensive? Could not the Commission for once take the initiative and recite its positive accomplishments? Too often, Shugg agreed, the Commission had left Congressional relations to the lawyers.

Somehow the Joint Committee should get a list of "plus items" every few months. Changes in tactics would help, but the underlying question of the balance of power remained.[85]

McMahon returned to the appropriation issue the following spring. On June 7, 1951, he introduced an amendment in the 1952 appropriation bill to require enabling legislation for any construction project costing more than $500,000. Confident that McMahon would not press for any legislation that would endanger the expansion of production facilities, the Commission restrained its opposition to the proposal. If the Commission did not object to the legislation, it could point out some of the difficulties it might create. For example, could the complicated procedures for authorization and appropriation meet the Commission's tight schedules for urgent construction? [86]

Dean told the Joint Committee on August 21 that the main difficulties with authorization would be mechanical. He was not sure how the Commission would coordinate the necessary actions with the Bureau of the Budget, the Joint Committee, and finally the appropriations committees. Dean's reference to practical matters rather than to constitutional issues provided a better climate for discussion. Borden admitted that the purpose was to adopt procedures more like those existing between the Department of Defense and the armed services committees. Holifield took a stronger position. He doubted that the authorization process would hold up construction projects; the Commission could still start engineering and design while the Joint Committee considered the proposal. Furthermore, Holifield was convinced that the committee should have the power of authorization. "It should assume that responsibility," he said to the Commissioners, "and then fight your battles for you on the floor of Congress, because you don't get your battles fought by the Appropriations Committee." [87]



By not protesting too much, Dean was able to keep positions on the amendment tenative. He left it to the Bureau of the Budget to take up constitutional issues. Perhaps as Dean hoped, McMahon soon found other matters engaging his attention. As chairman, Dean would never again have to face the question of authorization.[88]

## *CONGRESS AND INTERNATIONAL AFFAIRS*

In the summer of 1951 Dean saw new opportunities to remove another source of friction with Congress. For years legislative entanglements had harassed the Commission's efforts to exchange technical information with the British and Canadians. Dean had been following the subject since he joined the Commission in 1949. More than once that year he had suggested an amendment to remove the ambiguities in Section 10a. Under that section the

Commission was to control Restricted Data so as to assure the common defense and security, but not to exchange with other nations information which might be applied to industrial purposes. Defining categories of information inevitably led to problems. Already embroiled with Congressional committees over fellowships and management, Lilienthal had feared that any attempt to amend the Act would prove disastrous.[89]

Dean was free of the inhibitions that had bound Lilienthal. That was clear on October 20, 1950, when the Commission discussed the possible amendment of Section 10a. Relations with Britain and Canada were still paramount, but Volpe suggested that any revisions in the Act take into account the advancing efforts of other nations. Congressional guidance would also be necessary in negotiations to purchase uranium ore from Belgium and South Africa. Volpe and his legal staff had considered various statutory provisions which might make cooperation with other nations easier. Perhaps
480 the Commission or the President should have authority to negotiate arrangements with other nations after determining that such action would be in the interest of the common defense and security. To give the Joint Committee a direct hand in such matters, the staff suggested that the law provide for Executive agreements to lie before the Joint Committee for a specified number of days before becoming effective. For security reasons the staff had decided against any provision involving all of the Congress. Dean and the Commissioners thought the proposal had merit, but they were reluctant to suggest it to the Joint Committee in the abstract. It seemed better to wait until a request for technical assistance from Belgium or Canada provided a good case for amendment. In the meantime, the staff could sound out the Department of Defense.[90]

Dean had enough experience with the Joint Committee to know that favorable action on the amendment would depend heavily on support from the Department of Defense. He found it impossible, however, during the first six months of 1951 to come to any meeting of the minds with LeBaron. Finally on June 20 he asked LeBaron to join him in discussing their differences with Deputy Secretary Robert A. Lovett. Dean said the two agencies had been unable to agree on the areas in which the exchange of information would be useful if Congress amended the Act. In some respects the Commission was walking a tightrope. The Canadian heavy-water test reactor at Chalk River provided unique facilities for testing samples of fuel elements being developed for the Commission's new production reactors at Savannah River, South Carolina. But the Canadians could not irradiate the samples without receiving Restricted Data from the Commission. This would involve an exchange of technical information clearly outside the terms of the *modus vivendi* of 1948.

Dean admitted to Lovett that he found the military response to the Commission's appeals stiff and narrow. The trouble lay, he thought, in a fundamental difference in philosophy. The military saw the exchange of

technical information entirely in terms of providing complete weapons to the British for defense purposes, a move that would amount to giving the British all the information the United States had on these devices. Yet the military would not consent to a much more limited exchange of specific bits of information which promised a clear advantage to the United States. Dean thought he had made an impression, but Lovett promised no immediate action.[91]

As the summer of 1951 wore on, Dean become more than ever convinced that the advantages of international cooperation extended far beyond the exchange of weapon information by military personnel, as LeBaron contended. He had successfully demonstrated to Lovett how the Chalk River reactor could speed the production of greater quantities of fissionable materials for weapons. Outside the weapon field, the unique facilities of the Canadian reactor would prove invaluable in developing fuel elements for submarine propulsion systems. With some qualms Dean had supported the decision to authorize irradiations for the submarine systems under the *modus vivendi,* on the grounds that only an insignificant amount of classified information need be revealed to the Canadians. When he learned, however, in July, 1951, that the Canadians would need much more information about the test samples to assure safe operation of the Chalk River reactor, Dean had reluctantly requested the Commission to terminate the project. The action was unfortunate, but perhaps Dean hoped that it would help the military leaders to see the need for amending Section 10a.[92]



In almost every area of its activities the Commission could cite the advantages of closer cooperation with the British and the Commonwealth nations. The Commission could save large sums in processing uranium concentrates from Canada if American companies could help the Canadians in designing new refineries. Similar assistance to the Australians might assure the United States new sources of uranium from that country. Further exchanges with the British would be of mutual benefit in producing plutonium, developing new chemical processing techniques, and improving gaseous-diffusion plant operation. Even in the areas of research covered by the *modus vivendi* a more liberal statute would help by permitting research on topics which did not fall precisely into one of the approved areas. On July 19, Dean summed up all these advantages in a memorandum to the White House.[93]

Dean made his case again on August 24, 1951, at a meeting with Lovett and Secretary of State Dean G. Acheson. In his July 19 memorandum he had proposed an amendment which would authorize the transmittal of Restricted Data to other nations after notification of the Joint Committee and a Presidential determination that the arrangement would promote the national security. Both Lovett and LeBaron seemed anxious to exclude weapon information from the amendment. Dean agreed this was possible in theory, but in practice it was often hard to draw the line between weapon and nonweapon information. If the existing provisions of the Act had been in effect during

World War II, Niels Bohr, Enrico Fermi, Edward Teller, and all the British scientists would have been excluded from the American project. Acheson had no objection to Dean's proposal, but he saw no possibility of quick action by Congress. Dean disagreed. He thought he could get the unanimous support of the Joint Committee. What, Acheson asked, would Dean think of the amendment if the committee insisted on changing the requirement for "notification of" the Joint Committee to "approval by"? Dean thought even that condition would be acceptable. At least it would clarify the legal status of an exchange.[94]

By late August, events had all but forced Dean's hand in selecting the issue on which to propose the amendment. The Canadians were running out of time on their plans to expand the Port Hope refinery. Without help from the United States the Canadians would have no choice but to employ a much less efficient British process. There were ways of dodging the statutory restrictions, but Dean was against this course. It was time for Congress to take the responsibility for deciding whether the provisions of the Act should continue to jeopardize the nation's growing nuclear arsenal. Dean decided to see Truman and take the matter to the Joint Committee.[95]



In September, 1951, Dean spent four days discussing Section 10a with the Joint Committee. His skillful performance allayed the committee's fears that the information given to Canada might fall into the hands of the British. News that Guy F. M. Burgess and Donald D. Maclean, two trusted British civil servants, had defected to the Soviet Union had again raised doubts about the adequacy of British security. Dean knew that he was on firm ground with the Canadian issue; in a few years ore deposits in Canada might rival those in the Congo in importance. But Dean did not push his case too hard; otherwise, the committee might limit the application of the amendment to Canada and thus leave the Commission with similar problems in other countries. As further reassurance, Dean proposed that the amendment might require the concurrence of the President and the Joint Committee, with the committee receiving the facts a specified number of days before final action.[96]

Dean knew that if he could persuade Hickenlooper to accept the amendment, he could probably win over the rest of the Joint Committee. The prospects at first were uncertain as Hickenlooper explored the possibility of limiting the amendment to Canada. Then, as Dean may have expected, Hickenlooper brought up the Cyril Smith incident in 1948. Only quick and determined action at that time, Hickenlooper claimed, had prevented an unauthorized disclosure to the British, and he wanted to avoid the chance that loose phrases might permit a similar incident to occur. Not that Hickenlooper doubted the judgment of the present Commissioners, but no one knew who would be filling those positions in five years. Carefully Hickenlooper and his colleagues searched for precise words that would define exact procedures. "We are writing a statute that is important," he said, "and if we can arrive at language that we can all live with and understand, it is better to do it that

way." It was too early to say that Dean had won the day, but at least Hickenlooper was looking for solutions. Dean's patient efforts to build a working partnership with the committee at last seemed to be bearing results.

Final action on the amendment seemed agonizingly slow. The Canadians had all but lost hope. Lovett and Acheson seemed mildly sympathetic but offered no real help. According to reports Dean received, LeBaron was not only personally opposed to the amendment but also worked hard to raise military opposition to the amendment. At last, with firm support from the Joint Committee and General Omar N. Bradley, chairman of the Joint Chiefs of Staff, the amended Section 10 became law on October 30, 1951. Under its terms, the Commissioners would have to agree unanimously that exchanging information with another nation would substantially promote the common defense and security. The amendment specifically excluded weapon information, prohibited transmittal to a potentially hostile nation, and required the recipient nation to have adequate security standards. The Commission's recommendation would go first to the National Security Council and then to the President for approval. Then the agreement would have to lie before the Joint Committee for thirty days while Congress was in session.[97]



Dean had chosen his ground well. Because Canada had no interest in developing weapons, that aspect of information exchange remained in the background. Everyone could understand the United States need for ore, even more imperative since the outbreak of war in Korea. It was almost as easy to demonstrate the value of the Chalk River facility in developing American reactors for plutonium production and military propulsion. The checks imposed on the Commission, Dean admitted, were more rigorous than he would have liked, but they were probably inevitable.[98] In any case, Dean had taken a long step forward in removing one of the sources of friction that had troubled relations with the committee since 1947.

The Joint Committee's unruffled discussion of Section 10a illustrated the effectiveness with which Dean handled Congressional affairs. His shrewd instinct for realities helped him to assess the circumstances of the moment and to decide when to fight hard for the issues he believed were important. He tried to direct the course of events by talking with Truman, Acheson, and Lovett and by private conversations with McMahon. The hearing room was not Dean's arena. He was deeply conscious of the Commission's responsibilities to the nation, but he had no exalted conception of the Commission's role in the Federal structure. Nor did he share Lilienthal's tendency to consider the Commission an instrument for reform. Compared with Lilienthal, Dean might have seemed workmanlike and even unpretentious: but these were the very qualities that could help him improve relations with Congress.

Despite Dean's accomplishments. the Commission was still a frequent target for Congressional criticisms and inquiries. The same sparring with the appropriations committees, the ceaseless probing from the Joint Committee,

the steady flow of complaints about community management and contract awards continued much as before. But relations with Congress had taken on a new sense of maturity and reason. Much of the uncomprehending hostility had disappeared from the Congressional side, and the Commission's replies no longer reflected the same sensitivity to criticism or patronizing tone that had sometimes enraged the legislators in earlier days. From one point of view the Commission had simply joined the mainstream of the American system; from another, it had sold its individuality and independence for a temporary accommodation. The final verdict lay in the future.[99]

# *SCIENCE: SHIELD OF THE FREE WORLD?*

## CHAPTER 15

The outbreak of the Korean conflict in June, 1950, would certainly result in a shift of the Commission's efforts from peaceful to military pursuits. Scientists themselves, both in the Commission's laboratories and elsewhere, accepted work on military projects as a patriotic duty. But the shift in emphasis was always relative, not absolute. Research for military purposes inevitably created knowledge useful in nonmilitary studies. Except in the most extreme circumstances, a large laboratory could always justify supporting some efforts not directly related to military projects. In fact, in the Commission's laboratories during the Korean war many scientists continued studies in basic research without feeling any of the effects of the national emergency.

In the years after 1950, the Commission's research and development efforts did result in significant achievements for national defense. Reactors for propelling submarines and for producing special nuclear materials for weapons were evidence that research had become, as one scientist put it, "the shield of the free world." But the Commission's research activities did more than provide the hardware for national defense. Progress in developing nuclear power reactors, in high-energy physics, transplutonium chemistry, radiation biology, and the other basic sciences made a positive contribution to human welfare. In that broader sense, perhaps science could be an effective instrument for freedom, not only from political oppression but also from ignorance and pain.

### *SHADOW OF KOREA*

For Walter H. Zinn, director of the Argonne National Laboratory, the twilight zone between peace and war ended when fighting began in Korea in

late June, 1950. Zinn told the Argonne staff on July 18 that there were many rumors of change in Washington, some stemming directly from the Far Eastern crisis. Others, Zinn guessed, reflected the appointment of Gordon E. Dean as chairman of the Commission. Zinn predicted that the laboratory would have a direct role in developing production reactors and would probably have to step up its work on submarine propulsion. The Commission had already asked him how the laboratory could speed up military projects and how many of the others could be shelved for the duration of the conflict.[1]

Hard on the heels of the Korean conflict were other changes in Washington leadership. Dean's promotion to the chairmanship led to the departure of first Carroll L. Wilson and then Carleton Shugg. Oppenheimer and the General Advisory Committee were already considering replacements for Enrico Fermi, Hartley Rowe, and Glenn T. Seaborg, whose terms were expiring. Oppenheimer and several members told Henry D. Smyth in Los
 Alamos on July 19 of their fears that the committee might deteriorate into a collection of individuals if men of broad experience and high caliber were not appointed. There was general agreement that Willard F. Libby or Charles D. Coryell would be the best chemist to replace Seaborg. Oppenheimer wanted a very strong physicist if Fermi could not be convinced to remain, possibly John von Neumann or Hans A. Bethe. Robert F. Bacher also seemed a solid choice, not only for his capacities as a physicist but also for his understanding of industry. Smyth related his conversation to Dean, who at Smyth's suggestion called Oppenheimer to discuss the subject.

Dean thought the conversation with Oppenheimer helpful, but he had his own ideas about the appointments. When he wrote to Truman on July 31, he recommended Libby, an outstanding chemist at the University of Chicago; Walter G. Whitman, a chemical engineer at MIT who had directed the Lexington study of aircraft nuclear propulsion in 1948; and Eger V. Murphree, a petroleum executive who had undertaken the first major procurement of equipment for atomic energy research under Vannevar Bush in 1942.[2]

When Dean met with the new members and the rest of the committee in Washington on September 11, 1950. he told them that the Commission too had been discussing the committee's role in making policy. It was not just a matter of posing the most difficult questions to the committee and expecting immediate and simple answers. He thought informal and tentative discussions with the committee would be most helpful to the Commission. The big question at the moment was expansion of weapon and production efforts, and Dean hoped that the committee could participate in formulating plans. Here as in all aspects of the Commission's work, Dean was concerned about improving and strengthening relationships. True, the advisory committee was still firmly in the control of its charter members—Oppenheimer, Cyril S. Smith. Lee A. DuBridge, James B. Conant, and Isidor I. Rabi—a group Dean had differed with in the past, but he hoped the new members, with well-

rounded experience in business as well as science, would give the committee better balance in the decisions ahead.[3]

## *NO PLACE TO HIDE*

On June 26, 1950, W. Stuart Symington, former Air Force Secretary and now chairman of the National Security Resources Board, spoke before the annual convention of the American Red Cross in Detroit. For his subject Symington had chosen one of his principal responsibilities, civil defense. It was a timely topic on the day after the communist attack on Korea. For all any American knew, the attack was, as President Truman later suggested, the beginning of a shift of strategy from subversion to outright aggression in the communist world. With the Soviet Union in possession of the atomic bomb, it was time for the United States once again to consider what an atomic attack would mean for the nation's cities.



Symington's words that Sunday afternoon were not very comforting. "In this atomic age," he began, "there is no place to hide." The nation could improve its defenses against atomic weapons, but no amount of money could assure complete protection against surprise attack. The important thing was to understand the nature of atomic warfare and to prepare for it. For almost a year the Commission had been helping in this process of education. As Shields Warren had told the Joint Committee in March, 1950, operational responsibility lay with Symington's organization; the Commission's job was to provide technical data. The Commission had already declassified many documents for civil defense use and had prepared reports on the medical effects of atomic weapons, the use of radiation detection instruments, and the design of protective structures. Of most widespread interest was the handbook *Effects of Atomic Weapons,* which the Commission published in August, 1950.[4]

By September the deepening impact of the Korean war and the Government's educational efforts were beginning to have an effect. *The Bulletin of the Atomic Scientists* devoted a full issue to civil defense against atomic attack, and the Truman Administration began drafting legislation to establish a Federal civil defense agency. On October 18, the first air-raid shelter signs appeared on the streets in New York City, and within a few days the Government began distributing a pocket-size booklet, *Survival Under Atomic Attack.* Warren and his staff had provided material for the booklet and had helped to set up training courses for nurses, civilian defense instructors, and emergency radiation teams. With newspaper headlines full of reports of the sweep of Chinese communist forces deep into South Korea, there was little need to debate the existence of a grave national emergency when the

Senate Armed Services Committee began hearings on the civil defense bill in December, 1950. War with Russia seemed imminent. As the mayor of Boston put it, "Such a war, perhaps the most horrible war in history, will shake the very foundations of the world." After five days of hearings, the Senate was ready to act. The new law was in effect before the end of the year as the nation prepared for the worst.[5]

## *NATIONAL EMERGENCY*

Among American scientists the foreboding news from Europe and the Far East was causing some radical rethinking of their role in the national emergency. Louis N. Ridenour, now serving as special assistant to the Secretary of the Air Force, told the Atomic Scientists of Chicago on November 24, 1950, that the time had come "for the national scientific community to take its proper part in the administration of national scientific affairs." In a world of limited warfare and unlimited resistance to communist aggression, scientists could no longer restrict themselves to part-time service on advisory boards. "Science," Ridenour had said, was "the shield of the free world." Was it too much to ask that science take part in mobilizing for the defense of freedom? [6]



By the time the American Association for the Advancement of Science assembled in Cleveland for its annual meeting during the Christmas holidays, several proposals for mobilization of scientific manpower had become popular topics for discussion. Both the American Institute of Physics and a special group advising General Lewis B. Hershey had recommended expanding the Selective Service System to include a scientific or technical service in its own classification system. Lawrence R. Hafstad, acting as chairman of the Interdepartmental Committee on Scientific Research and Development, had warned Symington that the nation could not afford to deplete its supply of scientific manpower. He urged the creation of a national scientific service to assure a continuing flow of young men and women into the scientific professions and the best use of all scientists in the military services.[7]

Commissioner Smyth took a broad view of the question in a speech at the scientists' convention. He admitted that scientists did not like to concentrate their efforts on instruments of war and that every scientist feared regimentation by government. But the nation's experience in World War II had proved that the full cooperation of scientists was absolutely essential in preparing for modern warfare. "Today," Smyth said, "we face a possible struggle for survival, and so our first concern as scientists must be to ask how we serve this country." He proposed a scientific service corps in which all the nation's scientists would be registered and some assigned, hopefully without coercion, to defense projects.[8]

Within the Commission the crisis in Korea was producing a similar effect. Kenneth S. Pitzer, who had recently resigned as director of research to accept a fellowship in England the following summer, wrote Marion W. Boyer, the new general manager, on December 11 that he had reluctantly decided to stay on the job in order to help carry out the reorientation of the Commission's research and development program. He believed the Commission could now take a much more daring approach to such activities under emergency conditions. Administrative shortcuts would greatly speed directives to the field offices and laboratories. Early in January, 1951, he proposed to Boyer a new statement of research policy. The statement declared that basic research was still important and should be supported as far as possible, but that some applied research was now more important and would have to take precedence. He urged continuing fellowships in the sciences and clearing outstanding scientists for classified research on short notice even when the need for clearance was not immediately apparent. The laboratories should, in Pitzer's opinion, make more use of consultants and the universities should be prepared to undertake classified research.[9]



Boyer readily approved the proposal for the national laboratories, and Pitzer made plans to visit Oak Ridge and Argonne with Hafstad before the end of January to explain the new policy. Other events, however, had overtaken Hafstad. While Pitzer was in the field, Hafstad would be deeply involved in Washington in an effort to adjust the reactor program to new military requirements.

## *REACTORS FOR THE MILITARY*

For Hafstad the dangerous international situation in the closing weeks of 1950 could hardly have resulted in a complete reorientation of the Commission's reactor program. For almost two years he had seen a steady growth of activity on military reactors, first for submarine propulsion and more recently for aircraft. Although the original NEPA project had failed somehow to take hold, Alvin M. Weinberg's growing interest in aircraft nuclear propulsion had helped to stimulate new ideas. Working with the NEPA staff, the Oak Ridge laboratory had given the project a sense of direction in the first half of 1950. Weinberg had confidently expected that by the time the special technical advisory board arrived in the summer of 1950, the Oak Ridge group would have made enough progress to convince the board that nuclear propulsion of aircraft was feasible.

Events during the summer not only justified Weinberg's optimism but also resulted in some important decisions for the future. By early August the board under F. Wheeler Loomis had concluded that research on the aircraft

reactor was too diffuse and on too long a time scale. The Loomis committee thought the goal should be, rather than a nuclear-powered supersonic bomber in the 1960's, a demonstration of nuclear propulsion as soon as possible, probably in an existing airframe design, such as the B-52, at subsonic speeds. The board also believed that the exploratory studies by the NEPA group had outlived their usefulness.

Both Hafstad and General Donald L. Putt, director of research and development in the Air Force, saw the wisdom of these recommendations. The NEPA project had lost its sense of mission, and some of its best leaders had resigned. Expiration of the Fairchild contract for NEPA in November, 1950, offered a good opportunity for a change. The plan was that Putt would ask General Electric to take over development of the aircraft engines. One or several of the large aircraft manufacturers would be recruited to devise a modification of an existing airframe. The Oak Ridge laboratory would con-
490 tinue to develop the reactor portion of the plane, first as a small reactor experiment and then as a full-scale nuclear-powered engine on a test stand. The old NEPA project would die in April, 1951.[10]

The results of these decisions were clearly evident when Pitzer arrived in Oak Ridge in late January, 1951. The number of scientists and technicians working on aircraft propulsion—263 people representing thirteen divisions —was greater than for all other laboratory projects combined. Now that all design work on the materials testing reactor was complete, there remained in that group only enough people to operate the original mock-up assembly, which had been converted into a low-power research reactor. The only other reactor project of any significance at Oak Ridge was the homogeneous experiment, which required only about sixty of the laboratory staff.

Most of the research on the aircraft system centered on the aircraft reactor experiment, to be built at Oak Ridge. The decision in the summer of 1950 still stood to use liquid sodium to transfer the heat from the reactor, but research during the autumn had caused second thoughts about the use of solid fuel. By January, 1951, the plan was to place noncirculating liquid fuel in small tubes or "hairpins" that would be immersed in the sodium. Supporting the experiment were other groups studying shielding, control systems, heat-transfer and metallurgy problems, and radiation damage. For the first time since 1946, research on an aircraft reactor seemed to be headed in a positive direction.[11]

Despite these technical accomplishments at Oak Ridge, Hafstad was still worried about the future. A sound technical base at Oak Ridge and unreserved enthusiasm in the Air Force were good arguments for the project, but they were not sufficient. In considering NEPA over the years, the Commissioners had long since learned to discount Air Force claims of feasibility. It would also be dangerous to become too heavily committed to the Air Force without some positive indication of support from the Department of Defense. Hafstad had an opportunity to raise the issue on December 7, 1950, when the

Commission considered the annual Presidential directive for the production of fissionable materials. The aircraft program would require a diversion of 200 kilograms of uranium 235 from weapon use. The deepening international crisis and the mounting requirements for nuclear weapons made such a diversion questionable unless the nuclear-powered bomber was essential to national defense. The Commission decided to ask again for a military opinion.[12]

The letter which Hafstad drafted for Boyer's signature on December 12, 1950, did formally raise the issue of requirements but Robert LeBaron was not hopeful that it would elicit a positive decision from the Joint Chiefs of Staff. He had not yet told the Commission that he had already received from the Joint Chiefs a statement to the effect that the Military Liaison Committee would have to determine the rate and scale of the aircraft project. A similar request from the Navy for a nuclear-powered aircraft carrier had recently gone to the Joint Chiefs. The chiefs' reply would provide a new reading of their attitude.[13]



LeBaron did not have long to wait. On December 21 he received a second demurral from the Joint Chiefs. As with the aircraft reactor, they were willing to go no further than recognizing the technical feasibility of the carrier reactor. Any decision on a formal military requirement would have to await further information from the Commission.

On January 25, 1951, LeBaron dispatched a letter to Dean reporting the Joint Chiefs' response to both requests. Now that the chiefs had committed what Hafstad and Putt considered "a complete abdication of authority," LeBaron was ready to act through the Military Liaison Committee. The next day he wrote Dean that the committee was undertaking a complete survey of the Commission's reactor development program. He arranged for the committee a series of briefings with Hafstad on several nights the following week.[14]

For General Putt and the Air Force, the failure to obtain a military requirement for the aircraft reactor was a severe blow. Perhaps the Military Liaison Committee could keep the project alive, but Colonel Ralph L. Wassell, an Air Force officer who had been at Oak Ridge, had his doubts. He suspected that Weinberg's first interest lay in the homogeneous reactor. Any faltering on the aircraft project might lead to a reversal of priorities at Oak Ridge.

The Joint Chiefs had also caused trouble for Hafstad, but he was not ready to give up. He told Walter A. Hamilton of the Joint Committee staff that he could not move on budget matters without some priority statement from the military and that he would appreciate any help the Joint Committee could give. The hearing which Congressman Carl T. Durham called on February 16 covered little more than LeBaron's role in the events of the previous weeks, but perhaps it would assure the Commission of committee support for the aircraft reactor. Durham and LeBaron would be ready to help if necessary, but the fate of the project now rested clearly on Hafstad and the Commission.[15]

## NEW GOALS FOR REACTORS

By the time of the Joint Committee hearing on February 16, 1951, Hafstad had been able to review his plans for all types of reactors, for the production of plutonium and power as well as military propulsion. That same morning he told the Commissioners that he saw the decade ahead as one of competition with the Soviet Union, whether in war or peace. This competition would involve the total military and industrial potential of both countries. The Commission's principal task, in his opinion, was first to supply fissionable materials for weapons and military propulsion and then to strengthen the nation's industrial potential by using nuclear power to increase the nation's electrical energy supply. He estimated that this task would require $12 million more than the $101 million the Commission was proposing for reactor development in fiscal year 1952.[16]



Following this line of reasoning, Hafstad thought Argonne's highest priority should be on the plutonium production reactors for the Savannah River plant and then on a power-producing version of the same reactor. Work on the prototype of the submarine reactor would continue at its existing level, even if that meant higher costs. At Oak Ridge, Hafstad proposed to give highest priority to the homogeneous reactor, largely because of its promise as a plutonium and power producer. In the event of a conflict of priorities, the aircraft reactor would have to take second place, but Hafstad thought Oak Ridge could handle both assignments, particularly if the laboratory diverted much of the development work to industrial contractors as Argonne had done with Westinghouse. For this purpose Hafstad urged the Commission to approve a contract with General Electric at a cost of $3.7 million in 1952 for work on the aircraft reactor. Lesser priorities would go to the submarine project at the Knolls laboratory and to the development of reactors producing uranium 233. Whenever the Joint Chiefs might come up with clear-cut requirements for military reactors, the Commission could adjust its priorities accordingly.

The Commission was hardly ready to act on such a comprehensive proposal, but Smyth had some immediate reactions. Although he thought that work on the aircraft reactor would give Oak Ridge a sense of direction, he suggested that the Commission define the goal somewhat more broadly, in terms of high-temperature systems rather than aircraft application specifically. There were some reservations about the aircraft contract with General Electric, but the idea of building dual-purpose plutonium-power reactors received favorable comment.[17]

When the Commission returned to Hafstad's proposal two weeks later, opinion had crystallized in opposition to a full-scale aircraft reactor at Oak Ridge. Dean was unwilling to proceed without a formal requirement from the

Department of Defense. Pike had joined Smyth in favoring more general studies on high-temperature reactors, and T. Keith Glennan was skeptical about bringing General Electric in to work on hardware at such a preliminary point in development. Only Thomas E. Murray thought Oak Ridge should proceed on the entire project at once. When Hafstad observed that the small aircraft and homogeneous reactor experiments would represent a good start on the study of high-temperature systems, the Commission agreed to authorize their continuation with the reemployment of as much personnel as possible from the disbanding NEPA project. The Commission declined to take any action on the General Electric contract until LeBaron transmitted a formal requirement for an aircraft reactor from the Joint Chiefs on March 13, 1951.[18]

The military propulsion reactors were important to the defense effort, but plutonium production was still the first priority. Even the additional reactors at Hanford and Savannah River, authorized in October, 1950, would not guarantee an adequate supply of plutonium for all foreseeable requirements. In any event the Commission would not realize the full benefits of that action until the Savannah River reactors were completed, probably in 1956.



A further consideration, one which the General Advisory Committee had been following since 1947, was establishing a proper ratio between plutonium and uranium-235 production. Careful analysis of the alternatives the Commission might follow in feeding raw material through the production complex of reactors, plutonium separation plants, and the gaseous-diffusion chain demonstrated the need for increasing plutonium production even with existing plants. Similar analyses, which Manson Benedict and his staff were performing at Commission headquarters, showed that a higher plutonium-uranium-235 ratio would increase the total output of fissionable material with the existing stocks of uranium ore. There was also good reason to believe that military requirements for weapons would again increase, not only in terms of total numbers, but also in terms of models for specific uses. Either type of increase was likely to require more plutonium.[19]

All these considerations caused Hafstad to give increasing attention to plutonium producers in the spring of 1951. The problem as he saw it was not simply one of building more Hanford reactors as they were needed. For one thing, there was a lag of at least two years between the decision to build a reactor and the first delivery of plutonium from it. Furthermore, if the Commission waited until the last minute, there would never be any time to develop a more efficient design. Hafstad had found that very slight improvements in the reactors built at Hanford since World War II would have resulted in enormous savings as well as greater production of plutonium. And what would happen, Hafstad worried, if the military services suddenly needed large amounts of plutonium in the period before 1956, when the Savannah River reactors would be completed?

In the long run the answer might well lie in breeder reactors. Hafstad

told Congressman Durham and his reactor subcommittee on May 23, 1951, that he was closely following the progress on the experimental-breeder reactor, which Zinn's staff was completing at the Idaho test station. Another possibility was the old General Electric power-breeder project. In January, 1951, Hafstad had received proposals from Kenneth H. Kingdon and Bethe, now a General Electric consultant, for a new study of the power breeder. Hafstad had made it clear that General Electric first would have to complete the submarine prototype at West Milton, which would provide significant data on both the submarine and power-breeder systems, but he was prepared to act on the General Electric proposal when the time was right.[20]

Among the plutonium producers, Hafstad was still counting on the new Savannah River reactors, the sixth Hanford unit (C), and the homogeneous reactor at Oak Ridge. For short-term contingencies he had authorized a study of a reactor using ordinary water as both moderator and coolant and
494 slightly enriched uranium as fuel. This design, a cooperative effort by the H. K. Ferguson Company and the Brookhaven laboratory, would avoid the use of scarce materials such as graphite and heavy water and would minimize the diversion of uranium 235 from weapons. In January, 1951, Hafstad also arranged for North American Aviation, Incorporated, to investigate the best possible "quick" design of a production reactor requiring a minimum extrapolation of reactor technology.

The Commissioners were not enthusiastic about Hafstad's recommendations. In a Commission meeting on June 7, 1951, Smyth told his colleagues that momentary preoccupation with plutonium production might distort the future of reactor design. Glennan could see Smyth's point, but he observed that perhaps the Commission was at fault in not stating its priorities clearly for the staff. A second meeting on the proposal two weeks later led to no definite conclusions. Boyer could only say that Hafstad would continue to study the possibilities for better reactors.[21]

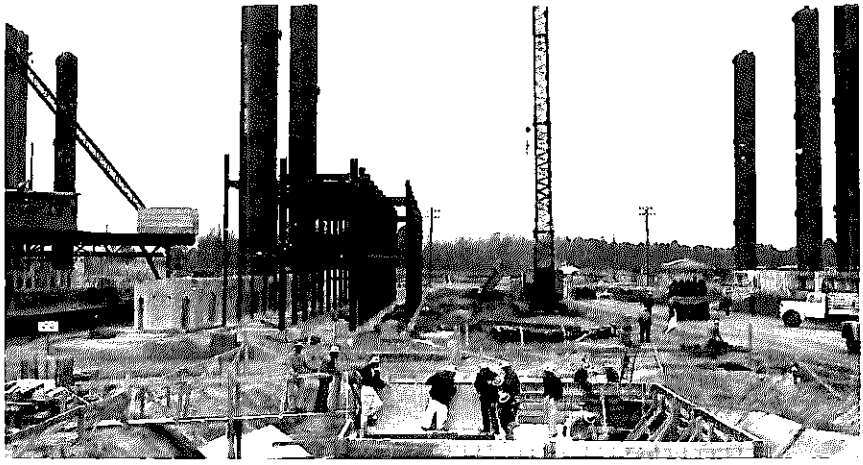
Hafstad himself could be philosophic about the Commission's difficulty in reaching a decision. He could understand how unusually capable and impressive men like Weinberg and Zinn could capture the Commissioners' interest and lead them first toward one reactor and then another. It was also difficult to keep priorities straight with a time lag of two or three years between the start of design and the completion of construction. For the short term he thought it was sensible for the Commission to concentrate on military propulsion reactors and plutonium producers. In the long run, nuclear power would be significant, but Hafstad believed private industry might best do that job.[22]

Before the end of 1950, other companies had followed Charles Thomas of Monsanto in offering to undertake studies of plutonium-power plants. John G. Grebe at Dow Chemical and James W. Parker at Detroit Edison had submitted a joint proposal on November 20. Because additional proposals seemed inevitable, Hafstad had decided to establish ground rules for power

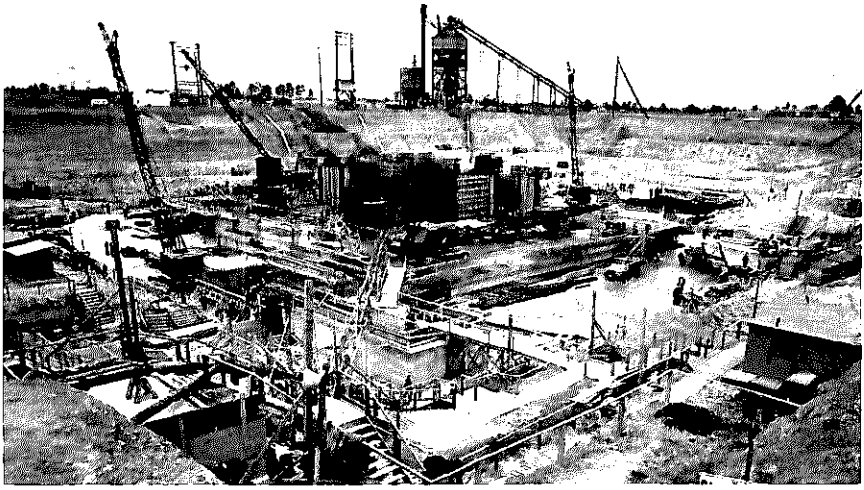
CONSTRUCTION AT OAK RIDGE, 1952 / Grading is in progress on the site of the new K-33 gaseous-diffusion plant as part of the Commission's expansion of production facilities. Other diffusion plants are in the background.

J. E. WESTCOTT

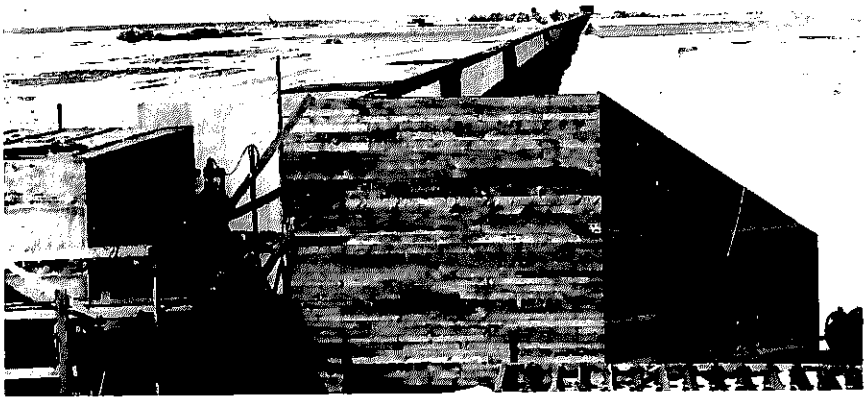
CONSTRUCTION AT PADUCAH, 1952 / Some of the 3,000 production workers on the day shift at the Paducah, Kentucky, gaseous-diffusion plant in 1952. The Paducah plant was part of the expansion program approved by the Commission in 1950.



CONSTRUCTION OF THE SAVANNAH RIVER HEAVY WATER PLANT, LATE 1951 / The first of the towers had been erected by November 28, 1951, for the hydrogen-distillation plant. The hydrogen-distillation process, although costly and dangerous, was selected as the quickest method of producing heavy water for use as moderator in the production reactors at Savannah River.

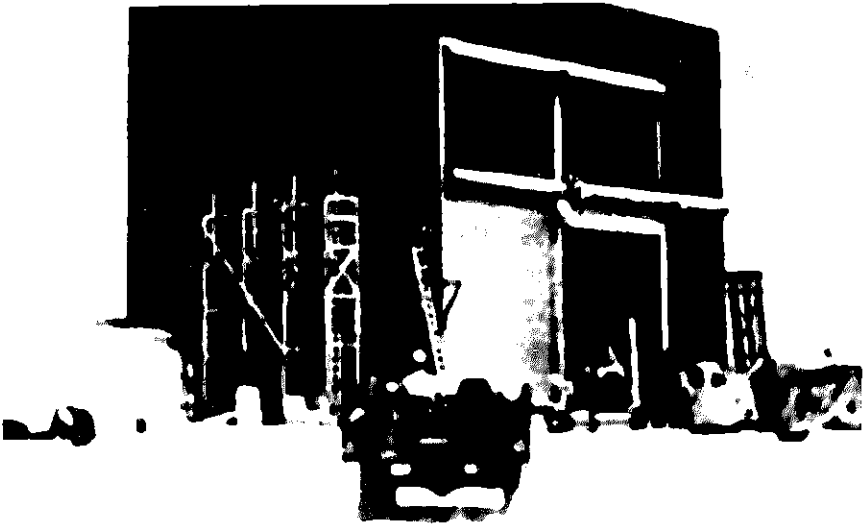


FOOTINGS FOR THE P REACTOR AT SAVANNAH RIVER, 1951 / Footings were being placed as this photograph was taken on November 28, 1951.



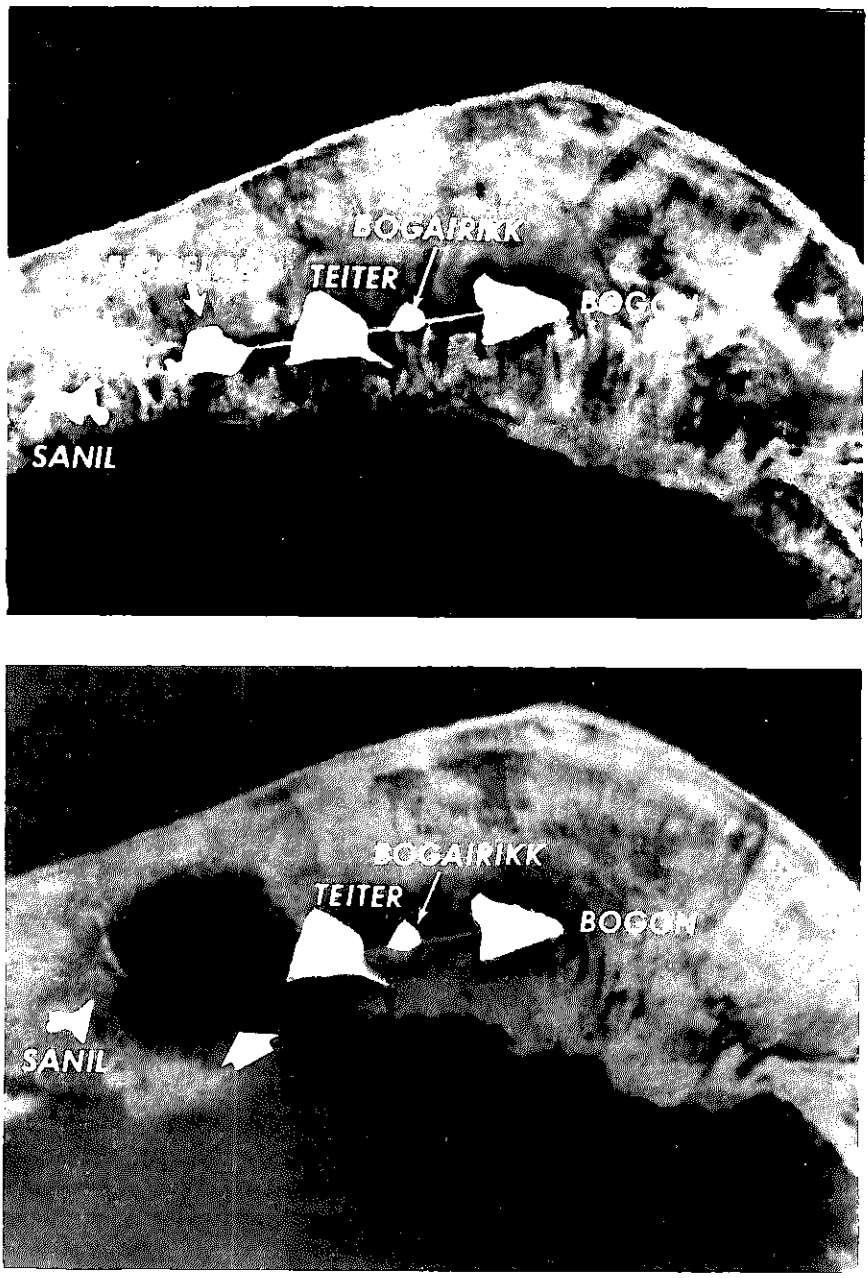
U. S. AIR FORCE

*MIKE* SHOT, OPERATION *IVY* / Some of the complex instrumentation for the first test of a thermonuclear device at Eniwetok in October, 1952. The large building at the end of the two-mile plywood tube housed the device.



UNITED PRESS INTERNATIONAL

A TEMPORARY HOME FOR MIKE / This structure at Eniwetok housed *Mike*, the first thermonuclear device, which was tested on October 31, 1952.




U. S. AIR FORCE

A PACIFIC ISLAND DISAPPEARS. OCTOBER 31, 1952 / The top photograph shows the Island of Elugelab in the Eniwetok chain before *Mike* was detonated. The lower photograph shows the crater, more than a mile in diameter, created by the first thermonuclear detonation.

reactor studies. The new policy, announced in January, 1951, limited the projects to surveys of existing reactor data. The Commission would clear a limited number of technical personnel and the companies would agree to submit a written report to the Commission. Only if the study projects indicated a feasible reactor design would the Commission consider financing further development. The public announcement brought additional proposals early in 1951 from the Commonwealth Edison Company of Chicago and jointly from the Bechtel Corporation and the Pacific Gas and Electric Company.[23]

Hafstad hoped the Commission would not commit itself too heavily to its own power-breeder projects until the industrial groups had surveyed the possibilities of private development. He had often pondered the ultimate conflict between the virtually unlimited military demands for fissionable material and the growing trend in Congressional hearings to conclude that the nation's expenditures for atomic energy were already large enough. The trouble was that the atomic energy industry was a tax-consuming rather than a tax-producing activity. As a Government monopoly, he thought, it was bound to be an anomaly in a basically free enterprise system. Hafstad had not forgotten discussing this subject six years earlier with Admiral William S. Parsons. The solution, they had concluded, was to build up a nuclear industry which could sustain itself in peacetime in energy production and which could readily turn to plutonium production in time of crisis. If the Commission could attain this goal, and it still seemed possible, there would be no need for plutonium-producing reactors at Hanford or Savannah River. Atomic energy would no longer be an anomaly in the American economy.[24]



## *REACTORS ON THE DESERT*

Long-term planning was essential in reactor development, but the immediate future rested with reactors then under construction. Three of these, the experimental-breeder reactor, the materials testing reactor, and the submarine thermal reactor, were now taking shape at the reactor testing station in Idaho. Striking changes had occurred on the Idaho desert since June, 1949, when Leonard E. Johnston had set up the first Commission office in Idaho Falls. Perhaps because the Commission had not yet taken title to the old naval proving ground that made up most of the site, Johnston had hastened to establish a *fait accompli* by drilling wells and starting work on access roads. Even before Zinn had selected the Bechtel Corporation as the construction contractor for the breeder reactor, Johnston had hired a local firm to start digging foundations in November, 1949.[25]

An unusually severe winter stopped almost all work on the site for several months, but by spring Bechtel was making rapid progress on the

building for the breeder reactor. The Fluor Corporation had been selected to build most of the materials testing reactor facility, and broke ground for the plant in May. The Mark I version of the submarine thermal reactor was still in the midst of design at Argonne and the Bettis Field plant, but the Rust Engineering Company had already chosen the site for the reactor halfway up the road from the central facilities to the materials testing reactor.

Construction progress slowed during the summer, not through any fault of the Idaho contractors but rather because construction was running ahead of blueprints. Both Argonne and Oak Ridge, even with the help of experienced architect-engineers, were discovering that building reactors was not an ordinary type of construction activity. So scarce were blueprints for the materials testing reactor in July, 1950, that Idaho gave up any hope of enclosing the main reactor building before winter set in.

Even harder hit was the experimental-breeder reactor. With relatively
496 low priority, the project commanded less than a dozen members of the Argonne staff. What had started as a small reactor experiment at Argonne had suddenly become a substantial engineering enterprise. No one at Argonne was any longer naive enough to think that satisfactory reactor components could be procured by mailing out specifications to manufacturers. Leonard J. Koch, in charge of procuring components, found it necessary to check on specifications as the work progressed with companies across the country. Even then there were components the laboratory simply had to fabricate itself, often without the proper equipment or experienced technicians. The hard lessons learned on the breeder project would save time on both the testing and the submarine reactors.

By August, 1950, F. H. McGraw & Company had broken ground for the submarine reactor building. Bechtel, now far ahead of the blueprints on the breeder, was turning to construction of a chemical processing plant for the Idaho site. Originally intended for processing fuel elements from the materials testing reactor, the plant would now be employed to process uranium-235 fuel slugs used in the Hanford reactors to produce tritium. The need to recover the relatively large inventories of uranium 235 for weapons made construction of the chemical processing plant the first order of business at Idaho.

Despite some disappointments, progress by the end of 1950 had been impressive. For the breeder reactor only some large bellows valves and the main reactor tank were still on the critical list; Bechtel was confident the building would be ready for the reactor by the end of February, 1951. Construction of the materials testing reactor was beginning to gain momentum. The plant was only 12 per cent complete, but it was not too early to select the operating contractor. Largely for the talents of Richard L. Doan, formerly at the Metallurgical Laboratory, the Commission had selected the Phillips Petroleum Company. On the submarine reactor, McGraw was making good progress on the site, and Argonne and Westinghouse had agreed on the design of all components and systems for the reactor.

## THE EXPERIMENTAL BREEDER

For the experimental breeder reactor, 1951 would be the critical year. Meyer Novick was the first of the Argonne staff to arrive in Idaho Falls with his family, in January, 1951. Harold V. Lichtenberger and seven others joined Novick in March and were ready to install the reactor when Bechtel finished the building on April 10. Work started first on the heat exchangers, pumps, and piping for the sodium-potassium system that would carry heat from the reactor to the small turbine. Then came the reactor tank and the thousands of internal parts. Final installation of the wiring, the calibration of instruments, and last-minute modifications proceeded in the fleeting weeks of the Idaho spring.[26]



Late in May Zinn arrived for the first attempt to reach criticality. This was to be a touchy, painstaking procedure. Unlike any previous reactor, the breeder would use uranium 235 as fuel. Only because the amount required was small and could be recovered quickly for weapons had the Commission permitted its use in the reactor. Lichtenberger had set up special facilities at Argonne for fabricating the uranium 235 into pencil-like rods and inserting them with a sodium-potassium bond into stainless-steel jackets. Unusual precautions were necessary to insure against any accidental assembly of a critical mass or against a fire in handling of the sodium-potassium alloy. Without the help of computers or any critical assembly of the reactor core, Zinn could really only guess at the number of rods needed to reach criticality. His best estimate was 40 kilograms of uranium 235, or 179 rods, but as a margin for error he had ordered 200.

The slow approach to critically began on May 29. After the crew had inserted thirty rods in the core, a neutron source was added and the safety rods withdrawn to check on neutron multiplication. From these data Zinn could begin to estimate the critical mass. Proceeding in ever smaller steps as he approached 40 kilograms on June 1, Zinn reluctantly concluded that criticality would require at least 52.5 kilograms. With all 201 rods inserted on June 2, the reactor was still not critical. Zinn estimated that he was 7 kilograms short, an agonizingly small error, but at least he could correct it without rebuilding the reactor core. He decided to add the necessary uranium by slightly increasing both the diameter and the length of some of the fuel rods. This decision required an additional authorization for uranium 235 from the Commission and refabrication of about fifty rods at Argonne.

Not until late August did Zinn have the necessary rods to resume operation. Following the same cautious procedure, Zinn at last brought the reactor just to the point of criticality on the twenty-first run on the afternoon of August 24, with a little more than 52 kilograms of uranium 235. During most of the autumn Lichtenberger and Novick operated the reactor at "zero" power while control and safety rods were calibrated, the negative temperature

coefficient was measured, and fast-neutron experiments were started. Then came some low-power runs, further tests of the control system, and the construction of more concrete shielding around the reactor.

On a wintry morning five days before Christmas in 1951, Zinn had his staff gathered for what they hoped would be a historic experiment. For the first time they would attempt to produce electrical energy from nuclear power. Zinn first started the reactor and leveled off at low power. At 9:50 A.M. the reactor cooling system was connected and the sodium-potassium alloy started circulating through the reactor. Then Zinn increased the power to about 250 kilowatts, or just enough to turn over the steam turbine and the generator. Shortly before noon, Zinn shut off the turbine and raised the power to 340 kilowatts. Novick made a check of the power output and Zinn went up to 410 kilowatts. Now the chain reaction was producing significant amounts of heat in the "blanket" of natural uranium surrounding the core, where plutonium
498 breeding would occur. Fifteen more minutes of checking instruments and all was ready. Zinn ordered the resistance load connected to the generato . He recorded in the log book:

> 1:23—Load dissipator connected to generator.
> Electricity flows from atomic energy.
> Rough estimate indicates 45 kw.[27]

Purely as a scientific experiment the test run on December 20, 1951, was all that Zinn could ask or expect. The theories and techniques he and his team had built into the reactor had proved valid, and it would now be possible in sustained power runs to produce data on fast neutrons and particularly on the possibility of breeding. In this respect the generation of electric power was only incidental to the larger purposes of the experiment. For the scientist there was nothing new in generating electric power from heat; the generating system was simply a means for dissipating energy so that the reactor could operate at higher power levels.

The fact was, however, that the accomplishment on December 20 was more than a scientific experiment. It was a practical demonstration to the world that the atomic nucleus could serve mankind as a source of power. There was added significance in that a reactor designed to breed fissionable material had first produced power from the nucleus. For two years leaders of American industry had been intrigued with the idea of building a power breeder. Now they had Zinn's sparkling achievement to fire their enthusiasm.

## *RESEARCH IN THE SHADOW OF WAR*

Commission support of the basic sciences continued and even grew during the national emergency created by the Korean war. As Zinn had told the

Congressmen at Argonne in March, 1950, even in an all-out crisis it did not speed results to put every scientist on applied research. For the most part, basic research in the national laboratories and the universities continued.

Only in a few special areas were scientists diverted to immediate tasks. On the suggestion of the General Advisory Committee, Pitzer asked the laboratories to help out in developing chemical processes for separating uranium from low-grade ores such as the Florida phosphates. Oak Ridge continued to devote a large part of its effort in chemistry to processes for recovering plutonium, uranium 238, and uranium 233 from reactor-irradiated materials. The new chemical processing plant at Idaho had been originally conceived as an experimental facility for reactor products, specifically uranium 235 canned in aluminum, but propulsion reactors for submarines and aircraft would require a variety of special processes at the "head-end" of the plant.[28]

In biology and medicine Warren continued to exercise his responsibilities for industrial health and safety and for providing technical assistance to the Federal Civil Defense Administration. With the increasing tempo of weapon testing, especially after the continental test site came into use in the *Ranger* series in 1951, the hazards of radioactive fallout took on increasing importance. In the spring of 1949, Nicholas N. Smith, Jr., at the Oak Ridge laboratory had undertaken a theoretical study of the number of fission weapons that would have to be detonated to cause serious damage to human populations through crop contamination. Smith decided that the most dangerous isotopes would be plutonium, strontium 90, and yttrium 90, which would fall out downwind from a fission detonation in an area of 350,000 square miles. Smith estimated that it would take three thousand such detonations in a single growing season to cause a serious hazard in the area; however, he acknowledged that scientists had only a fragmentary knowledge of strontium metabolism in the human body and that many more experimental data would be necessary for sound estimates.[29]



In the spring of 1951, after the *Ranger* tests, Boyer suggested the need for a reappraisal of Project *Gabriel*, as Smith's earlier study was now called. Warren suggested waiting until data from *Ranger* and *Greenhouse* were available. The result was that Smith did not complete his revised report until late November. His conclusions, based on recent fallout data, were that ten thousand nominal weapons (20,000 tons of TNT each) could be detonated without undue hazards from secondary effects. Warren organized a special committee of recognized experts in operations research, meteorology, soil technology, biology, and physics to examine the report. The committee agreed with Smith's conclusions about long-term effects, but the experts pointed to the potential hazards of heavy fallout near a nuclear detonation or even many hundreds of miles away if extensive precipitation should occur in the radioactive cloud. In short, fallout posed a definite potential danger, but not an immediate one in terms of existing weapon stockpiles or test plans. Appar-

ently no one raised the question of genetic effects, which was to cause widespread controversy a few years later.

Military requirements had relatively little impact on the construction of major research facilities at the national laboratories. Although the Commission continued to defer Weinberg's request for a new research reactor at Oak Ridge, it readily approved construction of a new version of the CP-3 reactor at Argonne in May, 1951, when the old reactor at the Palos Park site showed signs of old age, mostly in the form of tank corrosion. The Brookhaven research reactor, completed in the summer of 1950, was at last becoming the focus of research in the eastern laboratory.[30]

Only at Berkeley did the national emergency have measurable effects on the construction of high-energy accelerators in the billion-electron-volt (bev) range. After completion of the quarter-scale model of the bevatron in the spring of 1949, Ernest O. Lawrence diverted most of his high-energy crew
500 to the materials testing accelerator. Thereafter only occasional work, often by young physicists waiting for security clearances, was possible on the bevatron. In May, 1951, Luis W. Alvarez told the General Advisory Committee that the magnet for one quadrant of the accelerator had been wound and that the linear accelerator which would serve as the injector was being assembled in the bevatron building. Major developmental work on the vacuum system was still necessary. Alvarez estimated that the war effort had already slowed down the bevatron by nine months, and further losses could be anticipated.[31]

The war had almost no effect on the development and construction of the Brookhaven cosmotron. Early in 1951 G. Kenneth Green devoted several weeks to designing a small 18-inch, high-current cyclotron for special neutron reaction measurements for the weapon program, but otherwise the Brookhaven staff could concentrate its efforts on the large machine. By the summer of 1950 the cosmotron building was virtually complete. Most of the 188 individual magnet blocks had been tested and were being assembled on the ring foundation. The large, hollow, water-cooled copper bars which would bring power to the magnet were being wound in special shops at Brookhaven and installed in the magnet. Green had supervised development of the power supply system, and John P. Blewett and his group were completing the design of a radio-frequency accelerator of a new type. One aspect of the design which had not received sufficient attention was the vacuum system, a feature of the cosmotron that required intensive effort throughout 1951. The chamber, about four feet wide and one foot high, had to sustain a very high vacuum, have very thin walls to conserve space in the magnet gap, and yet have good structural stability. The final design called for stainless-steel panels supported by tie-rods and sealed with a blanket of synthetic rubber.[32]

The long process of assembly and tune-up began in the fall of 1951 with completion of the magnet, power supply, Van de Graaff injector, and first section of the vacuum chamber. Testing and modification of the vacuum chamber to eliminate leaks and short circuits took many weeks, and not until

early 1952 was Green ready to trace the beam through the first quadrant of the magnet. By March the Brookhaven group was able to follow the beam around the entire circle, an occasion that called for champagne, but many adjustments were still necessary to get up to significant power. On May 20, 1952, the cosmotron first attained the bev range, and after some further adjustments in the radio-frequency system reached 1.3 bev on June 10, the highest energy theoretically possible without energizing special pole-face windings on the magnets. This magnificent achievement more than justified the years of careful work. It would take the rest of 1952 to get up to full power and to make the machine available for experiments in high-energy physics, but successful operation now seemed assured.

## *BUILDING THE ACTINIDE SERIES* 501

In some departments of the national laboratories basic research continued almost independent of international pressures. One example was the work by Glenn T. Seaborg's group at the Radiation Laboratory in Berkeley. The procedures which Seaborg's team had developed in the middle 1940's for producing and separating the actinide elements were the pattern for further research in transplutonium chemistry during the last years of the decade. The new elements americium and curium were to be the steppingstones to heavier members of the actinide family. Because of its long half-life, americium 241 seemed the most practical isotope of that element, but the intense alpha activity of curium 242 made that material extremely difficult to manipulate. Nelson Garden and his staff at Berkeley designed equipment for handling these materials safely. The production of these elements was a tedious process. The americium, created after long irradiation of plutonium in the Hanford reactors, had to be separated in milligram amounts; the americium could be irradiated to form curium, which could be separated in microgram quantities.

Even after sufficient quantities of the two elements were available, the efforts of Seaborg's group to find element 97 proved unsuccessful during 1948 and most of 1949. From its position in the actinide series, element 97 appeared capable of some oxidation above the +3 state in solutions. If this proved true, it would be possible to recover significant quantities of the new element.[33]

The greatest difficulty was predicting the properties of the undiscovered elements. Until Stanley G. Thompson and Albert Ghiorso could get some idea of the possible distribution of alpha energies of the new materials, it would be almost impossible to distinguish them from other actinides in the multichannel analyzer. Because the heavier elements were likely to be increasingly unstable, it was all the more important to be able to perform the separation and analysis quickly, before the element disintegrated. As Seaborg

and his associates perfected their techniques and refined their estimates of the chemical and nuclear properties of 97, they came closer to their goal. Finally, on December 19, 1949, using a combination of the oxidation-reduction and ion-exchange processes, they identified an alpha emitter with a half-life of 4.6 hours. Further tests, showing that the decay products of the material were americium and curium, established its identity as element 97 by the middle of February, 1950. Seaborg and his group with reasonable confidence designated the isotope $97^{243}$.

Immediately after the discovery of 97, Seaborg with Thompson, Ghiorso, and Kenneth Street, Jr., began looking for element 98 in small samples of curium 242 exposed to helium ions in the 60-inch cyclotron. The discovery of 97 helped to confirm earlier predictions that element 98 would not be susceptible to oxidation above the +3 state. From the properties of dysprosium, the lanthanide analogue of element 98, Thompson, Street, and
502 Seaborg were able to estimate the elution order of the new element. The alpha measurements on element 97 by Ghiorso also indicated that 98 would have a relatively high-energy alpha emission, which would be clearly distinctive among the heavier elements. The estimates proved correct, and the isotope was identified as $98^{244}$ on February 9, 1950.[34]

In naming the new pair of elements, Seaborg and his associates were at last forced to abandon the analogy to the lanthanides. They were able to claim that the name "berkelium" for element 97 was appropriate for its analogue, terbium, which was named for the Swedish town of Ytterby, where that element was first discovered. Finding no good analogue for dysprosium, they called element 98 "californium." The naming of two successive elements "berkelium" and "californium" prompted the *New Yorker* magazine to suggest that they had erred in not calling the elements "universitium" and "ofium" and reserving "berkelium" and "californium" fer elements 99 and 100. Seaborg's reply was that someone else might discover 99 and 100 and subvert the scheme by naming them "newium" and "yorkium." The Berkeley scientists had matched wits with the eastern editors. Moreover, their knowledge and experience would assure them a good chance of earning the right to name elements 99 and 100 when they were discovered.[35]

## *FROM X-RAYS TO GAMMA RAYS*

During the same years Arnold H. Sparrow and his associates at Brookhaven were methodically pursuing their studies of radiation effects in plant genetics. After completing the initial X-ray experiments in the summer of 1948, they set about expanding the data they had collected on chromosome breaks induced by radiation. How could they explain the great variation in sensitiv-

ity from one stage of cell division to another? Perhaps, Sparrow reasoned, sensitivity was related to the amount of nucleic acid in the chromosomes at the time of irradiation. By the summer of 1949 Sparrow's group had prepared 6,000 slides from irradiated material and 1,200 from control plants. The additional data made possible some elaboration of the effects of radiation. Sparrow found that chromosome breakage alone was not the best measure of radiosensitivity; later studies took into account the extent to which the broken chromosomes rejoined to form rings or bridges. He also made allowance for spontaneous chromosome breakage, which could not be attributed to radiation.

Until spring of 1949 Sparrow did not have a convenient source of neutrons for his experiments. Although the research reactor at Brookhaven was virtually complete, certain inadequacies in design and construction had postponed operations almost indefinitely. But Sparrow had acquired a reliable and versatile source of gamma rays. From the Oak Ridge reactor he obtained 503
a 20-curie source of the radioisotope cobalt 60. After constructing a simple device for raising the source in a vertical pipe from a shielded underground chamber, Sparrow could arrange plants for irradiation in concentric rings around the source. Since the amount of radiation varied inversely with the square of the distance from the source, Sparrow could expose the plants to almost any amount of radiation he desired. Furthermore, since the gamma source had a long half-life, the Brookhaven scientists could expose plants to almost constant radiation during an entire growing season. The source had to be lowered into the shielded cavity for only a few hours each day to tend the plants and check results.[36]

Sparrow and other biologists began using the gamma field in the spring of 1949 to study the effects of chronic radiation on common food plants like corn and potatoes. The gamma field also offered Sparrow new opportunities for experiments in cytology. For these he chose the spiderwort *Tradescantia paludosa*, a plant quite sensitive to gamma rays and easy to propagate. The large amount of data which biologists had collected on *Tradescantia* in earlier decades would provide good correlation for studies of radiation damage. Irradiation in the gamma field, first with the 20-curie source and in 1951 with a new 200-curie unit, produced results comparable with those obtained with *Trillium*. The experiments also helped to determine the amount of radiation necessary to kill the plants and the effect of radiation on undifferentiated cells.

By the end of 1951, Sparrow and his associates had amassed an impressive amount of data on radiation effects on the plant cell, but there were still vast areas of the unknown for them to explore. Measurements of nucleic acid content had failed to show any correlation with sensitivity, and the reasons for the great differences in sensitivity at the various stages of cell division were not yet clear. The fact that radiation did cause chromosome

breakage suggested the importance of radiation in genetics, but no one yet knew enough to state that gene mutation occurred at the point of chromosome breakage. Research in radiation cytology was only beginning.[37]

## *RESEARCH IN JAPAN*

The initial field studies of the effects of radiation on the Japanese population as a result of the wartime nuclear attacks had provided convincing evidence of the value of this research, and the Commission readily granted requests for additional funds from the field group, now called the Atomic Bomb Casualty Commission. From $450,000 in fiscal year 1948, expenditures were expected to rise to almost $1.4 million in 1949 and $1.9 million in 1950. Even then
504 there would not be enough money to build the control station at Sasebo. Temporary laboratories were completed at Hiroshima and Kure in October, 1948, and regular clinical examinations began at Hiroshima in March, 1949. By that time there were fifty Americans, a few Australians, and one hundred fifty Japanese working for the casualty commission in Japan. Financial pressures and the lack of Japanese interest in the control studies later caused abandonment of the Kure station, and most of the work was ultimately centered at Hiroshima.[38]

Results of the studies, however, were significant despite the shortage of funds. By the spring of 1950 the casualty commission had collected data on more than 150,000 persons in the bombed areas. These data revealed a small but marked increase in the incidence of leukemia and forty cases of eye cataracts caused by radiation among eight hundred persons within 3,000 feet of the detonation. The appearance of these effects almost five years after the bombings justified the earlier insistence on long-term studies. The genetics group had amassed data on 20,000 births, still only a fraction of the number needed for sound conclusions. But the important fact was that under Dr. James V. Neel's direction the group had gathered the priceless reference data on the first generation and preserved it in a form that would make possible increasingly valuable future studies in human genetics.[39]

The dislocations in Japan stemming from the Korean War and the impending termination of the American occupation raised questions during the summer of 1951 about the future of the casualty commission. The Atomic Energy Commission, discouraged by the failure of other Federal agencies to pick up some of the costs, proposed to cut expenditures to $1 million in fiscal year 1952 and to drop the project altogether in 1953. At first believing that operation at the reduced level was impossible, the National Academy of Sciences eventually accepted some proposals for streamlining the organization. A compromise agreement with the Commission assured the indefinite continuation of the project.[40]

## *OF MICE AND MEN*

In the biomedical sciences, the first three years of Commission operations had done little to allay the concern of those who saw in the growing use of radiation new threats to the world of living things. To be sure, research at Commission laboratories was already revealing fascinating information about the processes of cell growth and metabolism, as Sparrow's work at Brookhaven illustrated. These fundamental studies had the advantage of analyzing relatively simple phenomena, which were easy to measure but difficult to extrapolate to man. Conversely, the Atomic Bomb Casualty Commission observed radiation effects directly in man, but the experiments were not reproducible and the compilation of results would take decades.



Fortunately, by 1950 preparations were well advanced for a major experiment which would strike a balance between basic studies in cytogenetics, with little direct application to man, and the long-term research going on in Japan. The project found its origins in Alexander Hollaender's efforts to bring new vitality to the moribund work in biology at the Clinton Laboratories. As director of the radiobiology laboratory at the National Institutes of Health in Bethesda, Maryland, Hollaender had over the preceding decade used radiation to probe the inner secrets of the living cell. In 1939, after studying the effects of ultraviolet radiation on fungi, he had suggested the possibility that the nucleic acids, and not the protein of the cell, carried the genetic information in reproduction. The extraordinary array of radiation sources available at the Clinton Laboratories attracted Hollaender's attention in 1946, and he went to Oak Ridge with the idea that he might be able to pick up the staff and equipment for a new Institute for Radiation Health in Bethesda.[41]

Hollaender's temporary assignment in Oak Ridge as an Institute employee turned into a career. Amid the futility and confusion at Clinton in the year after the war, Hollaender found the ingredients of a viable and promising research institution. In the old Y-12 area, where the racetracks for the electromagnetic process now stood silent, there were several large buildings which the Manhattan District had hastily constructed in 1945 for chemical extraction of uranium 235 but had never used. Carbide, now responsible for the Y-12 area, urged Hollaender to take the buildings off the company's hands. Before the end of 1946, Hollaender had decided to stay in Oak Ridge and had drafted a comprehensive research proposal for the new biology division of the Clinton Laboratories.

Hollaender's proposal reflected the thinking of most geneticists of the day. He intended to focus upon "the basic aspects of the effects of radiation on living cells." This meant relatively less attention to the wartime project of

determining radiation tolerances for workers in atomic energy plants. Instead Hollaender would expand the study of cell constituents begun at Bethesda; undertake new studies of radiation effects in the chromosomes of the fruit fly *Drosophila* or the spiderwort *Tradescantia*, which were especially amenable to observation; and start work on what then seemed the most promising new frontier in genetics, the study of radiation effects in microorganisms.[42]

Beyond these logical extensions of existing research there emerged early in 1947 a daring challenge for the new biology division. By chance Hollaender learned that William L. Russell, an outstanding geneticist, was thinking of leaving the Jackson Memorial Laboratory at Bar Harbor, Maine, where he had been conducting some interesting genetic experiments with mice. Russell was convinced that his experiments, if pursued on a very large scale, would produce important data on the mutagenic effects of radiation. To propose genetic studies in a mammal, where the embryo took form in an
506 environment sealed off from the observer, was an ambitious undertaking, but if the effort were successful it would provide information much more relevant to man than that from *Drosophila* or *Tradescantia*.

The prospects of bringing Russell to Oak Ridge were interesting, but there was a real gamble involved in the mouse project. Even Russell could not deny the difficulties of genetic experiments in mammals. To provide reliable results, the project would have to be the largest mouse experiment ever undertaken. That would mean high costs, a considerable fraction of the division's budget. It might take ten years to get results, and a failure after that investment might well destroy all of Hollaender's plans for Oak Ridge. Many geneticists thought that the project was much too difficult and that they had already acquired all the essential data in experiments with *Drosophila*. Others saw the future of genetics in studies of microorganisms. Physicians like Shields Warren were impatient with basic studies of the mechanisms of genetics and wanted more work on the total manifestation of radiation effects with direct application to man.

Hollaender liked long shots and he believed in Russell's ability. He found added reason for confidence in discussions with Sewell Wright, Russell's mentor and professor of genetics at the University of Chicago. Herman J. Muller, the dean of American geneticists, was slower than Wright to appreciate the possibilities of Russell's proposal, but he too eventually gave his support. Hollaender persuaded Warren to give the project a chance and convinced Russell that Clinton had more the atmosphere of a university than an industrial research laboratory.[43]

When Russell arrived in Oak Ridge in November, 1947, the biology division was still housed in the old temporary structures near the X-10 research reactor. The buildings which Hollaender had acquired at Y-12 would need extensive modification. Before that work started, Russell had to design the cages, racks, and other equipment needed to accommodate tens of thousands of mice. From the outset, Russell understood that the unprecedented

scale of his experiment would demand the ultimate in labor-saving devices. An automatic cage-washing machine was but one of the innovations which Russell and his group developed for their laboratory. Just as important was building up populations of mice in the proper strains for the main experiment. The disastrous fire at Bar Harbor in October, 1947, had destroyed the best source of supply and Russell had only three cages of mice in the strains he needed.[44]

The building at Y-12 was not ready for occupancy until early in 1949, and generation of the mouse population took still another year before the main experiment could begin. In the meantime, however, some valuable research was possible even with the limited stocks of mice. Russell's young wife, Liane, had come to Oak Ridge early in 1948 to complete her dissertation for a doctorate in genetics at the University of Chicago. Mrs. Russell had the interesting idea that she might be able to estimate the rate of mutations produced by radiation in the somatic cells of mice simply by measuring the area of splotches in the coats of offspring from irradiated mice. If she could irradiate the pregnant mouse at just that point in embryo development when the cells determining coat color were being formed, she reasoned that any mutations in somatic cells would be multiplied by cell division so that mutation of a single cell in the embryo would turn up in a gross pattern easily identified in the mature offspring. Her idea, although sound in theory, ran afoul of a practical difficulty. It was impossible to measure accurately the size of the splotches produced and thus she could not accurately determine the mutation rate.[45]



Despite this disappointment, Mrs. Russell's experiment led to some arresting if unexpected results. To produce changes in coat color, she had found it best to irradiate the female mice about 10¼ days after conception. Earlier studies by other geneticists had shown that a variety of abnormalities could be produced by irradiating mouse embryos, but Mrs. Russell's precision in controlling the time between conception and irradiation had revealed a strong correlation between the time factor and the kind of abnormality produced. Even with the limited number of mice available in 1948, she was able to see the outlines of the emerging pattern. Abnormalities in the eye and skull tended to occur in embryos irradiated on days 7½ to 9½ after conception; in extra digits at 8½ days; in the tail, from 9½ to 11½ days, in rib number, after 10½ days. Elaboration and refinement of these preliminary data in 1949 gave a much clearer picture of the effect of both the time and amount of irradiation in producing abnormalities.[46]

Important as these results were, the embryology experiments revealed a general pattern that had profound implications for humans. Mrs. Russell found that irradiation before the fertilized egg became implanted in the mouse uterus (before day 5½) resulted in a significant prenatal mortality, although the surviving offspring showed almost no abnormalities. The rate of prenatal mortality declined sharply after day 5½, but the number of abnor-

malities and neonatal deaths increased to even higher levels when irradiation was employed after that time. Translated to human embryo development, the most sensitive period was the second to the sixth week after conception, when many women would not be aware of their pregnancy. Even more alarming was Mrs. Russell's discovery that X-ray doses even as low as 50 roentgens, in the range of fluoroscopes commonly used in doctors' offices, produced a pronounced if slightly different pattern of abnormalities from those at 200 or 300 roentgens. Although initially there was some reluctance in the medical profession to accept the data from mouse experiments, Mrs. Russell's results did in time produce a change in medical practice.[47]

Meanwhile Russell had been preparing for the main genetic experiment. His aim was to measure mutation rates in certain genes located at specific points or "loci" in the mouse chromosome. Obviously he had to select genes determining characteristics which, after mutation, would be clearly
508 evident in the offspring. Because most mutations would be from dominant to recessive, Russell needed a strain of mice possessing a number of these traits as recessives to the dominant character in the normative or "wild-type" mouse. The "laws" of heredity dictated that requirement. If, for example, "wild-type" males were mated to females containing recessives for the specific genes determining coat color, the first-generation offspring would have the dark coat color fixed by the dominant gene of the male. If, however, the males were first irradiated and a mutation occurred in this particular gene, both parents would have the recessive and the offspring would have the easily recognized light coat color.[48]

Russell had no trouble acquiring a good strain of "wild-type" mouse in 1948, but the strain possessing the required recessive traits did not even exist. From a small number of mice with six of the necessary recessives, he bred a new strain with a seventh, the maximum number he could follow without confusing his results. By early 1949, Russell had bred and tested the first mice containing all seven recessives. Now it was a matter of multiplying the stock to the number needed for the experiment.[49]

During 1950 while the colony was growing, Russell began some pilot tests with the few mice available in order to develop the most economical methods for the main experiment. From the earlier work with *Drosophila*, he did not expect to find mutations at the selected loci in the pilot tests. When at least six probable mutations appeared at four of the seven loci by the summer of 1950, Russell had some assurance that the main experiment would produce enough mutations to give a reliable indication of the induced rate. Preliminary results in the main experiment enabled Russell to report in the summer of 1951 that examination of over 48,000 mice, whose sires had been exposed to 600 roentgens of X-irradiation, showed more than fifty mutations at five of the seven loci. Among the almost 38,000 mice in the control experiment, in which no radiation was used, only two mutations at the specific loci had been found.[50]

From this evidence Russell had shown that radiation could cause genetic mutations in the mouse. By crossbreeding of about half the mutants he had proven that the changes indicated by external appearance were truly genetic. Russell was also beginning to get some data on the number of mutations at each locus and some indication of which mutations had lethal or semilethal effects. In interpreting the data for humans, Russell was careful to point out that his work involved only a very small number of loci in the mouse chromosome and that the only mutations he could detect were those with visible effects. Thus the data were best used not in extrapolation to man but in comparison with data on *Drosophila.* Even this comparison was difficult, but Russell estimated in 1951 that the mutation rate in the mouse was significantly higher than that in *Drosophila.*

If Russell's estimates were correct, data on *Drosophila* might no longer be acceptable for establishing radiation safety criteria for humans. Additional concern developed in 1952 when Russell found indications that larger doses of radiation did not seem to produce a proportionately larger number of mutations. It was much too early to draw any conclusions, but there was a possibility that the cells producing spermatozoa in the male differed in their sensitivity to mutation and that the more sensitive cells were more easily killed by radiation. The implications of this hypothesis for humans caused Russell to undertake a new experiment with doses of 300 roentgens, but it would take several years to produce reliable data.[51]



By the end of 1952 the Oak Ridge experiments in mouse genetics were beginning to provide information of potential value in determining the effects of radiation in man. A sound understanding of the mechanisms of radiation damage was still far in the future, but Russell and others had taken the essential first steps toward that goal.

## *PLUTONIUM, PROPULSION, AND POWER*

Hafstad's plans for reactor development in 1951 clearly reflected the major demands which the national emergency had placed upon the Commission. First was the need for increasing amounts of fissionable material, which would require more reactor capacity for plutonium. Second were the requirements established by the Joint Chiefs of Staff for propulsion reactors for submarines and aircraft. Third, the national emergency had created a shortage of electric power in the United States. How the Commission, the military services, and American industry proposed to respond to these demands was the central theme in reactor development for the next several years.

The obvious advantage of a reactor which would meet more than one of these requirements had stimulated interest in power-breeder systems such as the homogeneous reactor which Weinberg was studying at Oak Ridge or

the power breeder which Kingdon was hoping to build at the Knolls laboratory. But other combinations were also possible, as the story of the carrier reactor demonstrated.

Late in 1950 the Navy had asked the Joint Chiefs of Staff to establish a formal requirement for a reactor capable of powering a large naval vessel such as an aircraft carrier. With Argonne and Westinghouse already fully committed to the submarine reactor, Hafstad was reluctant to impose any additional burdens in the absence of a firm military requirement, on which the Joint Chiefs had deferred action in late 1950 pending further information from the Commission. By summer, however, developmental work on the Mark I reactor at Idaho was beginning to ease at Argonne and Bettis, and Hafstad agreed to let Westinghouse begin some paper studies of various reactor designs that might be suitable for a carrier. To make sure that the study did not interfere with work on the submarine reactor, Hafstad maintained direct control of the
510 study in his own office under the veteran George L. Weil.[52]

The lure of propulsion and power was too great to allow a leisurely, methodical approach. The Navy took the first step to speed up the effort by assigning Captain Hyman G. Rickover the task of Navy liaison on the project. Then Commissioner Murray, disturbed by estimates from Weil that the paper studies would require as much as a year, urged Boyer to transfer the project to Rickover. Finally, in October, 1951, the Joint Chiefs approved a formal requirement for "a single shorebased prototype of a nuclear-powered propulsion unit suitable for driving one shaft of a major warship such as an aircraft carrier, and for use after completion of shore installation for the production of plutonium and electric power." What better justification for a reactor than that it meet all three of the Commission's goals? Another advantage of the Joint Chiefs' action was that it gave Westinghouse, a major supplier of electrical generating equipment, an opportunity to develop a power reactor under the aegis of a military requirement.[53]

It was not surprising under the circumstances that General Electric responded with a new proposal for the power breeder. Openly acknowledging the company's interest in power reactors, Henry V. Erben, General Electric's executive vice-president, wrote the Commission that the company considered the submarine intermediate reactor at West Milton an important first step toward a power breeder. Although its principal purpose was to develop a submarine propulsion plant, it would "greatly add to our knowledge of high temperature intermediate reactors." After completing the West Milton unit, General Electric proposed to build a much larger reactor which would produce power and some plutonium.

Erben's letter was but one of several expressions of General Electric's interest in plutonium and power reactors. Kingdon at the Knolls laboratory was still championing the power-breeder idea, and Harry A. Winne was interested in long-range development of a nuclear plant that would produce electric power at competitive costs without the benefit of plutonium credits. It

was obvious to Gordon Dean that not all parts of the General Electric organization had the same interests, but by early 1952 a single company plan began to emerge. Rickover had alerted the company that its next assignment after the West Milton reactor would be a more powerful submarine propulsion system. This task the company would assign to the operating division at Knolls. The technical division under Kingdon would then be free to develop the power breeder.[54]

The separation of propulsion from the power and breeder functions of the reactor also occurred in the carrier project. In February, 1952, Westinghouse completed its survey of possible reactor designs for the carrier propulsion system. Westinghouse found five of the six reactor designs investigated suitable for the carrier. After studying the report, Rickover's group favored a design similar to the Mark I submarine. The reactor would use ordinary water as coolant and moderator, and slightly enriched uranium as fuel. Rickover was well enough satisfied with the design to terminate all further paper studies by Westinghouse. On March 6, 1952, the Commission transferred responsibility for the project from Weil to Rickover, and Westinghouse began development work. Although the reactor system might be capable of some power and plutonium production, its primary function was propulsion, as assignment to Rickover's naval reactors branch seemed to make clear.[55]



With propulsion reactors now assigned to the military services, Hafstad and the Commissioners could limit their planning to production of plutonium and power. Nothing had happened since the summer of 1951 to change Hafstad's opinion that the immediate goal had to be plutonium. Under the relentless pressures of increasing military requirements for weapons and the watchful eye of the Joint Committee, the Commission was again considering a major increase in the production of fissionable materials. The big question was whether it would be practical to develop dual-purpose reactors which would produce power as well as plutonium, or whether, in the interest of immediate additions to the stockpile, the Commission should concentrate on single-purpose plutonium producers.

Support for the plutonium-only position was impressive. The General Advisory Committee, meeting in Washington in December, 1951, had cast a jaundiced eye on the future for nuclear power. Oppenheimer saw no great need for the committee to revise the rather pessimistic appraisal it had released in 1948. The only change in the situation which Oppenheimer would concede was the large increase in the supply of uranium ore. This fact in itself did not bring competitive nuclear power any closer than before, but it did suggest a declining importance for breeders and eventually a much greater economic impact for nuclear power if all or most of the fissionable material in weapons could ultimately be used to generate electricity. Some members of the committee thought the United States should concentrate on plutonium and propulsion and leave power to the British.

Chauncey Starr, an experienced reactor physicist with North Ameri-

can Aviation, substantiated some of these opinions in a detailed technical analysis which he presented to the committee. Under a Commission contract, Starr's group had studied a variety of reactor designs to find the best one for short-term plutonium production. Minimum cost would be achieved in a single-purpose reactor using slightly enriched uranium as fuel. Starr admitted that the same reactor type would produce power as well as plutonium at a very attractive price, but breeding did not look attractive unless ore costs greatly increased or nuclear power costs declined.

There was some question of whether a new reactor capable of producing plutonium at much lower costs deserved a high priority in view of the large number of reactors then under construction, but after some discussion the advisory committee agreed with Hafstad that additional production reactors were probably inevitable, if only as replacement units. Hafstad argued that the development of power reactors with existing technology could safely
512 be left to private industry. The Commission, in his opinion, should concentrate its efforts on the reactors of the future. For this purpose he was asking Zinn to form a task force at Argonne to select one design for a new group of production reactors. He had decided to establish a production reactor group in his own division and to do more work on evaluating reactor costs.[56]

Hafstad's confidence in private industry to develop power reactors stemmed from the initial reports of the four industrial study groups to which the Commission had offered classified information in the spring of 1951. The first report, submitted by Dow-Detroit Edison in December, 1951, found that atomic energy had an important potential for power production even if reactors were not yet economical for that purpose alone. Although they did not find that a specific design would be economically feasible, the two companies were interested in developing with the Commission a high-temperature, fast-breeder reactor. The other study groups had submitted interim reports early in 1952. Commonwealth Edison and the Public Service Company of Northern Illinois were interested in a helium-cooled graphite reactor of the Brookhaven type. Pacific Gas and Electric and the Bechtel Corporation were convinced that a dual-purpose reactor was feasible, and they were exploring arrangements under which private companies might lease reactors from the Commission. Monsanto and the Union Electric Company of Missouri were still investigating several reactor types. All the companies had expressed enthusiasm for further studies.[57]

Hafstad had examined all these possibilities before he presented his new proposal for production reactors to the Commission on March 27, 1952. The highest priority would go to improved designs for new reactors at Hanford and Savannah River. Next in order of priority would come more economical plutonium producers, a power-breeder using fast neutrons, a production reactor or breeder capable of economic power production, and a reactor for producing materials other than plutonium, such as uranium 233 or polonium. Under these priorities, Argonne would concentrate first on the

new production reactors and then on the fast power breeder. Oak Ridge would study homogeneous systems, both in the short and long term. General Electric would finish the West Milton reactor and then turn to the fast plutonium breeder. Westinghouse would restrict its activities first to the submarine reactor and then to the carrier propulsion system. Hafstad would leave power reactors to private industry.[58]

The discussion revealed anything but a consensus in the Commission. A majority seemed anxious to avoid any commitment to build additional production reactors, but Murray favored more action on all fronts. He thought the highest priority should go to improvements in existing production reactors—those operating at Hanford and those under design for Savannah River. He feared that Hafstad's stress on dual-purpose reactors would slow down the development of plutonium producers. Dean countered Murray with the opinion that the Commission would never build another production reactor that would not also yield power. There was some feeling that Hafstad's statement of priorities could be clarified, but just what the priorities should be was not decided.[59]



Hafstad's efforts to reflect Commission opinion in revising his proposal were not particularly successful. A new version, which he submitted to the Commissioners on April 8, 1952, clearly recognized the paramount need to improve the current designs of new production reactors for Hanford and Savannah River. The plan also would "place the Commission in a position to construct" large-scale versions of production reactors, rather than "to develop and construct" them. Although they had lower priorities, the improved production reactor and the fast breeder were still prominent on the list.[60]

In discussing Hafstad's proposal on April 17, Murray left no doubt that he considered it unsatisfactory. He could not understand the high priority for a more economical plutonium producer; if the Commission needed more plutonium, it should build more graphite reactors. Dean was inclined to agree with Murray that the new production reactor design was of doubtful value, especially if it did not provide for power as well as plutonium. Glennan, anticipating a $10-billion expansion program in the next several years, thought it would be prudent to have a better design on hand. In a similar vein, Glennan supported Murray's contention that the Commission should put more effort on a reactor for producing uranium 233. Dean thought the Commission should have better data on the economics of uranium-233 production before starting reactor design.

As the discussion proceeded, Dean saw the possibilities for a compromise. If his colleagues saw little value in undertaking the design of an improved plutonium producer, Hafstad could revise his instructions to Zinn's Argonne task force. Under his existing mandate, Zinn was to produce a design for the new production reactor within a year. Why not, Dean asked, add a requirement for power production and give the laboratory more time? He was also willing to accept the idea of designing a uranium-233 producer.

Hafstad thought the revisions were feasible. Zinn, he guessed, would welcome some relaxation of the time schedule. The laboratory could probably handle both the plutonium and uranium-233 projects. Hafstad's only concern was that, by deleting construction as the goal, the Commission might be destroying the incentive for an all-out effort in the laboratories.

The Commissioners probably saw their action as placing more stress on short-term plutonium production. After all, they had given the highest priority to improving current designs and the performance of existing production reactors. For Hafstad, however, reactor development involved long-range plans, not short-term goals. In his view, the Commission's action gave a high priority in the long term for power reactors. The industrial study groups might well come up with some good ideas, but how could the Commission itself participate? An obvious possibility was the fast breeder which General Electric had been proposing for years. The disadvantage of that idea was that
514 the company was having difficulty meeting its existing obligations to the Commission and hardly seemed prepared to take on new ones. A meeting with Erben, Winne, C. Guy Suits, and Kingdon on May 13, 1952, confirmed these reservations. On May 29, General Electric agreed to restrict its activities in reactor development to submarine propulsion.[61]

In a way General Electric's decision illustrated a more fundamental difficulty, which Weinberg had identified in a discussion with Hafstad. In Weinberg's opinion, it would always be harder to get money for long-term projects than for those aimed at pressing needs. Power reactors might in the long run be more important, but in the dangerous world of 1952 the preoccupation with propulsion and plutonium was not surprising. A telephone call to Zinn brought Hafstad no encouragement. Argonne had all the work it could handle. A new assignment to develop a power breeder would mean dropping something else, and Zinn had nothing but contempt for any idea of using a team of laboratories and industrial organizations to develop such a reactor.

Hafstad could not escape the unpleasant conclusion. Under the surface, particularly in American industry, there was a growing, even restless interest in nuclear power, but until the Commission met the requirements of national defense, it could not give the peaceful promise of atomic energy the attention it deserved.[62]

## *BUILDING REACTORS*

Far from the policy papers and conference rooms of Washington the Commission's laboratories and industrial contractors were making steady progress in constructing and operating the reactors which had existed only on paper in the autumn of 1948. Two were already operating in Idaho. The experimental-

breeder reactor continued to run at design power for extended periods in 1952 until a leak in a heat exchanger caused a temporary shutdown in June. While Novick was making repairs, Lichtenberger removed some of the fuel rods for analysis. In October the first results from Argonne suggested that the reactor would demonstrate the possibility of breeding.[63]

After almost six years of study and development, the materials testing reactor went critical on March 31, 1952. Long and careful training at Oak Ridge and in Idaho had prepared Richard Doan's team from the Phillips Petroleum Company to take over operation of the reactor from Marvin M. Mann and the Oak Ridge staff. Within a month the reactor was up to full power of 30,000 kilowatts and on August 5 began to fulfill its function as a testing reactor.

Not too far behind was the submarine thermal reactor, which was taking shape on the Idaho desert a few miles to the south. Within the large steel building, engineers had assembled a full-scale section of a submarine hull to be submerged in a tank of water. In the winter and spring of 1952 workmen from the Electric Boat Company installed the main turbine, the condenser, the reduction gear, and hundreds of other parts that would make up the engine room. In May the main pressure vessel for the Mark I reactor arrived for installation in the reactor compartment. Now with the highest priority in the Navy's submarine program, the project was moving at top speed. Two thousand miles to the east. at Groton, Connecticut, on June 14, President Truman laid the keel for the *Nautilus*, the world's first nuclear-powered submarine. During the Idaho summer Westinghouse engineers, working on two shifts and then around the clock on three, installed reactor systems and began leak tests. In the autumn the control drives and main coolant pumps arrived from Bettis. In November the reactor was complete except for the nuclear fuel and two heat exchangers. Barring unforeseen troubles, the nuclear propulsion plant for the submarine in the desert would soon come to life.[64]



At West Milton, New York, the huge spherical containment shell and auxiliary buildings for the second land prototype of a submarine reactor were well on the way toward completion by the end of 1952. Not authorized by the Commission until February, 1952, the project involved component testing at Knolls and contract negotiation until August, when foundations were poured. Erection of steel plates for the sphere proceeded rapidly during the autumn while General Electric coordinated the final design and fabrication of components for the submarine intermediate reactor Mark A. In November the Navy selected the name *Seawolf* for the submarine in which the Mark B reactor would be installed.[65]

The third Navy reactor, for an aircraft carrier, was in the early design stage at the Westinghouse Bettis laboratory in 1952. The Commission had authorized the project in March, and contract negotiations proceeded during the summer with Westinghouse, which would build the reactor, and with

Newport News Shipbuilding and Drydock Company for the shipboard features. Westinghouse already had a good technical base for the project in the work on the Mark I reactor at Idaho. Before the end of the year the company was already planning exponential experiments for the reactor and starting boiler design. During the summer the Navy had started looking for a site for the reactor, which Rickover hoped could be built somewhere near the Bettis laboratory rather than in Idaho. The carrier reactor was as yet little more than an idea, but under Rickover's drive and tight administration, the Commission and the Navy could expect rapid progress in the years ahead.[66]

The scope and variety of reactor development at Oak Ridge was a tribute to Weinberg's efforts to make the laboratory a national reactor center. In January, 1952, Weinberg's staff had completed the small homogeneous reactor experiment. Criticality came on April 15, followed by a series of zero-power tests during the spring. After several months of correcting minor
516 faults, Weinberg was ready for high-power runs during the autumn. The reactor performed well until December, when a gasket leak caused a substantial loss of the liquid fuel. The question still remained whether difficulties with corrosion would ultimately overbalance the distinct advantages of the homogeneous system.

Aircraft nuclear propulsion was still a major concern at Oak Ridge despite the decision in the spring of 1951 to transfer most of the project to General Electric. Oak Ridge continued to test thermal convection loops for a liquid-cooled system even after the General Electric group under Miles Leverett decided to go back to the "direct cycle," in which air heated in the reactor passed directly to the turbines of the jet engines. In February, 1952, as the building for the aircraft reactor experiment neared completion at Oak Ridge, Weinberg switched the reactor design from one using a static to one using a circulating liquid fuel, a change reflecting his lack of confidence in General Electric's decision. Work proceeded during the summer at Oak Ridge on design of components for the small reactor experiment, but in terms of dollars and personnel most of the effort on aircraft nuclear propulsion was shifting to General Electric's plant at Lockland, Ohio, and to the northern end of the Idaho test site, where General Electric would build test facilities for the direct-cycle reactor.

The decision to develop alternate designs for the aircraft reactor and to build the extensive facilities at Idaho caused cost estimates to skyrocket in the spring of 1952. The Commission's share of the General Electric project was now running at $16 million per year, plus $33 million for construction of the Idaho facilities. As Commissioner Eugene M. Zuckert remarked in June, 1952, the split of responsibility between the Commission and the Air Force was permitting the project to get more funds than either agency alone would have allowed. Furthermore, keeping a rein on the enthusiasm of the Oak Ridge and Lockland groups probably would require the administrative fiber of a Rickover. Hafstad raised the question of leadership with Boyer and then

with General Laurence C. Craigie of the Air Force in July, 1952. The best solution seemed to be a single liaison man like Rickover, and the best hope seemed to lie in General Donald J. Keirn, who had followed the project for the Air Force since 1946. Even if Craigie could get Keirn's services, the chances at this late date of establishing the kinds of controls Rickover had achieved in the Navy seemed small indeed.[67]

## *REACTORS FOR THE FUTURE*

The Commission's tentative decisions on power and production reactors in April, 1952, gave Hafstad some of the guidance he needed to devise a new plan for all the Commission's reactor development activities. Further help came from the Argonne task force, which found in July that the design for the new "Jumbo" reactor at Hanford would provide plutonium at the minimum cost possible with proven technology. The task force expected to have a report on the Savannah River design early in 1953. These studies would help to determine what the Commission would need for plutonium production or what the future of power breeders might be. There were some indications both in Hafstad's planning and in the work of the industrial study groups that the dual-purpose reactor was no longer the solution for the nuclear power industry. The power reactor, in other words, would have to be competitive with conventional plants without the subsidy provided by plutonium credits. By the time the last of the four industrial groups submitted its report in the summer of 1952, industry's approach to nuclear power was much more sober and tentative than it had been when Charles A. Thomas had made his proposal in the spring of 1950.[68]



In thinking about the future, Hafstad could draw not only on the work of the industrial groups but also on many studies by the Commission's own contractors, including North American Aviation, MIT, Oak Ridge, H. K. Ferguson, and Knolls. The number of options had greatly increased and the distinctions between them had blurred since the Commission had adopted the four-reactor program in 1948. At that time only a few designs seemed ready for development and then only by the Commission's own laboratories. Now dozens of reactor designs were under consideration, and many of these were the result of industry studies. Although annual costs for reactor construction and operation had almost tripled, public interest in reactors, especially for power generation, had grown at an even greater rate. Hafstad would have to choose carefully to make the best use of his resources. By December, 1952, his choices were still only tentative. Construction of military propulsion reactors and improvement of production reactors would continue to receive high priority. For power generation, Hafstad was considering a full-scale reactor using pressurized water as moderator and coolant, to be developed in parallel

with the carrier reactor; a sodium-cooled graphite-moderated reactor, which would generate power and test the possibilities of breeding uranium 233; and somewhat larger pilot-scale models of the breeder and homogeneous reactor experiments. The weeks between the presidential election and the beginning of the new Republican Administration in 1953 were no time to be making long-range policy on reactors. Perhaps when the time did come, a new set of conditions would prevail; in the meantime Hafstad's tentative plans would have to serve.[69]

## *A MOMENT FOR PERSPECTIVE*



The increasing tempo of activities in the 1950's left those associated with the nation's atomic energy program little time for considering the long view. Perhaps more than ever before, the average work day for the Commissioners and senior staff involved spending a little less time on each of a larger number of matters. Agendas, whether for the Commissioners, the general manager's staff, or the General Advisory Committee, tended to get longer with each passing year. Yet in the spring of 1952 Oppenheimer and the committee had an unusual opportunity for viewing the atomic energy program in broad perspective. In July the last three of the charter members—Oppenheimer, Conant, and DuBridge—would retire. There had been talk for some time of a summary report to the President, and Conant raised the question specifically at the committee's meeting on April 27.[70]

It would have been no exaggeration for Conant to say that when he and Oppenheimer left the committee, much of its spirit and direction would go with them. Perhaps there would be some value, as Conant suggested, in summarizing what the committee had tried to do, what it had accomplished, and what it saw in the future. Most of the committee members accepted the idea, provided the report did not dwell too much on the past or appear to be a "whitewash" of either the Commission's or the committee's actions. Oppenheimer thought the committee might well describe what it had accomplished in helping to build the nuclear arsenal, and what the outlook was for nuclear power. Conant, remembering the committee's experience with the decision to accelerate development of the thermonuclear weapon, wanted the report to speak to the real difficulties the President faced in making decisions involving highly technical considerations. As a case in point, he thought the President should be made aware of the results of Project *Gabriel* on the number of nuclear weapons that could be detonated without causing a health hazard. The discussion ended with the suggestion that Oppenheimer prepare a draft for the June meeting.

During the following weeks Oppenheimer found time between other activities to work on the draft. DuBridge, Conant, and Oliver E. Buckley all

provided ideas and portions of draft which Oppenheimer found useful. After some work, he concluded that two statements were necessary. The first, for public release, would attempt to explain how the committee had gone about its business during the previous six years, the kinds of decisions it had made, how problems were selected for consideration, and how the committee approached problems that were not strictly technical. The second report, for the President alone, would deal directly with the Commission's program and policy decisions.[71]

The reports were not the only concern on Oppenheimer's mind during those weeks. On May 16, Dean called him in Princeton to warn him of impending personal troubles. Dean would not elaborate on the telephone, but he told Oppenheimer the following week that the Justice Department was preparing to indict Joseph W. Weinberg, at one time a graduate student in physics at the University of California, Berkeley, for perjuring himself in testifying that he had never attended a meeting with Communists. The Government's case presumably rested on evidence of such meetings, one of which was allegedly held in Oppenheimer's Berkeley residence in 1941. Furthermore, Dean had heard reports that some scientists at the recent meeting of the American Physical Society in Washington had viciously attacked Oppenheimer on patriotic grounds. Dean was in frequent touch with McMahon, the Justice Department, and Oppenheimer's attorneys in an effort to keep Oppenheimer's name out of the Weinberg case, but he had no reason to believe he would be successful. Presumbly if the case could be delayed at least until Oppenheimer left the advisory committee, the press might spare Oppenheimer.[72]



On May 23 the Weinberg indictment hit the nation's headlines, but fortunately for Oppenheimer his name was not mentioned. Dean was still concerned and wanted to talk with Oppenheimer before the meeting of the General Advisory Committee in Washington on June 13. Oppenheimer offered to save Dean a trip to Princeton by coming to Washington a day before the meeting.[73]

When the committee met on Friday afternoon, June 13, Oppenheimer had drafts of both statements ready. After a brief discussion, the committee agreed to consider the reports at length that evening. Second drafts, prepared by Oppenheimer, Rabi, and von Neumann, were ready the following morning for further discussion, which lasted until noon. The final session was on Saturday evening with the Commissioners at Smyth's residence. The public statement won quick approval. Dean offered to include it in the Commission's semiannual report, which would be sent to Congress on July 1, and agreed that it might appropriately be published in *Science*.[74]

There were a few more changes in the letter to the President, but much of Oppenheimer's original remained. He began by referring to the "very great changes" that had occurred over the previous six years, mostly in the area of military affairs. Oppenheimer referred to the "many important and beautiful

discoveries in basic science," some of which were made possible by Commission support; but he also noted, as Conant had suggested, that most of the developments in atomic energy still rested on basic discoveries made before World War II. The Commission's accomplishments in weapon production Oppenheimer indicated by citing figures on the size of the stockpile. The remarkable increase was, in Oppenheimer's words, "no mean technical achievement," one based on substantial discoveries of uranium ore, plant improvements, and better weapon design.

Looking to the future, Oppenheimer described the recent accomplishments in developing a thermonuclear weapon. What the final result would be depended upon actual tests. "Yet we think it very likely that the feasibility of weapons hundreds, and perhaps thousands of times more powerful than the first atomic bomb will be manifest within the next years." The extraordinary increase in fissionable material production not only guaranteed a large
520 weapon stockpile but would also prove a great national resource for energy production if military requirements should disappear. In the absence of international control every major power would soon be able to possess nuclear weapons. "Thus atomic armament, which is now held to be the shield of the free world, may in a foreseeable time become the gravest threat to our welfare and security."

This fact, the committee believed, raised for the President the most serious problems of national and international policy. The difficulties of such decisions would be compounded by the complexities and rapidly changing nature of modern technology. The committee hoped that the Government could give more attention to methods of bringing scientific knowledge to bear on the great decisions of state.

The letter was an eloquent plea from one of the nation's most influential science advisers, now leaving a key government position, to a president soon to depart the government service. During their years in government the nation had felt the full impact of modern technology. Despite their mistakes, both the adviser and the president had helped the nation to find its place in the second half of the twentieth century. Whether atomic energy would be the shield of the free world or the scourge of mankind, others would have to decide.

# *QUEST FOR THE SUPER*

## CHAPTER 16

The summer of 1950 arrived with few questions about the hydrogen bomb answered. Los Alamos did not know how to fashion a Super. The Commission did not know how much its production facilities would have to be increased, how many reactors would be needed for plutonium or tritium, or how much new gaseous-diffusion capacity would be required for uranium 235. Some determination of the size of the expansion of the production complex would come through the Commission-Department of Defense report to President Truman on the scale of effort needed to provide materials for the hydrogen bomb. Whether the conclusion would satisfy the demands of the Joint Committee on Atomic Energy was problematical. Somehow, to achieve a thermonuclear bomb, materials and theory had to be brought together to reach a temperature higher than that in the sun.

A few days after summer solstice these questions took on sudden urgency when communist forces attacked South Korea. In Washington there was no way of knowing whether Korea was just the first step down the road to darkness. If it was, then Europe as well as Asia would be threatened.

### *THE ALARM*

To meet the contingency of a world war, the Joint Chiefs of Staff moved to reinforce American power in the West. One measure they urged was to store nonnuclear components of atomic weapons in Britain. Then only the nuclear cores would have to be sent if the situation grew worse. Action now could save planes and time under conditions when both might be in short supply. On July 10, Robert LeBaron and the Military Liaison Committee discussed the Joint Chiefs' recommendation with the Commissioners. General Frank F.

Everest of the Air Force set forth the military advantages of the proposal and described precautions to guard the components. For a few moments the committee left the room so that Dean and his colleagues, along with a few members of the staff, could talk freely. The Commissioners agreed that the President should make the transfer. Although they could not judge the military factors, the reasoning underlying the request seemed persuasive. At noon the next day Truman saw Dean and Secretary Louis A. Johnson. In a brief meeting the President agreed to the transfer.[1] It must have seemed to Dean a natural action to bolster the nation's strength, and not unlike the steps taken during the Berlin crisis in 1948. Only nonnuclear components were involved so far but Dean wondered whether civilian custody had been breached.

In the face of the darkening news from Korea, Carleton Shugg reported to the Commission various ways of speeding production. Some of the ideas garnered from the staff dealt with technical improvements designed to increase plant output; others would make certain that fissionable material used in research and development projects could be recovered quickly for weapons. Remembering his wartime experiences with a shipbuilding company, Shugg was well aware that the future might bring shortages of equipment. He had asked the staff to keep in close touch with the National Security Resources Board and the Munitions Board, both of which handled priorities and allocations of scarce materials. Walter J. Williams had set the division of production to compiling lists of critical suppliers.



Another threat was the shortage of manpower which might result from a call-up of reservists. Oscar S. Smith, director of the office of labor relations, found that for 1949 the Commission and its contractors had employed about 3,500 reservists, about 8 per cent of the total employment in the atomic energy program, exclusive of construction labor. At certain locations the figure was even more disturbing: 69 per cent of the key personnel at Los Alamos were reservists.[2] No doubt the Commission could make a good case for retaining key staff; on the other hand the military services had to be certain they had personnel fully trained to handle atomic weapons.

Korea increased Brien McMahon's concern about the adequacy of the nation's atomic energy effort. On June 26, 1950, he asked Pike for the cost of increasing by 50 per cent the existing and planned production rates over the next few years. The Commission was still gathering data for a reply when Truman submitted a request to Congress on July 7 for a supplemental appropriation of $260 million for the Commission. McMahon announced his support of the request, but he also warned against any feeling of complacency. The sum was not large compared to total defense expenditures; indeed, he interpreted the amount as indicating that a hydrogen bomb program was not terribly expensive. From this deduction he drew the corollary that such an effort was well within the capability of the Soviet Union.[3]

Again McMahon turned to William L. Borden to provide the philo-

sophical underpinning for a further expansion. Borden set down his ideas in three pages. He believed the Russians were moving with all the vigor, impetus, and confidence gained from their success in breaking the American nuclear monopoly. After the war, while the Americans had been drifting, the Russians had put large numbers of people into their program. To their own efforts the Russians could add the American secrets betrayed by Fuchs and others. Borden warned that the Americans had a long history of underestimating the Soviet Union. They had expected the regime to fall in 1917, to collapse in the turmoil between the wars, and to succumb to the Nazi attack. The Soviet detonation of 1949 was a grim warning not to err again.

Borden found the Commission response to the Soviet challenge too weak. What was needed was a second Hanford with three to five graphite reactors. Even if these were not the most advanced models, they alone could produce material for weapons within a comparatively short time. It was niggardly to look at expense: "If we act to increase our supply of atomic weapons and they turn out to be unnecessary, we may lose a few hundred million dollars. If we fail to produce these weapons and they do turn out to be necessary, we may lose our country." McMahon read the paper with approval. He wrote Dean that he would read it to the Joint Committee on July 21.[4]



The Military Liaison Committee was also pressing for expansion. On July 10, 1950, Shugg learned that the committee was thinking of proposing an increase of about two and a half times the existing capacity. Shugg turned to Edward J. Bloch for a measure of the economic impact of such an expansion. Bloch saw no difficulty in getting materials and equipment to complete the facilities then under construction, but he thought that the situation could change if military requirements forced the President to establish a priority system. The contingency against which Bloch warned occurred on July 19, when Truman asked Congress for authority to establish priorities and allocate materials. That evening over radio and television, Truman asked Congress for the powers to guide the flow of materials into essential uses; the Government would have to adopt measures to prevent inflation and national production had to be increased.[5]

Truman's request for control came at a time when Dean could show progress in the expansion of the Commission's production facilities. Richard W. Cook, the Commission's manager at Oak Ridge, could report in July that K-29 was scheduled for completion in mid-1951 and K-31 at the end of 1952. Together the two plants, added to the war-built K-25 and K-27, would more than double the gaseous-diffusion capacity. At Hanford, David F. Shaw, the Commission manager, reported that the DR waterworks were on schedule. If all went well, Shaw would have five graphite reactors in operation in early 1951.

In Washington Shugg could see progress in du Pont negotiations. Crawford H. Greenewalt had come down from Wilmington on July 20, 1950, and for an hour and a half had made, in Shugg's opinion, a superb presentation

of the company's position. In brief, du Pont thought heavy-water reactors were feasible, and the dual-temperature process the best way to provide heavy water. In talking with Walter H. Zinn, the du Pont engineers had come away impressed with the amount and quality of the Argonne work. Greenewalt saw Zinn's group as the primary source of technical aid. Although North American Aviation lacked reactor experience, the engineering capability of the company was good and its support would be welcome. Greenewalt emphasized that du Pont intended to provide the economic inducement to assure top management personnel to the project.[6]

The next step was to brief the Joint Committee on production plans. To Shugg the tenor of the meeting on July 21 must have been easily predictable. Only two days earlier at a reactor subcommittee hearing he had heard Representative Henry M. Jackson demand urgency. The Congressman was present as McMahon led off by questioning the adequacy of the Commis-
524 sion's production plans for thermonuclear materials. Dean responded that until Los Alamos could say how much material was needed in one weapon, it was hard to define a production effort for a stockpile of weapons. The Commission was attempting to balance the uncertainties. One could enlarge the present production of tritium; but, Dean and LeBaron warned, such a course meant decreasing plutonium for weapons.

To Jackson, the argument reinforced his belief that the Commission should build up to use all the uranium available. McMahon referred to a committee report that there was enough uranium to fuel five new Hanford-type reactors for the next few years. When Dean repeated that heavy-water reactors were more efficient and furthermore that Hanford could not process the additional output, McMahon and Jackson were unmoved. From LeBaron they heard that the Military Liaison Committee had just completed a paper on the need for another major jump in production capacity. The basis for the increase lay in the possible tactical uses of atomic weapons, and for this purpose there seemed to be no limit to the military needs. McMahon was pleased to learn of the analysis. He promised a hearing with the Joint Chiefs of Staff to learn how they set their requirements. "We are really going to find out next week."[7]

The Joint Chiefs of Staff were continuing their efforts to strengthen the military position of the United States in the face of the Korean emergency. On Saturday evening, July 29, 1950, LeBaron telephoned Dean to alert him that the Joint Chiefs might ask for another transfer of nonnuclear components, this time for an advance base in the Pacific. To LeBaron's query, Dean replied that he had heard nothing on the matter from the White House.

On Sunday morning, LeBaron called again. General Omar N. Bradley thought some action might be needed over the weekend. Still Dean had no word from Truman. Shugg proposed releasing the components already in the hands of the military for training purposes. As a practical approach, the suggestion was good, but it was no solution to the need for Presidential

approval. From James McCormack, Dean learned that at Sandia, General Robert M. Montague and Carroll L. Tyler were aware of the situation. At three o'clock in the afternoon, Kenneth D. Nichols called, but still Dean had heard nothing. Half an hour later the phone rang again. It was Secretary Johnson. Truman had been cruising on the Potomac and could not call Dean directly. Johnson hoped, however, that his assurance that the President had authorized the transfer would be accepted. Dean released the components. His had hardly been a comfortable position.[8]

McMahon was ready to discuss production expansion on August 2, 1950. As he glanced around the hearing room, he must have felt a deep sense of satisfaction. Across the table were the Secretary of Defense and the chairman of the Joint Chiefs of Staff. Nearly all of the committee were present; even Senator Richard B. Russell of Georgia made one of his rare appearances. From the House came such stalwarts as Chet Holifield, Melvin Price, Henry M. Jackson, W. Sterling Cole, and James E. Van Zandt.



After stating that the Commission estimated ore receipts would permit a doubling of present and planned production, McMahon drove to the heart of the issue. If the Joint Committee had any reason for existence, he declared, it was to make certain that atomic energy efforts were sufficient to defend the country. Secretary Johnson paid tribute to the committee for its understanding and to the Commission, which with Dean as chairman, was now fully cooperating with the Department of Defense. Occasionally as he spoke, Johnson asked that his remarks be kept off the record, but testimony which remained left no doubt of his position: The military considered the existing atomic energy effort too small. In his view, with which Bradley concurred, all raw material available should be processed for weapon production as soon as possible.[9]

Truman too, was convinced of the need to increase production. For some time, at least since mid-July, Truman had been considering reestablishing the special committee of the National Security Council to examine the matter. On August 8, he directed the Department of Defense and the Commission to prepare for the special committee a study of the scale and rate of effort required to increase the output of fissionable material in the immediate future. The study was to take into account the degree of mobilization in effect and the possibility of full mobilization. It was also to show the cost in facilities, manpower, and dollars. These were the areas the Department of Defense had begun to analyze.[10]

## *EXPANSION AGAIN*

Of the members of the Joint Committee, McMahon and Jackson were the most vocal in urging expansion. On August 9, 1950, Jackson wrote to Secretary

Johnson, sending a copy to Dean, that anything short of doubling the authorized output would be detrimental to the United States. Going beyond this mark would be even better. If plant capacity outran the supply of uranium, the proper step was to increase ore procurement. McMahon had a heavy responsibility to see that the atomic energy program met the defense needs of the nation. It was a duty he welcomed. He asked Dean and Johnson on August 22 for their opinions on doubling the authorized production rate by 1954. He wanted their assurances that the program they were to recommend to the President would meet national requirements. For Dean he had more specific questions: What did the Commission think of building more graphite reactors at Hanford or elsewhere, of adding to the gaseous-diffusion capacity at Oak Ridge or elsewhere, of constructing more heavy-water reactors and linear accelerators, of restarting the Y-12 electromagnetic plant, and of increasing efforts to secure more raw material? [11]

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The Commission staff met with the Military Liaison Committee on August 11 to set up the ground rules for the study which Truman had requested on the rate and scale of effort. They reviewed the tentative requirements set by the Joint Chiefs of Staff for 1954, an approach which Shugg thought was more realistic for defining production goals than setting an arbitrary percentage increase in nuclear material. Nonetheless, the staff agreed with the Military Liaison Committee on August 29 that preliminary planning for gaseous-diffusion expansion would be based on doubling the production of uranium 235.

Williams was averse to adding more capacity at Oak Ridge. Union Carbide had worked up plans for an installation which could be built at the Tennessee location or at another site and operated in close conjunction with the existing facilities. Williams pointed out that a new location would allow for future expansion should that prove necessary. Bloch reported that the National Security Resources Board was trying to find areas with power supply which, within the next year and a half, could meet the operating requirements.

As for reactor products, Williams, recently returned from Hanford, concluded that the site could accommodate another graphite reactor, but not within the eighteen months so often given as the construction period, unless other important projects were delayed. He still felt that heavy-water reactors were the best approach and he had already told du Pont that it might be asked to build four or five reactors instead of two.[12]

Shugg, acting general manager since Carroll L. Wilson's resignation in mid-August, tried to give the Commissioners on September 1 some perspective of the size of the endeavor. From current and pending appropriations, the Commission would have about $1.6 billion to operate the production plants and to construct authorized additions. The total scheduled expenditure for fiscal year 1951 was $883 million, a fantastic total in Shugg's opinion, since the amount exceeded the peak expenditures of the Manhattan project. The end

was not yet in sight. Undoubtedly there would be more expansion; perhaps another billion dollars would be needed. Adding this amount to the $1.6 billion already anticipated gave him a total of $2.5 to $3 billion for operations and construction, compared to $2.2 billion for the wartime project.[13]

Expansion plans and Los Alamos reports lay before the General Advisory Committee as it assembled in Washington on September 10. From Williams the committee received no sense of a rationale for expansion save the need to build enough facilities to consume projected ore deliveries. The members could find no basis for the proposed ratio of plutonium and uranium production. They thought a better balance could be achieved by adding reactors. Kenneth S. Pitzer's presentation, advocating large-scale design and construction of the Berkeley materials accelerator, received a mixed reception. Some of the committee thought that the raw material estimates were not sound enough to show that a shortage of uranium was certain. Unless there were such a shortage, the accelerator would have no advantages over reactors. Others saw the project as a new and challenging approach by an enthusiastic and able group.



When Oppenheimer had planned the meeting, he realized that for Los Alamos the time might not be opportune for a formal report on the thermonuclear weapon, but he assured Norris E. Bradbury that even informal accounts would be helpful. Edward Teller and John A. Wheeler had submitted an analysis which, Bradbury had cautioned McCormack, was more an expression of individual views than a laboratory report. In their survey the two physicists had found a few areas of encouragement, but for the most part months of hard work had shown only more clearly the enormous difficulties blocking the way to success. Further calculations by Stanislaw M. Ulam, with Cornelius J. Everett's assistance, had not relieved the pessimism.

Enrico Fermi and Ulam were working on another part of the problem: how the fusion reaction would proceed in a volume of deuterium once ignition was achieved. There was little doubt that the reaction would die before most of the material was consumed. One continuing obstacle which Teller and Wheeler saw was the lack of qualified theoretical personnel. The advisory committee pondered over the information received, in the words of Oppenheimer, with "frustrated gratitude." [14]

The time for decision was approaching fast. Soon, Oppenheimer pointed out to Murray, du Pont had to know whether to design its reactors for plutonium or tritium. Soon Los Alamos had to be told how to divide its effort between fission weapon development and thermonuclear research. The lack of a basis for decision bothered Murray. Carefully he asked each member for an estimate of success in the quest for the thermonuclear weapon. By and large the answers were pessimistic. In contrast, the committee had found striking progress in fission weapon development. It might be possible to offer the military small weapons which would allow a greater choice of targets and means of delivery. The committee thought some of the advances might have

the effect of doubling the atomic stockpile. The members warned that Los Alamos could not be allowed to let the preparations for testing thermonuclear principles in 1951 jeopardize work on fission weapons.

After the meeting Oppenheimer summarized the situation for Bradbury. The committee had tried to preserve the laboratory's freedom of action, but Bradbury had to understand that the Commission was pressing for answers. These had to come soon. The next meeting would be in October at Los Alamos. Some of the new members had been impressed by arguments for a new weapon laboratory. At Los Alamos they would be able to see the practical difficulties of such a step.[15]

Shortly before the General Advisory Committee met, the working group from the Commission and the Department of Defense had completed a draft of the report to the President. The group had started from the premise that the minimum production capacity and stockpile requirements established
528 by the Department of Defense were about double those of the existing authorized programs. Later these requirements might even have to be increased. To meet the new goals, however, the Commission would have to expand its facilities so that that they would consume almost all the uranium ore available to the free world at a reasonable price. More specifically, a new gaseous-diffusion installation would be built at a site other than Oak Ridge and reactor capacity would be increased by raising the total of heavy-water reactors from two to five. Assuming quick approval and a vigorous procurement effort, the group believed that the additional gaseous-diffusion capacity could be achieved in November, 1953. The first of the reactors could be finished in January, 1953, with the remaining four coming into operation at four-month intervals. Over-all capital costs were estimated at $1.4 billion.[16]

Priorities were still an unanswered question. Joseph A. Volpe, Jr., recalling the experience of the Manhattan project in getting materials and equipment, thought it would be a mistake for the Commission to accept as sufficient the assurances from the military that the atomic energy effort would have at least as high priority as others in the defense program. In notifying Johnson on September 15 of the Commission's acceptance of the joint paper, Dean stated that the Commission would need top priority.

Within the Department of Defense, the three service secretaries approved the new expansion. General Frederick W. Timberlake of the Munitions Board gave his opinion to LeBaron that the requirements in manpower, steel, copper, and aluminum did not raise significant difficulties. Only in columbium, used in stainless steel, might there be a conflict. Timberlake had matched the requirements against NSC-68, a National Security Council paper resulting from Truman's directive to Dean G. Acheson and Johnson on January 31, 1950, to reexamine the national objectives in peace and war, and the effect on these aims of the Soviet nuclear capabilities demonstrated by the detonation of August, 1949.

Because the Commission had not seen the paper, Dean was reluctant to

make a formal statement that the new expansion was consistent with NSC-68. However, from his own private knowledge of the document, he was confident that the program requirements were not out of line. It did not take long for Truman to act. He received the paper on October 2 and approved it on October 9.[17]

The next day Truman announced his trip to the Pacific to see MacArthur.[18] The war news was good. An amphibious assault at Inchon had suddenly reversed the military situation, and United Nations forces breaking out of the grim perimeter of Pusan joined in the pursuit of the shattered North Korean army over the 38th parallel. With MacArthur's brilliant success came the possibility of uniting Korea. For Secretary Johnson it was too late. In his efforts to carry out Truman's defense policies he had aroused strong opposition. The triumph that might have vindicated him must have had a taste of bitterness. Once again Truman had turned to George C. Marshall. As the nation's third Secretary of Defense, Marshall had entered upon his duties on September 21, 1950.



## *GLOOM AND THE SUPER*

Progress on fission weapons was the first concern of the General Advisory Committee at Los Alamos in late October. Bradbury and Marshall G. Holloway, leader of the W division responsible for new weapon development, reported recent progress, but they admitted that tests in the spring were needed to confirm the laboratory advances. Oppenheimer thought Bradbury's plan sound for the next year and a half, although he did suggest more effort on fission weapons. Reducing the amount of material needed in a bomb would be the quickest way to increase the stockpile, because production from new plants would not come for years. Oppenheimer brushed aside Bradbury's comment that the stockpile directives showed no trace of this thinking. The laboratory could not expect to get detailed guidance on such complex matters from the military.

For much of the time, the committee considered the Super. During an inconclusive discussion of the underlying philosophy, Oppenheimer remarked that the military interest in large-yield weapons stemmed in part from the desire to compensate for errors in hitting the targets. Turning to the Super itself, the committee members heard Carson Mark summarize the calculations of Ulam and the ENIAC. From this account John von Neumann concluded that a thermonuclear reaction was possible, but not by the method which would be easiest to develop. Mark also presented the pessimistic findings of Fermi and Ulam, stressing that under the pressure of time the two men had made several assumptions to cover some of the uncertainties. Reducing the uncertainties, Teller argued, might change the results. Fermi

admitted the possibility, but he countered that better data would probably only reinforce the appraisal. The lack of computers was a continuing hindrance. Mark thought that some of the most difficult questions would have to wait until well into the following year. Wheeler proposed various experimental verifications of key hypotheses and explained the test of thermonuclear principles planned for *Greenhouse* the next spring. Fermi was favorably impressed: "A test should have a probability of failure to be a good one."

Teller took the floor to summarize the Super. In his briefing he could offer little more than determination. He saw more theoretical work as essential. He thought Los Alamos lacked people to perform the detailed calculations and to carry on imaginative thinking. More than once he stressed how much there was to explore. He admitted to von Neumann that the practicality of the Super depended on the amount of tritium that might be needed and that the trend was unfavorable. He had no new ideas. In some way success
530 would be grasped—how, he did not know. Even the victory might be dangerous to Los Alamos. If the spring, 1951, test showed the Super impossible, Teller believed the laboratory was strong enough to continue its work, but if the reverse were true—if the test showed the Super was possible—the laboratory might not be strong enough to exploit the triumph.[19]

If nothing else, the Los Alamos meeting gave further evidence of the growing polarity of opinions on the Super. Teller held that boldness, imagination, and unremitting effort would win. Oppenheimer felt otherwise. Theoretical analyses showed that a thermonuclear reaction might be started, but that it would not propagate. Unenthusiastic about the Super, unwilling in a vain pursuit of the Super to squander skills that might increase fission-weapon efficiency, Oppenheimer and others feared the effort was aground upon the unyielding rock of natural phenomena. They saw no shrewd and clever tricks, no subtle scientific insights, around this harsh reality.

Oppenheimer could make his views felt. Not only was he chairman of the General Advisory Committee, but he had also been chosen to head an *ad hoc* panel to establish the military objectives in the use of atomic energy. He had been chairman of a similar panel in 1948. As LeBaron had told Dean on October 16, 1950, the first report needed revision. Although Oppenheimer was the obvious chairman for the new study, LeBaron was aware that some of those who followed the thermonuclear effort closely distrusted the physicist's attitude toward the Super. It was not inconceivable that Oppenheimer might use the report to check a further increase in the effort. By careful selection of the other panel members, LeBaron thought he could run the risk.

In its report on December 29, 1950, Oppenheimer's panel emphasized fission weapons. Citing Korea as grim evidence that limited wars were possible and believing that a general war with Russia could happen, the panel saw an important place for atomic weapons. Certainly atomic bombs would have a place in the larger struggle. They might also be used in smaller wars. Much depended upon time. If an all-out war came soon, victory might depend

on the ability to use atomic weapons in several military situations. Fortunately the increasing mastery of weapon development by Los Alamos opened up that possibility, and the laboratory had to continue its effort to reduce the dimensions of fission weapons and to increase their efficiency. As for thermonuclear weapons, feasibility could not be established without more analysis. Perhaps there were ways through the difficulties, but none proposed so far seemed practicable or attractive. "In fact, we believe that only a timely recognition of the long-range character of the thermonuclear program will tend to make available for the basic studies of the fission weapon program the resources of Los Alamos Laboratory." After the Commission and the Military Liaison Committee made some minor changes the General Advisory Committee approved the report.[20]



## *PRODUCTION*

Although Los Alamos might have seemed blocked in its thermonuclear quest, the effort to produce thermonuclear and fissionable materials was gaining momentum. Du Pont, with the help of the Corps of Engineers, had studied hundreds of locations for the new reactors, a task made easier by Truman's injunction to Dean to let political pressures play no part in the decision.

An area on the Savannah River, near Aiken, South Carolina, appeared favorable because the chemical composition of the river water was good and the climate promised a long construction season. Even though an advisory committee had confirmed the choice, the Commissioners were troubled. For a possible six reactors, du Pont recommended acquiring 240,000 acres, rather than the 160,000 acres originally planned. Moreover, three rural communities —Ellenton, Jackson, and Snelling—fell within the proposed boundaries. In November Smyth and Commissioner T. Keith Glennan had inspected the site. They believed that a slight shift in boundaries would save Ellenton, but du Pont justified the need for the area, and on November 28, the Commission announced its selection. The Commission appointed Curtis A. Nelson as local manager. Nelson, an engineer with broad construction experience, had been a colonel in the Manhattan project; as the Commission's liaison officer at Chalk River, he had gained familiarity with the Canadian heavy-water reactor technology.[21]

November saw the completion of the pilot plant for the dual-temperature process of heavy-water production. Because reactor development moved more swiftly, the Commission would have to speed up heavy-water production. Dean and his colleagues accepted a du Pont recommendation to add six dual-temperature production units to the pilot plant. If all went according to plan, the first unit would be completed in mid-1951, with others following at monthly intervals. Putting the six units at the Wabash ordnance works would

strain the capacity of the local utility system, but probably no more so than would any other location. In recognition of the growing importance of the Wabash plant, the Commission in October had renamed its facility the Dana plant, and set up an area office reporting to Nelson.[22]

Progress in reactors could be matched by additions to gaseous-diffusion capacity. In November, 1950, the Commission approved constructing a new gaseous-diffusion plant near Paducah, Kentucky. The plant was to be built in two stages: C-31 was scheduled for completion in November, 1952, and C-33 in July, 1953. The Commission selected F. H. McGraw and Company as the construction contractor, despite Dean's fears that some of the Commission's critics would charge political influence because the company was located in McMahon's state of Connecticut. As the Paducah plant would operate closely with Oak Ridge, Carbide would manage both. Commission coordination would be assured by having Kenneth A. Dunbar, manager of the new Paducah area office, report to Samuel R. Sapirie, the Commission's manager of Oak Ridge operations. Sapirie could see in the Oak Ridge production reports in mid-December the effect of K-29, although the entire facility would not be completed until January, 1951, about five months ahead of schedule. K-31, however, would dwarf K-29. Authorized in November, 1950, K-31 was to be completed in December, 1951, and when it became fully operational, it would double the capacity of the K-25-K-29 complex.[23]



## *NATIONAL EMERGENCY*

In late November, 1950, Chinese communists caught MacArthur's forces unprepared and forced them back through winter snows and biting winds that swept down from the rugged mountains. In New York the United Nations Security Council considered a resolution calling upon the Chinese to withdraw in exchange for promises that their frontier would be held inviolate and that United Nations forces would leave Korea once a unified, independent, and democratic government was established. At his press conference on November 30, Truman slowly read a statement acknowledging the seriousness of the Chinese intervention and the United Nations determination to resist aggression. He laid the paper aside to face a barrage of questions: What of general mobilization, of his relations with MacArthur, of criticisms in the European press on the conduct of the war? Truman said that the nation would take any necessary steps to meet the situation. Swiftly came the next question: "Will that include the atomic bomb?" "That includes every weapon we have," Truman replied.

Charles G. Ross, the press secretary, heard the President with dismay, knowing that the quick rejoinder was bound to have wide repercussions. Later that day Ross issued a clarifying statement. Any nation possessing

atomic weapons would have to consider their use under certain circumstances but, Ross stressed, only the President could authorize American employment of them. This the President had not done. Hence, the remarks that morning represented no change in policy. The following day Truman sent a special message to Congress, asking for an additional $16.8 billion for defense and a little over $1 billion for the Atomic Energy Commission to produce more fissionable material and atomic weapons.[24]

To Western Europe, and Britain in particular, the Washington atmosphere seemed ominous and bellicose. Some members of Parliament addressed a letter to Prime Minister Clement R. Attlee, protesting the possible use of the bomb. Cheers echoed in the House chamber when Attlee announced he would fly to see Truman. On December 4, 1950, the Prime Minister and his party arrived in Washington and late that afternoon were driven to the White House. For an hour and a half they heard Marshall, Acheson, and Bradley present the American views. In this and succeeding meetings, conversations ranged widely over the risks and hazards of broadening the war, the role of Chiang Kai-shek, the future of Japan, and the defense needs of Britain. Truman was pleased that Attlee acknowledged the need to fight on in Korea. On certain matters, such as Chinese representation in the United Nations, they agreed to differ. Not until late in the conference did Attlee raise the question of the atomic bomb. Truman replied that there had been no change in American policy. For the public the two leaders agreed upon a few cautious words: "The President stated that it was his hope that world conditions would never call for the use of the atomic bomb. The President told the Prime Minister that it was also his desire to keep the Prime Minister informed of developments which might bring about a change in the situation." [25]



Attlee must have had some long thoughts as he departed. Almost five years earlier he had come to Washington to discuss atomic energy with Truman and Mackenzie King. Then Attlee had been interested in preserving the special relationship that Churchill had established with Roosevelt. Subsequent events had been disillusioning. His letter of June 7, 1946, to Truman on atomic energy had long gone unanswered; the promise of the *modus vivendi* was largely unfulfilled. From Truman's statement Attlee could conclude that the Americans would not use the bomb without informing the British. "Inform" was not the same as "consent," the term which Roosevelt and Churchill had used to describe the obligations between their two nations, but Attlee could rightfully claim that on the use of the atomic bomb he had taken a big step toward resuming the partnership.

The Attlee conversations revealed no fundamental cleavage between the United States and Great Britain, a calm and reassuring note among the flood of bad news from Korea. Even before Attlee had departed, Truman had begun his preparations to proclaim a national emergency. In one meeting after another in mid-December, Truman talked with cabinet members, Congressional leaders, and the heads of the main Government agencies to explain

his plans and to gain support. Dean attended the meeting of December 14. From the White House he returned to his office and talked with Marion W. Boyer, the new general manager, on the effect the proclamation might have on the atomic energy program. Neither foresaw any great impact. Boyer thought Los Alamos might receive a psychological lift and perhaps the rest of the program might gain a similar benefit, but in his opinion events had forced the Commission into an expanded effort before the latest developments in Korea. There was little, under the present circumstances, which Boyer could suggest.

Two days later, the President issued the proclamation, framed in the traditional sonorous phrasing, "Whereas recent events in Korea and elsewhere constitute a grave threat to the peace of the world . . . I summon our farmers, our workers in industry, and our businessmen to make a mighty production effort to meet the defense requirements of the nation. . . ." [26]



Korea gave further impetus to McMahon and Jackson in their drive to increase the size of the atomic energy program. Both men wanted more graphite reactors. McMahon urged building more than one production accelerator, placing more emphasis on making the fissionable material uranium 233 from thorium, and making greater efforts to develop processes for treating low-grade ore.

A few days from the close of 1950, Dean set forth again the Commission position to McMahon: To meet danger in the near future, increasing production from the Hanford reactors was a better solution than new graphite reactors; another 350-mev accelerator was premature until the Mark I had proved itself; the Commission was doing all it could on thorium and processing low-grade ore.[27] It was a balanced and logical reply, but hardly the stuff to calm McMahon.

The need for an additional Hanford reactor was still a live issue. When Williams briefed the General Advisory Committee on Friday, January 5, 1951, he found the members reaffirming their earlier recommendation for increasing the plutonium-uranium ratio by building an additional graphite reactor. On Tuesday, Williams ordered David F. Shaw at Hanford to ask General Electric for a schedule and an estimate of manpower, costs, and materials for a reactor to be located about two and a half miles from an existing unit. Shaw and General Electric already had plenty of data from earlier studies. If a new reactor were built as a twin of an existing unit, operation could be expected about twenty months after authorization. The same reactor, but located in a new Hanford area, could be built within the same time, but at greater costs and labor. Williams presented the estimates to the Commissioners on January 22. He favored building a twin reactor of the most advanced design, a task he thought could be completed in less than twenty months. The Commissioners gave their approval, and the next day Williams wired Shaw to begin work on the sixth Hanford reactor, to be known as "C." [28]

The impact of Korea could also be seen in the preparations during January for the first atomic tests held in the United States since the Trinity detonation in 1945. The advantages of a continental test site had long been obvious, but as Pike had remarked in March, 1949, only a national emergency could justify testing within the United States. Korea had fulfilled that condition. Shortly after the outbreak of fighting, Dean had proposed that the Commission and the Department of Defense search for a continental test site. In October, 1950, the two agencies had recommended an underground test at Amchitka Island in the Aleutians in the late fall of 1951. Although Truman had given his approval, there was still the need for a more convenient site and the search continued. On December 14, 1950, the special committee recommended the Las Vegas bombing and gunnery range.

The selection of the Nevada site to carry out the *Ranger* weapon tests had the hearty approval of the General Advisory Committee. The range seemed a good choice for the test series needed to verify some of the Los Alamos improvements in fission weapons. But differences had arisen in Washington over issuing a public announcement of the coming tests. Secretary of Defense Marshall and his deputy, Robert A. Lovett, thought it unwise in the tense international situation to reveal that the United States had small nuclear weapons. Truman overruled the defense officials, and on January 11, 1951, the Commission released a statement. Dean flew to the test site on January 31 and returned on February 2. Three days later he saw Truman to report that the tests had been successful.[29] In fission weapons, at least, there was progress.



## *THE POSSIBILITY*

For much of the nation, 1950 ended somberly, and the future seemed ominous, foreboding, and uncertain. On its isolated mesa, Los Alamos was prey to its own anxieties. The laboratory had accomplished much during the last year, and those working on fission weapons could look with anticipation to the *Ranger* tests at Nevada.

To others, involved in the quest for the hydrogen bomb, the outlook seemed bleak. Ulam's superb mathematical analysis was confirmed by computer. His feat had been a remarkable accomplishment, but it had not disclosed a new line of advance. January began with long debates which sometimes boiled over into angry recriminations among those of the T division and staff who had to decide the next step. At Cornell, Hans A. Bethe could sense the tension in correspondence and conversations. Nothing had changed his dislike of the Super but, as he wrote Teller, he worked honestly on the effort, making no attempt to suppress good or bad results. Bethe

thought that the differences separating him from Teller were narrow, and he saw as a valuable adjunct to his own role the part of an assayer of Teller's ideas.[30]

From Washington Dean viewed the Los Alamos scene with growing perplexity. He had information describing tension between Teller, Wheeler, and von Neumann on the one hand, and Bradbury, John H. Manley, and Holloway on the other. The schism was not only between those who urged a more vigorous assault instead of a more measured approach to the hydrogen bomb. It also divided those who were largely outside the laboratory hierarchy and those who as regular members of the staff had performed so effectively in the critical period after the war when Los Alamos was finding itself. In early February, Dean learned that Teller was in Washington, marshalling support for his own views. Wheeler was about to abandon Los Alamos for Princeton where, as Dean understood the plan, he would organize a group to work with
536 the Princeton computer. This move Bradbury apparently opposed on the belief that Wheeler's task would consume a year and would weaken the effort at Los Alamos.

Dean heard too a charge that Oppenheimer had effectively dampened enthusiasm over the Super, and would rather see Los Alamos follow a more deliberate approach. Dean confided to his diary: "I do not know the answer to this one, but we will have to find one, no matter how unpleasant the results may be." And finally, Dean learned that Los Alamos had not completed all the "most fundamental calculations" on the fusion reaction. On February 9, he received Lewis L. Strauss and in the privacy of his office listened to the former Commissioner read a long memorandum advocating more effort on the Super. Dean was disturbed that Strauss chose to throw his memorandum into the fireplace rather than leave a copy behind. Dean was also troubled to learn a little later that Strauss was thinking of taking the matter to the White House.[31] The pressures on Dean were enormous, but those fighting for the Super had no choice. Lacking any convincing evidence that a Super could be built, they could but struggle for time, hoping that with each day gained, Teller and his group would find a way.

To Teller and Strauss, for the United States to be first with the hydrogen bomb was worth almost any price. Their thoughts were focused mainly on the Super, for theoretically there was no upper limit to the yield, a possibility which attracted some physicists and repelled others. The Super was, however, only the leading candidate of several proposed thermonuclear weapons. This fact Bradbury had recognized in early 1950 when he asked Teller to head a "family committee" and coordinate the laboratory's thermonuclear work. Within the committee and the T division, ideas flowed from one group of physicists and mathematicians to another.

In this atmosphere, sometimes abrasive but always stimulating, Ulam suddenly saw a path through the obstacles. On February 23 he penned a letter to von Neumann. After a prosaic opening paragraph on hopes for an early

meeting with the Princeton mathematician, Ulam continued, "Had the following couple of thoughts (ideas) about bombs. . . ." He needed only a few sentences to sketch a scheme which could be applied to several members of the thermonuclear family, even the Super. He had mentioned his idea to Teller: "Edward is full of enthusiasm about these possibilities; this is perhaps an indication they will not work." [32]

Teller was indeed enthusiastic. He listened to Ulam describe a particular approach to apply his idea. Teller's mind raced over the possibilities. He rejected Ulam's approach as posing enormous technical difficulties. He had a scheme of his own, based partly on the nuclear mechanics which were to be used at the *Greenhouse* test of thermonuclear principles. In March Teller and Ulam completed a joint report in which each presented his own scheme to achieve the conditions which Ulam had suggested.[33]

Within a new framework scattered ideas began to assume a pattern of promise, but whether these new hopes would have more substance than the old could not be determined until intense analysis had charted areas of unknowns and devised means to explore them. Much more work was needed to see whether the new member of the thermonuclear family would survive. Consequently the meeting of the General Advisory Committee at Argonne in March, 1951, was largely a continuation of the same refrain heard earlier. Willard F. Libby again urged a large experimental program of hundreds of people to hasten the development of the Super. The other members still saw no value to a large-scale effort without more theoretical data.[34] The arguments were stale and weary. In mid-March of 1951 they could not be anything else.



## *CUSTODY—THE BREACH*

Whether, in the stream of events that flowed through 1950, Dean ever stopped to compare his circumstances as chairman with those of Lilienthal cannot be known. Of all the Commission battles which Lilienthal fought, probably the one he believed most important was over the civilian custody of nuclear weapons. Although Lilienthal had won his case before Truman, the issue of civilian custody continued.

In March, 1950, McCormack had raised with the Commission the question of asking the President to approve the transfer of nonnuclear weapon components to the military. Arguments for the transfer were based on the growing military competence to maintain the components and relieve the Commission of part of its custodial burden. Since the Commission would continue to control the nuclear components, civilian custody would still be maintained. Pike and Dean had demurred, believing that Truman had not made his 1948 decision on technical grounds, and that to reopen the matter with such arguments was unwise. Nonetheless, the Commissioners had de-

cided to seek the advice of Bradbury and Los Alamos. Dean did not like the idea of transferring the nonnuclear components. He believed that to do so was to reduce civilian control to a fiction.[35] Dean could not have received much comfort from the casual manner in which Truman had arranged to release a number of nonnuclear components to the military in the summer of 1950 and had informed the Commission only after the fact.

During the dark days in the fall of 1950, the question of the use of atomic weapons came up before the special working group of Commission and Defense officials. Dean read an agenda for a meeting of the group which Captain James S. Russell, the Navy deputy in the division of military application, was to attend. Among the items was a list of State Department questions about procedures for obtaining Presidential permission to use an atomic weapon. Of the fifteen points, Dean was particularly interested in what effect the use of the atomic bomb would have on public opinion—in the
538 United States, allied countries, and Asia and whether the United States should receive the prior concurrence of the United Nations. From Russell's report of the next day, Dean learned that if the Joint Chiefs of Staff recommended using an atomic bomb at a given place, the Secretaries of State and Defense and the chairman of the Atomic Energy Commission would advise the President. Dean was satisfied. This procedure would assure Commission participation.[36]

Dean clearly saw that the custody issue and the procedures used to make the Commission's voice heard were both aspects of civilian control. Both facets were relevant in the spring of 1951. A few months after taking office as Secretary of Defense, Marshall had established procedures by which he would funnel requests for atomic weapons to the special committee of three agency heads. On April 5, 1951, Dean learned that the Joint Chiefs were about to request the transfer of a limited number of complete atomic weapons. He immediately alerted his colleagues. That afternoon he set down his views on the salient issue of civilian and military control.

Dean was concerned lest the Commission, without sufficient thought, drift into a position from which it could no longer exercise its responsibility as the civilian custodian of atomic energy. Not only did the Commission have the best understanding of weapon effects and technical problems, but the moral and psychological implications inherent in the use of atomic weapons needed more than military consideration. From the legislative history of the Act, Dean did not draw the conclusion that the civilian interest in atomic weapons terminated at their transfer. He saw two Commission responsibilities: readiness to transfer weapons to the military as soon as the President gave his approval, and safeguarding of the country against wasteful or unwise expenditure of fissionable material.[37] In this latter role Dean saw the Commission's responsibility for safeguards as transcending custody.

Uncertain of Truman's intentions, Dean telephoned James S. Lay at the White House to ask whether the Commission and the State Department

would see the Joint Chiefs' recommendation. At Truman's request, Dean went to the White House on the afternoon of April 6. He found that the President had decided to sign the memorandum prepared by General Vandenberg of the Air Force requesting transfer of a number of nuclear and nonnuclear components. As Truman talked, however, Dean began to see that the President was willing to have the Commission and State Department participate in any decision to use nuclear weapons. Dean returned to his office and worked out the means to implement the transfer. Looking back on the day, Dean realized its importance. The President's action, "marked the end of the Commission's civilian responsibility over a portion of our war reserve." [38]

Just how the President would receive civilian advice before deciding to use nuclear weapons was still an open question. After a meeting with Acheson and Marshall on April 16 to set up the ground rules for such a study, Dean asked Glennan to serve as the Commission member of the working group. By April 27, the group had finished its task. It had seen its job as outlining procedures under which the President could most effectively obtain advice whenever he might be called upon to decide under what circumstances atomic weapons should be used. It was a baffling assignment and difficult to grasp. Certainly the recommendation to employ atomic weapons would come from the Joint Chiefs, but it was impossible to predict what the circumstances might be. The more time the President had, the more civilian sources he should consult. In an extreme emergency the President might have little time. Even so, he should seek the advice of at least the Secretary of Defense, the Secretary of State, and the chairman of the Atomic Energy Commission—the members of the special committee.[39]



The Commissioners approved the report on May 1, but the action was not decisive, as the Joint Chiefs subsequently took the position that no agency had the right to interpose itself between them and the President on matters touching military operations.[40] Because the President had ultimate authority in such matters, the Joint Chiefs' position in a strict sense did not violate the principle of civilian supremacy in the Government. But that position did raise questions about the mechanism, if not the principle, of civilian control. With their responsibilities under the Act, with the technical information they had acquired on atomic weapons, how could the Commissioners make their views known most effectively to the President?

## *TENSION AT LOS ALAMOS*

As the time drew near for the *Greenhouse* tests, scheduled for late April and early May, 1951, an increasing amount of the Los Alamos effort went into the preparations. There would be more than one shot, but most crucial for the thermonuclear work was the test of fusion principles. Success would give experimental proof of theory. Failure would mean a severe setback, perhaps

even the abandonment of the quest for a thermonuclear bomb. Teller and his coadjutor, Frederic de Hoffmann, watched the preparations tensely. They wondered whether the test of thermonuclear principles was not premature. In their view some of the basic calculations were hurried and incomplete. Teller's dissatisfaction with Los Alamos erupted again when Bradbury on March 6 distributed plans for reorganizing the laboratory.

From the replies Bradbury had a good cross-section of the opinions among his division leaders. Mark wanted more data and that meant more personnel. Darol K. Froman shrewdly warned that Los Alamos was politically vulnerable, since many people outside the laboratory thought its sole aim was to devise a thermonuclear weapon. Of course this contention was not true, and Froman thought some reorganization and some definite goals might relieve the pressure. He saw enough areas needing investigation to base a laboratory program on, even if it was still too early to plan a thermonuclear test after
540 *Greenhouse*. Because Ulam was not directly involved in organizational matters, he confined himself to technical affairs. Certainly the feasibility of the Super had to be settled once and for all; if the MANIAC were operating by summer the answer should be ready in the fall. For the other approaches on the thermonuclear weapon, he saw years of work. The idea that he and Teller had set forth in their March report would require much theoretical effort. Perhaps years might be needed to evaluate the approach. Some small-scale experimental work could provide data, but even so, Ulam foresaw a long future of hard analysis.

Teller's reaction to Bradbury's proposal was forthright and critical. Much of the present laboratory effort had gone into preparations for *Greenhouse,* leaving little time for thermonuclear research. As long as the program was a part-time project directed by a committee, Teller could see no chance for success.[41]

Establishing a separate division for thermonuclear research was the obvious rejoinder to Teller's charges that Los Alamos was ineffectual in this area. Froman found the idea of a new division to raise more problems than it solved. It would be hard to define the tasks and to reassign personnel without damaging morale. In details the present organization could be improved, but it was important to maintain the flexibility of calling upon the various divisions for their special resources. Lothar W. Nordheim believed that a new division would cause delay, and suggested a task force led by some prominent physicists.

Teller wanted a new division. He was convinced that effective results could only come from people who had no other mission. The division would need certain facilities, and at first might consist of about a hundred individuals, most of whom would be scientists. Bradbury was well aware that Teller, with all of his brillance, was no manager. Froman, however, was an administrator who might be able to coordinate the relations between a group under Teller and the rest of the laboratory. Froman's ideas were much less grandi-

ose than Teller's. A group of about twenty-five, under Teller, would be free to attack any problem and to call upon any part of the laboratory for help. Froman knew his assignment would be difficult. He realized that he and Teller might disagree over priorities as well as other matters. If differences did develop, Froman declared that he had to have the backing of Bradbury. There could be no other alternative.[42]

Some of Teller's anxiety might have stemmed from his realization that he was, at last, upon the right track. His report with Ulam had done little more than to point out possible approaches. Another idea, based upon the first, came to him probably in the latter part of March. De Hoffmann began a mathematical analysis, feeling fortunate, as he worked night and day, that the calculative techniques he had worked out for some of the *Greenhouse* tests were applicable to Teller's latest suggestion. The results looked good. In early April de Hoffmann signed the report with Teller's name. The approach could have been called the "New Super." [43]



Teller came to Washington and for two hours in the morning of April 4 was closeted with Dean. Teller argued that Froman's twenty-five-man group was far too small, and the right to call upon the rest of Los Alamos of little value, since so few in the laboratory knew enough to help. Yet Dean did not feel that Teller was raising insurmountable obstacles; for so intense an individual he seemed very objective. For two hours on April 16, Dean heard the Los Alamos part of the story from Bradbury and McCormack.[44]

Soon after returning to Los Alamos, Teller on April 20 summarized his position in a memorandum to Dean. Only at a new laboratory could there be assembled the people with the skills and talents who, working with single-minded devotion, offered the best chance of success. After considering several locations, Teller had decided that Boulder, Colorado, offered the best possibility for the 50 senior scientists, 82 junior scientists, and 228 assistants that he saw as needed. If the Commission acted quickly, a theoretical group might be in the preliminary facilities by fall, some experimental work in progress by Christmas, and routine operation achieved by the summer of 1952. Dean must have known how strong Teller's position was. As the most ardent scientific advocate of the thermonuclear bomb, he had strong ties with McMahon, Borden, and Strauss. In de Hoffmann, Teller had an able and shrewd scientific aide of high managerial and political ability. Dean must have sensed that the chances of compromise between Teller and Los Alamos were small.[45]

## *GREENHOUSE*

Eniwetok preparations for *Greenhouse* were proceeding under General Elwood R. Quesada of the Air Force, commander of Joint Task Force 3. Dean

found time to leave Washington with all of its pressures, to witness the test of thermonuclear principles. He was vividly impressed as he saw the bulky volumes of complicated operation orders and procedures take on meaning. Initial worries over squally weather faded as the sea and wind fell on the day of the test. The firing team took its position in the control station on Parry Island and all began smoothly. Forty-five minutes before detonation a short occurred in the monitoring arming circuit. Tension mounted, falling most heavily upon Alvin C. Graves. As Quesada's scientific deputy and leader of the Los Alamos J division, Graves had to make the decision. He listened to accounts of the difficulty and warnings that the test might fail. He chose to go ahead.

Soon came the blinding light, the boiling and seething clouds that reached high into the atmosphere. Dean was awed. A little later he put down his impressions: the 300-foot tower containing the device, a concrete shelter housing experimental equipment, some cast-iron structures—all had vanished. Where once they stood was a crater into which rolled the waters of the lagoon. As the first data came in, Dean watched the enthusiasm and satisfaction of the scientists. He noticed how Teller kept his feelings in check, but he remembered Teller's remark that Eniwetok would not be big enough for the next test.



It would take time to sort the data, but enough was known for Teller to inform Los Alamos: "It's a boy." Frederick Reines, physicist from Los Alamos, studied the preliminary results and in his comment to Bradbury back in New Mexico summed up the feelings of many, "We are all very well satisfied." [46]

## *PRINCETON*

Dean thought that the next logical step was a strategy meeting to discuss the results of *Greenhouse* and to plan the next moves. Princeton appeared a good place for the gathering. There Oppenheimer could be host to those members of the General Advisory Committee particularly interested in weapon development, the Commissioners and a few members of the staff, Bradbury and a small Los Alamos group, and a few others who in one way or another over the years had followed the work on the hydrogen bomb.

Teller was elated. *Greenhouse* had done more than successfully test thermonuclear principles; it had shown that the mechanism he had described might well make a thermonuclear weapon possible. "It is now my conviction that the thermonuclear program is past its ignition point," he wrote to Smyth.[47]

At Los Alamos, Froman drew up the laboratory plans for the Princeton gathering. In distributing his proposal to the division heads and a few

other key personnel, he warned that the laboratory resources would be so fully committed that new ideas or a shift of emphasis could be accepted with only the greatest of difficulty. The heavy burden upon the laboratory provoked the most comment. Bethe wondered whether too many assignments were being given to Mark's theoretical division. Maybe greater use could be made of Wheeler's group, now getting established in Princeton. Eric R. Jette worried about overtaxing his men in the CMR division, which performed chemical and metallurgical research on fissionable material and produced nuclear components for weapons. He saw in the near future the possibility that his people might be so fully engaged that they would have no time to develop new ideas or recognize them when they appeared.[48]

Of high priority in the Los Alamos plan was the need to analyze the data from *Greenhouse*. Whatever approach would be chosen for a thermonuclear weapon, these results were of crucial importance. Despite the unfavorable calculations of Ulam, Everett, and the ENIAC, the Super was still in the running; indeed some recent data showed its chances to be slightly improved. If this trend continued, the Super might be tested in the spring of 1954. The New Super also appeared promising, but because its origin was so recent, there had been no time for close and critical study. Teller, Mark's T division, and Wheeler's group were to undertake the analysis as a main task. It was too soon to establish a test schedule for the New Super, but if a general feasibility study were finished in October, 1951, and showed promise, perhaps a test of a device based on the New Super principle could be held in the spring of 1953. Los Alamos would not carry all the approaches through the testing stage. As soon as one became less attractive than the others, it would be dropped until eventually the effort would narrow to a single approach. Los Alamos would not attempt another test, similar to *Greenhouse*, to acquire further data on thermonuclear phenomena. To do so would detract from the effort to test a full-scale device.[49]



Bradbury recognized that at Princeton some of the emotions surrounding the Los Alamos effort might be unleashed. If, however, he could focus attention on the laboratory program, it might be possible to avoid some stormy sessions. In his view, the purpose of the meeting was to show that Los Alamos was attacking the right problems with the right emphasis. As an agenda, Bradbury proposed a report by Mark on thermonuclear data from *Greenhouse*, a discussion by Froman of the laboratory plan, and a few remarks by himself on the laboratory philosophy and the division of effort between fission and fusion development. Bradbury did not include Teller in the list of laboratory spokesmen so that the physicist could express his own views freely. His thoughts on the meeting Bradbury sent to Teller, with the observation that Nordheim and Wheeler could also speak with no strings attached.[50]

Dean must have seen the Princeton meeting as an end to a period of uncertainty. He could now begin to see where thermonuclear weapon develop-

ment and increased production could meet. At Savannah River, clearing and grading were in progress and foundations were being poured. The heavy-water plant at Dana was well along. Because of increasing estimates of the amount of heavy water needed, the Commission had approved constructing six more dual-temperature units, but at Savannah River. At Hanford, building of the C reactor had little more than begun in June. K-31 at Oak Ridge was offering the pleasant possibility of completion at the end of January, 1952, about six weeks ahead of schedule. Labor problems, design changes, and difficulties in attracting qualified personnel within the salary limits were slowing down the C-31 plant at Paducah. Although Berkeley enthusiasm for the materials testing accelerator continued, there was a growing uncertainty over cost estimates. The Commission had approved Weldon Spring, Missouri, as the site for the Mark II, but had decided not to begin construction until Mark I at Livermore yielded operating experience. One concern that must have bothered Dean was the growing shortage of materials as the national defense effort gained momentum.[51]



Oppenheimer welcomed an impressive group of men on June 16 in the long conference room at the Institute for Advanced Study. From the General Advisory Committee, in addition to himself, were Fermi, Cyril S. Smith, Isidor I. Rabi, and Lee A. DuBridge, all of whom from the earliest days of the committee had watched the Commission activities. Some of the new element in the committee was represented by Walter G. Whitman and Richard W. Dodson, the committee's executive secretary. From Washington had come all of the Commissioners—Dean, Smyth, Glennan, Murray, Pike—and Boyer, Williams, and McCormack from the staff. Bradbury headed the Los Alamos delegation of Mark and Froman. Somewhat independent, as far as organizational allegiance was concerned, were Teller, Bethe, Nordheim, von Neumann, and Wheeler.

For two days the group reviewed the laboratory program, the results from *Greenhouse*, and the status of the various thermonuclear approaches. To Mark's presentation of the *Greenhouse* data, Wheeler added a technical briefing on how the information might be applied. His young Princeton group, barely established in recently acquired and poorly equipped buildings some miles away from the Institute, had adopted the designation "Project Matterhorn" and labored over their calculations. Kenneth W. Ford, one of Wheeler's group, charted data and plotted graphs up to the last possible moment, and then raced across town to hand the charts through the window as Wheeler began to speak. To those parts of the meeting which dealt with what he considered a rehash of stale data on old approaches, Teller listened with obvious impatience and restlessness, betraying occasionally his dissatisfaction with Los Alamos. With impassioned eloquence he portrayed how the data from *Greenhouse* opened the way for the New Super. Bethe thought the main task was to discover how the proposed thermonuclear devices would work. Although the data at hand were more than preliminary, much remained

to be done. He and Wheeler opposed another test to verify thermonuclear principles or to cast light on some of the unknowns. The effort it would cost would not be worth the results. As for the laboratory program, the group after a very few changes, gave its approval.[52]

To most participants, the meeting had been significant, but not particularly startling. They had known of the *Greenhouse* results and the possibility of applying them to the New Super. What flowed from the discussion was a feeling of confidence, shared by Oppenheimer, that success was at last possible. The period of tense anxiety and frustration was over. Now there was a course to follow. Never had prospects for the thermonuclear weapon appeared so bright. Nor had the pursuit of the chimera of the Super been in vain, for Los Alamos had gained data and experience which it could quickly adapt to the New Super. However, there was a legacy of bitter feeling. One evening at Princeton, Dean took Bethe aside and asked whether there was any way to ease the tension between Los Alamos and Teller. Bethe shook his head: This was a problem to which he saw no solution.

# *FORGING THE ATOMIC SHIELD*

## CHAPTER 17

The conference at Princeton over the weekend of June 16, 1951, had marked a turning point in the quest for a thermonuclear weapon. From Norris E. Bradbury and his Los Alamos associates, and especially from Edward Teller, the Commissioners and the General Advisory Committee had gained a feeling of confidence that the end of the search was in sight. The *Greenhouse* test six weeks earlier had given Los Alamos desperately needed experimental data on thermonuclear principles. Not until Los Alamos had completed further study of the results would it be possible to determine whether the Super, the New Super, or another approach, was promising enough for a full-scale test, an essential step in developing a weapon. Nonetheless, the New Super which Teller had described in his April report had aroused great interest. Probably as the group at Princeton listened to Teller's impassioned arguments favoring the New Super, few of them could have disentangled the individual contributions of Teller, Stanislaw M. Ulam, and others. Nor were such distinctions important at the time. What mattered was that the thermonuclear effort move as fast as possible. For Gordon Dean and the other Commissioners the question was whether establishing a second laboratory would hasten or delay progress. Of one thing they could be certain: there was still much to be done before a thermonuclear weapon would be part of the nation's atomic shield.

There were other matters than Los Alamos and a second laboratory for the Commissioners to consider. The Joint Committee and the military were continuing to press for more plutonium and uranium 235. Despite the construction of more reactors and additional gaseous-diffusion capacity, there seemed to be no end to the demand for fissionable material. The flow of ore concentrates from the Colorado plateau and from Canada were increasing, and promising to remove ore supply as a limit to production. Of growing concern to Dean was the competition with the defense establishment for material and equipment falling into short supply as the nation rearmed itself.

However, the major issue for the Commission, the President, the Joint Committee on Atomic Energy, and the Department of Defense was this: How large should the nation's atomic energy program be?

## *THE TRUMPET SOUNDS AGAIN*

The demand from Capitol Hill for more and bigger weapons, unceasing from the time McMahon had assumed chairmanship of the Joint Committee, showed every sign of growing more intense. An obvious ally for McMahon was the Department of Defense. In May, 1951, the senator had sent Secretary George C. Marshall a Joint Committee resolution urging expansion of the Commission's production facilities. A few days before the Princeton conference, McMahon had asked Dean and Marshall for a cost estimate for increasing production capacity by 50, 100, and 150 per cent. A week later, Robert LeBaron, Marshall's assistant for atomic energy and chairman of the Military Liaison Committee, told Dean that the Joint Chiefs of Staff were moving in the same direction. Not casting the question in such gross terms as percentage increases, the chiefs were interested in exploring every means for maximizing production. They needed cost estimates, construction schedules, and a full appraisal of the engineering possibilities. LeBaron observed that the Commission and the liaison committee would review the study before he sent it to the Joint Chiefs. He had also been in touch with the Joint Committee about the study. The strong identity of interest between the Department of Defense and the Joint Committee drew from Marshall a cordial invitation for McMahon to come to lunch and an offer to work closely with LeBaron and the Department of Defense.[1]



Even with massive help from the Commission's staff and contractors, Dean thought it would take forty or forty-five days to make even rough estimates of costs for McMahon. As an expedient, Dean offered to discuss with McMahon the practical difficulties in compiling the information. The Commission moved more gingerly on LeBaron's proposal. Marion W. Boyer suggested that some of the LeBaron group could take part in the current studies, but others of the Commission were not certain whether this was a responsive answer to the request. At times discussion turned to the advantages of reconvening the special committee of the National Security Council, which President Truman had previously used in reaching major policy decisions on atomic energy and defense, and which had the merit, from the Commission's point of view, of bringing into the balance the State Department's opinions.[2]

To Commissioner Thomas E. Murray, deliberating over administrative procedures was temporizing. The main thing was to get data for the studies as soon as possible, but Murray did not limit his concern to the reports. Within the Commission he searched for ways to hasten the production of weapons

and fissionable materials. He was anxious to find a contractor and a director for a second weapon laboratory which he thought might be located at Sandia Base, near Albuquerque. He advocated splitting the headquarters division of military application into two divisions, one for weapon production and the other for weapon research and development. He supported Commissioner T. Keith Glennan's interest in improved reactors, so long as the search for efficiency did not take precedence over the immediate need for more production. Murray was eager to find a new site and contractor for more production reactors, and explored with Union Carbide officials ways of increasing the flow of uranium 235 from the gaseous-diffusion plants.[3] With his restless energy Murray combined an impatience for administrative detail.

McMahon was not waiting for the cost study before plunging into the intricacies of the Commission's operations. He told Dean on June 22 that the Joint Committee had voted eleven to six to ask the Commission for top secret
548 data on production and the weapon stockpile. McMahon was pleased at the action: The vote was historic and it cut across party lines. As a step in that direction, Commissioner Henry D. Smyth briefed William L. Borden, executive director of the Joint Committee, on the recent Princeton meeting. On July 5, McMahon and Congressman C. Melvin Price met in the Pentagon for lunch with Marshall, Deputy Secretary Robert A. Lovett, and LeBaron. The conversation reinforced McMahon's conviction that the nation needed "thousands and thousands" of atomic bombs. Both Lovett and Marshall spoke enthusiastically of the tremendous impact large numbers of nuclear weapons would have on military strategy. Elated to find such a close meeting of minds, McMahon left the Pentagon more determined than ever to end what he considered the Commission's fumbling, half-hearted efforts to build the nuclear stockpile.[4]

In a budget hearing on August 16, 1951, General James McCormack gave to the Joint Committee some idea of how far the Commission had gone toward creating an arsenal of reliable, sophisticated, and specialized nuclear weapons. The supplemental budget would provide funds for developing almost a score of different weapon models, including several for missiles. As always, McCormack's testimony was impressive, but there was another reason for giving his remarks close attention. This occasion was his last appearance before the Joint Committee as director of the division of military application.[5]

Nonetheless, McMahon still worried. He had received from General Kenneth D. Nichols, chief of the Armed Forces Special Weapons Project, an estimate of the number of weapons necessary to cripple the industry of the Soviet Union. Nichols had concluded that the Commission's most optimistic forecasts of weapon production would not meet military requirements.

The following week, McMahon read to the Commissioners a memorandum prepared for him by J. Kenneth Mansfield of the committee staff. Mansfield argued that the military answer to the hordes of the Soviet bloc was tactical atomic weapons. He feared, however, that full implications of this fact had not permeated military thought; rather, the pace of technical develop-

ment had outstripped military doctrine. Opening the question of tactical uses of atomic weapons might revive bitter interservice rivalry as each arm of the military sought to define its role, but national security demanded realistic estimates of the need for tactical and strategic atomic weapons. Mansfield thought the committee should ask the armed forces to accelerate their study of the tactical possibilities for nuclear weapons and come up with new requirements based on military judgment.

The memorandum struck a responsive chord in McMahon, who found it "challenging." Dean, in the course of explaining that the Commission dealt every day with such arguments, chose the more deliberate adjective "thoughtful." [6] There were obviously two sides to the argument, and a decision would have to wait the outcome of the Commission's studies.



## *HANFORD*

For any appreciation of the Commission's growing production capabilities, McMahon and the Joint Committee would have to understand some of the developments at the Commission's field installations, especially at Hanford. At the August hearings, Walter J. Williams, the deputy general manager, had described the first successful operation of the Redox plant just a few days earlier. Like most of the Hanford facilities, the Redox building was massive, over 450 feet long with a thirteen-story silo at one end. The desert, stripped of sage brush, bunch grass, and greasewood, was criss-crossed with truck trails leading to the clutter of construction equipment around the building. A railroad track for heavy shielded cars carrying irradiated fuel elements from the reactors, entered the low end of the building. Inside, remotely controlled machinery unloaded the car and transferred the fuel to the first cell, where it was dissolved in acid and fed through a labyrinth of pipes, tanks, and pumps in the series of cells extending the length of the "canyon" building. In the silo at the far end stood the packed columns which separated the plutonium, uranium, and waste products.

The long and uninspiring history of Redox went back to the Manhattan project, but most of the recent effort stemmed from the survey which du Pont had completed for the Commission in the spring of 1949. The du Pont engineers had begun with the premise that, although prospects for obtaining uranium ore were improving, it was still vital to recover uranium from the chemical processing operations at Hanford. The bismuth-phosphate process, developed during the war, removed plutonium from the irradiated fuel but left uranium in the wastes. The Commission wanted a process which would not only recover the uranium from wastes but would also separate plutonium, uranium, and wastes from current reactor production. The uranyl-ammonium phosphate technique which Carbide at Oak Ridge had carried into early

development stages looked good for waste recovery but not for current production. The situation was similar in the work by the Kellex Corporation on a solvent-extraction process for uranium recovery. Only Redox, which General Electric was studying at Hanford and Knolls, and which had attracted the attention of other laboratories, offered the possibility of handling recovery and current operations in a single process. Redox too presented difficulties, but du Pont had concluded that the best course was to build one plant to treat current reactor production before constructing another to recover uranium from the wastes.[7]

General Electric had come to a similar conclusion about the same time, and with this kind of agreement, the Commission in May, 1949, had approved the idea of using Redox for both purposes. Before the end of the year, however, research at Oak Ridge on other types of solvent extraction had opened new possibilities. Redox was still the best method for processing
550 current production, but for the material in the waste tanks the Commission decided to switch to a solvent-extraction process using tributyl phosphate (TBP) as the solvent. Theoretically the TBP process, developed at Oak Ridge National Laboratory, could be coupled to the existing bismuth-phosphate plant at Hanford to accomplish the purpose of Redox. Economic analysis showed, however, that Redox offered the greatest assurance for steady production at the smallest capital cost. Williams had at once ordered General Electric to abandon all work on a second Redox plant and terminated Kellex's efforts to design a link between the bismuth-phosphate process and TBP.[8]

General Electric's long development effort on Redox made it possible for the company to start final design of the plant almost immediately. Construction had started early in 1950, and by fall there was every assurance that the plant would be completed by August, 1951.

TBP had encountered the troubles often experienced in transferring a process from the laboratory work bench to the engineering drawing boards. Kellex had not been able to start design until the fall of 1950, and construction work had lagged far behind Redox during 1951. Some of the reason for the slower pace was the delay in delivering plant equipment, a consequence in part of the growing burden on industry from the Korean war. When operations started in the new Redox plant in August, 1951, the TBP plant was not yet half complete.[9]

The only other major construction project at Hanford was the new production reactor, C, which the President had authorized in October, 1949. Limited to only minor improvements in the original Hanford units, design of the new reactor progressed rapidly and construction had started in the spring of 1950. Despite the usual troubles with priorities and labor, C reactor was completed almost on schedule in November, 1952.

By the middle of 1951 both General Electric and the Commission's staff at Hanford were overcoming the construction difficulties that had plagued the project in earlier years. One factor was General Electric's grow-

ing experience with large construction enterprises. Another was the leadership of Wilfrid E. Johnson, a tough-minded engineer who understood the nerve-racking art of building a complicated facility with construction crews pressing hard on the heels of designers. Matching Johnson in talent and experience was the Commission's own construction expert at Hanford, William K. Maher. Working together, Johnson and Maher were giving Hanford a new reputation for accomplishment in construction.

## *NEW SOURCES OF URANIUM*

If at last the Commission could recover uranium from reactor slugs and wastes, the nation was still vitally dependent upon overseas sources for most of its uranium needs. About three-fourths of the Commission's raw material still came from the Belgian Congo; the rest from Canada and the Colorado Plateau.



The most striking development had been the sharp increase in domestic ore receipts in late 1950. By December, deliveries from the Colorado Plateau had exceeded the 1950 forecast by 60 per cent, and for the first time American production was greater than Canadian. Much larger quantities were in prospect from new deposits near Grants, New Mexico. The Commission's laboratory at Watertown, Massachusetts, and the Bureau of Mines laboratory at Salt Lake City had found the New Mexico ore amenable to treatment despite a high lime content. To encourage further production on the plateau, the Commission in February, 1951, had offered a new bonus for the first 10,000 pounds of acceptable but relatively low-grade ore to be produced from new or existing mines. The Commission also increased the guaranteed minimum price schedule for uranium ores. Miners on the plateau could deliver their ores directly to the Commission's processing plant at Monticello, Utah, to the Commission's ore buying station at Marysvale, or to private ore-purchasing depots. All these incentives, the Commission hoped, would soon make the plateau a major producing area.[10]

Jesse C. Johnson, director of the division of raw materials, was supporting research that he hoped would produce uranium at low cost from phosphate beds in the West and in Florida. Although the uranium content was low, the large amounts of phosphate processed in the fertilizer industry made the recovery of by-product uranium attractive. In the summer of 1951 Johnson's main concern was that personnel limitations imposed by Congress on the Commission and the Geological Survey would slow down exploratory drilling for new deposits.

Sumner T. Pike, the Commissioner with the best knowledge of the mining industry, still considered South Africa the largest potential source of uranium ore. Frank W. McQuiston, Jr., who was Johnson's deputy, had

returned from the Transvaal with encouraging news. Mine owners, who had previously limited their cooperative efforts to gold mining and marketing, were now showing an interest in working together on the technical aspects of uranium processing. McQuiston believed the first South African plant should be in production by March, 1952, and three more by October. Additional uranium might come from running gold mine tailings through flotation mills, an operation Commission officials would discuss with the South Africans in the fall of 1951. The obstacles McQuiston found were shortages of sulfur, water, electric power, and skilled labor near some of the most promising sites.[11]

The outlook for uranium deliveries from other Commonwealth nations was improving in 1951. Canada's difficulties in obtaining American technical assistance in enlarging its refinery capacity disappeared when Dean succeeded in obtaining an amendment to Section 10a of the Atomic Energy Act
552 in October. With these statutory difficulties removed, the Commission could soon expect substantial increases in deliveries from the new processing plant to be built in the Lake Athabaska region. There were also hopes for uranium ore from South Australia. Thomas Playford, premier of the state, met with the Commissioners on August 21, 1951, during a visit to Washington, to sound out American interest in uranium deposits at Radium Hill. Subsequent investigations showed sufficient quality and amounts to justify negotiations.[12]

As promising as all of these developments were in the summer of 1951, the Belgian Congo showed every evidence of continuing to be the main source of uranium for the Americans for several years to come. At least to Borden and the Joint Committee, the important point was that ore deliveries were likely to exceed requirements by the end of the year. At last, availability of raw materials would no longer be a limiting factor in the nation's atomic energy effort.

## *REACTORS FOR SAVANNAH RIVER*

The Commission's growing stocks of uranium concentrates would help to fuel the new production reactors which the du Pont Company was starting to build at Savannah River in South Carolina. The du Pont assignment included not only the five reactors but also facilities for preparing the reactor fuel, separating plutonium or tritium from the irradiated fuel elements, and producing the heavy water that would serve as moderator in the reactors.

For technical assistance in designing the reactors, du Pont depended heavily on Walter H. Zinn and his staff at Argonne National Laboratory. Stuart McLain coordinated the laboratory effort on the project and served as liaison with du Pont on technical matters. Argonne had also agreed to accept some du Pont engineers—preferably young men with advanced degrees and

some years of experience with the company—for training and work in physics, physical chemistry, chemical engineering, and inorganic chemistry. By August, 1951, sixty-six du Pont employees were working at Argonne. Much of the effort centered on the metallurgy of the fuel elements, particularly on fabrication techniques and the behavior of various alloys under irradiation. For some of these tests, Argonne was depending on the very high flux of neutrons in the Canadian NRX reactor at Chalk River. The successful use of critical assemblies in designing the submarine propulsion reactor at Argonne led to Zinn's decision to build a similar zero power reactor, called ZPR-II, which McLain expected to have operating before the end of 1951.[13]

By that time McLain's group would need about twenty-five tons of heavy water for reactor experiments. Zinn proposed to take four tons from his own laboratory, about seventeen tons from stocks at Oak Ridge, and one ton from the Trail plant in British Columbia. The rest Oak Ridge would have to produce from contaminated materials in storage. Heavy water would still be 553
in critically short supply until January, 1952, when six dual-temperature production units would go into operation at the Dana, Indiana, plant. The Dana operation had already provided valuable corrosion data for the larger, permanent dual-temperature units being built at Savannah River.

The Commission had recognized from the beginning that Savannah River would be a huge installation, but some of its dimensions were not fully apparent until the autumn of 1951. A rough estimate of costs for the entire plant was more than a billion dollars. With almost 25,000 workers on the site, the project was rapidly transforming the whole area along the river below Augusta, Georgia. Because the Commission had firmly decided to avoid operating a Government town at Savannah River, dozens of trailer camps and low-cost housing projects were springing up around the site. Drawing on Oak Ridge experience, the Commission had built some barrack-type dormitories for construction workers, but times had changed since 1943. Most of the barracks stood empty as workers preferred to live off the site, even in substandard accommodations, with their families. Curtis A. Nelson, the Commission's local manager, had all the headaches that a gigantic construction camp created, but he could take comfort in the fact that his problems were temporary.[14]

Compared to the intricacies of building production reactors and chemical separation plants, it was an easy task for the Commission to add gaseous-diffusion capacity for producing uranium 235. The original K-25-27 plant at Oak Ridge consisted of 2,800 stages, each of which included a "compressor" or pump for moving the uranium-hexafluoride gas, a "converter" or tank containing the barrier tubes which separated the uranium 235 and 238 isotopes, and the associated valves, piping, and instruments. Increasing capacity simply meant adding more stages to the long chain or "cascade" of separative units.

The new K-29 plant at Oak Ridge was an example of Carbide's

mastery of gaseous-diffusion technology. Although the new plant incorporated many design changes, including the use of axial-flow compressors, improved barrier, and remote controls, it had gone into full operation almost five months ahead of schedule in January, 1951. By August, 1951, some of the units of the new K-31 plant were also operating. When K-31 was completed in December, it would raise the total number of stages in the Oak Ridge cascade to 3,700. With their higher efficiencies, the new plants would greatly increase the output of uranium 235.[15]

By the summer of 1951 construction was moving rapidly on the C-31 and C-33 diffusion plants at Paducah, Kentucky. Despite a plague of labor disputes, construction forces by late summer had erected most of the structural steel for C-31 and had completed most of the excavation for C-33. The new plants, containing almost 900 stages of very large compressors and converters, would perform the big task of processing the great quantities of already depleted uranium which had come from the "bottom" of the Oak Ridge cascade. The gaseous-diffusion cascade was lengthening, and with it would come a multiple increase in uranium-235 production.[16]



## *TROUBLES AT LOS ALAMOS*

While Dean could see progress in the growing production capacity for fissionable material, problems at the weapon laboratory steadily resisted solution. Pressures of military requirements seemed to force Los Alamos to work from test to test, a pattern which made long-range research on weapons difficult. Dean could see some validity in Murray's arguments for another weapon laboratory. Perhaps two such installations could do more than one. Perhaps results might come more quickly if two laboratories tackled the same problem. But there were other factors which Dean had to consider. Deciding what work to take from Los Alamos and recruiting a new staff could be devastating to the morale of the laboratory on the mesa, and might even cause such confusion as to delay the thermonuclear test planned for late 1952.

Uncertain in his own mind, Dean asked the other Commissioners to study the question. When Murray, Smyth, and Glennan made their report on August 23, they agreed that continued growth in weapon research was probably inevitable and that a much larger laboratory was probably not practical. Smyth and Glennan had not yet decided on the best solution, but Murray was convinced that the Commission should either establish a second laboratory or move thermonuclear work from Los Alamos.

The tangled situation at Los Alamos was further complicated by personalities. Never satisfied with the resources Bradbury was willing to devote to the thermonuclear project, Teller had grown increasingly restless. More than once there had been rumors he was about to leave the laboratory.

When in Washington, Teller unburdened himself to Borden or McMahon, either of whom would offer a sympathetic ear. Dean usually felt the repercussions of a Teller visit. The week after his discussion of Los Alamos with the Commissioners, Dean received an invitation from Borden to join him, Teller, and McMahon for dinner at the Metropolitan Club in Washington. Believing acceptance would compromise his position, Dean had declined. McMahon was too busy with the Senate debate on the mutual aid bill to attend but he had sent a warm letter to the physicist assuring him that his services were vital to the nation and the free world.

Knowledge of the close ties between Teller and McMahon must have been at least in part responsible for Dean's concern when Frederic de Hoffmann, Teller's trusted assistant, told him by telephone late on September 11, 1951, that Teller had resigned. What made this resignation significant to Dean was that for once Teller had put his intentions in writing. Dean did not relish the task of giving the news to McMahon, LeBaron, and Lewis L. Strauss.[17]



Dean received more detail on the Los Alamos situation when Bradbury arrived the next afternoon to report on the laboratory work. Bradbury's obvious mastery of the facts renewed Dean's confidence in the laboratory and its director. Colonel Kenneth E. Fields, McCormack's replacement as director of military application, gave the same impression. An outstanding engineering officer already marked for big things in the Army, Fields had acquired a good background for his new assignment by serving under General Groves with the Manhattan project and for a brief period as McCormack's assistant. With his usual political acumen, Dean decided that a similar briefing of the Military Liaison Committee by Bradbury would dispel some of the uncertainties about the common thermonuclear effort. A telephone call found LeBaron willing. The day had been a busy one for him. At 10:00 A.M. Secretary Marshall had told him that the new Secretary of Defense would be Lovett. There would be other changes in the Department, and as a whole LeBaron thought they would strengthen the role of his group.

The next day the threatening storm over Los Alamos blew over, but the atmosphere remained charged. The first break in the clouds occurred when de Hoffmann came to Dean with news that Teller once again had reconsidered his decision to leave Los Alamos. The second break was Bradbury's performance that afternoon before LeBaron's committee. In a survey of the several approaches to the thermonuclear weapon, Bradbury reported that so far the New Super was easily the most promising. Despite the fact that some of the data were still preliminary, Bradbury could speak with confidence about possible yields, preliminary specifications for materials, and tentative schedules for testing, probably in September, 1952.[18]

Both Dean and Boyer realized that two briefings could not cure the troubles at Los Alamos, an observation Oppenheimer reinforced a few days later in a conversation with Dean. In talking with Teller, Oppenheimer had

concluded that the physicist might agree to stay at Los Alamos if Enrico Fermi, Hans A. Bethe, or Oppenheimer took over the direction of the thermonuclear project. Bethe and Oppenheimer had feared that the arrangement would only create awkward problems. Discerning in Teller signs of fatigue and strain, Oppenheimer thought Dean would have to accept as an ever-present risk the possibility that Teller might resign. Even should this happen, Oppenheimer had hopes that Teller would at least be available as a consultant.

Events at Los Alamos were not making life there any easier for Teller. In reorganizing the laboratory, Bradbury had proposed to give Teller responsibility for all theoretical work and initial design of the New Super test device. Marshall G. Holloway of W division was to coordinate Teller's theoretical work with engineering design and fabrication. Of all the scientists at Los Alamos, Holloway seemed the best for this job. As director of weapon development he had a reputation for toughness and administrative ability, both crucial qualities for meeting the 1952 test schedule. Fields agreed with Bradbury's appraisal of Holloway, but there were difficulties in the appointment. Holloway and Teller had already differed on several matters, particularly test schedules. Teller was furious. Holloway's appointment was, as one observer remarked, "like waving a red flag in front of a bull." Two days later Teller told Dean, Smyth, and Boyer in Washington that he was leaving Los Alamos, but not the thermonuclear effort. He would return to the University of Chicago, but would visit Los Alamos when needed.[19]



Los Alamos was clearly moving along the course Teller had charted in the spring of 1951. Others had made important contributions, but Teller's restless, driving, nervous energy had been the goad. In the twenty-one months since President Truman had issued his directive, Los Alamos had moved from a vague theoretical possibility to a firm idea ready for engineering and development. Perhaps the time had passed for Teller's most effective participation, but he himself was largely responsible for the accomplishments which brought about that situation.

## *McMAHON ON THE MARCH*

On August 31, 1951, Dean sent McMahon the Commission's cost study of the expansion proposals. In sticking closely to the three cases McMahon had proposed—expansions of 50, 100, and 150 per cent—the staff had decided not to consider other possibilities that might have given better results in terms of economics or composition of the stockpile. Even if preliminary, the cost estimates were revealing. For the 50 per cent expansion, construction would cost about $2.8 billion and annual operating costs would run about $220 million. The figures for the 150 per cent expansion were over $7 billion and

$774 million, respectively. Although more Hanford reactors would be the quickest route to greater plutonium production, the Commission had used the Savannah River design in its assumptions because of its promise of better performance. To meet McMahon's production goals would require from six to eighteen additional reactors at one or two new sites. The various possible combinations in gaseous-diffusion operation made the calculations for uranium-235 production more complicated, but in any case a site other than Oak Ridge or Paducah seemed desirable for strategic reasons. The new facilities would make a significant impact on the national supply of nickel and stainless-steel tubing for equipment and hydrofluoric acid and sulfur for plant operation. Estimates of the demand for labor and electric power were just as impressive.[20]

McMahon did not miss the implications of the Commission's report, but he believed the expenditure in money and material would prove economical. He told the Senate on September 18, 1951, that atomic weapons were the new hope for defense. The rhythm of recent history showed staggering national budgets, increasing centralization of government, more official secrecy, and greater restrictions on the rights of citizens. From this pattern there seemed only two choices: military security at the risk of economic disaster, or economic safety at the price of military disaster.



McMahon asserted that these need not be the alternatives. Nuclear weapons would give the United States "peace power" at bearable cost. Atomic energy could deter Stalin until his enslaved peoples could break their bonds and unite with America in peace and brotherhood. The amount the nation was spending on atomic bombs was only three cents of every defense dollar, a ratio reflecting outdated thought. McMahon proposed building an atomic army, navy, and air force. Then the nation could reduce the number of men in uniform and the heavy expenditures for conventional weapons. He then introduced two concurrent resolutions: one calling for the United States to "go all-out in atomic development and production," the other asking the people of the world to join a moral crusade for peace and freedom.[21]

From that day, McMahon was on the march. The next morning he went to the Commission's headquarters building for the Joint Committee's first briefing on weapon stockpile data. A few days later he began a series of hearings on his expansion proposals with Defense and Commission officials. McMahon was now convinced that even the 150 per cent expansion was feasible, given the money, priorities, and manpower.

Within the space of a few days McMahon and the Joint Committee heard the three service secretaries declare their appreciation of the value of nuclear weapons. In one way or another, each asserted that the Commission was not producing enough fissionable material to meet defense needs. They believed unhesitatingly that expansion of production would be in the interest of national security: anything less would squander a priceless asset for defense. Most of the testimony was of necessity behind closed doors, and

judging from the fragmentary evidence, only once did Dean get a chance to describe his understanding of how the military set its requirements for fissionable material. With Hickenlooper in corroboration, Dean said he believed that the services based their estimates on the Commission's production capacity, plus a few percentage points for an incentive.

The session with the Commissioners concentrated on the prospects for the New Super. Smyth explained that Los Alamos still did not have the computers necessary for reliable calculations, and he doubted work could go much faster without them. Most of the qualified people, in Smyth's opinion, were already contributing to thermonuclear research at Los Alamos. He thought the limiting factor was not personnel but the need to proceed one step at a time. Dean pointed to the enthusiasm over the New Super at the Princeton meeting and the steady progress since that time. Differences of opinion at Los Alamos were to Dean the sign of a healthy spirit. He admitted that Teller's departure would be a loss, but he reminded McMahon that Teller's services would still be available.



Only on the question of a second laboratory did the Commissioners reveal a difference of opinion. Dean wanted more time to study the need for a second laboratory. Murray frankly disagreed. He thought Los Alamos was already overworked and faced even heavier burdens in the future. Admittedly it would take time to move thermonuclear work out of Los Alamos but Murray could not see why the Commission could not make the decision at once.[22]

As Dean left the hearing room, he learned from Walter F. Colby, the Commission's director of intelligence, that there was evidence of a second Soviet nuclear test. Dean could only vaguely recall the incidents surrounding the first detection of a Soviet test just twenty-five months earlier, but within a few days he was feeling the same concerns that had troubled the Commissioners then. As in 1949, Truman wanted to keep a tight lid on the information until the evidence was strong enough to warrant a public announcement. Dean wondered what the Soviet propaganda machine would do if the United States never made an announcement. More to the point, he saw that complying with the President's request might well jeopardize his relations with McMahon and the Joint Committee. He thought it would be safe to tell McMahon even if the President did not wish to make a public statement at once. Within a few days, however, Dean had worked out a public statement with LeBaron and James S. Lay at the White House. The brief statement, released on October 3, 1951, did little more than acknowledge the event and point out that it discredited the Soviet claim of exclusive devotion to the peaceful uses of atomic energy.

As Dean expected, the news of the second Soviet test quickened McMahon's pace. If Dean and Smyth had done anything at the September 28 hearing to convince McMahon that the second laboratory question needed

more study, news of the Soviet test placed the issue again in a context of urgency. McMahon had but one question for Dean: "Could you do more than you are doing to speed the hydrogen program and improve chances of ultimate success?" McMahon was convinced there could be only one answer.[23]

## *DEFINING MILITARY REQUIREMENTS*

The study the Joint Chiefs had requested in June the Commission sent to LeBaron on September 25, 1951. The Commission's first inclination had been to make the exercise into a broad policy study involving the State Department, but LeBaron had convinced the Commissioners that only an engineering study for the Joint Chiefs was needed at this moment. Both the Commission and the liaison committee would review the study before it went to the chiefs. With these understandings, the Commission staff, with help from LeBaron's group, restricted the analysis to the technical dimensions of the expansion effort. If the United States continued to acquire most of the uranium mined in the free world, it would be feasible to triple the production of plutonium and perhaps even of uranium 235. Requirements in manpower and critical materials would be high but not limiting, provided the effort had the highest priorities.



Instead of calculating across-the-board percentage increases in uranium and plutonium production, the group analyzed several combinations. For plutonium production, the analysts proposed two new sites, one for graphite reactors, the second for heavy-water units. For uranium 235, there were several possibilities, but one of the most attractive was a new site so that not all the gaseous-diffusion capacity would be a concentrated target for an enemy attack, and so that the heavy power demands could be met by a different utility net. Replete with tables of cost data, construction schedules, and possible stockpile combinations, the study gave some idea of the complexity of the issues and the need for careful weighing of alternatives before a final decision was made.[24]

Dean stressed this point in a conversation with LeBaron on October 1. The Commission was not yet ready to recommend a course of action and wanted to discuss the report with LeBaron's committee. Apparently LeBaron understood, for he assured Dean that the Joint Chiefs had taken no position on the subject.

That there had been a misunderstanding became evident on October 5 when the Commissioners met with the liaison committee. With misgivings, Murray, Smyth, and Glennan heard LeBaron announce that he had already sent the study to the Joint Chiefs. Dean, in California on a speaking engagement, was not present to take up the Commission's cause. Admiral Frederic S.

Withington added to the Commissioners' uneasiness by remarking that the committee had also recommended certain percentage increases to the Joint Chiefs.

In Dean's absence, Smyth spoke for the Commission. He thought the military were moving too swiftly. The issues were too complex. A quick decision could foreclose a course of action which more analysis might prove to be better. Because of the probable impact of the expansion on the national economy, Smyth held that not even the Joint Chiefs and the Commission together could make the decision. That power rested with the National Security Council, the President, and the Congress. LeBaron did not deny Smyth's assertion; he simply stated that the logical first step was to define military requirements. Smyth still had his reservations. As a citizen, he was worried about undertaking a huge and costly program which would not add to the stockpile for years.[25]

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Beneath the immediate issues were the philosophical differences that had disturbed the Commission's relations with the military establishment since 1946. Lilienthal's struggle over custody of the stockpile in 1948, Dean's insistence in 1950 upon a civilian voice in any decision to use nuclear weapons were both related to the fundamental question of the Commission's part in making national policy. Did the Commission, as Dean believed, have an obligation under the Atomic Energy Act to participate in policy matters which bore upon the production or use of nuclear weapons? Or was LeBaron correct, as a memorandum from his committee had suggested, that in the development of atomic weapons, the Commission and the Department of Defense fell inevitably into a contractor-buyer relationship? It was an interpretation of roles the Commission did not accept. To Dean and his associates the Commission was an independent agency, with a positive responsibility to the President and the Congress. It was not a contractor to the Department of Defense for the atomic weapon program.

The actual course to be followed probably fell somewhere between the two positions. As Fields suggested, the Act seemed to indicate that both agencies were to work together for the common good. In practical terms, there was no disagreement on the need for further expansion, but only a question of size and speed. The answer would depend in large part on the capabilities of American industry and the supply of critical materials.[26]

While the Commissioners were debating with LeBaron, Boyer was trying to gauge the reaction of key contractors to the proposed expansion. In New York, Ralph J. Cordiner and Harry A. Winne of General Electric expressed some interest in new reactors at Hanford, but they were less certain about a new site. They thought they might have trouble convincing their board of directors that the company should take on a large project which promised small monetary returns. A second site using graphite reactors would compete with Hanford, and any larger role for General Electric would interfere with defense orders for turbogenerators. At du Pont, R. Monte

Evans and Granville M. Read saw no difficulty in building more heavy-water reactors at Savannah River, but they too hesitated over a new site. They wanted nothing to do with graphite reactors and had reservations about taking on the construction job.[27] Boyer must have listened to these arguments with understanding. His industrial background made it easy for him to sympathize with manufacturers who found their plant capacity increasingly absorbed by military demands triggered by the Korean war. On the other hand, as general manager he knew how few companies could meet the Commission's needs. Somehow McMahon's enthusiasm and industry's realism had to be brought into harness.

## *A QUESTION OF NATIONAL POLICY*



From experience the Commission could be confident that when national policy questions arose, the Joint Committee would speak out. In a hearing on October 8, 1951, Representative Henry M. Jackson explored not only what the Commission could do, but also how the committee could help to speed expansion. The next day he urged in the House a large commitment in money and resources. Many of his arguments were similar to McMahon's, but Jackson put more stress on the tactical value of nuclear weapons. Because the number of strategic targets seemed limited, military planners had seen no need for large numbers of weapons. Jackson thought that argument, if ever valid, was no longer true. The nation's military strategists were in the midst of an intellectual revolution and were beginning to see the whole range of possibilities for nuclear weapons. This new conception of nuclear defense might cost the nation $6 to $10 billion annually. Jackson's appeal for tactical weapons inevitably raised questions about their possible use in Korea. Although truce talks had begun in July at Kaesong, American newspapers were still carrying stories of "Heartbreak Ridge" and "Bloody Ridge," names which reflected the stalemate in which General Matthew B. Ridgway's forces were locked along the 38th parallel.[28]

Glennan pondered over the course of events and with Smyth wondered whether the Commissioners were measuring up to their responsibilities. Few Americans had the facts to judge the need for expansion. By and large, Glennan believed, the statements of Congressional leaders, military officers, and newspaper reporters were misleading. Except for the Joint Committee, the nation's elected representatives knew little more about atomic energy than the people themselves. Glennan thought this lack of understanding surely caused the troubles the Commission had encountered in appropriation hearings. The amounts the Commission had requested in the past would seem small compared to those likely in the future. These considerations, Glennan admitted to his colleagues, probably came too late, as did most soul-searching, but he was

not convinced of the need for haste nor could he find it easy to support the expansion effort with the information available.[29]

Some of these thoughts were in the air when the Commissioners met with the General Advisory Committee on October 11, 1951. Smyth urged the committee not to confine itself to technical matters but to take up the broad question of production goals and national policy. Perhaps recalling events in the fall of 1949, the committee declined to enlarge the scope of the discussion, but there were some observations reassuring to the Commissioners. Because the expansion effort would not produce results for several years, the committee thought the Commission should concentrate on maximizing production from existing facilities. Moreover, improvement by the military in their delivery systems was the equivalent of enlarging the stockpile. The committee also heartily endorsed Bradbury's plans for weapon development and preparations for the *Buster-Jangle* tests that would begin in a few days in Nevada.

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The only policy issue the committee was willing to consider was the question of a second weapon laboratory. Willard F. Libby argued that the best way to ease the burden on Los Alamos was to move thermonuclear weapon development to a new site. Isidor I. Rabi countered that a second laboratory would cause a scramble for the few good people available. Bradbury argued that competition made no sense in research. He thought the proper course would be to relieve Los Alamos of routine production assignments it had acquired in recent years. When the discussion ended, the committee, except for Libby, would go no farther than to recommend a reduction of workload at Los Alamos. The only argument the committee could find for a second laboratory was to make use of people who would not work at Los Alamos, and the committee knew of no one in that category.[30]

The failure to gain broad support from the General Advisory Committee was but the first disappointment the Commissioners encountered that week. The chances of stopping a headlong rush into a huge expansion now seemed slim. On Wednesday, October 17, McMahon sent Dean a copy of the resolution Jackson had been discussing on October 8. Stripped of its parliamentary phrasing, the resolution called upon the Commission and the Department of Defense to send the committee by January 3, 1952, a report "on maximizing the role which atomic energy can and should play in the defense of the United States. . . ." The committee wanted a definite plan, complete with cost estimates, numbers and specific types of facilities, lists of priorities, and appraisals of the probable impact on other defense projects and the national economy.[31]

The second shock came on Thursday morning when Dean heard that the Joint Chiefs had come to a decision on the expansion effort. Dean and Smyth hurried to the Pentagon to see Lovett. No determination should be reached, they argued, until other Executive agencies—the Bureau of the Budget and the Defense Production Administration, to name two—had been consulted. Lovett said he would try to keep the matter open, but pressures for

budgetary funds and allocating critical materials were forcing the Joint Chiefs to take a position. Further, Lovett observed, their action was only the first step toward a decision.[32]

On Friday Dean received the official notice that the Joint Chiefs had recommended a specific expansion in plutonium and uranium-235 production. Furthermore, this was to be only an interim plan because the Commission's engineering study had shown that uranium concentrates would be available for a larger increase. Military requirements would determine the final figure, and the Joint Chiefs warned that it might exceed ore supplies.[33] The Commission's first reaction to the Joint Chiefs' statement was one of exasperation. Smyth wanted to search the record for proof that Defense had agreed not to act without consulting the Commission. Dean took the pragmatic view that the expansion was inevitable. Before he left for a trip to Los Alamos, he pointed out that it was the Commission's task to accomplish the increase in production capacity swiftly and effectively.



## *BUSTER-JANGLE*

Dean left Washington on Friday afternoon for Los Alamos. He had many things to discuss, but the preoccupation at the moment was the start of *Buster-Jangle*, the second test series of the year in Nevada. The double name for the series reflected the complexities of management and planning that had overtaken weapon testing. *Buster* had been the designation for the Los Alamos plan for developmental tests of new weapon models. *Jangle* had been assigned to a number of experiments on weapon effects, originally scheduled for the canceled *Windstorm* series in 1951. *Jangle* had grown into an elaborate study of physical effects of blast, radiation, and heat as related to the special interests of the armed services, the Federal Civil Defense Administration, and the U. S. Public Health Service.

Meshing the two series at the Nevada Proving Ground with their differing aims and large numbers of personnel had placed additional burdens on the Commission's Los Alamos staff headed by Carroll L. Tyler. An added complication was the Army's decision to use the tests for a combat training exercise. Tyler found that some of the military equipment to be tested had been so hastily set up that it would be difficult to obtain any reliable data. He concluded that in the future the Commission would have to assume complete jurisdiction over Nevada tests; there could be no more joint operations with the military participating with its own units in its own areas.

The first shot in the series was to have been on the day Dean left Washington. When everyone was in place and the test group had completed the elaborate countdown procedure, the test director gave the order to fire. For once the blinding flash and thunderous roar did not shatter the desert

peace. A failure in the control circuit, not in the device itself, had been the cause. Still, Dean remarked, "It must have been an awfully funny feeling." Fortunately, the event turned out to be only a minor incident in an otherwise successful series.[34]

## *THE COMMISSION TAKES A STAND*

Dean returned to Washington on October 24. Only two days earlier the White House had announced the third Soviet nuclear test. Although he could expect the demand for expansion to increase more than ever, among his colleagues nothing much had changed. Pike was adamant, holding that the Commission had a responsibility to pass on the need and goals of the expansion. To him

the Commission was more than a technical adviser to the Department of Defense. Glennan was inclined to accept the Joint Chiefs' interim goal, but he thought final action should await further studies of priorities for manpower and materials. Only Murray was ready for immediate action. He urged the Commission to join the Department of Defense in recommending the Joint Chiefs' proposal to the National Security Council. He pressed for the Commission to begin selecting plant sites and contractors and to adopt a new ore procurement goal of 10,000 tons per year by 1955.[35]

A session on October 25 with Charles E. Wilson, head of the Office of Defense Mobilization, gave Dean a better idea of the priorities situation. Among the requirements for the Joint Chiefs' proposal, only those for nickel and stainless steel would prove troublesome. Structural steel, not on the list, would be in short supply through 1952. For the highest or overriding priorities, the Commission would need approval from the Defense Department or the President. Wilson was against superpriorities, because once they were established for one project, other similar priorities tended to creep in and so defeat the purpose. The best thing the Commission could do would be to define its needs quickly and replace rumor with fact.[36]

From exploring priorities with Wilson, Dean and his associates turned back to considering the course they should follow. They had two choices: accept the Joint Chiefs' goal and join in a recommendation to the National Security Council, or try to bring the entire question of expansion, with all of its ramifications, before the council. Dean agreed with Smyth that the latter alternative was better. The council would be a forum for Secretary Dean G. Acheson's assessment of the international implications as well as for Wilson's estimates on economic effects. Only the council could consider such aspects as the value of expansion as a national investment, and the possible psychological advantages of producing fissionable material in excess of military requirements. Save for Murray, all the Commissioners agreed that they should bring

the matter before the council, along with their opinion that expansion beyond the level set by the Joint Chiefs would place a severe strain on the economy.

Murray dissented because he believed that misunderstandings between the Commission and the Department of Defense were causing confusion and delays in the nuclear weapon program, which was vital to national security. Not until the role of each agency was clarified would doubts and hesitations be swept away. For his part, Murray believed the Department of Defense should decide the size of the expansion, and the Commission its technical feasibility. On this basis he was prepared to approve the Joint Chiefs' proposal. He had never accepted the argument that ore supply was the limiting factor to plant expansion. He was certain that a vigorous effort would reveal sufficient quantities to support a multiple increase in fissionable material production.[37]

Lovett read both the majority opinion and Murray's dissent. He had no objection to referring the broad issue of expansion to the National Security Council so long as there was no question about the interim goal or the responsibility of the Joint Chiefs and the Department to determine military requirements for atomic weapons. These qualifications swept away the last bit of ground on which the Commissioners were trying to stand. They were no more successful than Lilienthal had been in 1949 in challenging the Department to reveal the basis for military requirements. In time, however, Lovett's one concession might prove important. The very process of preparing a study for the National Security Council and the President might afford the Commission an opportunity to raise issues beyond those of technical feasibility.[38]



## *REPORT TO THE PRESIDENT*

Whatever success the Commission might ultimately have in raising the broader issues, the first step was to obtain the technical data for the study. This task was the prime responsibility of Major General Thomas F. Farrell, who, as assistant general manager for manufacturing, had inherited most of Carleton Shugg's duties as a top-level expediter. Farrell had served for twenty years as a civil engineer on large public works projects in New York and about as long as an Army officer in the Corps of Engineers during both World Wars. His knowledge of atomic energy stemmed from his service as General Groves's deputy in the final months of World War II, as a member of the evaluation board for the Bikini weapon test in 1946, and as an adviser to Bernard M. Baruch in the United Nations Atomic Energy Commission. Farrell had returned to active duty in the Army for the Korean War and came to the Commission from the Defense Production Administration.[39]

By the middle of November, 1951, Farrell had both headquarters and the field offices preparing for expansion. The Corps of Engineers and Stone & Webster Engineering Corporation were investigating new sites for a reactor facility and for a gaseous-diffusion plant. Du Pont at Savannah River, General Electric at Hanford, and Carbide at Oak Ridge were planning the steps they would take should the President approve the new expansion. As data flowed in from the field, the headquarters divisions compiled information on critical materials and equipment for the Munitions Board. Manly Fleischmann, administrator of the National Production Authority, did his best to help the Commission in procuring scarce items, meeting electric power requirements, and obtaining priorities. The headquarters staff was also collecting data for the expansion plan McMahon had requested and a separate study of the requirements for tripling existing production capacity.[40]

The Commissioners were concentrating their attention on the report to
566 the council. Lay, after talking to Smyth, suggested that the Commission confine its formal study to technical matters, and leave policy issues to a covering letter. Lay's proposal might have made easier the preparation of the report, but there was still much to be done. If the White House deadline of the end of November were to be met, the Commission would have to make a special effort with the Department of Defense to reach an understanding of many aspects of the study.[41]

That common ground would be difficult to find was apparent in the Commission's discussions with the Military Liaison Committee on November 20. LeBaron saw in McMahon's goal of maximizing production a mandate for the Commission to stockpile as much ore as possible before new plants were completed. Manson Benedict, director of the Commission's operations analysis staff, explained that ore stockpiling alone was not the most effective means of accumulating resources. It would be more economical to run the new material through the gaseous-diffusion plant as rapidly as possible so that it would be at least partially enriched for further processing in an emergency. To the suggestion that the Commission obtain as much thorium ore as possible, Dean replied that there were no plans to develop weapons using uranium 233.[42]

Priorities seemed to be the biggest stumbling block to agreement between the Commissioners and the committee. LeBaron was mainly concerned about materials and equipment which were needed for new facilities but which were also in short supply for military projects. Until the Commission provided detailed schedules, the Munitions Board could make no firm commitments. The Commission, however, was worried less about the future than about plants presently under construction. Boyer held that completion of the first Savannah River reactor had already fallen behind six months. In most cases the amount of material responsible for delays was small in comparison with requirements for the whole defense effort. Boyer argued that giving the Commission top priorities on these small amounts of critical

material would not jeopardize the big military projects. LeBaron made it clear that he would not support a Commission claim to priorities that would override those available to the military. He saw no choice for the Commission except to struggle along from one delivery crisis to another and to meet construction schedules as best it could.

In the closing days of November the Commissioners were hard pressed to follow all the ramifications of the expansion report to the President. The study of technical feasibility alone, which Boyer presented on November 27, contained a number of perplexing questions. It seemed likely, for example, that Jesse C. Johnson and the division of raw materials could procure the 6,500 tons of uranium concentrates required for the expansion effort by 1955, but how much could the Commission count on obtaining the 12,500 tons needed by 1961? Construction of additional reactors at Hanford and Savannah River would meet the Joint Chiefs' recommendation for the increase in plutonium production, but the increase in uranium-235 output would require a third site for a gaseous-diffusion plant. A 200 per cent increase, tripling the production of both materials, would probably require several new sites. Estimates of needed critical materials, manpower, and money seemed fantastic. The Joint Chiefs' plan would cost $5 billion for plants and equipment and would require $1.3 billion for annual operations. The same figures for the 200 per cent expansion were $10 billion and $1.8 billion.[43]



The striking fact was that, even with all this expenditure of money and resources, neither expansion would have any appreciable effect on the weapon stockpile before 1956. Even then, the Joint Chiefs' plan would have a much greater impact than the "200" plan for several more years because the large amount of uranium needed to fill reactors would not be available for weapons. Boyer and the staff concluded that the chiefs' plan appeared feasible and appropriate, but the 200 plan appeared inadvisable in view of the heavy incremental costs and the meager contribution to the stockpile before 1961. Boyer thought the Commission could better spend its money and effort on improving procurement schedules in existing construction projects, designing more efficient reactors and production processes, and improving weapon design.

The Commissioners decided that with a few minor changes the feasibility report could serve as the basis for a recommendation to the President. One revision was to delete the word "appropriate" from Boyer's statement that the plan was "feasible and appropriate." The second adjective seemed to go beyond the Commission's authority. Murray's unflagging optimism that with sufficient effort enough ore could be found to meet any expansion required another change. Smyth would add to the memorandum transmitting the study to the National Security Council a statement that the Commission would increase its efforts to stockpile ore, whether or not the President approved a new expansion.

The memorandum which accompanied the feasibility report added

certain qualifications to the general statement that the Joint Chiefs' plan was feasible. The Commission observed that it was already embarked on an expansion effort which would be completed by January, 1955. Improvements in weapon design would have the effect of still another addition to the stockpile. With the new plants under construction, the Commission could eventually reach any weapon goal; more expansion would only ensure reaching that goal by a specific date. Because a new expansion would have no immediate effect on the stockpile, a recommendation for additional facilities would have to rest on the premise that otherwise production after 1956 would not be adequate. The memorandum contained a final warning about the need for overriding priorities of the type the Manhattan project had enjoyed.[44]

Following Smyth's earlier suggestion, the Commissioners wanted to submit a general policy statement going beyond questions of technical feasibility. As a first draft, Smyth had prepared a list of topics which he believed
568 the National Security Council should consider before making any recommendation to the President. Many of these clearly went beyond the Commission's purview. How did estimates of the danger of Soviet attack fit with the fact that any new expansion would not be effective until 1956 or 1957? What understanding did the United States have with its allies about the use of nuclear weapons on hostile troops occupying their territory? Considering the already impressive destructive capacity of the stockpile, was another major expansion justifiable or desirable? What were the assumptions underlying requirements for strategic or tactical weapons? What were the limitations imposed by radiological hazards on the use of nuclear weapons? How did improvements in weapon design or the promising outlook for a thermonuclear weapon affect requirements? Obviously the Commission could not answer such questions; but, as Smyth stated in a covering memorandum, the representatives of State, Defense, and the Commission would have to consider these and other matters in coming to a decision.[45]

The Commissioners accepted most of the topics in Smyth's draft, although Murray took exception to some of the phrasing. The remedy, which Smyth himself proposed, was to make clear in the covering memorandum that the Commissioners did not necessarily approve the precise language in agreeing that the topics deserved consideration. With this qualification, Smyth's draft could go to the White House. It would now be up to Smyth as the Commission's representative to carry these ideas forward in discussions with State and Defense.[46]

## *A SECOND LABORATORY?*

Priorities, procurement goals, construction schedules, and all the other questions which the expansion proposals raised were still overriding concerns

when the General Advisory Committee arrived in Washington on December 13, 1951. Smyth described the Commission's efforts in preparing the feasibility study and some of the reasoning that went into it. Boyer and the staff needed most of the afternoon to explain the tables in the feasibility report and the troubles the Commission had encountered in getting adequate priorities for current construction projects.[47]

Important as the issues surrounding the expansion plans were, the uncertain future of Los Alamos was of even deeper concern to those assembled in the Commissioners' conference room. Bradbury's convincing defense of Los Alamos at the committee's October meeting had merely staved off proposals for a second laboratory. If anything, opinions had hardened in the two months since the October meeting. In a letter to Fields, Bradbury had spoken caustically of the "rather thinly veiled criticism" that progress on weapon research and development at Los Alamos was not adequate to the national need. He could only "invite attention to the somewhat ironic fact that every current weapon development has arisen out of the suggestion (and in many cases, the urging) of this Laboratory." Bradbury found it hard to accept criticisms of the laboratory's research efforts at the very time Los Alamos was being called upon to assume a greater burden of what might be called routine production tasks for national defense. Even harder on morale was the Commission's lack of confidence in the laboratory. At least, Bradbury read that attitude into the Commission's repeated delays in approving construction of badly needed buildings and the exasperating requests to justify and rejustify space requirements. As for the charge that Los Alamos had failed to attract personnel, Bradbury pointed to the extensive campaign that John A. Wheeler had organized for thermonuclear research at Princeton. Out of more than a hundred scientists approached only eight had accepted.[48]



If Bradbury's arguments were covered with a veneer of reasonableness and practicality, Teller's were frankly emotional and intuitive. Far from dampening his interest in a second laboratory, Teller's departure from Los Alamos had increased his concern. Early in November, he had called on Oppenheimer at Princeton to express his lack of confidence in Los Alamos. With an intensity few others could muster, he told Oppenheimer that the General Advisory Committee had been wrong in failing to support the proposal for a second laboratory at the October meeting. He wanted a chance to talk to the committee in December. Oppenheimer had agreed.[49]

Teller met with the advisory committee on the morning of December 13. He began by expressing his great respect for his former colleagues at Los Alamos. They were experts in their craft, but their tendency to set for themselves a sequence of limited goals stultified the spirit of research. In the past this approach had made good use of the laboratory's limited resources, but it could not exploit all the possibilities for thermonuclear research. The inflexibility of the Los Alamos organization had been discouraging to some scientists interested in thermonuclear development. Teller did not demand

that the new laboratory have the responsibility for all thermonuclear research, but he thought that should be its chief interest. The new facility should also be free to explore other kinds of nuclear weapons and engage in pure research. The laboratory should be as small as possible, probably requiring not more than three hundred people.[50]

The committee's reactions to Teller's remarks ranged over many questions. If there were a new laboratory, how would it recruit personnel? What would be its relationship to Los Alamos? If there were no second laboratory, what changes would bring Los Alamos up to Teller's standards? Throughout the debate Teller insistently maintained the need for urgency. The United States had been slow to take up the thermonuclear weapon; perhaps the Russians were already ahead. Teller warned against postponing the decision on the new laboratory until the test of the New Super device. Success of the test would bring a spirit of complacency which would make recruiting for a
570 new laboratory all the more difficult. To Teller the success or failure of the test device was largely irrelevant to the second laboratory issue, for the test, although important, was only a step toward the goal of a thermonuclear weapon. Beneath his arguments ran the theme that fission and thermonuclear weapon development had grown too large for Los Alamos alone.

Perhaps to give some balance to Teller's views, Oppenheimer had asked Darol K. Froman from Los Alamos to attend the meeting. Ostensibly Froman was there to discuss the results of the *Buster-Jangle* tests and to describe the laboratory's plans for the future, but inevitably the conversation turned to the second laboratory. Froman spent the lunch hour discussing Teller's ideas with the committee members. In the session after lunch he told Oppenheimer and the committee that he could not support Teller's proposals. He repeated familiar Los Alamos arguments: A new laboratory would lead to competition for already scarce talent, while a new thermonuclear division at Los Alamos would create administrative complications.

In the final session of the meeting on December 14, the Commissioners heard Oppenheimer summarize the committee's opinions on a second laboratory. There was general agreement with Teller and Murray that the situation called for more effort and perspective than Los Alamos was bringing to thermonuclear research. It was also important to find some solution that would make the best use of Teller's abilities. Between Teller's insistence on a new laboratory and the limited organizational shifts Bradbury was willing to make, the committee saw an intermediate possibility. A new division at Los Alamos, explicitly charged with broad, long-range assignments and carefully protected from immediate demands, might be the solution. The new division would need a leader acceptable to both Bradbury and Teller, and the committee would have to be diplomatic in suggesting the idea to Bradbury. Rabi did not wish to confront Los Alamos with an ultimatum, but rather to ask the laboratory for suggestions. Individual members of the committee might be able to talk informally with Bradbury. This common-sense approach appealed

to the Commissioners, although Murray thought more should be done. Oppenheimer ended with one further point: If the Commissioners accepted the proposal, they would have to act soon. The time for decision was short.

Fields and the division of military application shared the committee's reservations about the need for a second laboratory. A few days after Teller's appearance, Fields presented a comprehensive study of the Los Alamos workload. His report had originated in the September discussions of the second laboratory. In recent years, Fields admitted, Los Alamos had taken on certain production operations on an emergency basis; but the long-term trend was to transfer nonresearch functions elsewhere. New facilities at Sandia; Kansas City, Missouri; and Burlington, Iowa, since 1949 had taken over much of the production and testing of weapon components; and a new plant then under construction at Rocky Flats, Colorado, would further relieve the burden on Los Alamos. After considering past accomplishments at Los Alamos, predicting trends in weapon development, and analyzing the value of competition as a stimulus to research, Fields concluded that a second laboratory was neither desirable nor necessary. One point in Fields's summary intrigued the Commissioners. He suggested that a sense of responsibility for results would be a more effective spur to progress than competition between two laboratories. This argument, plus a catalog of undeniable difficulties a second laboratory would raise, was convincing. If Fields could reduce the workload at Los Alamos, as he proposed to do, there would be no need for a second laboratory. With only Murray dissenting, the Commissioners accepted Fields's recommendation. Bradbury had won the second round.[51]



Before the end of December, Bradbury sent the Commission his plans for the next eighteen months. In fundamental research, the laboratory would continue theoretical and experimental studies of nuclear reactions, cross-sections, and the fission process. Chemistry, radiochemistry, and cryogenics would receive a share of the effort, as would metallurgy and research on high explosives—particularly the mechanism of detonation, equations of state, and hydrodynamics. In describing plans for reactors, accelerators, and computers, Bradbury expressed the hope that the MANIAC would come into operation at Los Alamos during the period. He cited a number of important areas for research on both fission and thermonuclear weapons. For what he hoped was the last time, Bradbury presented his plans for fabricating weapon components at Los Alamos. By July, 1952, he expected all production and stockpiling activities to be transferred elsewhere.[52]

Bradbury's plans for full-scale nuclear tests were impressive. At the Nevada Proving Ground there would be the *Snapper* series in the spring, *Upshot* in the fall of 1952, and a third series in the spring of 1953. At Eniwetok there would be tests in both years. Most attention, however, centered on the Eniwetok series in the fall of 1952. That series, already called Operation *Ivy*, was designed to test the New Super approach.

Through December, 1951, the Commission staff and the Military

Liaison Committee pressed hard to complete the expansion studies for the President and for McMahon and the Joint Committee. One of the most difficult parts of that task was formulating military requirements. As Lovett pointed out to Lay on December 11, the Joint Chiefs were now developing military requirements based on actual needs and independent of uranium ore supplies or production schedules. Therefore the expansion of plutonium and uranium-235 production recommended by the Joint Chiefs was only an interim measure. Lovett did not believe that the Joint Chiefs of Staff could ever state categorically that one certain number of weapons would assure the security of the United States. There were too many variables. Enormous strides in weapon technology had widened the variety of targets suitable for atomic weapons, and new delivery systems, including artillery, would soon be available. Still another factor was the estimation of Russian capabilities. For all these reasons the total number of atomic weapons needed was uncertain, if
572 not unlimited. He believed that the recommendations of the Joint Chiefs should be adopted, with the understanding that a complete study of weapon needs would probably lead to greater requirements.

Lovett's position crystallized the doubts held by Smyth and Glennan. Smyth saw no hope of getting an understanding of weapon requirements that would permit him to judge the need for expansion. Convinced that the nation could no longer assume that there were unlimited resources for defense, he did not see how the President could separate atomic energy from the rest of the military effort. Glennan had come to the same conclusion. He did not construe the Atomic Energy Act as granting the military a blank check for ordering military weapons. The heart of the Commission's concern lay in Lovett's letter of December 11 to Lay. After setting forth that the Joint Chiefs' proposal was only interim, Lovett had acknowledged that ultimately the President would ask, "How much is enough?" Lovett had given no real answer. "It is my opinion that we must err, if we must, on the side of rather too much rather than too little, within our economic capabilities and the over-all defense effort." [53] The wording was vague, the qualifications obscure, but the meaning was plain. Lovett was offering to the Commissioners nothing they could accept to justify spending $5 billion on expansion.

# *THE END OF THE QUEST*

## CHAPTER 18

Gordon Dean might have had some reason to hope that 1952 would bring major decisions on issues affecting the Commission. As the year began, he was preparing for a meeting with President Truman, Secretary of State Dean G. Acheson, and Secretary of Defense Robert A. Lovett on expanding fissionable material production. No doubt there would be an expansion, but Dean could not have guessed how thoroughly the group would consider the basis for military requirements or would assess the impact of expansion on the national economy. At least the Commission had been successful in creating a situation in which these matters could be examined if the President desired. The meeting would also give Dean a chance to raise the need for priorities on scarce materials, a rasping issue between the Commission and the Department of Defense. He might also have suspected that the year would see a decision one way or another on a second weapon laboratory.

Of one thing he could be certain: The quadrennial cycle of the American political system would bring a summer and fall of presidential campaigning. The election would take place near the time planned for the detonation of the thermonuclear device, designed as a full-scale test of the principles of the New Super. Success of the test would ratify the decision made almost two years earlier that the nation had to have a thermonuclear weapon as part of its atomic shield.

### *THE CHURCHILL INTERLUDE*

As 1952 began, official Washington awaited the arrival of Winston S. Churchill, for the second time prime minister of Great Britain. Even before the Conservative victory in October, 1951, observers in the American Embassy

had predicted Churchill would reorganize the British atomic energy program and strive to restore its close ties to the United States. Judging from experience, the Americans could expect their old friend to use all the eloquence at his command and it behooved them to look to their negotiating position.

In preparing for the Churchill meetings, R. Gordon Arneson incorporated the State Department's ideas in two position papers, one for the Commission, the other for the Department of Defense. For the impending negotiations Arneson saw the United States goals as continuing existing arrangements under the *modus vivendi* and convincing the British of the need to tighten personnel security procedures. To these the Commissioners added a third purpose: to determine whether new elements in the British program offered promising areas for additional cooperation. For their part, the Joint Chiefs of Staff cautioned vigilance to assure that the United States retained full freedom to decide when and where to use the atomic bomb.



On January 5, 1952, the British party landed at the National Airport. After the usual honors, Truman led the seventy-seven-year-old Churchill to the battery of microphones. "I hope," said Truman, "you will enjoy your visit. I hope it will be a satisfactory one." After Churchill responded briefly, Truman added: "Peace on earth is what we are both striving for." [1]

The next evening Churchill was host at the British Embassy to Acheson, Lovett, and General Omar N. Bradley. After dinner the Americans sat around a table with Churchill; Anthony Eden, again secretary for foreign affairs; Sir Oliver Franks, British Ambassador; and Lord Cherwell, Churchill's scientific adviser and a veteran negotiator with Americans on atomic energy.

The conversation ranged widely, from the Near East, where Mohammed Mossadegh of Iran was causing difficulties over oil, to the Far East, where the Americans and British differed over policy toward Chiang Kai-shek. Korea brought up the subject of the atomic bomb. What would happen, the British asked, if there were no armistice, or if an armistice were later broken? The resulting speculation included suggestions of a blockade and air attacks against China. In response to Churchill's opinion that use of the bomb would be unwise, Bradley observed that in the present circumstances there were no suitable targets for this weapon in the Far East. Presumably events could change the situation, but Bradley thought any such discussion was highly theoretical.[2]

In the late afternoon of January 7, Churchill and Truman met at the White House with their advisers to discuss atomic energy. The Prime Minister recalled the days of cooperation during World War II, mentioned the restrictions of the American Atomic Energy Act, and referred to British progress. He disclaimed any desire to go beyond the Act, but he felt certain that talks between Cherwell and the appropriate American authorities could replace the existing unsatisfactory situation with effective cooperation. He suggested a number of areas in which mutual assistance would be beneficial.

Churchill's proposal made sense to Truman. Quickly Acheson and Lovett cautioned that conditions of cooperation had changed. A recent amendment to Section 10a of the Act stipulated that a nation receiving American atomic energy information would have to have an adequate security system. Churchill was confident the British would meet the requirement.[3]

Dean had been out of Washington, first at Savannah River and then in New York when Churchill arrived. On January 9, Dean met Cherwell at a dinner party at the McMahons'. The next morning in Dean's office Cherwell met Smyth, Robert LeBaron, and Arneson. Dean had outlined in advance the points he wanted to cover: the difficulties caused by Fuchs's defection, the limitations on information exchange imposed by the Act, the recently added requirements for adequate security standards, and the spirit in Congress which militated against any general exchange of information.

Cherwell began by setting forth the principle that any cooperation which enabled the British to make more effective use of uranium would be to the advantage of the United States. Agreeing in general, Dean asked for specific topics for information exchange. Cherwell offered several areas, some of which Dean thought verged on weapon information, a topic expressly excluded by the amended Section 10a. LeBaron observed that his department had taken no part in formulating the amendment, and would doubtless have to exercise its own judgment on each request for information. Sensing a dangerous challenge, Cherwell promptly and vigorously reminded the Americans of the spirit of the Churchill-Truman conversations a few days earlier. The logical extension of LeBaron's position, Cherwell believed, would only lead to an unimportant exchange of unclassified information. LeBaron observed that the only significant data in atomic energy fell into the prohibited category of weapons. Cherwell countered by pointing to British efforts to develop power reactors.



It was evident, as Dean frankly admitted, that the Commission and the Department of Defense had differing views. Dean suggested, with LeBaron's concurrence, that the two nations try exchanging information for a year to see if further legislative changes were needed. Before the meeting broke up, Cherwell asked again whether the Commission considered exchange with the British in the United States' interest. Dean firmly agreed, and Smyth voiced his hope that within a year or so it would be possible to coordinate their production efforts.[4]

Cooperation with the British was still a sensitive subject, to be treated cautiously and with deference to Congressional and Defense sensibilities, but it no longer held the explosive power which had caused so much anxiety only a year or two earlier. Probably several factors accounted for the change. The second and third Russian detonations must have been grim reminders of who was friend and who was foe. The British program was now substantial, and its leaders could confidently expect to test a nuclear device in the fall of 1952. There was also reason to hope that tighter personnel security regulations

would alleviate some American concern. Undoubtedly the amendment to Section 10a exerted a calming influence. Although Dean and his colleagues were left with little discretion, the procedures prevented the misunderstandings, doubts, and confusion that had caused the first Commission and the Joint Committee so much tension.

## *A PRESIDENTIAL DECISION*

Technically the Commission's report to the Joint Committee on maximizing the role of atomic energy in national security was overdue in January, 1952. Despite the effort required to complete the feasibility study for the National Security Council, the Commission staff could have finished the report by the end of 1951, but Truman had asked Dean to hold it until the Executive
576 Branch had made its decision on expansion. When that would be Dean did not know, but probably not until after the State of the Union message and the President's annual economic report to Congress.

Events in the intervening weeks gave the Commissioners reason to believe that the expansion issue would receive broad consideration. In a sense, the procedure would be as important as the decision itself. Certainly the spectrum of opinion suggested the need for a full-scale review. On one hand, Acheson had endorsed the plan on the grounds that it would give the United States overwhelming superiority in nuclear weapons in a period when the Soviet nuclear capability would be substantial. On the other hand, Charles E. Wilson in the Office of Defense Mobilization agreed with Dean that the Joint Chiefs had not yet presented any justification for building plants that would not come into production for years. As no one else, Wilson was aware of the heavy demand the expansion would make on critical materials.[5]

Lovett firmly accepted the position that on matters of military requirements the Joint Chiefs and the Secretary of Defense were answerable only to the President. On this particular issue, however, the President was changing procedures. In the past the Secretary of State, the Secretary of Defense, and the chairman of the Atomic Energy Commission as a special committee had jointly proposed written recommendations to the President. This time Truman wanted to hear a discussion of the alternatives in a joint meeting. LeBaron thought that the change might be the result of the Commission's argument that it could not support expansion without knowing the basis for the requirements. While members of the Defense group working on the study felt that Truman should look to Lovett and Bradley on this matter, they did prepare charts on weapon requirements for Truman, to be used either at the meeting or, if he desired, privately.[6]

On January 14, 1952, the Commissioners discussed their strategy for the meeting with the President, now only two days off. Murray thought Dean should state that attaining the production goal in the Joint Chiefs' proposal was possible, and that perhaps an even greater increase was practicable.

Smyth thought Dean should be free to use his own judgment, particularly if the discussion raised points unknown to the Commission. Dean promised to circulate a draft of his proposed remarks. On one matter there was complete agreement: It had to be crystal clear that meeting any expansion schedule depended upon correcting the priority situation.[7]

On the afternoon of January 16, Dean went to the White House armed with charts and his statement, not knowing whether the meeting would end with a decision or an assignment of further studies. Truman began by declaring that the further expansion of atomic energy production was one of the most important matters ever to come before him, a curious statement from one who had decided to use the atomic bomb in World War II and had determined that the nation must have thermonuclear weapons.

Lovett built his presentation around the theme that the rapid development of nuclear weapon technology had made tactical weapons possible and had changed the basic assumptions for military requirements. From the standpoint of energy released per dollar, fissionable material was less expensive than conventional explosives. Furthermore, if atomic weapons were never used, the fissionable material would later be available for peaceful purposes. Dean was ready to pick up the idea when Lovett turned to him. The argument was valid, Dean said, but hardly a good justification for the expansion. But was it not true, the President asked, that the nuclear components could be converted to civilian uses? Again admitting the fact, Dean believed that peaceful applications could not justify an effort which would place so heavy a burden on the national economy.



In Bradley's absence, General Hoyt S. Vandenberg spoke for the Joint Chiefs of Staff. He cited the number of weapons believed necessary to assure the national security in the event of an all-out war. There was, he said, nothing magical about the figure; it was derived from the estimates of the various services. As Vandenberg talked from the charts, Dean commented briefly on some of the assumptions. Acheson used only a few sentences to set forth his views. He saw no signs that international tensions were decreasing. The Russians were undoubtedly doing all they could; the Americans could hardly do less.

Dean was next. Carefully he explained that the Commission's reluctance to accept the recommended expansion did not stem from opposition to the proposal, but from an obligation which the Act imposed on the Commission. He and his colleagues were convinced that any expansion had to rest on the assumption that production from existing facilities and those under construction would not be sufficient. The Commission thought the Joint Chiefs' plan was feasible if overriding priorities were granted. Wilson frankly admitted that the estimated requirements for critical materials and equipment had appalled him. The Commission's construction schedule would require some miracles. In view of the military importance of the project, Wilson saw no alternatives, but he warned that there would be trouble, especially in 1952 and 1953.

Truman asked Frederick J. Lawton, director of the Bureau of the Budget, a few questions and made some general remarks about military requirements. Then he paused. "In view of these considerations, does anyone feel we should not undertake this?" There was no response. The President nodded and asked Lawton to get the necessary budget documents ready for Congress.[8]

The next day James S. Lay told Dean that Truman wanted the Commission, in collaboration with the Department of Defense and the Office of Defense Mobilization, to draw up a Presidential directive carrying out the decision. Dean was relieved that the Commission would have the major responsibility in preparing the document. The Commission could best decide how to meet production goals and therefore would be in a better position to get the necessary priorities. Dean felt, as well, that previous cooperation with the Department of Defense had been cumbersome and caused tension. Lay also wanted Dean's advice on a public statement by the President. Truman

was thinking of a background press conference on Saturday, January 19, when he might refer to the expansion part of the budget he was sending to Congress on Monday. Dean feared Brien McMahon might call a hearing before Monday. Since McMahon was to see the President just before noon on January 17, perhaps Truman could ask him not to call the hearing before the budget was delivered. Truman adopted the suggestion, but much to his anger McMahon broke the news to the press as he left the White House.[9]

McMahon's precipitous action, which received little attention in the newspapers, no doubt reflected some of the frustration he had felt in recent weeks. In the summer of 1951, he and the Joint Committee had taken the initiative to promote the expansion, but the Administration had neatly shunted the committee aside until its own proposal was ready. Not until January 17 did McMahon receive the report he had requested on "maximizing the role" of atomic energy for military purposes. Closely tied to the chiefs' proposal, the report contained the Commission's feasibility study as an attachment. Also transmitted was the usual opinion from Murray that any failure to obtain the required amounts of uranium ore would be the result of a lack of effort, not the paucity of nature.[10]

McMahon tried to regain the initiative. On January 22 he held a meeting with the Commission to examine the expansion decision. It was evident from a memorandum which William L. Borden had prepared in advance that McMahon and his aide were not completely convinced that the expansion was large enough or that the Commission would prosecute the effort with sufficient vigor. On February 6, McMahon tried to entice Lovett into recommending a larger program by citing Murray's views that ore supplies were ample to support a still greater effort. Lovett avoided the lure. The chiefs' plan, he said, would enable the nation to meet its stockpile goals ahead of previous schedules. In all honesty, he could not say a greater expansion was warranted. McMahon and Jackson still held doubts, but they could take some comfort from the fact that a decision had been made.[11]

## THE BUYER-CUSTOMER RELATIONSHIP

As the hearings had shown, the Commission and the Department of Defense could now speak with a fair degree of unity on the subject of expansion, but achieving that unity had raised again the old question of custody. As Dean later learned, Lovett had discussed with Truman on January 29 the Commission's role in advising the President on the use of nuclear weapons. Truman again turned to the special committee of Defense, State, and Commission leaders for a recommendation.

The Joint Chiefs held that the number of nuclear weapons entering the stockpile was revolutionizing military thought and changing the development pattern for future delivery systems. Nuclear weapons were now a central factor in military planning. Because the Joint Chiefs had to be prepared for emergencies, they were strongly opposed to any agency placing itself between them and the President on military matters. The Commission merely produced atomic weapons; the Department of Defense as consumer should have custody. The chiefs thought the existing divided responsibility was inimical to the nation's best interest.[12]



Before framing the Commission's position, Dean discussed custody with LeBaron and Arneson. Then he asked Roy B. Snapp, the Commission's secretary, to pull together a historical summary of the custody debate. For Snapp's guidance, Dean outlined some of his thoughts. No system of custody, he reflected, would be feasible if it involved substantial delay in transferring a Presidential order to the military commanders. His bedrock philosophy was: "No system of custody should give to the military exclusive control of the fissionable material which the country looks to the civilian Commission to hold for peaceful purposes, if not exploded in war." At the very least, weapons deployed in an emergency were only on loan.

The size of the Commission's files on custody gave Snapp some difficulty in preparing his report; but with swift and careful judgment he selected the materials and completed the assignment within a week. Dean sent Snapp's paper to Oppenheimer, who was in Washington for a meeting of the General Advisory Committee. On February 17, Oppenheimer summed up the views of the committee. It shared the concern of the Joint Chiefs that delays in the use of atomic weapons had to be kept to an absolute minimum, and recognized that there were certain targets where the loss even of hours could have serious consequences. Moreover, the committee agreed that under existing arrangements for storage and deployment, delays were inevitable. Therefore the group hoped that some way could be found to minimize these difficulties. Changing custody, however, did not seem to be the entire answer. Further, the Joint Chiefs had stated that no other agency should interpose itself between them and the President in recommending military courses of

action, nor in determining when, how, and in what numbers and types atomic weapons were to be used; and that the Department of Defense had the military and technical competence in atomic weapons to be the principal source of advice to the President. These arguments the advisory committee rejected, finding that they seemed to limit the authority of the President to consult with civilians in bringing political considerations to bear on strategic planning. The summary was a hurried effort, Oppenheimer admitted to Dean, but it could be used if the custody struggle erupted again. As for himself, Oppenheimer confessed that he could not decide whether to take the military position in such matters, as set forth in the document, seriously or as a "relatively meaningless piece of insolence."

By this time Dean may well have concluded that he was merely going through another round in a continuing struggle. He and Oppenheimer might reject as captious the buyer-customer relationship, but the plenitude of
580 nuclear weapons was unquestionably changing military perspectives. Every successive expansion of the Commission's production capabilities had raised the custody issue in a new form. There was no reason to believe the current expansion would lead to any different result.[13]

Dean probably had some intimation of the tension caused among the armed services by the increasing size and versatility of the nuclear stockpile. On February 27, 1952, he and his fellow Commissioners called for copies of the Project *Vista* report. The project had been established in the summer of 1951 under Lee A. DuBridge at the California Institute of Technology to study military problems which would confront the NATO forces in the event of Russian aggression. Robert F. Bacher had led the group which was analyzing the tactical role of atomic weapons. In the fall of 1951 he had asked Oppenheimer to look at the preliminary draft of the team's work. Oppenheimer had gone to Europe with a few members of the project to talk to Eisenhower, had pondered the conclusions, and with his usual facility had polished the language. In tactical situations the Project *Vista* group found a need for atomic weapons which could be delivered accurately in any weather to support ground forces. Tactical uses of hydrogen bombs received light treatment. Some of those who followed the project saw in the report a threat to the mission of the Strategic Air Command and its claim to most of the atomic stockpile. Some remembered that Oppenheimer in the military objectives panel study issued in December, 1950, had called for development of atomic weapons and relegated thermonuclear weapon work to a lesser priority. In both instances it was possible to interpret the conclusions as further evidence of Oppenheimer's distaste for the hydrogen bomb effort.[14]

As for the Presidential directive on expansion, Dean's major worry was that the Joint Chiefs might insist on including a specific requirement for a third reactor site. The Commission staff did not think another reactor complex was needed. In November, 1951, the idea had been to build three new reactors at Hanford and three at Savannah River. But by February,

1952, studies by General Electric had demonstrated the larger production capacity of the new "Jumbo" design. It would save both money and material to build two Jumbos at Hanford and an improved heavy-water reactor at Savannah River. On February 20, the day Dean sent the draft directive to the President, Richard W. Cook authorized David F. Shaw, the Hanford manager, to begin preliminary planning for the Jumbo reactors.

The Presidential directive was short and simple. It cited the annual production rates which would require constructing new reactors at present sites, increasing existing gaseous-diffusion capacity at Oak Ridge and Paducah, and building a diffusion plant at a new location. Roughly the plan would cost the nation about $4.9 billion for construction and would add about $700 million in annual operating costs when all the plants were running. Truman's only remaining concerns were the probable economic impact and the political effects in an election year. He discussed both aspects privately with Dean, Murray, and McMahon on February 11. Two weeks later, on February 25, he signed the directive. The Commission was free to forge ahead.[15]



## *NEW LIFE FOR LIVERMORE*

Although McMahon had been unable to change the President's decision on the expansion, he still hoped to convince the Commission to increase its efforts on the thermonuclear weapon. An important step in that direction, in McMahon's opinion, would be the establishment of a second weapon laboratory. On February 21, 1952, he summoned the Commissioners to a closed hearing. He was worried that the Soviet Union might be the first nation to test a thermonuclear device and to have a deliverable hydrogen bomb. He had before him most of the documents expressing the Commission's position on the expansion effort and the second laboratory since the fall of 1951. Now he wanted to know what progress the Commission was making.

After Smyth summarized work at Los Alamos, Kenneth E. Fields described how other contractors were beginning to take over the development and fabrication of components for the test of a thermonuclear device in the fall of 1952. Briefly he described the work of American Car and Foundry, the Arthur D. Little Company, and the National Bureau of Standards. In one aspect of the work, Fields thought the Commission had almost every qualified scientist employed. Every individual who might be expected to work at Los Alamos was already there; even Edward Teller visited the laboratory frequently. Dean said he knew of no one who would work at a new laboratory but not at Los Alamos. Murray, however, contended that a new laboratory might attract competent scientists not already involved in the project. He paid tribute to Los Alamos, but he would not accept the proposition that competition was not a good stimulus for research. It was a difficult matter, McMahon

admitted, but the Commission would have to decide. Nothing could be allowed to keep the United States from being first with the hydrogen bomb.[16]

A few weeks later McMahon asked Lovett for his views on the thermonuclear effort and the second laboratory. McMahon was sowing his questions on fertile ground. For several months military interest in a second laboratory had been growing, especially in the Air Force. David T. Griggs, an energetic young geophysicist at the University of California at Los Angeles, had followed the development of the thermonuclear weapon with great interest as part of his duties as the Air Force's chief scientist. He had been as susceptible as most people to Teller's enthusiasm for the thermonuclear weapon. Furthermore, Griggs learned that Teller's hopes for establishing a second laboratory were more than an idle dream.

On February 2, during a visit to Berkeley, Ernest O. Lawrence had taken Teller to Livermore, where most of the Radiation Laboratory's senior
582 staff were working on Lawrence's latest pride and joy, the materials testing accelerator. Lawrence's daring idea was to build a linear accelerator of incredible size and power which would provide neutrons for generating plutonium or tritium. The massive vacuum tank for the accelerator stood in a barnlike, corrugated-metal building as long as a football field. Looming above the valley floor, it was visible for miles. The Mark I accelerator at Livermore, however, was but a small section of the full-scale machine which the Commission was planning to build at a new site near Weldon Spring, Missouri.[17]

When Teller visited Livermore in February, the Mark I was nearing completion and the first tests were to begin in several weeks. Lawrence was confident the machine would work and would soon make possible the production of large amounts of fissionable material without consuming substantial quantities of uranium 235. Once the production model had been built at Weldon Spring, the Livermore site would provide excellent facilities for Teller's second laboratory. Back in Berkeley that evening, Lawrence asked Teller if he would consider leaving the University of Chicago to establish the new laboratory at Livermore. Teller said he would, provided the mission included thermonuclear work. In Lawrence, Teller had an advocate whose enthusiasm for new ideas matched his own. Both men were convinced they could find the scientists to staff the laboratory.

A few days later Griggs called Teller to tell him that Air Force Secretary Thomas K. Finletter had agreed to see Teller in Washington. Once in Finletter's office, Teller found the Secretary preoccupied and rather cool to Teller's ideas, but as the scientist talked, the Secretary's interest began to grow. As a result of the meeting, Finletter agreed to visit Los Alamos to review the work on thermonuclear research himself. As usual Carson Mark and the Los Alamos staff provided an unimpassioned and soundly factual account of the work that had to be done before the New Super could be tested.

The crucial question for Teller was how quickly he could bring his ideas to bear on Pentagon policy. His meeting with Finletter obviously had

not influenced Lovett's statement to McMahon on March 9 that it would be a mistake to move thermonuclear work from Los Alamos at that time. The only source of encouragement was Lovett's concession that steps to create a second laboratory should begin at once. In the following weeks Teller made faster headway. On March 19, Griggs arranged for him to brief Lovett and the three service secretaries. After the meeting the secretaries asked Lovett to take the question of the second laboratory to the National Security Council. On April 1, 1952, Dean went to the Pentagon for a Teller briefing with Acheson and Deputy Secretary of Defense William C. Foster. There was now no doubt that a second laboratory would be established at Livermore.[18]

Norris E. Bradbury spent two days at Berkeley in May to work out arrangements for weapon work at Livermore. He suggested that eventually Livermore should undertake weapon tests, but for the moment the new laboratory should concentrate on the New Super. These tasks would serve the dual purpose of educating the Livermore group and bringing the two laboratories into direct contact. Bradbury's main concern was that Los Alamos not become a recruiting ground or a supply house for Livermore.



The choice of Livermore as the second laboratory site looked even better as the fortunes of the materials testing accelerator declined during the summer of 1952. Despite troubles with minor leaks in the huge vacuum chamber, the accelerator had passed the first vacuum and voltage tests in April. Not only were technical results heartening, but the scientists from the Radiation Laboratory had also built an excellent working relationship with the engineers from the California Research and Development Corporation under the energetic and practical leadership of Frederick Powell. As summer approached, however, the question of whether the accelerator would be useful in the production effort began to overshadow the claims of technical success. Until Mark I was actually operating, the Commission decided to postpone the construction of Mark II at Weldon Spring. Lawrence was already turning to a new idea of building a production cyclotron, an approach Smyth doubted Congress would ever support. In April, Manson Benedict and his operations analysis staff in Washington had concluded that there was no economic justification for building production accelerators. Against the growing supply of uranium and the improving efficiency of production reactors, the production accelerator could not compete. On August 7, 1952, the Commission deferred all plans for Mark II and left the Mark I to die a natural death at Livermore.[19]

By September, 1952, weapon development had replaced the production accelerator as the driving force at Livermore. When Lawrence and Teller met with the Commissioners on September 8, both were pleased with the laboratory's rapidly developing capabilities for weapon research. Original plans for diagnostic measurements at Livermore had evolved into more ambitious projects related to new weapon designs. Lawrence felt confident that close cooperation with Los Alamos would prevent duplication. Teller and Herbert

F. York outlined Livermore's plans in some detail and Wallace B. Reynolds, the Radiation Laboratory's business manager, pointed out that there were already 123 scientific and technical people working on weapons at Livermore. He thought the total, including supporting personnel, would reach 1,000 in two years. Whatever the reservations in the past, the Commission now had a second laboratory. Livermore had found a new role in the nation's atomic energy program.[20]

## *LOOKING TO THE FUTURE*

The political skirmishing in the early months of 1952 was an unmistakable sign of a Presidential election year. These first tremors of the upheaval to

come must have given Dean cause to speculate about his own future. His term would expire in June, 1953, but conceivably he might wish to leave the Commission sooner than that. By the time the national political parties held their conventions in July, Dean was better able to judge how extensive the changes might be. In March, Truman had decided not to seek a second term, a move which threw the Presidential race wide open. In July at Chicago the Republicans had nominated Dwight D. Eisenhower and a few weeks later in the same arena the Democrats had selected Adlai E. Stevenson. Undoubtedly many of Dean's associates in the Truman Administration would be leaving Washington in January, 1953. Dean thought Acheson would almost surely go, and Lovett would probably welcome a chance to return to private business.

One event Dean could not have predicted was the loss of Brien McMahon. After a brief illness he died of cancer at Georgetown Hospital in Washington on July 28. Not yet forty-nine years old, McMahon had left an indelible mark on the history of atomic energy. More than any other American, he had come to personify the new force of atomic energy in the nation's life. From Vista, California, Dean issued a statement calling McMahon a statesman of vision and energy, a good friend of the Commission, and a champion of world peace. Truman in Kansas City, Missouri, paid tribute to McMahon, whose greatest achievements, in the President's estimation, were those he made as chairman of the Joint Committee.[21]

How serious McMahon had been about seeking the Presidency was not easy to say. In the maneuvering of Democratic leaders after Truman's decision not to seek reelection, McMahon had entered the lists as a favorite son, perhaps with hopes of becoming the Vice-Presidential nominee. From his sickbed he had telephoned the Democratic state convention in Hartford that, if elected, he would direct the Atomic Energy Commission to manufacture hydrogen bombs by the thousands. A man moved by strong convictions, McMahon never faltered in his determination that in war and peace his nation would be first in atomic energy.

## *FORGING THE SHIELD*

Whatever the future might bring, the Commissioners still faced the day-by-day task of translating the Presidential directive into the plants, fissionable material, and weapons the national security required. One unpleasant task Dean could not ignore was ironing out his differences with Defense over control of the weapon stockpile. The encounter with Lovett and the Joint Chiefs in February, 1952, had done no permanent damage, but it had failed to resolve the misunderstanding. More than anything else, Dean and his colleagues resented the Joint Chiefs' assertion that divided responsibilities for the custody of the stockpile were inimical to the best interests of the United States. Dean, Glennan, and Murray were all willing to see a substantial portion of the stockpile under military control. There was no escaping the fact, however, that both the military and the Commission had statutory responsibilities for building and maintaining the stockpile. What both sides needed, in Dean's opinion, was a clear understanding of their own part in that task.[22]



A special committee consisting of Dean, Acheson, and Lovett succeeded in September, 1952, in defining a procedure for carrying issues of atomic energy policy to the President. The National Security Council, the new statement declared, had the statutory responsibility to advise the President on domestic, foreign, and military policies as they affected national security. The special committee representing Defense, State, and the Commission would give its counsel on Presidential directives affecting all three agencies. These opinions were to be clarifications only and were not to alter the positions of the Joint Chiefs as the main source of military advice. As for custody, the armed forces were to control a much greater share of the stockpile so that they would have the necessary flexibility for military operations. The Commission would retain custody of the remaining weapons and would have access to the entire stockpile for technical purposes. In establishing military requirements, the Department of Defense would state the needs for numbers and types of weapons; the Commission would propose production rates for meeting the goals; and the President from both views would determine the schedule for weapon production. Hopefully, the new formula would more nearly fit the rapidly changing structure of weapon technology.[23]

Although the directive the President had signed on February 25, 1952, had granted the Commission the manpower and materials it would need to meet construction schedules, priority difficulties continually dogged the new expansion program. Manly Fleischmann, as head of the Defense Production Administration, was close enough to the Commission's troubles to appreciate them. In late January, he had asked the Joint Chiefs to establish a single priority for certain Commission projects. While waiting for a response,

Fleischmann and Henry H. Fowler, head of the National Production Authority, did what they could. Each appointed a deputy on Commission priorities. Fowler assigned a representative to Savannah River and established a branch office at Wilmington, Delaware, with the sole mission of helping du Pont.

The Joint Chiefs' reply finally came on March 5, 1952. Although admitting that the Commission should have help, the chiefs thought a superpriority would jeopardize attempts to correct some of the existing difficulties. They proposed further consideration of a detailed list of critical items. To Dean more study meant more delay. The measures which Fleischmann and Fowler had taken were inadequate, but they had shown that there were few actual conflicts between the Commission and the Department of Defense. On July 7, John R. Steelman, now acting director of Defense Mobilization, agreed to put Savannah River at the top of the Defense master urgency list. Until February 1, 1953, and with a limit of $45 million, the
586 Wilmington office of the National Production Authority could issue in two days top priorities for critical items certified by du Pont.[24]

Despite priority difficulties, the construction outlook was improving by the summer of 1952. The first Savannah River reactor was scheduled for completion in March, 1953. Four of the twenty-four dual-temperature heavy-water units were undergoing preliminary testing. The C reactor at Hanford was nearly complete, and the working force in November would turn to building the Jumbo reactors, now called KE and KW. In August, Cook gave the Commissioners some impressive statistics on the new units. In dimensions, amount of graphite, number of process tubes, cooling water requirements, and above all in power level, the new reactors were much larger than the old. Improved technology, however, made possible a reduction in the number of water pumps and a simplified water plant.

Oak Ridge in the summer of 1952 was procuring construction material for the K-33 gaseous-diffusion plant, and Samuel R. Sapirie, the Oak Ridge manager, hoped to supplement his tentative construction estimates with a firm schedule in October. Labor difficulties still hampered construction at Paducah, where the C-35 and C-37 diffusion plants were to be added to the C-31 and C-33 installations. The new gaseous-diffusion plant called for in the expansion program was to be built at Portsmouth, Ohio. Kenneth A. Dunbar, the Commission's manager at the new site, knew that Peter Kiewit's Sons would do the construction, but the operating contractor had not been chosen. By the end of August, the Goodyear Tire and Rubber Company was the leading contender for the contract.

New facilities were also springing up at other locations to enlarge and strengthen the production chain from ore to weapons. A new feed materials production center at Fernald, Ohio, near Cincinnati, would relieve some of the heavy burden the Mallinckrodt Chemical Works had been carrying since 1942 in refining uranium concentrates to provide feed for the reactors and diffusion plants. As part of the weapon production complex, new component

plants were under construction at Rocky Flats, Colorado, and Amarillo, Texas. Caught up in the Commission's total construction activities in the summer of 1952 were about 150,000 workers, including Commission and contractor employees but not military personnel serving with the Commission.[25]

## *THE DEAN ADMINISTRATION*

By the autumn of 1952 it was clear that the Dean Commission was well along in its search for a thermonuclear weapon. That pursuit had been a dominating force upon Dean and his associates, and had given them and the staff a unifying purpose which the Lilienthal Commission had lacked. Moreover, the somewhat chaotic character of the early days when trial and error had been necessary had yielded a harvest of experience, and Dean had beneath him a mature and seasoned staff. With these factors Dean's personality combined to give a style which characterized the Commission in 1952.



Marion W. Boyer readily accepted the restricted role of the general manager. As he told reporters, his was "strictly a production job"; he left matters of policy to the Commissioners. Aware that his lack of background in atomic energy and of experience on the Washington scene were his limitations, Boyer wisely and effectively concentrated his efforts on building a smooth and efficient staff. Membership of the staff had changed since Carroll L. Wilson's resignation. Joseph A. Volpe, Jr., Wilson's trusted legal adviser, had gone into private practice at the end of 1950, and had been succeeded as general counsel by his deputy, Everett L. Hollis. Carleton Shugg had found working with Boyer pleasant enough, but he missed the free-wheeling days of 1949 and 1950. Seeking more challenge than the job as Boyer's deputy offered, Shugg had resigned in January, 1951, to return to the shipbuilding industry. Walter J. Williams, a stalwart of the Washington staff, had succeeded Shugg as deputy general manager and Cook had come to Washington as director of production. Lindsley H. Noble, whom Wilson had appointed controller in 1950, had resigned in May, 1952. Fletcher C. Waller, who had served Wilson in several capacities, but mainly as director of organization and personnel, had resigned the following month and had been succeeded by Oscar S. Smith, the director of labor relations. In response to Dean's pleas, the Department of Defense had extended General James McCormack's tour as director of military application for six months at the end of 1950, but Dean welcomed the assignment of Colonel Kenneth E. Fields, an outstanding officer with a sound knowledge of the Commission's activities, as McCormack's replacement in June, 1951. In the research and development part of the Commission's program, only Lawrence R. Hafstad was still in harness as director of reactor development. Thomas H. Johnson, a physicist from Brook-

haven, had replaced Kenneth S. Pitzer as director of research in June, 1951, and John C. Bugher, deputy director of biology and medicine, had succeeded Shields Warren in June, 1952. Of those who had been appointed in 1947, only Morse Salisbury, director of the public and technical information service, was still on the job.[26]

At the Commissioners' level the last remnant of the Lilienthal regime disappeared with Pike's resignation in December, 1951. Aware of Pike's intention in November, Donald Dawson at the White House had already found a replacement in Eugene M. Zuckert, Assistant Secretary of the Air Force in charge of management operations. Although McMahon liked Zuckert, he was concerned about appointing someone from Connecticut. Dean too thought this might cause trouble. Once Zuckert had joined the Commission, however, Dean found him to have an incisive mind and a good sense of administration. Just forty years old, Zuckert had studied law at Yale and
588 business administration at Harvard. After three years in Washington as an attorney with the Securities and Exchange Commission, Zuckert had returned to the Harvard Business School as a professor and an associate dean during World War II. Having helped to organize the Department of the Air Force in 1946, he had become assistant secretary to W. Stuart Symington a year later. Six years in the Pentagon had left Zuckert a seasoned veteran of the Washington scene.[27]

## *TOPNOTCH*

Dean and his colleagues saw policy matters as touching every facet of the Commission's operations. As a consequence, the Commissioners' conference room had replaced the general manager's office as the cockpit for discussions and decisions. The growing demand of the Commissioners for information had its hazards. In May, 1952, Glennan complained that so many of the staff were attending Commission meetings that it was hard to get frank expressions of opinion. As a partial solution he suggested regularly scheduled oral reports to the Commissioners on such matters as construction progress, finance, production rates, the weapon stockpile, and reactor development.[28]

Having assumed full responsibility for making policy decisions, Dean and his fellow Commissioners no longer relied on the general manager to flush out important issues. To keep tabs on policy matters, Snapp had set up a small policy analysis staff in his own office under the direction of Philip J. Farley, who had served in the secretariat since 1947. Before joining the Commission, Farley had earned his doctorate in English at the University of California. His keen mind and intellectual bent had helped him to master all the subtleties and nuances of the Commission form of administration. From his broad knowledge of the Commission's program, he could grasp the crucial issues and present them to the Commissioners in a provocative way.[29]

One of Farley's policy studies in August, 1952, suggested the long-term possibility that private industry and other agencies of Government might eventually assume all the Commission's responsibilities, leaving the Commission with no reason for existence. The Department of Defense might well take over weapon production; private industry might produce all the plutonium necessary and generate electric power. The mining industry might finance uranium exploration and production. The National Science Foundation could conceivably take over the government's responsibility for basic nuclear research and the Public Health Service the regulation of radiation uses. Farley's point was not to contend that such a trend should or would occur, but rather to suggest the importance of examining the Commission's functions and relationships against the rapidly changing pattern of American life.

Farley's paper succeeded in stimulating a discussion of long-term policy questions among the Commissioners. Glennan, who was always seeking a higher perspective for looking at Commission business, became fascinated with the discussion and suggested that the Commissioners get away from Washington for several days in September to consider some of the broad questions Farley had raised. Dean, never losing touch with the practical, expressed the hope that Farley could have several of his policy studies ready for the conference, which soon acquired the name *Topnotch.*[30]



The agenda which Farley submitted to the Commissioners several weeks later reflected many of the concerns of the Dean administration. How could the Commission more sharply define the role of the field offices? Did decentralization of authority still make sense? What could be done to free the Commissioners from the deluge of meetings and papers? Could the use of cost-plus-fixed-fee contracts and reliance on a few proven contractors yield to more relaxed and normal Government practices? How could the Commission best "educate" the new President who would replace Truman in 1953? How could the Commission improve relationships with the military? All these questions were much on the minds of the Commissioners, but the letter for the new President seemed the best subject around which to organize *Topnotch.* With drafts of the proposed letter, the Commissioners, Boyer, Snapp, and Farley set off by train for the Greenbrier at White Sulphur Springs, West Virginia, on September 25.[31]

When the conference opened on Friday morning, September 26, the first topic was the letter to the President and the Commissioners' relationships with the Chief Executive. The consensus was that through the special committee of the National Security Council the Commission had reasonable access to the President, but the Commissioners could not speak so highly of ties to the Department of Defense thrcugh the Military Liaison Committee. Part of the trouble was that Dean found it difficult to work with LeBaron. The Commissioners also favored a new committee in which military members would have the authority to speak for the Department of Defense. The Commissioners hoped that something could be done, perhaps by amending the Atomic

Energy Act, to put senior representatives of the military departments on the committee. The Commissioners also discussed the division of responsibility with the Department of Defense in matters of weapon production.[32]

In considering relations with private industry, the Commissioners at *Topnotch* saw very little opportunity in the next ten or fifteen years for private industry to participate in atomic energy activities, except perhaps in building and operating power reactors. There was, however, great interest in nuclear power plants in the autumn of 1952, and the Commissioners were unanimous in supporting any actions which would assist private industry to enter the field.

In the final session on September 29 the discussion turned again to the briefing for the new President, members of the Cabinet, and the Joint Committee. In all of these the Commissioners themselves would bear the main burden of presentation. The last topic was to develop a new schedule which the
590 Commissioners would follow each week in conducting their business. As Dean and his associates started back to Washington on the evening train, they agreed that *Topnotch* had been a success. It had been exhilarating to shake off for a few days the daily routine of details and tc look again at the fundamental responsibilities. One of these was approaching culmination: The test of the thermonuclear device was little more than a month away.

## *IVY-MIKE*

On the morning of June 30, 1952, Dean entered the President's oval office as he had done many times before, but this was no ordinary discussion of priorities or even of military requirements. Anyone acquainted with the Commission's staff might have guessed that the subject was weapons when Bradbury and Fields followed the Commissioners into the White House. Once seated in the President's office, Fields opened a wooden carrying case to reveal a small model of the thermonuclear device—christened *Mike*—which would be detonated in the Pacific on November 1, 1952, as part of the *Ivy* series. The purpose of the session was to show Truman the model and to explain how the device would work. It was not an occasion for policy matters.[33]

That there were policy issues Bradbury knew. The *Mike* device would be the most powerful detonation ever created by man. Its very size would lead the public to associate it with the thermonuclear effort. Another complication was that the test would come only three days before the Presidential election. Oppenheimer and Hans A. Bethe had already raised the possibility of postponement. They feared that the test, coming at a time of heightened political emotion, would be seized upon by irresponsible elements in a last-minute attempt to sway the vote. Bradbury could see no technical reasons for delay except adverse weather conditions. On the average, there would be five days

in October, three in November, and one or two in December suitable for the test. Reversing the order and firing a smaller device first might damage the test structures built for *Mike*. The Los Alamos laboratory, its contractors, their subcontractors, and the military task force with its ships, planes, and men were all aiming at an October 31 date—November 1 in the Pacific.

To change the schedule was not a light task. Within a limited period the schedule could be shifted, but Bradbury thought that a delay past mid-November would throw the test over to March of the next year. Such a delay would conflict with the already overscheduled spring tests and hurt the morale of those who had labored under the insistent demands for speed. Bradbury hoped Eisenhower, Stevenson, and Truman could be apprised of the difficulty.[34]

Dean discussed the possibility of changing the date in August with Lovett and, in Acheson's absence, with Arneson and Paul H. Nitze from the Department of State. Lovett was opposed to altering the timetable, and he confirmed his initial reaction by a quick check with Bradley and Foster. Their reasons were not identical, Lovett noticed with amused interest, but all agreed delay would cause more harm than holding to the schedule. Doubtless some people would draw political implications from the close coincidence with the election date, but was this any worse than obviously postponing the test for political reasons? Besides, a carefully worded announcement issued in advance would draw the sting of some of the adverse reaction. Arneson thought the matter would come up naturally when Truman authorized the expenditure of fissionable materials for the test. These recommendations to the President usually contained test dates. Dean rather thought that among themselves they should be able to formulate a position for the President. When Bradbury telephoned on August 12 to learn if there had been a decision, Dean could not give a definite answer.[35]



The request for Presidential approval went to the special committee of the National Security Council on August 15, 1952, but with no date specified. Although Dean himself had no strong opinions, all his colleagues wanted to postpone *Mike* until after the election. Dean was anxious to confirm the date for the benefit of the testing group, and told Lay that Truman should be aware of the implications when his approval was requested. On August 28 Lay told Dean that the President would not change the date, but he would certainly be pleased if technical reasons caused a postponement. Lay did not see how four or five days could make much difference in the cost. On September 9, the Commission and the Department of Defense issued their press release that in the autumn months Joint Task Force 132, under the command of Major General Percy W. Clarkson, would hold atomic tests in the Pacific. There would be no other public announcement until the tests were over, and then only a brief statement.[36]

On October 15, Fields, just back from Eniwetok, told the Commissioners in executive session that there was every indication that *Mike* would be

ready by October 31. The hope that somehow technical delays would intervene was gone. If *Mike* were to be held up a few days—and the Commissioners felt it should—some justification had to be found quickly. From the discussion came the idea of sending Zuckert to Eniwetok to see if it were possible to postpone the test. If it were, Zuckert was to authorize the delay. Obviously Zuckert would need a mandate from the Secretary of Defense as well. Lovett was reluctant, but he would accept the scheme if Dean gained Truman's approval. Dean hurried to the White House and saw the President, about to leave on a campaign tour at 4:15 in the afternoon. Truman accepted the suggestion.[37]

In Washington, the Commissioners and Lovett waited for word from Zuckert. Dean had Truman's campaign itinerary from Monday, October 27, when the President would be at Gary, Indiana, to November 2, when he would be at home in Independence, Missouri, until after election day. When Dean
592 heard from Zuckert that postponement would be exceedingly difficult, he called Lay to ask whether a messenger who would not be identified by the press with the atomic energy effort could deliver a letter to Truman. Lay suggested a telephone call. Of course Dean would have to make his comments oblique, but Lay thought it would not be too difficult to make the subject clear to Truman. Dean drafted a few remarks—almost as a letter—and waited.

Wednesday, October 29, was one of those days Truman enjoyed. Beginning at nine o'clock he made platform remarks at Waterloo, Iowa, then at Cedar Rapids, West Liberty, and Davenport, and then crossed the Mississippi to halt briefly at Moline, Illinois. In the later afternoon he spoke at the Negro War Memorial in Chicago. At eight o'clock Washington time, before Truman began a major address at the Hotel Sherman, Dean placed his call. Truman understood the situation at once, and appreciated the information.[38]

On October 31—November 1, at Eniwetok—Dean waited in his office. Shortly after 2:30 P.M. Dean received a telephone call from General William M. Canterbury at the Pentagon. Canterbury had news; he could be in Dean's office in ten or fifteen minutes. Dean called Fields and together the two men met Canterbury and his group. After Canterbury confirmed that the detonation had taken place, Dean called Borden, to suggest that he stop by later in the afternoon. A few minutes later Dean took another telephone call. It was Morse Salisbury, the Commission's director of information. Salisbury had just hung up from a conversation with a *Time* magazine reporter who was seeking information about the H-bomb that had just gone off. Obviously there had been a bad leak.[39]

With rumors in the press, Dean thought he should notify Truman. At four o'clock on November 1, the President's train should reach St. Louis, Missouri. Dean could not tell him over the phone that the detonation—later measured to be 10.4 megatons—had erased from Pacific charts the island of Elugelab. But he could convey that the test had been successful. He placed the call and soon heard the familiar voice of Truman, a few weeks from the end

of his presidency. Truman was pleased at the news.[40] Dean too, must have felt relieved. Fears that the *Ivy-Mike* test—the thermonuclear effort—would be injected into the campaign had proved groundless. Truman might have used the test in a last-minute attempt to assert that his party was well along in the search for a superweapon, a claim that he might have hoped would counter the military prestige of the Republican candidate. To his credit, Truman had not done so.

## *A SHIELD FOR THE FUTURE*

Truman had reason for satisfaction. The United States had been first to achieve a thermonuclear detonation. A hydrogen bomb was possible. Yet the achievement was not the true measure of the revolution which had occurred since the Atomic Energy Commission had taken the direction of the nation's atomic energy program. The change was to be seen on the stocks in Groton, Connecticut, where the hull of the *Nautilus* was taking shape. It was to be seen in sleek aircraft, capable of carrying nuclear weapons, rising from isolated bases and the decks of carriers. It was to be seen in the huge artillery piece being readied for the inaugural parade. Through nearly every military sphere the effects of atomic energy were evident. Nor was this the sum and substance of nearly six years of anxiety and travail. The gauge of progress was to be seen in the reactors at Hanford and Savannah River, and the gaseous-diffusion plants at Oak Ridge, Paducah, and Portsmouth. From these came the material for the experimental reactors standing on the lava beds of Idaho, and for the laboratories where technology was at work to harness atomic energy to peaceful uses. Surely it was significant that probes for secrets of life, for knowledge of the microcosmos were taking place under Commission auspices. The new world had shown hazards and peril for all mankind, but also wonder and hope. Perhaps under the atomic shield all these could now be explored.

# *SOURCES*



The development of atomic energy in the United States from 1947 through 1952 was essentially a Commission enterprise. Many private corporations, universities, research institutions, and other Government agencies had a part in the Commission's work, but the Commission supported and determined the course of most of that activity. Except in some areas of basic research, virtually every document was "born classified" and therefore subject to strict security procedures and document control. As a result, only a small amount of this material has ever been available to the independent historian. But to those who have been admitted behind the security barrier, the riches of historical documentation are almost unparalleled. Although some of these records may not be available to the public for many years, historians may take some comfort in the fact that such a record collection exists and that it will, hopefully, help historians of another generation to understand the role of atomic energy in the history of the United States in the years following World War II.

## *UNPUBLISHED SOURCES*

### *COMMISSION RECORDS*

The most important single collection of documents relating to the history of atomic energy in the United States is that held by the Secretary to the Commission at the headquarters building in Germantown, Maryland. Since 1947 the Secretary and his staff have been responsible for ordering the daily business of the five Commissioners. The secretariat receives memorandums and other official papers from the staff, processes staff papers and correspondence for Commission consideration, schedules Commission meetings, prepares the minutes of meetings, and assures that appropriate action is taken to carry out Commission decisions.

The secretariat has carefully documented each of these functions in the official files. For each subject coming before the Commission, the secretariat has prepared a file of the pertinent documents, annotated and arranged in chronological order. The files include internal memorandums and reports, staff papers, correspondence with other Government agencies, contractors, and private individuals, summaries of Commission

action, and implementing papers. From the subject files alone, the historian can easily trace at least the broad outlines in the evolution of policy.

Among the variety of documents in the subject files, the staff papers are of special value for historical research. These papers, prepared by the secretariat from material submitted by the staff, follow a prescribed format based on that used by the Joint Chiefs of Staff during World War II. The papers contain a statement of the problem or issue, background information, a discussion of factors or alternatives to be considered, recommendations of the general manager, and appendices of related material. Although the format and the sometimes stilted language of staff papers often obscure the human quality in policy formulation and occasionally even the real issue, they are indispensable for understanding Commission decisions.

Not a part of the subject files but almost as important are the official minutes of Commission meetings. The secretariat has recorded the minutes of each formal meeting in numerical sequence since the first meeting in November, 1946. In order to assure a free exchange of opinions, the original Commissioners decided against verbatim transcripts of meetings, and that decision has prevailed. Instead, the Secretary and his staff take long-hand notes which later provide the information for the official minutes. The minutes during the first six months of 1947 reflect the absence of a trained secretariat, but the quality of the minutes rapidly improved under the direction of Roy B. Snapp, the first full-time Secretary. On most subjects the minutes provide at least a summary of the decisions, usually some indication of the issues raised in the discussion, and often the position taken by individual Commissioners. To those who may object that the secretariat has presumed upon the function of the historian, we must confess that we are grateful to the members of the secretariat's professional staff who used their good working knowledge of the Commission's activities in preparing the minutes. They have rendered a valuable service in summarizing in about one thousand pages what surely would have been hundreds of thousands of pages of redundant, contradictory, and often misleading information in verbatim transcripts.



Less formal records, among them the papers of the individual Commissioners, are also in the Secretary's files. These collections vary in historical usefulness. Some Commissioners kept a good bulk of correspondence and memorandums while others retained nothing. David E. Lilienthal's papers are extensive but are overshadowed by his published journals. Important for the period from mid-1949 through mid-1953 are the office diaries of Gordon Dean. These contain a record of his appointments, extensive accounts of telephone conversations, and occasionally memorandums. Carroll L. Wilson and Marion W. Boyer during their tenures as general manager kept office diaries which are little more than appointment lists. The diaries of Walter J. Williams and Carleton Shugg give personal perspective to the problems they faced in directing operations. They are less useful in throwing light on policy evolution.

The Secretary also holds the minutes of the Commission's statutory advisory committees and several international policy groups. By far the most illuminating collection in this category are the minutes of the General Advisory Committee. Well-written, detailed, and covering the entire scope of the Commission's activities, these minutes are essential, particularly for the early years of the Commission's existence when the committee members knew more about some aspects of the atomic energy program than did the Commissioners and the staff. More formal and less detailed are the minutes of the Commissioners' meetings with the Military Liaison Committee. Valuable insights into policy formulation and negotiations on atomic energy with the United Kingdom and Canada can be found in the minutes of two other groups: the American members of the Combined Policy Committee, consisting of representatives of the Commissioners and the Secretaries of State and Defense, and the Combined Policy Committee itself, composed of officials of the three governments. After early 1950 the value of these minutes decreases, because the broad outlines of cooperation with Britain and Canada had been established

and much of the committee business concerned implementing policies. Minutes of the Combined Development Agency, another tripartite organization, are burdened with details of the procurement of uranium ore, and do not contain much of policy significance.

Several of the headquarters divisions have maintained historical files. Very helpful are those for the divisions of military application and production, which had well-defined missions from the start and were led by directors with broad interests. The division of research has a large collection of administrative material containing a few papers of importance on policy formulation. When the division no longer had the responsibility for reactor development and biology and medicine, the files were divided and appropriate material given to the new divisions. This decision, which must have seemed reasonable at the time, later proved disastrous for the historian. Sometime before 1958 the division of reactor development destroyed virtually all its files, an act which greatly complicates research on early reactor policy. One alternate source is an extensive documentary collection held by the division of naval reactors.

Commission records at field installations fall into two groups. Those at the Commission offices tend to be heavily administrative while records held by the contractors are usually voluminous and highly technical. Memorandums and correspondence between and within the laboratories often throw light on the field reaction to Washington policy decisions, particularly during 1947–1948 when organizational patterns and laboratory responsibilities were being established.



On production matters the field offices hold large volumes of technical records. The best sources of information on the gaseous-diffusion plants are in the Union Carbide and Commission files at Oak Ridge. The Richland Operations Office has extensive and detailed records on the operation and construction of the Hanford production reactors, supporting facilities, and the Redox plant. Oak Ridge, Argonne, and Schenectady took part in Redox development, and all can document their part. Argonne has extensive coverage of its role in developing heavy-water production reactors for Savannah River.

For a history of nuclear weapons down to 1953, the best single source is the Los Alamos Scientific Laboratory. The mail and records unit at the laboratory has preserved intact virtually all records it has received. Because of its highly sensitive nature, information on weapons was segregated at Los Alamos, with the result that these records may be superior to those held at Washington headquarters on many topics. An equally large collection of records, to some extent duplicating the laboratory files, was until recently maintained by the Commission's Los Alamos Area Office. Most of these records, except for those of obvious historical value, have recently been destroyed and the remainder removed to the Commission's Albuquerque Operations Office for eventual transfer to the Federal Records Center in Denver.

On reactor development the records of the laboratories are more valuable for the period before 1949 than those at headquarters. The collection at Oak Ridge is essential to the understanding of the ill-fated Daniels reactor, the vaguely defined aircraft propulsion effort, the high-flux reactor, and the activities of the Navy group. Argonne has thorough coverage of the experimental breeder, the materials testing reactor, and the submarine thermal reactor. Because Argonne was the center of the Commission's reactor development program during these years, the laboratory files contain the kind of policy records the historian would expect to find at headquarters, and happily this collection largely compensates for the loss of the headquarters division's files. The Idaho Operations Office and the various contractors on the site maintain records on the origin of the National Reactor Testing Station and on the technology of reactor projects. Knolls Atomic Power Laboratory has excellent technical records on the intermediate-power-breeder and the submarine intermediate reactor.

Research—physical, biological, medical, and metallurgical—is a function of many Commission laboratories and installations, although some specialize in certain disciplines. As the two oldest and largest Government laboratories for nuclear research, Oak Ridge

and Argonne are of primary interest for the historian of science and technology. At both laboratories, the operating contractors have maintained extensive files on the many areas of research under investigation. The Commission's files at these sites contain administrative records, but far more important to the historian is the Oak Ridge file of all technical reports prepared since 1947 under Commission research and development contracts. The Division of Technical Information Extension at Oak Ridge maintains the file and provides photoreproductions of reports upon request.

The records of other laboratories are neither so extensive nor so comprehensive as those at Oak Ridge and Argonne. The Lawrence Radiation Laboratory at Berkeley has an excellent collection of materials on high-energy physics and transplutonium chemistry. It also holds the Ernest O. Lawrence papers, one of the most valuable collections in modern American physics. The Brookhaven National Laboratory has some useful historical records on formation of the laboratory and early research efforts.

A word of warning is necessary about the Commission's records. Facing the ever-increasing pressure of the document explosion, management is constantly consolidating and moving record collections. Materials which the authors saw in one location may now be in another. In a few instances some records of historical interest may have been destroyed, but the authors found the Commission's record officers eager to preserve historical material.



## *OTHER GOVERNMENT ARCHIVES*

Other Government archives contain material which throw a different perspective on the Commission. The military aspects of atomic energy and the complicated relations between the Commission and the military establishment cannot be traced without the help of documents in the Modern Military Records Division, National Archives and Records Service of the Washington National Records Center at Suitland, Maryland. The center holds the records of the Manhattan project, the Military Liaison Committee, the Research and Development Board, the Armed Forces Special Weapons Project, and some records from the Office of the Secretary of Defense. The historian's office in OSD holds some records of historical interest and controls access to the Forrestal diaries, which are located in the Office of Research Administration at Princeton University. The manuscript diaries differ from the published edition in details, many of which pertain to conversations with the British.

The Armed Forces Special Weapons Center at Kirtland Air Force Base, Albuquerque, New Mexico, has exceedingly valuable records showing the difficulties of transition during 1946 and 1947 in working out the relations between the Army, the Air Force, and the Commission. The Naval Historical Division, Department of the Navy, Washington, has some useful documents on Navy reactor development.

The records of the Department of State on the negotiations with the United Kingdom and Canada on cooperation in atomic energy often duplicate the materials held by the Commission and the Department of Defense, but some of the files are unique. Most helpful in State archives were memorandums by Dean G. Acheson and James E. Webb reporting conversations with President Truman. These documents reflect the President's attitude toward cooperation with Britain and Canada, and toward Congress on this subject.

Other Government archives are less significant. Materials open to the scholar at the Harry S. Truman Library at Independence, Missouri, including the papers of Sumner T. Pike and Clark M. Clifford, contain little information about atomic energy. In Washington, the historian will find some helpful documents in the unclassified files which the Joint Committee on Atomic Energy has transferred to the National Archives. This

material, however, is rather low-grade ore and appears to represent cullings from the extensive files still held by the committee. Unfortunately the authors were not granted access to the committee's classified files, a fact which made our task more difficult. Although the Commission's files contain most of the classified correspondence and the classified transcripts of Joint Committee hearings relating to the Commission, the committee apparently holds valuable records relating to other Government agencies and officials.

A large group of records of interest to historians of atomic energy and American science generally is the J. Robert Oppenheimer collection at the Library of Congress. The extensive correspondence files contain letters from scientists and political leaders in all parts of the world. Like the Joint Committee's unclassified files, however, this collection merely complements the main body of records which are still classified. For an accurate picture of Oppenheimer's role in atomic energy, the historian must consult the classified portion of Oppenheimer's records in the Commission's custody.



## *PRIVATE ARCHIVAL SOURCES*

We know of only a few collections of archival material on atomic energy in private hands. David E. Lilienthal's personal papers at the Firestone Library at Princeton consist of scrapbooks, drafts of articles, and correspondence. The latter are useful in supplementing his journal. The library also has the microfilm of Mr. Lilienthal's journals, which contains very little information not in the published journal. The personal papers of James V. Forrestal have been placed by his estate in the custody of the Curator of Manuscripts of the Firestone Library. These papers are mainly routine correspondence and not particularly helpful on atomic energy matters.

## *PROJECT HISTORIES*

Most of the project histories touching upon the Commission's activities are still classified. In this category is the "Semiannual History of AFSWC (Armed Forces Special Weapons Center), April 1, 1952—December 31, 1952," Vol. I, "Narrative Account," in the historical collections at the Kirtland Air Force Base, Albuquerque, New Mexico. Another is Lee Bowen's "The Development of Weapons," Vol. IV of "U.S. Air Force, A History of the Air Force Atomic Energy Program, 1943–1953," in the files of the USAF Historical Division Liaison Office, Silver Spring, Maryland. These accounts are valuable because they are based on military records not otherwise available. In this sense, however, they are not primary sources and must be used with some caution.

Frederic C. Alexander, Jr., an employee of the Sandia Corporation, has written several historical studies, including "History of Sandia Corporation," completed in 1962. Mr. Alexander's other works include classified histories of the development of early models of nuclear weapons. Some years ago the Joint Committee on Atomic Energy compiled "The Scale and Scope of Atomic Production: A Chronology of Leading Events, Jan. 30, 1952." This is a selective catalogue of events showing the committee's role in weapon development and fissionable material production. The main value of the chronology is its quotations from documents held by the committee and not otherwise available. Of similar value is Russell S. Greenbaum's "Nuclear Power for the Navy, the First Decade (1939–1949)," which is focused on administrative matters within the Department of the Navy. The work is helpful but, as Greenbaum admits, suffers because he did not have access to all sources.

# PUBLISHED SOURCES

## BOOKS ON NUCLEAR TECHNOLOGY

One of the major sources of information on nuclear technology is the multivolume *Progress in Nuclear Energy* series, published partly by McGraw-Hill and partly by Pergamon Press. Twelve series of volumes cover such topics as physics and mathematics, reactors, process chemistry, metallurgy and fuels, biology, medicine, law and administration, and plasma physics. This series supplements the earlier *National Nuclear Energy Series.* Written by the scientists themselves, the volumes are technical in approach.

Especially valuable among books on nuclear technology are the volumes presented by the United States to the Second International Conference on the Peaceful Uses of Atomic Energy held in Geneva in 1958. These volumes cover reactor technology, biology and medicine, and uranium metallurgy and processing. Of particular interest is Glenn T. Seaborg's *The Transuranium Elements* (New Haven, 1958), in which he relates the discovery of transuranium elements. A more general approach dealing with this subject is by Glenn T. Seaborg and Evans G. Valens, *The Elements of the Universe* (New York, 1958).



Certain books on particular aspects of nuclear technology deserve mention. Robert R. Wilson and Raphael Littauer in *Accelerators, Machines of Nuclear Physics* (Garden City, N. Y., 1960) present an unusually readable explanation of particle accelerators. Samuel Glasstone as editor of *The Effects of Nuclear Weapons* (Washington, 1962) has written the most detailed published account of this subject. His *Sourcebook on Atomic Energy* (Princeton, 1958) is a comprehensive survey of the principles of atomic energy and its applications. A good quick reference source is John R. Hogerton's *The Atomic Energy Deskbook* (New York, 1962).

## PERIODICALS

In the months following World War II articles about atomic energy appeared in many periodicals, but in time only a few regularly followed the Commission's activities. The largest coverage by far was in the *Bulletin of the Atomic Scientists,* which had been started as a part of the scientists' movement on atomic energy legislation in 1945 and 1946. During the early years the contents of the *Bulletin* were almost exclusively related to atomic energy matters and provided a running account of scientific opinion. More general in coverage but still useful are the weekly issues of *Science,* which document the evolution of a national policy for scientific research and development during these critical years. Many scientific journals and engineering periodicals provide grist for the historian's mill. Most frequently consulted for this book were the *Physical Review* and the *American Journal of Biology.* Occasional articles of historical interest appeared in *Scientific American.*

## GOVERNMENT PUBLICATIONS

The Commission's Semiannual Reports to the Congress, required under the Atomic Energy Act of 1946, are indispensable reference sources for the historian of atomic

energy. The first report, submitted in January, 1947, consisted of only a few pages on organizational matters; but later issues, especially those concentrating on specific aspects of the Commission's activities, contain solid information on administration and management. Frequently the appendices include reports by the Commission's advisory committees.

One Commission publication requiring special mention is *In the Matter of J. Robert Oppenheimer* (Washington, 1954). Over 900 pages long and indexed only by the names of witnesses, the document is difficult to use. Although it reveals much information on Oppenheimer's role in the General Advisory Committee and his part in decisions on weapon development, the document is at best the raw material for history. Public interest in the hydrogen bomb decision and the paucity of other sources on the subject have caused some writers to overlook this fact, with bizarre results. The experienced historian will recognize the limitations of this fascinating document and sympathize with the witnesses who were trying in an atmosphere of tension and sometimes high emotion to recall the details of events long past.

Congressional publications provide a large but cumbersome source of information. Although the Joint Committee on Atomic Energy published few documents in the early years, a growing stream of publications began to appear in 1949 with the release of the *Investigation into the United States Atomic Energy Project*, the record of the committee's investigation of Senator Hickenlooper's charge of "incredible mismanagement." These hearings and others on such matters as the Commission's community management policy provide a wealth of detail on Commission activities. Another Congressional source is the annual budget hearings before the House and Senate appropriation committees. Scattered within hundreds of pages of financial detail the historian will find excellent descriptions of the Commission's programs and management problems. The Joint Committee has also published useful handbooks containing all atomic energy legislation to date and lists of committee membership for each Congress since 1946.



The Department of State has explained the United States policy at the United Nations in *The International Control of Atomic Energy, Policy at the Crossroads* (Washington, 1948), which covers the period from October 15, 1946, to May 17, 1948. As a reference work, the Department also issued two volumes of *Documents on Disarmament 1945–1956* (Washington, 1960). The first volume contains selected documents for 1945–1946.

## *PERSONAL NARRATIVES*

Two of the Commissioners who served between 1947 and 1952 have written of their experiences. *The Journals of David E. Lilienthal*, Vol. II, *The Atomic Energy Years, 1945–1950* (New York, 1964) contains almost daily entries providing candid descriptions and impressions which do much to explain the character of the first Commission. More formal in spirit and autobiographical in style is Lewis L. Strauss's *Men and Decisions* (Garden City, N. Y., 1962). Mr. Strauss has organized recollections of an eventful life around a series of decisions. Those dealing with his first term on the Commission are the decisions to establish a system to detect nuclear detonations and to accelerate development of a hydrogen bomb. Both narratives are revealing accounts by a participant looking back upon key points in his own career.

Gordon E. Dean's *Report on the Atom* (New York, 1957) reflects some of his personality but supplies little historical information. Dean was a shrewd and perceptive man, and one can only regret that his early death robbed him of the opportunity to write his memoirs. Thomas E. Murray's *Nuclear Policy for War and Peace* (New York, 1960) contributes little to the early history of the Commission.

Personal narratives by prominent men whose careers at some point touched upon

atomic energy are largely disappointing. Harry S. Truman's *Memoirs* (2 volumes, Garden City, N. Y., 1955–56), relate events with the same vigor and simplicity that characterized his decisions as President. Written more to defend than to explain his actions, the *Memoirs* must be used with other sources. Even less useful are *The Forrestal Diaries* (New York, 1951), edited by Walter Millis, and *The Private Papers of Senator Vandenberg* (Boston, 1952), edited by Arthur H. Vandenberg, Jr. Both provide occasional glimpses of interesting personal relationships but severely condense atomic energy problems and give little clue to their complexity.

Although many scientists are highly skilled in presenting research results, very few have written about their part in policy matters. A noteworthy exception is *The Legacy of Hiroshima* (Garden City, N. Y., 1962) by Edward Teller with Allen Brown. The book expresses Teller's deeply personal views on developing the hydrogen bomb, establishing the Lawrence Radiation Laboratory at Livermore, California, and framing reactor safety criteria.



## *SECONDARY ACCOUNTS*

Although there have been several good secondary works on the development of the atomic bomb, there have been surprisingly few on the postwar history of atomic energy. Perhaps the quest for the atomic bomb had a singleness of purpose which was lacking in the later period, when the Commission was not only developing atomic and hydrogen weapons, but also establishing research programs in the physical, biological, and medical sciences, and trying to build reactors for power and propulsion.

Some authors have seized upon the hydrogen bomb decision as the scaffolding for dramatic narrative. Because neither the most crucial technical difficulties nor the means to overcome them can yet be made public, there has been a tendency to focus on personalities. Another weakness lies in the failure to master the details of technology and the historical setting. Both these defects are apparent in Nuel Pharr Davis's *Lawrence and Oppenheimer* (New York, 1968), which includes scores of factual errors and portrays the attitudes and relationships of the scientists almost in caricature. Not much better is *The Hydrogen Bomb* (New York, 1954), by James R. Shepley and Clay Blair, Jr. Robert Gilpin's *American Scientists and Nuclear Weapons Policy* (Princeton, 1962) takes a scholarly approach to the subject, but is weakened by overdrawn analysis.

There have been few biographies of the leading personalities, probably because most of them are still living. The most substantial work yet to appear is by Herbert Childs: *An American Genius: The Life of Ernest Orlando Lawrence* (New York, 1968), written with full access to the Lawrence papers and Lawrence associates at Berkeley. Giving a sympathetic portrayal of Lawrence's human qualities, the book avoids the hard questions of historical interpretation. A biography of Enrico Fermi and several books on Oppenheimer are in preparation, but we had no opportunity to consult them in our research. Another work, *The Atomic Submarine and Admiral Rickover* (New York, 1954), by Clay Blair, Jr., is a journalistic account of little value to historians.

Some scholarly research has been done on various aspects of the atomic energy program. Morgan Thomas, in *Atomic Energy and Congress* (Ann Arbor, Michigan, 1956), used extensive interviews to explore the complicated and dynamic relations between the Commission and Congress. More recent and more penetrating, focusing sharply on the Commission and the Joint Committee, is the work by Harold P. Green and Alan Rosenthal, *Government of the Atom* (New York, 1963). Richard A. Tybout, in *Government Contracting in Atomic Energy* (Ann Arbor, Michigan, 1956), details the Commission's use of various types of contracts and the development of the Commission's contract policy.

## *INTERVIEWS*

The common criticism of historians writing about the contemporary scene is that they lack perspective, that time has not yet sifted the seed from the chaff. Contemporary historians, it is said, cannot tell what is significant and what is not. The charge is also made that the historian of recent events has difficulty in gaining access to the papers of living men and even more trouble in writing the truth about them. But the contemporary historian does have compensating advantages over students of the more distant past. He has himself sampled the flavor and tone of the period he is describing and he enjoys the priceless boon of being able to interview the actors who figure in his narrative. From conversations he can discover relationships and ideas that often bring to life the restrained prose of an official document.

Interviews require careful preparation to prevent them from becoming random recollections of humorous anecdotes. No doubt each interviewer has his own technique. Ours was to master the documentary evidence we possessed, to discuss our ideas and interpretations, and to draw up together questions which we believed struck at the central issues. In a few instances we drafted working papers which summarized our understanding of events or technical processes, and submitted them for critical comment. Most often we conducted our interviews jointly, one asking questions while the other took notes. We did not attempt to record the voices of those we interviewed for fear that the presence of a tape recorder might inhibit the free flow of thought. Among the satisfactions of the oral historian are seeing the expression of interest light up a face, hearing the cautious warning over too simple an interpretation, and receiving new insights freely volunteered.



We have talked with about 200 individuals, ranging from former Commissioners who searched their memories and files to laboratory technicians who patiently explained techniques and equipment. We talked to military and naval officers, Government officials, scientists, and engineers. We hoped to interview many others, but time and circumstances denied us the benefit of their recollections.

David E. Lilienthal discussed with us the events during his term as chairman. Others who helped us to understand the difficulties facing the new Commission were Robert F. Bacher, G. Lyle Belsley, John H. Burchard, John A. Derry, James B. Fisk, William T. Golden, Paul M. Green, John K. Gustafson, Lawrence R. Hafstad, Ralph P. Johnson, David B. Langmuir, James McCormack, Philip Mullenbach, Richard O. Niehoff, Sumner T. Pike, Wallace S. Sayre, Carleton Shugg, Oscar S. Smith, Lewis L. Strauss, Joseph A. Volpe, Jr., Shields Warren, William W. Waymack, George L. Weil, Walter J. Williams, and Carroll L. Wilson.

For our understanding of the Dean Commission we turned to Marion W. Boyer, John H. Burchard, T. Keith Glennan, Lawrence R. Hafstad, John A. Hall, Philip Mullenbach, Kenneth S. Pitzer, Philip N. Powers, Oscar S. Smith, Henry D. Smyth, Oliver Townsend, Shields Warren, Walter J. Williams, and Eugene M. Zuckert.

For perspective from other organizations—such as the General Advisory Committee and the Military Liaison Committee—we had the assistance of Donald F. Carpenter, Edward U. Condon, Lee A. DuBridge, David T. Griggs, Leslie R. Groves, John H. Manley, Kenneth D. Nichols, Robert Oppenheimer, Isidor I. Rabi, Cyril S. Smith, Glenn T. Seaborg, Anthony A. Tomei, and William Webster. Congressman Chet Holifield and William L. Borden helped us to understand how atomic energy matters looked from the Joint Committee.

Views from field offices and laboratories are often very different from those at headquarters. Consequently we visited the major Commission installations to talk with individuals and read documents. For the perspective from Argonne we talked to Austin

M. Brues, Harold Etherington, John J. Flaherty, William B. Harrell, Norman Hilberry, John R. Huffman, Harold V. Lichtenberger, Winston M. Manning, David Saxe, and Walter H. Zinn. For similar help on Brookhaven we talked to John P. Blewett, Howard J. Curtis, G. Kenneth Green, Mariette K. Kuper, Isidor I. Rabi, Arnold H. Sparrow, Emory L. Van Horn, and Clarke Williams. On the activities of the Knolls Atomic Power Laboratory and the General Electric Company in Schenectady we met with William C. Bartels, Harvey Brooks, Earl B. Haines, Henry Hurwitz, Jr., Kenneth A. Kesselring, Kenneth H. Kingdon, James Marsden, Stanley W. Nitzman, Thoma M. Snyder, and C. Guy Suits. For our understanding of the trials and accomplishments of Los Alamos and Sandia, we owe much to Hans A. Bethe, Norris E. Bradbury, William M. Canterbury, G. Foster Evans, Darol K. Froman, Leslie R. Groves, Marshall G. Holloway, Robert D. Krohn, James McCormack, J. Carson Mark, Ralph Carlisle Smith, Edward Teller, Carroll L. Tyler, and Stanislaw M. Ulam.

At the National Reactor Testing Station in Idaho we met Charles B. Amberson, Deslonde R. deBoisblanc, William A. Erickson, John D. Ford, William L. Ginkel, James R. Howard, Sidney Kauffmann, Fred R. Keller, Phil C. Leahy, Joe P. Lyon, Fred L. McMillan, Howard E. Noble, Meyer Novick, Ronald G. Reid, George Smith, and L. Joe Weber.



In several trips to the Lawrence Radiation Laboratory at Berkeley and Livermore we sought the counsel of many individuals: some for their recollections, others for assistance in understanding laboratory techniques. Those who helped included Luis W. Alvarez, Hugh Bradner, William M. Brobeck, Donald M. Cooksey, Burris B. Cunningham, Eleanor Davisson, Harold A. Fidler, Albert Ghiorso, Jere L. Green, Harry H. Heckman, Arthur J. Hudgins, Robert W. Kenney, William A. S. Lamb, Edward J. Lofgren, Edwin M. McMillan, Burton J. Moyer, Wolfgang K. H. Panofsky, Isadore Perlman, Wallace B. Reynolds, Duane C. Sewell, Emilio Segre, Frances M. Smith, Robert L. Thornton, James T. Vale, James C. Wallman, and Daniel M. Wilkes.

Although many of the scientists have left Oak Ridge, Hanford, and Savannah River, most are still available for interviews. To get the perspective from Oak Ridge we sought the recollections of Frank P. Baranowski, Harold Etherington, John C. Franklin, Alexander Hollaender, John R. Huffman, Miles C. Leverett, Stuart McLain, Merlin D. Peterson, C. Nelson Rucker, Liane B. Russell, William L. Russell, Alvin M. Weinberg, Eugene P. Wigner, Walter J. Williams, and Gale J. Young. The excitement and activities at Hanford were portrayed for us by Mark H. Arndt, Joseph T. Christy, Milton R. Cydell, Herbert M. Parker, Marvin R. Schneller, Carleton Shugg, and Donald G. Williams. Our understanding of the operation of the Savannah River plant was immeasurably increased by Gerhard Dessauer, Julian D. Ellett, Isaac A. Hobbs, Stewart W. O'Rear, Wilcox P. Overbeck, and George O. Robinson.

Certain decisions in atomic energy were of crucial importance to the history of the United States. First in this category was the decision on the hydrogen bomb. Those to whom we talked about the detection of the Soviet detonation, the decision to build the bomb, and the course of its development were Luis W. Alvarez, R. Gordon Arneson, Robert F. Bacher, Hans A. Bethe, William L. Borden, Norris E. Bradbury, Frederic de Hoffmann, Lee A. DuBridge, Spofford G. English, G. Foster Evans, Paul C. Fine, Kenneth W. Ford, Darol K. Froman, Albert Ghiorso, David T. Griggs, Chet Holifield, Marshall G. Holloway, David E. Lilienthal, Alexander K. Longair, John H. Manley, J. Carson Mark, Lothar W. Nordheim, Robert Oppenheimer, Isidor I. Rabi, Glenn T. Seaborg, Robert Serber, Cyril S. Smith, Ralph Carlisle Smith, Henry D. Smyth, Sidney W. Souers, Lewis L. Strauss, Edward Teller, Carroll L. Tyler, Stanislaw M. Ulam, William Webster, John A. Wheeler, Carroll L. Wilson, and Walter H. Zinn.

On the various aspects of reactor development, we spoke to Charles B. Amberson, William C. Bartels, Manson Benedict, Harvey Brooks, Deslonde R. deBoisblanc, Harold

Etherington, John D. Ford, Lawrence R. Hafstad, Earl B. Haines, Norman Hilberry, John R. Huffman, Henry Hurwitz, Jr., Donald J. Keirn, Kenneth A. Kesselring, Kenneth H. Kingdon, Miles C. Leverett, Earle W. Mills, Stuart McLain, Meyer Novick, Merlin D. Peterson, Donald G. Reid, Hyman G. Rickover, Henry D. Smyth, Thoma M. Snyder, C. Guy Suits, L. Joe Weber, George L. Weil, Alvin M. Weinberg, John A. Wheeler, Eugene P. Wigner, Carroll L. Wilson, Abel Wolman, Gale J. Young, and Walter H. Zinn.

On physics, biology, and medicine, and on the development of research policy, we received help from Luis W. Alvarez, Karl P. Baetcke, John P. Blewett, William M. Brobeck, Burris B. Cunningham, James B. Fisk, Albert Ghiorso, G. Kenneth Green, Alexander Hollaender, Arthur J. Hudgins, Ralph P. Johnson, William A. S. Lamb, David B. Langmuir, Edward J. Lofgren, Edwin M. McMillan, Holbrook M. MacNeille, Burton J. Moyer, Bruce D. Old, Robert Oppenheimer, Wilcox P. Overbeck, Wolfgang K. H. Panofsky, Herbert M. Parker, Isadore Perlman, Kenneth S. Pitzer, Virginia Pond, Anne Rogers, Liane B. Russell, William L. Russell, Emilio Segre, Duane C. Sewell, Thoma M. Snyder, Arnold H. Sparrow, Robert L. Thornton, James T. Vale, Shields Warren, Alvin M. Weinberg, and Clarke Williams.

To help us understand the complications of international relations we turned to R. Gordon Arneson, Donald F. Carpenter, James B. Fisk, Edmund A. Gullion, John A. Hall, Frederick T. Hobbs, Ralph P. Johnson, David E. Lilienthal, Alexander K. Longair, Frederick H. Osborn, Sumner T. Pike, Cyril S. Smith, Lewis L. Strauss, Joseph A. Volpe, Jr., William Webster, Carroll L. Wilson, and Walter H. Zinn.



## *PHYSICAL SURVIVALS*

Historians have always tried to visit the scenes of the events they narrated. In our age travel is less arduous and less adventurous, but the effort is still rewarding. Somehow a sense of the physical surroundings often helps in understanding the context of events.

As Commission employees, both of us worked in the old headquarters building on Constitution Avenue and visited the T-3 building in the shadow of the Washington Monument. As historians we visited the laboratories at Argonne, Berkeley, Brookhaven, and Oak Ridge, and saw accelerators, reactors, and research efforts in the life sciences, many of which had their origin in the years we have chronicled. We toured the production sites and saw the heavy-water reactors standing among the pines at Savannah River, the graphite reactors along the bank of the Columbia, and the gaseous-diffusion plants sprawling along the Clinch River at Oak Ridge. Many of these facilities are silent now, having accomplished the task for which they were intended. At Livermore, the site of the materials testing accelerator, almost nothing is left but the huge building itself, which dominates the flat valley floor. We saw the Brookhaven cosmotron as it was being dismantled. On the ancient lava beds of Idaho we saw the first fruits of the new reactor technology: the Zinn fast-breeder—now recognized as a national historical landmark, the materials testing reactor, and the Navy submarine thermal reactor. Of the ill-fated intermediate-power-breeder little remains at Schenectady; the West Milton site, planned for the breeder, is now used by the Navy for nuclear propulsion development.

No one can grasp from reports, interviews, statistics, or photographs the immense size of some of the production facilities, or the incredibly complicated and delicate techniques demanded by research. An appraisal of the physical remains and of their environment is part of the historians' craft. Undoubtedly our visits tempered some of our early judgments.

## NOTES

The notes which follow are a guide to the material we consulted, not rigorous citation of documentary evidence. From them the reader should be able to find the documents of major interest to him. Citation, however, does not imply that the documents are unclassified or available for inspection. Nor do the notes indicate information gained through interviews. Many people with whom we spoke are still active; many of the topics which we discussed are controversial. Consequently some individuals would speak freely only if no attribution was made of their opinions. We preferred the benefits of recollections freely tapped and issues thoroughly explored, to the trappings of scholarly annotation.