RESEARCH: NEW APPROACHES TO A NEW AGE

CHAPTER 8

Louis J. Ridenour, dean of the graduate school at the University of Illinois, was a peppery scientist who did not hesitate to express his views on public policy. He had been active in the scientists' movement to win support for the McMahon bill in 1946, and in the spring of 1947 he had badgered the Commission through his friend Robert F. Bacher to support the foreign distribution of radioisotopes. Now, in the spring of 1948, he was really angry. In a stinging letter to Lilienthal, he spoke of grave shortcomings in the Commission's leadership, stemming, he thought, from a reluctance "to engage in acts which might be unpalatable to ultraconservative members of the Congress or of the armed forces."

Ridenour made clear the heart of his dissatisfaction. It lay in what he saw as the Commission's continuing failure to exercise leadership in fostering research. As evidence he cited current rumors that the Commission would not come to the aid of the Office of Naval Research, whose funds for high-energy accelerators were being trimmed by Congress, and the Commission's reluctance to support basic research except in a few of the nation's largest universities. "If General Groves were in your position," Ridenour warned, "and he had done what you have done, . . . I should long ago have attacked him publicly." [1]

On the surface Ridenour's charges made some sense. James B. Fisk, the Commission's director of research, had not yet answered the Navy's appeal of June, 1947, for help in funding the completion of high-energy accelerators at a dozen universities. He had taken only a few tentative steps toward providing the kind of financial support which would permit the universities to make nuclear physics a part of their curricula. Even in those branches of nuclear physics and chemistry which did not require expensive equipment like accelerators, the Commission had offered very little encouragement in 1947. Fisk had extended a few contracts with the larger universities

to continue the sort of applied research which the Army had financed during the war, but these represented no important commitment for the future.

These cautious moves reflected Fisk's interpretation of his function as director of research. He thought his first duty was to serve the general manager as staff adviser on the scientific aspects of all Commission activities. He would coordinate the long-range plans of the Commission's laboratories, but he had no intention of creating a staff in Washington to review the details of every research project proposed. Certainly Fisk rejected any suggestion that he might become the administrator of a Federal program to finance scientific research in the universities until the National Science Foundation could be established. The Atomic Energy Act seemed to speak directly to that point in outlawing grants-in-aid and prohibiting the division of research from awarding contracts. In enunciating his principle of "the area of availability" in 1947, Fisk had warned the Commission that only with great caution should it support basic research, either in the national laboratories or in the universities.[2]

If Fisk had qualms about using Commission funds to support basic research, the question was a central issue for Shields Warren, who became the first director of biology and medicine in October, 1947. The very nature of the wartime programs had relegated the life sciences to a support function in industrial health and safety, and the initial organization of the Commission hardly suggested a more prominent role. So completely did the physical sciences dominate both the division of research and the General Advisory Committee that the Commission early recognized the need for both a separate division and a special advisory committee for the life sciences. Most of 1947 had slipped by before the division and its committee were established, and even then they could not claim the prestige and influence of their counterparts in the physical sciences. Warren and the committee were likely to face an uphill fight in convincing the Commission that it should support more than an industrial health program in the life sciences.

THE NATIONAL LABORATORIES

One fact was clear by the end of 1947: The Commission intended the national laboratories to be the backbone of its research program. In theory at least, the national laboratories had the potential of becoming a new type of research institution in which both the Government and the universities could participate. The Government could meet the exceptional needs of the nuclear sciences by providing and retaining title in the buildings and equipment. The universities in the region of the laboratory would furnish the scientists and the leadership which would assure the kind of academic environment deemed necessary for research. But would the laboratories really become regional

research centers, as the Army's advisory committee on research and development had intended in 1946? Rumors about a centralized laboratory staffed with Government scientists in 1947 did not suggest that the Commission was enthusiastic about regional facilities open to university scientists. Even if the Commission fulfilled its promises and supported the national laboratories, some scientists would be dissatisfied. After all, was it not still a general assumption that only universities and private institutions could provide the proper climate for basic research? [3]

Certainly the Commission had yet done little to convince most scientists not associated with its activities that it could create such a climate. The change of contractors at the Clinton Laboratories had not inspired confidence. Despite assurances from Union Carbide that the company intended to stress basic research now that reactor development had been transferred to Argonne, the Commission's decision to turn the laboratory over to an in-
224 dustrial contractor suggested to many scientists how little the Commission knew about managing research. Few at Oak Ridge, not even the indomitable Alvin M. Weinberg, had much faith in Carbide's ability to build a new Oak Ridge National Laboratory on the ruins of Clinton. Some scientists at Oak Ridge were talking of resigning and others were scheduled to move to Argonne. Weinberg and those remaining at Oak Ridge would have little more to work with than the obsolete X-10 research reactor, used mostly for producing radioisotopes, and the crumbling temporary buildings from the wartime project. The Commission had promised to build a new laboratory at Oak Ridge, but by March, 1948, the Commission had not yet selected an architect-engineer, and Carbide had still not found a director for the laboratory.[4]

The future of Oak Ridge looked dismal, but it was a mistake to assume, as some scientists did, that the Oak Ridge malady was infecting all the Commission's laboratories. Quite the reverse: Oak Ridge seemed a dark spot in an otherwise bright picture. At the Argonne National Laboratory there was every reason for optimism. Ideally located near a major city, tied to one of the nation's leading universities, and blessed with a strong director in Walter H. Zinn, Argonne seemed to have everything in its favor. The laboratory was already rising on the new site in Du Page County, southwest of Chicago, and the sudden decision to centralize all reactor development at Argonne appeared to guarantee the preeminence of the institution in the Commission's future. Zinn's chief concern was an embarrassment of riches. He could not yet gauge the effect of concentrating reactor development at the laboratory. Perhaps, as some of the participating universities feared, there would be a shortage of time and resources for the kind of basic studies that would make Argonne a useful research center for universities in the Midwest.[5]

The fledgling Brookhaven National Laboratory, though lacking the wartime foundations Argonne enjoyed, was not worrying about the inroads of

Commission requirements. Like Argonne, Brookhaven could rely on experienced leadership in Philip M. Morse, its director, and in men like Lee A. DuBridge, Henry D. Smyth, and Isidor I. Rabi, who served on the board of Associated Universities, Incorporated, the sponsoring group of nine institutions in the Northeast. Demonstrating keen perception of the ways of Government, the Brookhaven leaders made an asset out of an apparent liability—namely, that the laboratory had been created in the 1946 interregnum between Army and Commission control. As a new laboratory, it would not have to shake off the remnants of responsibility for applied research which haunted Oak Ridge and Argonne. Brookhaven could be from its beginning a national laboratory in the true sense of that term: a regional research center providing the kinds of experimental facilities the individual member universities could not afford, supplementing university research projects, and offering training opportunities for graduate students and young faculty.

The Brookhaven leaders had taken a chance and moved to establish their new laboratory before the Commission came to power. Capitalizing on their knowledge of General Groves's lack of confidence in his successors, the scientists in the Northeast had selected the Long Island site, formed their corporation, and negotiated a contract with the Army by the end of 1946. In a sense, all the Commission had to do was sign the contract and provide the money. The Brookhaven leadership had already made the policy decisions the Commission would never have been able to reach in the chaos of 1947.[6]

This kind of foresight gave the new laboratory some real momentum in 1947. It could quickly recruit a staff of talented scientists, many of whom were disgusted with the lip service paid to basic research in large corporations or discouraged by the disintegration of Government laboratories after the war. Under Lyle B. Borst, a former Clinton physicist, plans quickly developed for the new research reactor, around which all nuclear research at Brookhaven was expected to revolve. Supplementing the reactor as a source of radiation and subnuclear particles would be several "electronuclear machines" or accelerators which M. Stanley Livingston, a student of Ernest O. Lawrence, was planning to build. Commissioner Pike had broken ground for the reactor on August 14, 1947, and Livingston had arranged to purchase a 60-inch cyclotron and a horizontal Van de Graaff generator capable of producing high-energy protons. By the end of 1947 Brookhaven was taking on the semblance of an operating laboratory.[7]

The only other large center for nuclear research in the United States, at the University of California, Berkeley, did not enjoy the formal title of a national laboratory. The discrepancy reflected not a lack of prestige but an unusual degree of independence which Lawrence had established before World War II. He had built the Radiation Laboratory with university funds and with financial help from private sources. The 37-inch cyclotron and the giant magnet for the 184-inch machine were in the laboratory in 1941, when

the Government first showed an interest in using them for experiments in uranium isotope separation. After the war, the Government was obliged to restore them to their intended purpose, basic research in high-energy physics.

Lawrence, however, was among the first to understand that the extraordinary costs of research in this new field would require Government support. Although the Government already had a sizeable investment in buildings and equipment on university property, much better insurance of Commission support was Lawrence's world-wide fame as inventor of the cyclotron and foremost pioneer in its development. If the Commission intended to support research in high-energy physics, it would have to plan for a large investment at Berkeley.[8]

None of the Commission's other research installations bore the formal title of "National Laboratory," perhaps because they did not at that time have any extensive facilities open to scientists in the region where they were

located. The Los Alamos Scientific Laboratory was a major center for basic research, but its activities were almost completely related to weapon development. Although there had been some hope in the Commission that General Electric's Knolls Atomic Power Laboratory would become a regional development center, that idea faded as Knolls moved toward submarine work, which was highly classified. The Commission's laboratories at Iowa State College and the University of Rochester had important missions but ones too specialized for a national laboratory.

Clearly the national laboratories in 1948 had no single mission or organizational structure. The differences in some respects were the accidents of circumstance, but they served Fisk's purpose in keeping open all options for a research policy. He could reasonably claim that by strengthening the national laboratories he was helping to support basic research. The question was whether the national laboratories alone could foster the kind of achievement that most scientists assumed to be the exclusive product of the university or private laboratory. Until he had more evidence on the question, Fisk would continue to favor the national laboratories without ruling out the possibility of research contracts with the universities.

Practical experience in 1947 had demonstrated the advantages of a deliberate, tentative approach to a research policy. For the moment it might have pleased scientists like Ridenour if Fisk in the spring of 1947 had quickly responded to the Navy's request for research funds and committed the remainder of his 1948 budget to whatever research projects the universities could reasonably justify. But such action might well have proved irresponsible. Fisk had only $10 million for fiscal year 1948, and he had been granted only $15 million in the 1949 budget requests. Impulsive generosity in the summer of 1947 might have spawned commitments to relatively weak projects in 1948. Not only might they have wasted money; even worse, they might also have squandered the talents of the few people trained in the nuclear sciences.

Perhaps enduring attacks like Ridenour's was the price the Commission would have to pay to assure that it was making the best possible use of a scarce national resource.[9]

PROBING THE MICROCOSMOS

Administrative principles and budget realities had their part in determining the Commission's place in American science in the postwar period, but equally important were the broad currents within science itself. The end of the war in 1945 made it possible for scientists to resume their pursuit of the exciting ideas which had appeared on the horizon of discovery in 1939. The years of conflict had built up new anticipation in basic research, not only by forcing a delay in accomplishment, but also by providing in technological development new methods and tools for research. No single theme could adequately describe the scope and variety of this scientific endeavor in the late 1940's, but as it affected the Commission's activities, it was primarily an interest in probing the microcosmos.

In the physical sciences, the discovery of nuclear fission in 1938 had opened new possibilities for exploring the heart of the atom. No longer a solid, homogeneous mass, the nucleus had been discovered to be an intricate composite of still smaller "particles." If man were to understand the fundamental nature of matter, he would have to penetrate the mysteries of the nucleus. For this adventure the scientist would need fission reactors and particle accelerators of unprecedented size and complexity, tools which only the Government, and most likely the Commission, could provide. From this research would come not only a new understanding of the nucleus, but also new elements which man himself would add to the panoply of nature.

In the life sciences, there was a similar probing of the microcosmos. Like the nucleus for the physical scientist, the living cell became the center of interest for the biologist in his search for a scientific understanding of life. Like nuclear physics, genetics and cytology had been young but exciting sciences before the war. By 1945 the Manhattan project had created for science an almost limitless supply of radiation. No longer dependent upon minute quantities of radium or cumbersome and expensive X-ray machines, the biologist and the physician had oceans of radiation in reactors and a virtually free supply of radioisotopes which could be used as radiation sources or as radioactive "tags" for studying life processes. These cheap, inexhaustible sources of radiation revolutionized the biomedical sciences in the postwar period and served the scientist as he probed the secrets of the cell and the mechanisms of genetics.

THE ACCELERATOR: KEY TO THE NUCLEUS

Had not World War II intervened, the early 1940's would have been a golden age of physics. Both theory and experiment had concentrated attention on the atomic nucleus, and Lawrence's cyclotron had provided a feasible means for revealing its contents. Like many great inventions the cyclotron was not only ingenious in conception but simple in principle. Electrostatic generators, such as the Cockcroft-Walton and the Van de Graaff, depended upon a single high voltage to energize the particles and were therefore limited by the amount of voltage which the insulators could sustain. An obvious alternative to the direct-voltage device was one in which the particles were accelerated by a series of electrodes, each carrying a relatively low voltage. Even the simplest

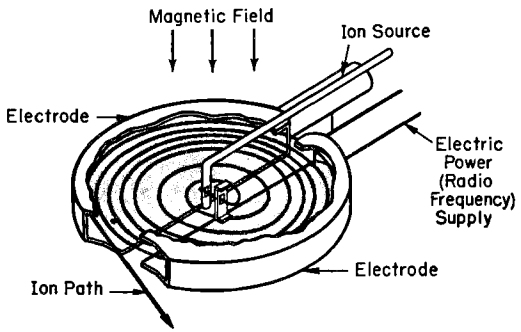


Figure 1. A schematic diagram of the cyclotron. The magnetic field forces the ions into a curved path. As the electrode voltages accelerate the ions, they follow a path of ever-increasing radius until they emerge from the machine.

machine, however, which would accelerate particles in a straight line through several hollow cylindrical electrodes, involved complexities in voltage control that were essentially insuperable in prewar technology.[10]

Lawrence saw that he could avoid the difficulty of multiple electrodes by placing the particles in the field of a large electromagnet. The magnetic field would cause the particles to move in a curved path, requiring only two electrodes, shaped like halves of a round pillbox between the magnet poles. By alternating the charge on the electrodes at the proper frequency, Lawrence realized, he could cumulatively increase the speed of the particles as they moved in a spiral path through the fields created by the magnet and the electrodes. (Figure 1) Particles introduced near the center of the cyclotron would spiral in tight orbits at low energies and in successively larger orbits as they picked up speed. Thus the particles would be able to keep in step with the accelerating voltage no matter what their energy. In other words, the particles, whatever their speed, would be resonant with the single accelerating

frequency. The resonance principle made possible the acceleration of protons to energies of more than 10 million electron volts (mev) with oscillators delivering modest amounts of power at frequencies common to the electronic circuits of those days.

Starting with the first verification of the resonance principle by Livingston in 1931, Lawrence and his associates built successively larger cyclotrons culminating in the "Crocker" machine, completed in 1939, with pole faces 60 inches in diameter. This device became the prototype for standard cyclotrons built by many universities before the war for accelerating light, positively charged particles such as protons or deuterons.[11]

The acceleration of electrons was not a major concern at Berkeley in the 1930's, but work done elsewhere had implications for accelerator development by the end of the war. Donald W. Kerst at the University of Illinois and

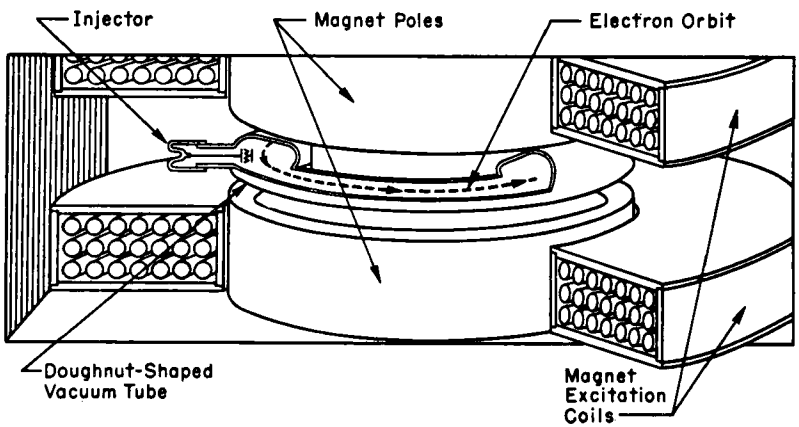


Figure 2. A schematic drawing of a betatron magnet and vacuum chamber, showing the electron orbit and the central magnet core which supplies flux for acceleration.

for a time at General Electric was the primary architect of the electron accelerator, called the "betatron." Like the cyclotron, the betatron used a magnetic field to force the particles into an orbit. Kerst chose, however, to accelerate the electrons not with electrodes but with an electromagnetic force induced by the changing flux of a central magnetic core. In a sense, the orbiting electrons themselves formed the secondary winding of a transformer in which the accelerating voltages were induced. (Figure 2) Another distinctive feature of the betatron was that it kept the particles in an orbit of constant radius by increasing the strength of the guide field as the energy of the electrons increased. This feature of the betatron permitted Kerst to confine the electrons to a small doughnut-shaped vacuum chamber between the magnet poles. By 1940 Kerst had accelerated electrons to 2.3 mev in the betatron at Illinois.[12]

The particle energies achieved in the cyclotron and betatron repre-

sented a substantial advance in the study of nuclear physics, but even by 1940 the pace of research was pressing against the limitations of these machines. In the cyclotron higher energies would require magnets and vacuum chambers of staggering size, as the dimensions of the 184-inch magnet at Berkeley suggested. The ultimate limitation of the cyclotron, however, appeared to be the increasing mass of the accelerated deuterons at energies above 25 or 30 mev. As the particles approached relativistic energies in the large cyclotrons, their increase in mass would slow them and disrupt the resonance upon which successful operation depended. In the cyclotron this phenomenon posed what could be called the relativistic barrier. In the betatron the limiting factor was electron radiation. Because charged particles radiated energy when forced into orbits at high velocities by a central accelerating force, energy losses from radiation overrode additional increments of power as the particle energy increased. The 100-mev betatron which General Electric completed in 1945
230 was already approaching the limits for this kind of machine.

SKIRTING THE RELATIVISTIC BARRIER

By the end of World War II two new developments had promised a way to bypass the limitations of the prewar accelerators. The first, a product of wartime research in electronics, was the resonant-cavity oscillator which made possible the generation of large amounts of power (several megawatts) at very high frequencies (several thousand megacycles). The second was a discovery as fundamental as Lawrence's conception of the cyclotron. In 1944 Vladimir I. Veksler of the Lebedev Physical Institute in Moscow and a year later Edwin M. McMillan, then at Los Alamos, independently proposed a new principle for accelerating particles as they reached relativistic energies. The discovery was that small variations in the speed of particles would be automatically corrected if the frequency of the accelerating voltage were kept reasonably in step with the equilibrium speed of the particles. Applying the principle to the cyclotron, McMillan reasoned that a particle crossing the gap between the electrodes too early would receive some acceleration, which would push it into a wider orbit and cause it to reach the second gap more nearly in phase.[13]

In describing this new principle of "phase stability" McMillan proposed to apply it to a new type of electron accelerator, which he called the "synchrotron." This new device would combine the accelerating system of the cyclotron with the ring-shaped, pulsating guide field of the betatron. A radio-frequency electrode would replace the cumbersome, expensive magnet core as the accelerating device. Although the electrons in the ring-shaped vacuum chamber would move at a constant speed close to the velocity of light, differences in their masses would cause them to follow different paths within

the guide field and thus to arrive at the electrode at varying times. The electrode, operating under the principle of phase stability, would maintain the electrons in the proper orbit. Then, if the operator slowly increased the strength of the guide field, the electrons would move in a tighter orbit, only to be restored to the proper orbit with additional energy supplied by the radio-frequency electrode. In this manner phase stability could be used to increase the mass and hence the energy of the electrons to values far exceeding those possible in the betatron.

McMillan also saw the possibility of using phase stability in the cyclotron. If, as the speed of the particles approached the speed of light, the frequency of the accelerating voltage were gradually decreased, phase stability would assure that the particles stayed in step and continued to accelerate. Changing the frequency of the accelerating voltage, however, would disrupt the slower-moving particles spiraling out from the central source and destroy the cyclotron's ability to accelerate them in a continuous stream. Instead, the cyclotron would have to use short bursts of particles, perhaps several hundred bursts per second, with the accelerating voltage swinging from the initial to the lower frequency as each bunch of particles approached relativistic speeds. In pulsed operation, the cyclotron would produce fewer particles than in continous operation, but it would accelerate them to higher energies and would be better able to produce particles of one specific energy.

Phase stability and better high-frequency oscillators would also renew interest in the linear accelerator. In fact, phase stability had made possible the operation of the earliest machines of this type even though the principle had not yet been explicitly recognized. McMillan's discovery assured operation of the linear accelerator at higher energies; its linear arrangement avoided the difficulties cyclotrons encountered at relativistic energies; and the new oscillators opened the possibility of effective control. As the thoughts of physicists began to turn once again to pursuits of peace, Veksler and McMillan had opened the door to new opportunities in high-energy physics.

BUILDING FOR HIGHER ENERGIES

McMillan's discovery had shown physicists how they might accelerate particles to relativistic energies, but the idea alone did not explain the exuberance with which the scientists rushed to cross the barrier into unexplored territory. The new realm of physics would be exciting and worth studying. Their expectation lay in the results of cosmic-ray experiments and certain theoretical studies that had been going on since the early 1930's. At very high altitudes, reached by mountain-top expeditions, balloons, and airplanes, physicists had discovered tremendous showers of high-energy particles, mostly protons, sweeping into the earth's atmosphere from outer space. Experiments

had already demonstrated that the cosmic-ray particles, having many times the energy of those produced in the laboratory, could bring about some extraordinary changes in the atomic nucleus.

During this same decade, in 1935, the Japanese physicist Hideki Yukawa had predicted the existence of a subnuclear particle which might explain the enormous force binding the atomic nucleus together. He gave the particle the Greek name "meson," implying that it had a mass intermediate between the heavy proton and the very light electron. Within two years cosmic-ray experiments had revealed the existence of a particle very much like Yukawa's hypothetical "meson," except that it did not react strongly with an atomic nucleus as physicists had expected.[14] The discovery made clear that a substantial increase in deuteron energy, to perhaps 300 mev or more, would make possible the production of mesons in the laboratory and might solve the mystery of the meson's behavior. Cosmic-ray research had provided a new
232 goal for physics and McMillan had offered the means for reaching it.

Two months before McMillan sent his paper on phase stability to the *Physical Review*, he had suggested the idea to Lawrence. At the time Lawrence was planning to overcome the relativistic barrier in the 184-inch cyclotron simply by applying more power to drive the protons through the barrier. McMillan addressed his remarks to his own plans for a high-energy betatron, but his comments applied equally well to the cyclotron. "Brute force" methods, he thought, were acceptable only if he could find no neater solution. Phase stability seemed the answer. Lawrence, though cautious, was willing to investigate the suggestion. Instead of building the 184-inch machine as a fixed-frequency cyclotron, he would consider making it a pulsed machine using the synchrotron principle.[15]

Maintaining the wartime pace of the laboratory, Lawrence immediately ordered design studies for the synchrocyclotron. Before the end of 1945 the Berkeley staff was designing an experiment to simulate the synchrotron principle in the 37-inch machine. Successful results in the spring of 1946 gave new impetus to the reconversion of the 184-inch magnet for accelerator work. Driving hard through the summer and early fall of 1946, the Berkeley group had the 184-inch ready to operate on November 1. The next day Lawrence dashed off a note to his old friend Warren Weaver in New York: "We obtained 200 million volt deuterons last night. The 184 inch performed beautifully." The immediate success of the machine demonstrated not only the caliber of Lawrence's team but also the soundness of the synchrotron principle. Within a few years Carnegie Tech, Chicago, Columbia, Harvard, and Rochester would have synchrocyclotrons constructed with funds from the Commission and the Office of Naval Research.[16]

Equally swift was scientific reaction to McMillan's proposal for the electron synchrotron. In November, 1945, he wrote Lawrence that he was designing the new machine to be built at Berkeley to generate 300-mev electrons and perhaps produce some mesons. The existence of such particles

suggested to McMillan that neutrons and protons "cannot really be considered as simple indestructible units, but have a possibility of change, and may even have a fine structure of some sort." By January, 1946, McMillan had completed the design of the magnet for the synchrotron, and in May the Berkeley laboratory announced the start of construction. Scientists at other laboratories did not wait for the completion of McMillan's machine to test the synchrotron principle. Two English physicists had a small 8-mev electron synchrotron in 1946 and General Electric had a 70-mev machine working well early in 1947.[17]

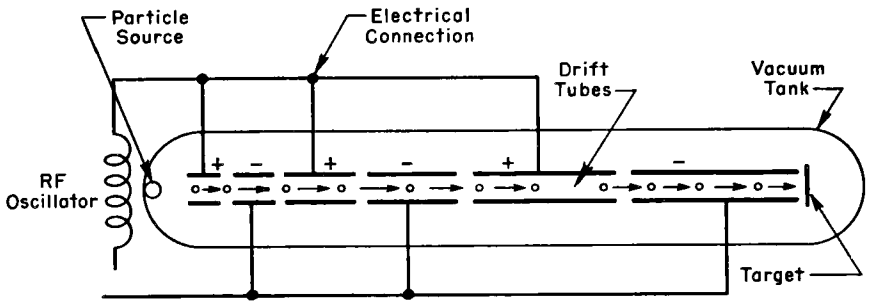


Figure 3. Schematic drawing of the linear accelerator. Voltages on the drift tubes are alternated so that the ions are accelerated as they move toward the target.

McMillan was not the only Berkeley physicist at Los Alamos in the spring of 1945 who was looking for a way to bypass the relativistic barrier. Luis W. Alvarez saw in the magnetron tube, developed for wartime radar equipment, a solution to the high-frequency power requirements for the electron linear accelerator, which Wilbur W. Hansen had been studying for a decade before the war at Stanford University. (Figure 3) The linear machine would avoid the losses from electron radiation in the betatron. McMillan's discovery of phase stability canceled the advantages of the linear machine for electron acceleration, but Alvarez thought it might still be the quickest way to produce high-energy protons. When he returned to Berkeley in 1945, he had a proposal designed to win quick support from Lawrence and Groves. Alvarez thought he could get started quickly and at low cost by building a short

section of a linear accelerator which could later be extended to generate 300-mev protons for producing mesons. He also proposed to use surplus military radar sets to generate the radio-frequency voltages for the electrodes, or "drift tubes" as they were called in the linear accelerator.[18]

With prompt approval from Lawrence and Groves, Alvarez set about acquiring the radar sets and some staff early in 1946. He was particularly fortunate in recruiting Wolfgang K. H. Panofsky, an imaginative young physicist who had just left Berkeley to join the Bell Laboratories. From the outset Alvarez showed himself a true disciple of the Berkeley style in research, with its stress on hardware and practical results and an impatience with interesting but marginal theoretical studies. Alvarez did not yet have a clear enough idea of the accelerator's design to know whether the Army radars would be useful, but they gave his group something to work with. By January, 1947, Alvarez and Panofsky had assembled most of the essential components
234 for a 40-foot accelerator designed to produce 32-mev protons. The Commission endorsed the project on January 22.

In the following eighteen months the Berkeley group worked to turn these components into an operating accelerator. These tasks ranged from such theoretical studies as Panofsky's calculations of beam dynamics to such practical matters as fabricating grids to keep the beam in focus as it crossed the gaps between drift tubes. By the time the accelerator was ready to operate in the summer of 1948, several smaller machines were already operating or under construction at other universities and other approaches to high-energy proton generation looked promising; but Alvarez's linear accelerator could still prove useful in research and accelerator technology.[19]

LOOKING TOWARD THE BILLION-VOLT RANGE

Soon after McMillan set forth the synchrotron principle in the summer of 1945, William M. Brobeck, Lawrence's trusted engineering designer, began to translate McMillan's idea into blueprints for a new proton accelerator. Brobeck saw that even with phase stability, the cyclotron had already reached its practical limits. A cyclotron ten times more powerful than the 184-inch would require a gargantuan magnet with pole faces 60 feet in diameter. A much more practical approach was to adopt the ring-shaped magnet which McMillan had proposed for the electron synchrotron and to increase the field strength of the magnet sufficiently to confine protons, the most effective projectiles for high-energy physics. The ring would have an immense radius, depending on the desired energy of the protons, but the relatively small cross-section of the beam would greatly reduce the dimensions of the magnet and the vacuum chamber at any point on the ring.

Before the end of 1946, Brobeck had completed a preliminary design

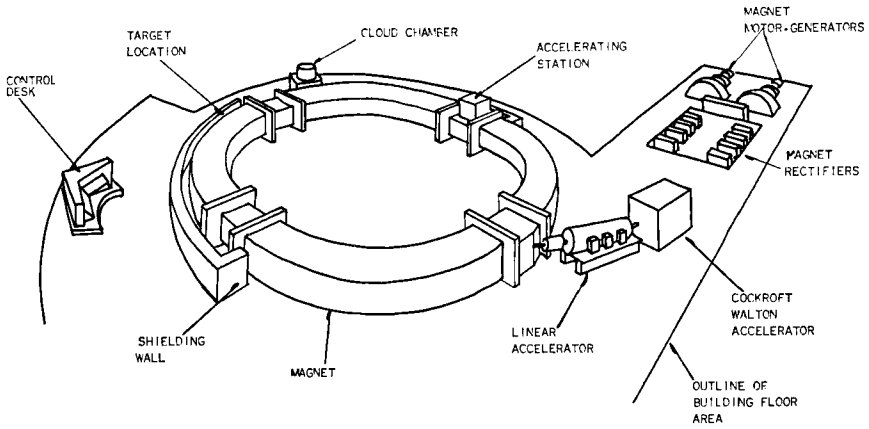


Figure 4. A schematic drawing of the bevatron.

for a synchrotron capable of accelerating protons to 10 billion electron volts (bev). The magnet ring would consist of four quadrants on a radius of 80 feet, each quadrant consisting of a series of magnet blocks standing 9 feet high and 15 feet wide. (Figure 4) Between the pole faces would be the vacuum chamber, 4 feet wide and 6 inches high, in which the protons would circulate. An unusual feature of the design was the four "straight sections" connecting the quadrants. These sections would contain no magnets and would thus give access to the vacuum chamber for injecting the protons, inserting vacuum pumps, installing the radio-frequency accelerating equipment, or extracting the proton beam. To minimize the range of proton velocities the machine would have to accommodate, Brobeck proposed to install a 4-mev horizontal Van de Graaff accelerator at one of the straight sections. The entire installation would cost about $25 million and would take four or five years to build. By the summer of 1947, Brobeck had revised the magnet gap dimensions and lowered the cost estimate to $10 million, but the essential plan remained the same. Since the accelerator would be in the bev range, he proposed to call it the "bevatron." [20]

McMillan's discovery had also stimulated scientists in other laboratories to consider building proton synchrotrons of the ring-magnet design. At the University of Birmingham in England, Marcus L. E. Oliphant had proposed a ring-type proton accelerator in 1943, long before Veksler and McMillan had propounded phase stability. In 1947 the Birmingham group,

capitalizing on Oliphant's work, had ordered components for a 1-bev machine.[21]

At Brookhaven interest in high-energy physics first found expression in a meeting called by Jerrold R. Zacharias of MIT in the spring of 1947. Although the large graphite reactor was expected to be the principal research facility of the laboratory, the Zacharias committee proposed construction of accelerators in two categories: those too expensive for a single university to build and those which would supplement fundamental research either in the physical or biological sciences at Brookhaven. In the first category they placed a large proton accelerator, either a synchrocyclotron or a synchrotron. A 60-inch cyclotron, resembling the Crocker machine at Berkeley, would fill the second need.[22]

The most important requirement for a strong accelerator program was people, and in this respect Brookhaven was particularly fortunate. To head
236 the accelerator department the laboratory had obtained the services of M. Stanley Livingston, who had fabricated some of Lawrence's first experimental cyclotrons. Now at MIT, Livingston was one of the outstanding authorities on accelerators in the United States. A second Lawrence disciple at Brookhaven was G. Kenneth Green, whose lean frame suggested that he had the same kind of drive and enthusiasm for work that motivated Lawrence. A sharp mind, coupled with an engineer's sense of the practical, made him a valuable member of the group. John P. Blewett, quiet and scholarly in contrast to the exuberant Green, brought to the project several years of experience in accelerator development at General Electric. Leland J. Haworth, a big, friendly physicist from the Midwest, was a continual source of strength, although his duties as assistant director of the laboratory prevented him from giving full time to accelerators.

Initially Livingston felt certain that the laboratory needed a large synchrocyclotron, but the more Green and Blewett learned about the studies at Berkeley and Birmingham, the more interested they became in the proton synchrotron. Rabi had visited Berkeley as a member of the General Advisory Committee and had come back to Brookhaven ecstatic about the synchrotron. It would certainly be a gamble to build the machine, especially since the design had never been tested even on a small scale with protons. The greatest question was whether a magnet ring 50 feet or more in diameter could be built accurately enough to keep the proton beam in focus as it traveled millions of times around the ring. The slightest error in design, the slightest distortion might destroy the beam entirely. Could a new laboratory like Brookhaven afford a $10- or $20-million gamble?

The Brookhaven physicists were inclined to take the chance, but they had no intention of being reckless. They would build their first synchrotron no larger than necessary to give it a distinct advantage over the synchrocyclotron. To assure a really good producer of mesons, they would need something over 2.5 bev. This energy was substantially below the 10 bev Brobeck was

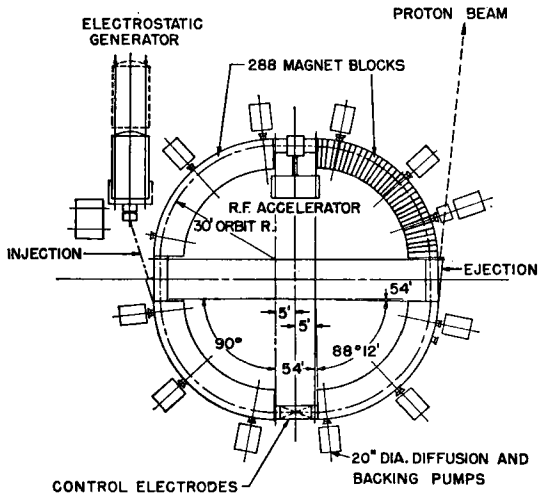


Figure 5. Plan view of the cosmotron showing the magnet blocks arranged in quadrants. The four straight sections accommodate equipment for injecting, accelerating, controlling, and extracting the ions.

planning for the bevatron, but the Brookhaven scientists concluded that they could always build a larger machine if their first proved successful. Before the end of 1947 Livingston and his associates had established the design parameters for a 2.5-bev machine. Similar to the Brobeck design in that it would use the large ring magnet with four straight sections, the Brookhaven design incorporated new features which Livingston hoped would be improvements. (Figure 5) In place of the huge, square "H"-shaped magnets of the Berkeley design, the Brookhaven machine would use "C"-shaped magnets which would provide great efficiency with a minimum use of steel, the largest single cost item in a big accelerator. The Brookhaven group also devised a new type of radio-frequency system to supply the accelerating voltage and a new system for automatically controlling the amount of voltage applied. Thus by the end of 1947 both Berkeley and Brookhaven had completed design proposals for a proton synchrotron in the bev range.[23]

CREATING FOR DISCOVERY

The interior of the atomic nucleus was not the only new realm which the wartime effort had opened to the nuclear scientist, nor was the high-energy accelerator the only instrument at his disposal. The feverish dash for the weapon in the mid-1940's had left in its wake the raw material for years of research and study. As they completed their wartime assignments, both

physicists and chemists would turn to the thousands of interesting investigations they had set aside during the war. Before 1945 ended, many were carrying the war's unfinished business in the basic sciences back to their university laboratories.

In many respects, Glenn T. Seaborg, the young chemist who had gone to the Metallurgical Laboratory from Berkeley in 1942, faced the same prospects open to thousands of his colleagues in exploiting the research opportunities which the Manhattan project had created. What set Seaborg apart from the others was exceptional ability as a director of team research, a keen sense of what was significant in a mass of scientific data, and a determination to make a name for himself in the annals of science. He had made a good start, establishing himself as a codiscoverer of an element before the age of 30. In all the history of science only a few men had earned the distinction of discovering one of the building blocks of nature and even fewer had more than one element to their credit. Seaborg was in a good position to break all records in element-discovery. He had the knowledge and means at his disposal to create new elements and in the process "discover" and name them. This strong personal motivation sparked some extraordinary accomplishments in opening new realms for science and technology in the postwar world.

In a sense, there was nothing very difficult about creating new elements. Seaborg and many of his associates at the Berkeley Radiation Laboratory knew that bombarding heavy atomic nuclei with deuterons, alpha particles, or neutrons was likely to lead to heavier elements. The production of neptunium and plutonium had provided steppingstones to new discoveries. Even during the war it was possible for Seaborg to pursue his interest in element-creating. The ultramicrochemical techniques he and his staff had developed for processing minute quantities of plutonium would permit him to continue his search for heavier elements with quantities of material of no consequence to the war effort. He could send a few micrograms of plutonium to his friend Joseph G. Hamilton, who directed the operation of the 60-inch medical cyclotron at the Crocker Laboratory in Berkeley. After exposing the sample to bombardment by helium ions in the cyclotron, Hamilton could send it back to Seaborg for analysis at the Metallurgical Laboratory.[24]

Seaborg knew enough about the structure of the atomic nucleus to be confident that the samples contained new elements awaiting discovery, but how could he prove they were there? How could he observe the chemical or physical properties of a substance he could not see? One answer seemed to lie in the time-honored techniques of chemistry. In the early decades of the century, chemists had used the periodic table to predict the properties of undiscovered elements. Knowing what to look for, the chemist was more likely to make the discovery. Seaborg could use this approach if he knew the "chemical family" to which his new elements belonged. This was not an easy matter to determine at the upper end of the periodic table. Seaborg's best

guess was that the new elements might be members of a "uranide" family, all having properties similar to uranium, as neptunium and plutonium did.

When occasional efforts to detect new elements in Hamilton's samples failed to produce any results after more than a year of study, Seaborg and his associates began to suspect they were on the wrong track. In seeking a new relationship, they saw significance in the fact that lanthanum fluoride had served as an effective carrier of plutonium in one of the oxidation-reduction processes the group had developed for recovering plutonium from the Hanford reactors. If lanthanum had chemical properties similar to plutonium, perhaps the uranium family was similar to the lanthanides. This seemed extraordinary, for the lanthanides were a strange family of elements which

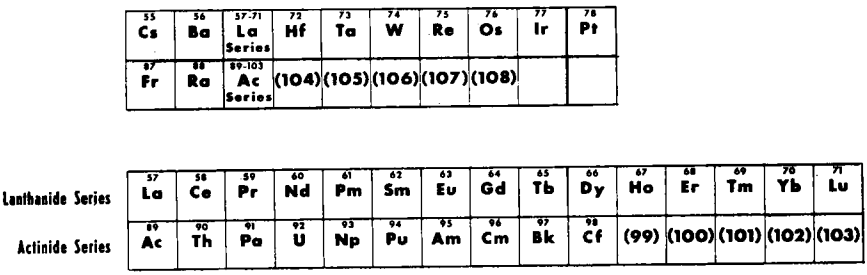


Figure 6. The lanthanides and actinides in the periodic table of the elements.

had no regular place in the periodic table. They were usually depicted on a separate line at the bottom of the periodic chart with an arrow pointing to the one space between barium and hafnium. The lanthanides were transition elements whose special chemical properties were explained by the arrangement of electrons filling an inner orbital shell.

Suppose, Seaborg asked himself, the transplutonium elements fell in a second transitional series, also missing electrons in an inner shell? In this case the first of these elements, called actinium, might be similar to lanthanum; the second, cerium, similar to thorium, and so up the series. (Figure 6) This hypothesis would explain why he had not been able to isolate the suspected new elements with his plutonium separation techniques, which depended on a series of oxidation-reduction steps. The new elements would be similar to europium and gadolinium in the lanthanide series. These elements

were known to be very stable in only one oxidation state, the +3. Now Seaborg had a new set of properties to look for.[25]

Seaborg was ready to test his new theory in July, 1944. He asked Hamilton to expose about 10 micrograms of plutonium nitrate to the beam of helium ions in the 60-inch cyclotron, on the supposition that some of the plutonium nuclei would absorb the proton pairs to form element 95 or 96. When the samples arrived, Ralph A. James, a recent graduate at Berkeley, dissolved the target material in acid and used the standard oxidation-reduction process with lanthanum-fluoride carrier to remove the fission products and plutonium. If, as Seaborg had predicted, the new element could not be oxidized to the +6 state, it would be concentrated in the final precipitate.[26]

Now Seaborg and his group resorted to a second test to prove the existence of the new element. It was common knowledge in the laboratory that most heavy elements were radioactive. Furthermore, each had characteristic
240 radioactive properties. It was easy to determine that the concentrate emitted both alpha and beta particles, the former perhaps indicating the presence of the new element and the latter coming from the few remaining fission products. To determine the energy of the alpha particles, Seaborg went to Albert Ghiorso, a young electronics engineer who had become an expert in such measurements. Using a simple ionization chamber Ghiorso determined that there were 500 disintegrations per minute with an energy equivalent to a range of 4.75 centimeters in air. Later measurements showed the half-life of the material to be 5 months. From their knowledge of nuclear processes, Seaborg's group surmised that they had produced a new element with an atomic number of 96 and an atomic weight of 242 (or 96^{242} in the physicist's notation). Further experiments would have to confirm the deduction.

This confirmation came before the end of 1944 from other experiments which the Seaborg team had arranged for insertion in the Hanford and Oak Ridge reactors. It seemed possible that long exposure to the very large neutron flux in the reactors would lead to the formation of both elements 95 and 96. When Leon O. Morgan and James analyzed the samples in the closing weeks of 1944, they found two alpha emitters, both of which behaved like actinides. Ghiorso's measurements revealed one of the alpha emitters to have a range of 4.75 centimeters; the other, 4.05 centimeters. The first confirmed the earlier detection of element 96; the second indicated the presence of element 95.[27]

Still working under the rigid security restrictions of wartime, Seaborg and his associates could not announce their discovery in the customary way through the scientific journals, but they prepared for the day when publication would be possible. To the discoverers fell the privilege of naming their discovery. To recognize the relationship of the actinides to the lanthanides, the Seaborg group proposed to call element 95 "americium," after its analagous lanthanide, europium. Element 96 would be known as "curium," corresponding to its lanthanide analogue, gadolinium, after the Finnish rare-earth

chemist Johan Gadolin. It was also necessary for security reasons to describe the discovery of elements 95 and 96 in terms of cyclotron rather than reactor irradiations. Although 95 had actually been first detected in samples exposed in reactors, the Seaborg group had to use a later experiment, involving the exposure of uranium 238 in the 60-inch cyclotron, to establish the discovery in the open literature.[28]

Significant as the discoveries in 1944 were, they marked only the beginning of research on transplutonium elements. As preliminary research often did, the first experiments revealed impressive obstacles to future progress as well as new incentives. For one thing, much larger samples than those produced in the cyclotron were needed to obtain truly definitive results and to provide source material for building even heavier elements. For another, the chemical similarity of the actinides, and particularly the difficulty of raising americium or curium above the +3 oxidation state, ruled out the separation processes the Seaborg group had devised for plutonium. There was always hope that one of the alternate processes under study at the wartime laboratories would prove effective, but in the meantime Seaborg's team proceeded as best they could with existing techniques. As the war came to a close in the summer of 1945, Burris B. Cunningham, one of Seaborg's senior researchers, succeeded in isolating microquantities of americium 241, but the techniques relied heavily on ingenuity and persistence.[29]

Study of separation processes other than oxidation-reduction continued for more than a year after Seaborg and his group returned to Berkeley in the fall of 1945. The best hopes seemed to be in ion-exchange processes, which Waldo E. Cohn and Frank H. Spedding had tried during the war to separate lanthanides. Stanley G. Thompson, who had had a leading role in developing the oxidation-reduction process, brought some first-hand knowledge of ion-exchange methods with him when he returned to Berkeley. The attractive features of the process were that it automatically selected the various elements to be extracted, it was relatively fast if somewhat tedious, and it required only very small quantities of material. It depended on the unique ability of certain organic polymers or resins to adsorb lanthanide ions in aqueous solutions. When the adsorbed material was placed in the top of a column containing more of the polymer, the various lanthanides were dissolved (or eluted) in a definite order by a solvent dripped slowly through the column. (Figure 7)

The Seaborg group needed almost a year of research to determine whether the ion-exchange process would work with actinides. After experimenting with a variety of polymers and solvents Louis B. Werner and Isadore Perlman were ready for the first effort to separate curium and americium in July, 1947. In a column 50 centimeters high and 8 millimeters in diameter filled with the polymer Dowex-50, they used ammonium citrate as the solution to elute many small samples of the two elements. They could then identify the samples by their characteristic alpha activity. A new multichannel pulse

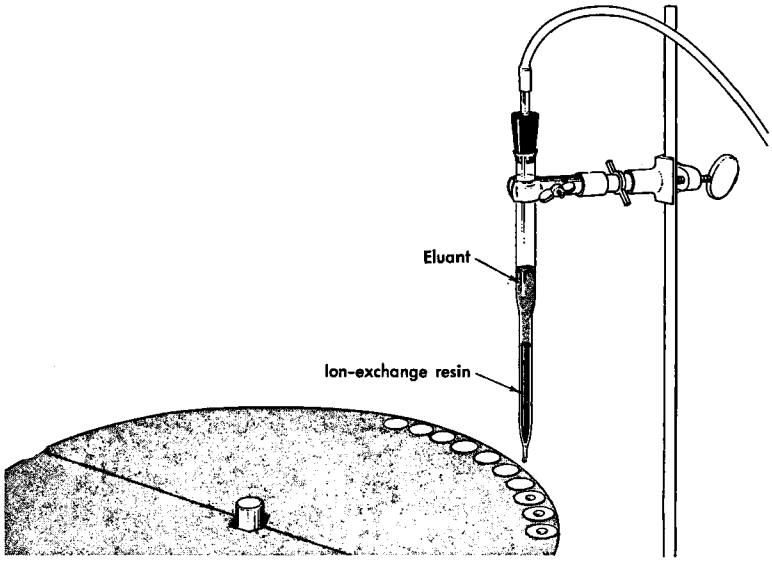


Figure 7. Equipment used for elution experiments. Successive drops of eluant are collected on the small discs.

analyzer which Ghiorso had developed was of great help. The analyzer, containing 48 channels, each set for a different voltage threshold, could automatically sort out and count the number of disintegrations at many specific energies. A plot of these data revealed the various elements present in the samples. By using the elution techniques with the ion-exchange process and Ghiorso's multichannel analyzer, Seaborg's group was prepared to separate any of the actinide elements. They had established the foundations of a new technology for the postwar world.[30]

RADIATION AND THE PLANT WORLD

Studies of radiation effects on plant life long antedated the Manhattan project. Since the turn of the century biologists had been subjecting various plant species to X rays and to gamma rays from radium sources. The findings, however, had been largely restricted to observation of gross effects, without any very precise definition of the amount of radiation received or its wavelength. Radium sources were almost prohibitively expensive for biological work, and the use of X-ray machines imposed severe limitations on the duration of exposure and the number of plants irradiated. Not until the 1920's had scientists amassed enough fundamental data and agreed upon sufficiently standardized units of measurement to claim the establishment of a

new discipline called radiation biology. Even then, published data rested on conceptions related more to the physical than the biological sciences, as demonstrated by the common practice of describing the mechanism of radiation damage as an "ionizing effect."[31] Helpful as this conception was in establishing standards, it described only in physical terms what were essentially biological phenomena.

On the eve of World War II, enterprising young biologists were beginning to move beyond such expedients in an effort to describe radiation effects in biological terms. In attempting to explain not only what radiation did to plants but also how it produced such effects, biologists with enough courage to try could find intriguing questions, whatever their special interest or approach. Among the various subdisciplines in the field, the study of cells, or cytology, was perhaps the most promising. Since the cell was the fundamental unit of all life, it seemed likely that the mechanism of radiation effect would be explained in terms of changes produced in the cell.[32]

Among the many biologists intrigued with this idea was Arnold H. Sparrow, a young Canadian who had gone to Harvard on a research fellowship in 1942. After a wartime stint with the Office of Scientific Research and Development, Sparrow returned to his research at Harvard on the effects of radiation on plant cells. From his earlier research he had concluded that plant cells were most likely to be sensitive to radiation during division, particularly during the process of meiosis, which halved the number of chromosomes in forming reproductive cells. For his experiment Sparrow selected *Trillium erectum*, a type of Appalachian mountain lily frequently used in genetic experiments. *Trillium* had the advantage of large anthers, which produced many mother pollen cells; it also had a small number (10) of large chromosomes, which reacted in a relatively uniform manner during meiosis. Except for a 160-kilovolt Coolidge-tube X-ray machine, the experiments required only the usual equipment of the cytologist's laboratory: slides, stains, microtomes, and microscopes.[33]

To finance his research at Harvard, Sparrow had applied in 1946 for a three-year fellowship from the American Cancer Society. The private research grant was the accepted mode of supporting scientific research, and the great public interest in using atomic energy in cancer therapy suggested the cancer society as a likely source of support. Another possible source was the Atomic Energy Commission. Early in 1947 George B. Kistiakowsky, the Harvard chemist who had worked at Los Alamos, mentioned to Sparrow the opportunities at the new Brookhaven laboratory. Late in June, a week before Sparrow was to begin his fellowship, he received a definite offer to join the biology department at Brookhaven. There was perhaps some risk in committing one's future to as untried an institution as a national laboratory, but a visit to Brookhaven convinced Sparrow that the advantages far outweighed the dangers. The resources of the Long Island laboratory promised to surpass both in staff and equipment the headiest dreams of the university scientist.

When Sparrow arrived at Brookhaven in the summer of 1947, there was

as yet little evidence of the facilities which had been promised him. The biology department was housed temporarily in a former post exchange; work was only beginning on the research reactor and particle accelerators which would provide radiation sources for experiments. But before the end of the year, plans were completed for a small greenhouse, and Sparrow was continuing his research on *Trillium*.

Sparrow's special interest in *Trillium* was in determining which stage in the process of meiosis was most sensitive to X-rays. Obtaining the plants in a dormant state late in the fall, Sparrow kept them at rather low temperatures to slow down the process of meiosis. From time to time he removed some of the pollen from the anthers to determine what stage of meiosis the microspores had reached. At the desired stage, he exposed the plants to X rays and then put them in cold storage until mieosis was completed and the next cell division had begun. He and his staff then prepared new smears from
244 the plants and examined them under the microscope. They determined the effect of radiation by counting or "scoring" the number of broken chromosomes. After examining the data from thousands of scorings, Sparrow concluded in the fall of 1948 that irradiation at one meiotic stage produced fifty times more breakage than that obtained with the same dosage at another stage.[34] The Brookhaven scientists needed still more data to be certain of their conclusions, but they were at least beginning to formulate a systematic understanding of the effects of radiation on the reproductive cells of one plant species.

RADIATION AND MAN

The effects of radiation on plant life provided many exciting possibilities for biological research, but its effects on man were of more than academic concern. Under ordinary circumstances humans could not be the subjects of laboratory experiments with radiation. But the bombings of Hiroshima and Nagasaki in August, 1945, had provided an exceptional (and hopefully unique) opportunity to measure radiation effects in a human population.

The first able to respond to the catastrophe were the Japanese physicians and scientists who, despite the chaos and devastation in the crumbling empire, marshalled their forces to estimate the location and force of the detonations, the number of people killed, and the extent and nature of injuries. By the time the first American medical teams arrived with the occupation forces and a special Manhattan District attachment in September, 1945, the Japanese were completing a series of reports on the disaster. An American joint military commission supplemented the Japanese studies in 1946 by examining seven thousand survivors and preparing a comprehensive summary of the acute effects of the bombings.[35] These reports, however,

covered only a small sample of the great mass of evidence available, and in many respects it was the least valuable. Physicians were more interested in long-range effects on the blood cells, the physical growth of children, the mechanisms of heredity, and the development of various pathological conditions such as the formation of massive scar tissue. Reliable estimates would take years to formulate; determining hereditary effects would require decades, if not generations, of observations.

Both the military services in 1946 advocated long-term research directed by the National Academy of Sciences, and before the end of the year the services obtained a Presidential order directing the Executive Branch to assist the academy in organizing the project. Early in 1947 the academy established a committee on atomic casualties and asked the Atomic Energy Commission for financial support. All the members of the committee, including Shields Warren, could speak to the need with authority. The Commission responded promptly. An interim allocation of $100,000 in the summer of 1947 supported preliminary surveys by the new committee until the Commission signed a formal contract with the academy in April, 1948.[36]

By this time several survey groups had visited Japan and formulated plans for comprehensive studies involving all the medical sciences. The main research centers were to be in Hiroshima and Nagasaki, with similar but smaller facilities for control studies at Kure and Sasebo. The first projects, directed by Melvin Block, Fred M. Snell, and James V. Neel, concentrated on scar tissue formation, blood damage, and genetic data. The shortage of supplies and laboratory space, the lack of heat and trained personnel made the work almost impossible in the early months of 1948. Despite these obstacles, by spring Snell had completed a blood survey of 950 casualties at Hiroshima and an equal number of control patients at Kure. Even more difficult was Neel's task of collecting pregnancy data for the genetic studies. Extra rations were offered as an incentive for initial registration of mothers, but traditional Japanese reserve made it difficult to obtain subsequent data on birth defects.[37]

The Japanese and then the American team had earned the gratitude of scientists the world over by preserving the priceless data for long-term studies of the Hiroshima and Nagasaki victims, but their work was only a start. Substantial increases in financial support would be required in the years ahead, and the task of finding that support fell primarily on Warren.

MEETING THE DEMAND

By early 1948 both Fisk and Warren were well aware of the new interests and opportunities that were generating a demand for Commission support of basic research. The achievements of McMillan, Seaborg, Livingston, Sparrow, and

Neel were but isolated examples of the activities of hundreds of American scientists. Fisk felt the greatest pressures from high-energy physicists who needed accelerators. The demands on Warren were more diffuse, but they pointed to a substantial expansion of basic research in the biological sciences, both in the national laboratories and the universities.

Whatever his reservations about Commission support of basic research, Fisk recognized the inevitability of Government investment in high-energy accelerators. Without waiting to formulate a definite plan, he obtained a commitment from the Commissioners in October, 1947, to set aside $15 million for this purpose. Berkeley and Brookhaven were already competing for this prize.

For the eleven smaller accelerators being constructed on university campuses, the Office of Naval Research was still pleading for funds. As Fisk had predicted, the Navy had found the $8 million it needed to continue these

projects until June, 1948, but there was little chance that the Navy could carry the entire burden for another year. Alan T. Waterman, chief scientist of the Office of Naval Research, had warned the Commission that Navy support for the nuclear sciences in 1949 would have to be cut back to $2.6 million. By this time Fisk was ready to help in a cautious way. In January he had hired Holbrook M. MacNeille, a mathematician who had represented the Office of Naval Research in London during World War II.

Thoroughly familiar with Navy procedures for handling research contracts, MacNeille in a few weeks worked out a joint program both the Navy and the Commission could accept. Fisk agreed to transfer the $4 million the Navy had requested for 1948, with the understanding that the money would be used only for funding new projects but not to replace money the Navy was already contributing to existing projects. Fisk would also require joint approval of the new projects by both agencies, a key factor being the availability of qualified scientists to perform the research. This condition would prevent the Navy from transferring funds away from nuclear research, give the Commission some voice in the use of the funds, and incidentally, increase the total Government support of the nuclear sciences.[38]

Waterman found only minor fault with the proposal and accepted its general terms on February 3, 1948. It would take several months to select from the more than seven hundred Navy projects in over one hundred institutions those suitable for the joint program, but the Commission transferred the first $1 million to the Navy on the strength of the February 3 meeting. The final plan for 1948 came to $3.1 million for physical research and $1.3 million for biomedical studies, the total being slightly more than the original Navy request. The Commission announced the new cooperative effort on April 26, just ten days after Ridenour's letter to Lilienthal.[39]

The joint projects provided an excellent buffer against the growing demands from the scientists for Commission support of basic research. All the projects were in nongovernment institutions and dealt with unclassified projects. At the same time, as part of the Navy program, they did not constitute a

clearly independent commitment on the Commission's part to sponsor basic research outside its own laboratories. Another advantage was that the Office of Naval Research took the full burden of negotiating and administering the contracts, a task Fisk's small staff could not have assumed even by the summer of 1948. Fisk and MacNeille could observe the joint program in action, calculate its strengths and weaknesses, and hazard a few research contracts on their own to see what problems would arise.

One of these difficulties was sure to be the narrow range of topics that were clearly unclassified. In response to the General Advisory Committee's appeal for sweeping away all security restrictions on fundamental scientific data, the Commission had cautiously opened a few topics to unclassified investigation. These were limited to radiation instruments, particle accelerators, fluorocarbon and fluorine chemistry, including industrial applications, and medical research and health studies. The fact that the Manhattan District reviewers had recommended all of these subjects for declassification in August, 1946, did not make the Commission's action seem especially aggressive. When Lilienthal asked why additional topics had not been proposed, John E. Gingrich, the director of security and intelligence, could only reply that they were difficult to define. The General Advisory Committee found this answer absurd. The proper approach, in the committee's opinion, was to consider all basic research in essence unclassified, with the few sensitive topics an exception to the rule.[10]

Such a sweeping proposal seemed out of the question in the spring of 1948, particularly in view of Commissioner Strauss's overriding concern about the security of technical information. The best the Commission could do was to declassify additional areas, or as Strauss preferred to call them, "topics," for research. The fourteen topics declassified in August, 1948, essentially removed restrictions on all instrumentation, on mathematics, and on all aspects of research in the physical and biological sciences which did not involve the fission process, weapons, or the properties or characteristics of elements above atomic number 90. This restriction effectively prohibited unclassified work on thorium, uranium, and plutonium. To preclude the possibility that unclassified research might reveal classified information, the research divisions adopted the practice of providing a security clearance for the principal investigator, who could presumably steer his research associates away from classified areas.[41]

QUEST FOR THE MESON

The demands for Government support of research, particularly for high-energy accelerators, gained new impetus as accomplishments at Berkeley and elsewhere in 1946 and 1947 opened the possibility for some spectacular experiments. Among these none promised to be more rewarding than the

production of mesons in the laboratory. For this task Lawrence's 184-inch cyclotron was marginal at best. At top performance it could push alpha particles to about 380 mev, which Lawrence's staff believed would be sufficient to assure that one proton in the nucleus would occasionally have the collision energy needed for meson production. If it was physically possible, Lawrence was confident that Duane C. Sewell, James Vale, and the cyclotron group would reach that goal.

The second ingredient of success was the ability to record meson production on photographic plates. This was a specialized art with a history going back to the turn of the century, when Henri A. Becquerel had discovered the effect of radiation on photographic emulsions. Over the years physicists had met new requirements by developing new techniques for producing more sensitive emulsions, exposing the emulsions to radiation, developing the emulsions, and analyzing the events they recorded. By the
248 1930's, when cosmic-ray experiments were taking on new importance, Cecil F. Powell and his associates at the University of Bristol in England had become the world's leading authorities on photographic emulsions for this kind of research.[42]

Lawrence's laboratory had used photographic techniques extensively at Berkeley and had built up a competent group headed by Eugene Gardner, a young physicist from Utah who had been exposing photographic plates in the 184-inch machine since it began operation. For the all-important meson experiments, Gardner had obtained some of the new emulsions developed by Ilford Limited in England, some especially sensitive material which Powell had used with great success in cosmic-ray studies earlier in 1947. With McMillan's help, Gardner and his group designed the experimental assembly, consisting of a thin target probe and a stack of photographic plates mounted in a block of copper, which would shield them from unwanted particles. The alpha particles accelerated in the cyclotron would strike the target to create negatively charged mesons, which would curve outward from the target under the influence of the cyclotron's magnetic field and hit the plates. Robert Serber checked out the theoretical calculations, and all seemed to be in order.[43]

Despite these special preparations, Gardner's group encountered trouble from the start of the experiments on October 13. Nothing appeared on the plates, even when different target materials and exposure times were used. Gardner checked to see that his group was following exactly all the steps in the sensitive process for developing the Ilford emulsions. Still the developed plates revealed no meson tracks under the microscope. The Berkeley group knew enough about the cyclotron and the theory of meson formation to be confident that the machine was producing mesons. The fault, then, seemed to lie in the emulsions. Perhaps knowing of Gardner's difficulties, Powell suggested sending one of his assistants to Berkeley for a year on a Rockefeller Foundation fellowship.[44]

In February, 1948, a vivacious Latin-American, just twenty-three years old, arrived at the Berkeley laboratory. He was Caesare M. G. Lattes, a Brazilian physicist who had worked with Powell on some of the classic cosmic-ray experiments. Gardner needed only a few days to explain the experiment to Lattes, and the cyclotron runs started again on February 15 with Lattes handling the plates. In ten runs during the first week, the results were still disappointing, but Lattes was confident of success. At last in one run on February 22, Lattes detected two of the characteristic meson tracks. Within a few days, Lattes was finding mesons in numbers. Gardner's group could measure with an eyepiece micrometer the range and density of each track in the emulsion to determine the velocity of the meson. They could determine the mass of the particle by measuring the point and angle at which it struck the photographic stack, the lighter particles moving in tighter orbits under the magnetic field. Some tracks terminated in a characteristic star pattern, which indicated that the meson had disintegrated in collision with a nucleus.[45]

The Berkeley scientists wanted to be certain of the results. Although they had found numerous mesons on February 26, they were not ready to announce their success until March 9, 1948. Each plate showed about 50 meson tracks along its edge. Gardner and Lattes had measured 49 of these to obtain an estimate of mass consistent with the Bristol data. The advantage of the Berkeley experiments, as Lattes explained glowingly, was that they had obtained 27 tracks in ten minutes, while eight members of the Bristol group had worked a year to get 100. The event was a ringing accomplishment for Lawrence and Berkeley. They had for the first time brought cosmic rays into the laboratory, and the exploration of the atomic nucleus seemed only beginning.

COMPETITION FOR POWER

By the time Lawrence announced the laboratory production of mesons, both Berkeley and Brookhaven had completed their proposals for proton accelerators in the billion-electron-volt (bev) range. Lawrence had kept Fisk and the Commissioners well informed of the progress Berkeley was making on the bevatron in the summer and fall of 1947. The Commission seemed more than interested in Lawrence's ideas, but he had no assurance of Commission support. The Brookhaven design, calling for an accelerator substantially smaller than the bevatron, seemed to offer quicker attainment of the bev range. If the Commission should decide to build only one accelerator, it might well choose the less expensive Brookhaven proposal. Lawrence himself could appreciate the wisdom of modest steps in moving to higher energies. Perhaps it would be prudent to build a small machine which could later be expanded

to higher energies. Early in 1948 Lawrence asked Brobeck to start designing a 1.8-bev machine which could be enlarged to 3.0 and then to 6.5 bev.[46]

With interest mounting in both laboratories, the Commission turned to the General Advisory Committee to referee the contest. The committee meeting scheduled for February, 1948, in Washington, was an opportune time to discuss the two projects; the two "bevatrons," as they were then called, became a big item on the agenda. From the outset there was a wide diversity of opinion in the committee. The only general consensus was that one synchrotron in the low-bev range would probably be enough, but there was no hope for agreement on which machine should be built or where. Rabi and Seaborg demonstrated their respective loyalties to Brookhaven and Berkeley, and the other members seemed undecided. Enrico Fermi, revealing his usual conservatism on expensive research tools, favored only one machine, but he feared that approval of only one would impair the morale of the unsuccessful
250 laboratory. The committee concluded that two machines should be built for substantially different energies, but in a rare moment of indecision, the committee suggested that the two laboratories decide with Fisk the design energies and locations of the machines.[47]

The subsequent meeting in Berkeley on March 8, 1948, was a curious affair in which each group found it in its interests to defer to the other. Both sides understood the dilemma: whichever group built the smaller machine would probably reach the bev range first, but it would also have to run the risk that it would never overtake the other in the race for bigger machines. It was easier to agree that one machine should be in the 2.5- to 3.0-bev range for plentiful meson production and the second around 6 to 7 bev for production of fundamental particles in pairs. Because the Brookhaven group had already given much study to a machine at the lower energy, Morse was willing to accept the smaller machine, provided Fisk could assure him that the Commission would not limit the laboratories to one machine each. Fisk said he knew of no limitations. Lawrence accepted the larger machine, and both groups agreed they should cooperate in exchanging ideas between the two laboratories and with the British group at Birmingham.[48]

By the time the Commission approved the new arrangement on April 14, 1948, both groups were moving rapidly into design studies. Brobeck, faced with the larger scale-up in size, had decided to build a quarter-scale model which would actually accelerate protons. To direct the work on the model he brought Edward J. Lofgren back to Berkeley from the University of Minnesota in the fall of 1948. Lofgren concentrated on the design of the magnet, particularly the defocusing effect that might occur in the straight sections where there were no magnets to guide the beam. Under the stimulus of Lawrence's enthusiasm, the laboratory completed the building for the quarter-scale model in the fall of 1948. Lofgren succeeded in getting the first beam of protons in the machine on April 30, 1949. This was a remarkable achievement, but refining the operation would take the rest of the year, and

by that time Lawrence's interests were moving elsewhere. The bevatron was truly becoming the machine of the future.[49]

The "cosmotron," as the Brookhaven group insisted on calling its accelerator, would follow the established conceptions of Livingston, Green, and Blewett. In contrast to Lawrence's emphasis on flexibility, the Brookhaven group concentrated on precision in design. Lawrence's approach had always been to get a beam and then discover how to improve it. Livingston proposed to determine the kind of beam desired and then tailor the design to produce it. The cross-section of the beam in the cosmotron would be smaller than the dimensions Brobeck was planning for the bevatron. A smaller vacuum chamber would mean lower costs and higher efficiencies, but it placed a heavy burden on Blewett and Green to build the machine with such close tolerances. In the spring of 1948, Blewett undertook an intensive theoretical study of the magnet design, while Green conducted several experiments with small-scale models of the magnet. Before the end of the year they had ordered the steel for the magnet and construction forces had poured the reinforced-concrete foundations for the magnet ring. As the magnet blocks began arriving in 1949, William H. Moore, Jr., and his team began extensive tests of their magnetic properties, using the techniques Green had developed. Green and Joseph A. Kosh were preparing with great care to wind the water-cooled copper bars which would form the magnet windings. By the end of 1949 many of the magnet blocks were ready for installation as soon as the last sections of the roof on the cosmotron building were put in place. The firm predictions of early 1948 that the cosmotron would be operating before the end of 1949 had proved optimistic, but progress had been good nonetheless, and confidence at Brookhaven was growing as the machine took shape on the ring foundation.[50]

ORGANIZING BIOLOGY AND MEDICINE

For Shields Warren, the delay in creating the division of biology and medicine had made it difficult to rebuild the biomedical units at the major Manhattan District installations. Under the wartime security system each unit had concentrated on the industrial hazards at its own site: Clinton and the Metallurgical Laboratories on dangers in reactor operations and the plutonium separation process, Hanford on ecological effects of operating the production reactors, Los Alamos on the special hazards of fabricating fissionable materials, and the University of Rochester on the potential risks in uranium-235 production. With reduced staff and incentive, these biomedical teams had struggled through the uncertainties of 1946 and 1947 and were now looking to Warren and the advisory committee for biology and medicine to give them a distinctive and effective role in the Commission's research program.

Offsetting these handicaps, Warren found certain advantages in his

position. Had he been required to operate within the division of research and the General Advisory Committee, he could never have hoped to get more than occasional attention from the general manager and the Commissioners. Now he had direct access to these officials. What his advisory committee may have lacked in prestige and influence by comparison with the General Advisory Committee its members more than made up in technical competence and enthusiasm. Rather than rushing to put biology and medicine on the Commission's organization chart, Warren and the members of the interim advisory committee had laid down the broad outlines of a vigorous research effort in the life sciences. Compared with the problems Fisk faced in the research division, Warren's task was simple and straightforward. There were other advantages too. Unlike the physical sciences, the life sciences could operate completely outside the barriers imposed by classification. With no military applications, the biomedical sciences seemed to lie entirely in the realm of
252 humanitarian uses of atomic energy.[51]

Fortunately for Warren and his colleagues, they were organizing the new division at the very time public interest was mounting for a new assault on one of man's oldest enemies. On the eve of the Fourth International Cancer Research Congress in September, 1947, Dr. Charles B. Huggins, an eminent surgeon at the University of Chicago, had warned on a "Round Table" broadcast that "cancer is as great a scourge to the human race as war." Cancer had advanced in twenty-five years from seventh to second place as a cause of death in the United States. In 1947, when Congress was trimming appropriations for research, it added a specific authorization of $5 million for Commission support of cancer research.[52]

DISTRIBUTION OF RADIOISOTOPES

Radioisotopes were the weapon that gave new hope for ultimate victory over cancer. Scientists had demonstrated the effectiveness of isotopes in cancer therapy before the war, but the development of atomic energy had opened up undreamed-of possibilities in making available virtually limitless, inexpensive sources of radiation. Since the summer of 1946, the Oak Ridge laboratory had been shipping radioisotopes to universities and hospitals in all parts of the nation. Of the almost 2,000 orders filled by the end of 1947, about three-quarters were for small amounts of phosphorus 32 or iodine 131. The phosphorus isotope, which tended to concentrate in tumors, was excellent for locating small but dangerous cancers deep in the human body, particularly in the brain. Iodine 131, which concentrated in the thyroid, had revolutionized the treatment of hyperthyroidism. Most of the other orders were for research in physics, chemistry, and metallurgy, and for industrial and agricultural applications. Isotopes were especially useful as tracers. By substituting the

radioisotope carbon 14 for the naturally occurring carbon 12 in many organic substances, scientists could instantly detect with a Geiger counter the presence of the smallest trace of the compound in a chemical solution or a growing plant. Under the enthusiastic direction of Paul C. Aebersold, the isotope production facility had become the Commission's most convincing demonstration of the beneficial uses of atomic energy.[53]

The extraordinary potential of radioisotopes in cancer therapy led Warren and the advisory committee to advocate further strengthening of the isotope program in 1948. In addition to closer ties with the medical profession, the committee recommended free distribution of those isotopes used in cancer therapy and research, a suggestion the Commission quickly adopted. Aebersold undertook the task of obtaining better facilities to replace the temporary buildings used to process and package the radioisotopes at Oak Ridge. He had also arranged for the production of a number of stable isotopes in the electromagnetic plant at Y-12.

After a detailed appraisal of all aspects of isotope distribution in the spring of 1948, Aebersold concluded that the Oak Ridge reactor would be able to produce all the radioisotopes required for several years. Costs were not a serious deterrent to the use of isotopes, and a modest increase in personnel would eliminate administrative delays. The greatest obstacle to the wider use of radioisotopes, Aebersold found, was the shortage of scientists and technicians trained to use the new materials.[54]

FELLOWSHIPS IN THE NUCLEAR SCIENCES

The shortage of scientists with any knowledge of atomic energy was a problem extending beyond the use of isotopes. In the nation's hospitals and universities, few physicians or scientists were aware of the new opportunities for research which the wartime project had revealed, and even fewer knew how to take advantage of them. One of the first recommendations of the Commission's interim medical committee in early 1947 had been establishment of an extensive training program in using atomic energy in the biomedical sciences. In June, the Commission's medical board of review recommended that fellowships be awarded by the National Research Council of the National Academy of Sciences and financed by the Commission. Warren and the new advisory committee carried forward these recommendations in the fall of 1947, and drafted with the division of research a general plan for training fellowships in both the physical and biological sciences.

When Fisk ran into some philosophic reservations, Warren announced his part of the program in January, 1948. With about $1 million for the first year the Commission would provide 180 fellowships, 30 of which would be for postdoctoral research using atomic energy in the basic biomedical sci-

ences, clinical medicine, or surgery. The remaining fellowships would go to graduate students for doctoral dissertations in the biomedical sciences or for training technicians in health physics or industrial safety. The National Research Council would award the fellowships on a basis comparable to that followed in the other sciences.[55]

Although the initial response was disappointing to Alan Gregg and the other members of the advisory committee, the fellowships met an obvious need. They quickly became an effective means not only for training scientists and physicians but also for accomplishing significant research in biology and medicine. To increase the opportunities for fellowship training the Commission also decided in March, 1948, to establish regional facilities at smaller universities throughout the nation. In time the support provided by the Commission helped to establish first-rate research institutions outside the major universities and the national laboratories.

254 Early in February, Fisk resolved his misgivings and the Commission approved an almost identical plan for the physical sciences. With generous Commission support and good administration by the National Research Council, the fellowship program earned the Commission almost as much good will as isotope distribution in 1948 and early 1949. Then new developments, involving both security and politics, suddenly threatened to destroy all hopes for continuing the effort.[56]

BIOMEDICAL RESEARCH

In addition to the isotopes and fellowship programs, the Commission was supporting other activities which would help in cancer research. Early in 1948 Warren proposed an extensive but sensible plan for utilizing at least some of the $5 million provided by the Congress for fiscal year 1948. By limiting his proposals to those activities in which atomic energy would be particularly useful, he could avoid duplicating the work of the American Cancer Society and the U. S. Public Health Service. He proposed to spend $400,000 to study the radiation hazards from the fission process, $50,000 for free isotopes for cancer research, $1.5 million for independent research contracts, and $75,000 for research on the victims of the atomic bombings in Japan. To this request of about $2 million, the Commission, largely on Strauss's initiative, promptly added an extra $1 million "if it could be effectively expended." In July, 1948, the Commission as quickly approved Warren's proposal to provide $2 million to construct the Argonne Cancer Research Hospital at the University of Chicago. Any project Warren could tie to cancer research seemed likely to find support.[57]

Not all research projects enjoyed the same popular interest. More prosaic but equally important were the long-term efforts in health physics,

radiation effects, and ecological research which the Commission supported. Austin M. Brues in the late 1940's led Argonne in a series of important studies of the toxicity of plutonium and the radiation effects of ingested substances as internal emitters. At Hanford, Lauren R. Donaldson of the University of Washington continued the studies started during the war to determine the effects of radiation on Columbia River salmon. Donaldson also led the radiobiology teams on two expeditions in 1948 to measure the effects of the 1946 Bikini tests and the 1948 Eniwetok tests on marine life. In Japan the preliminary work of the field group, now called the Atomic Bomb Casualty Commission, had assured that fundamental data would be available for long-term studies supported by the Atomic Energy Commission. Routine work in health physics and industrial medicine at all Commission installations not only made possible an unprecedented safety record over the years but also helped to tone down some of the almost hysterical public reaction to atomic energy, kindled by its dramatic advent during the war. Slowly the public was coming to realize that, like all afflictions of mankind, the effects of atomic energy could be understood and therefore controlled through scientific knowledge and techniques.[58]

NEW AVENUES FOR BASIC RESEARCH

The steady growth of research activities in both the physical and the biomedical sciences by the summer of 1948 was a tribute to Fisk, Warren, and the few dozen scientists who worked with them in Washington headquarters. So far they had concentrated most of their attention on the national laboratories, as illustrated by the isotope distribution program at Oak Ridge, the decision to build high-energy accelerators at Berkeley and Brookhaven, and the environmental health studies at several Commission installations. In many branches of the sciences—chemistry, physics, metallurgy, biology, genetics, and medicine—the national laboratories were beginning to demonstrate capabilities for conducting basic research on a professional level approaching that of the better private institutions. Special devices such as reactors and the experience acquired in the wartime project gave the national laboratories an obvious advantage in the nuclear sciences; but the variety of facilities, the abundance of research equipment, and the level of financial support in the Commission's installations were all setting new standards far above those accepted in the best universities before the war.

Beyond the Commission's own facilities, Fisk and Warren had taken short but important steps toward supporting basic research in the universities and private institutions. The granting of fellowships and support of the projects originally financed by the Office of Naval Research broadened the base of Commission support in both the physical and the biomedical sciences.

Once these steps had proved effective, the Commission could begin to consider granting research contracts directly to the university scientists, as the General Advisory Committee had been urging since early 1947.

By the summer of 1948 the time seemed ripe for this step. Experience with the Navy contracts and a few trial agreements for specific research projects in the universities had convinced Fisk's and Warren's assistants that they could handle the administrative load. They would be responsible only for technical evaluation of proposals, the details of contract negotiation and administration being the task of the operations offices. At both Chicago and New York the Commission had personnel with extensive experience in drafting contracts which provided both the necessary controls and the flexibility needed in sponsoring basic research. Alfonso Tammaro, the Chicago manager, had administered contracts for the Manhattan District during the war and had served on a special committee, led by John R. Loofbourow, which
256 had made a study of the Commission's relationships with academic contractors in 1947. The burden of the Loofbourow report was that close ties between the field office and the contractor would make it possible to negotiate contracts which avoided bureaucratic restrictions and gave the scientists the greatest possible freedom. The Loofbourow report applied most directly to contracts for operation of the national laboratories, but it established a pattern which would be equally useful in direct contracts with the universities.[59]

Equally influential as Tammaro at Chicago was James T. Ramey, a young attorney who had come to the Commission in 1947 from the Tennessee Valley Authority. With a strong interest in administrative law and management, Ramey had seen in the unique relationships between TVA and other regional agencies the opportunity to develop new contract forms to replace the conventional Government instruments with their pages of fine print and legal technicalities. Ramey's TVA experience was particularly valuable in the Commission's contract work at Chicago. The standard Government contract was no more useful in defining an agreement for basic research at a university than it had been in TVA activities. Furthermore, the prohibition against grants-in-aid in the Atomic Energy Act required the Commission's staff to build into the contract form the kind of flexibility usually achieved by means of a grant. Ramey's assignment in Chicago gave him new opportunities to develop his conception of the "administrative contract," which in everyday terms described a working partnership between the Commission and the contractor.

Wilbur E. Kelley, manager of the Commission's New York office, found the administrative contract form popular with the universities in the Northeast. He wrote Carroll L. Wilson in August, 1948, that the simple, straightforward terms of a Commission proposal for basic research was the factor "which really broke down the traditional M.I.T. skepticism about Government contracts." In negotiating for basic research, Kelley maintained, the Government official had to remember that the value of basic research

could not be measured in dollars. "Getting the most for our money in research involves two factors, the creation and maintenance of enthusiasm for the project and the setting of goals which can be followed score-wise through reports." [60]

Abetting this new understanding of the research contract was the functional realignment of the headquarters divisions and the field offices which Wilson announced on August 5, 1948. Under the new system the director of research would no longer serve merely as a staff adviser to the general manager, but would have executive responsibility for administering the research program. The reorganization also called for a separate division of reactor development, a step which would enable the director of research to concentrate his attention on basic research to the exclusion of applied technology.[61]

Having assisted Wilson in planning the reorganization, Fisk resigned as director of research to return to teaching at Harvard. His departure not only deprived Wilson of a trusted adviser but also removed from the Commission's councils a strong conservative voice on matters of research policy. Perhaps in time Fisk would have adjusted to the changing attitudes toward supporting basic research in the universities, but now the Commission could recruit a new director who could make a fresh start under the new charter provided by the reorganization.

As autumn came, hopes for the National Science Foundation bill faded once again when Congress adjourned without acting. President Truman had voiced his support of both the foundation in particular and greater Federal assistance to basic research in general, in a speech before the American Association for the Advancement of Science. Few people, however, beside the President believed that his support would count for much after the November election.

Truman's stunning victory was very much on the minds of Commissioner Pike and Wilson when they called on Robert G. Sproul, president of the University of California in Berkeley, on the day after the election. When the two officials got around to their business, they told Sproul they wanted to invite Kenneth S. Pitzer, a young chemist at Berkeley, to take the position of director of research. Not quite thirty-five, Pitzer had done his graduate work at Berkeley, had served as research director of a small eastern laboratory during the war, and had received several awards for his research accomplishments. Pike and Wilson found him receptive to the idea. After visiting Washington, Pitzer agreed to come for about two years if the university would grant him a leave of absence.[62]

By the time Pitzer arrived in Washington in January, 1949, Warren had already laid much of the groundwork for direct research contracts with the universities. In the interest of efficient operations, he welcomed the new executive authority which the reorganization had provided, and he was willing to accept a proposal in the reorganization plan that a single group

handle all the administrative functions at headquarters for both divisions. As interest in this idea dissolved, Warren began to develop procedures for negotiating and administering research contracts with the universities in the biomedical sciences alone. The plan, approved by the general manager in late January, 1949, followed closely the tentative procedures the two divisions had tried in 1948. Headquarters would evaluate proposals from the universities and select those which would provide a balanced research effort with the funds available. After determining the probable duration of the project and the annual level of expenditure, the headquarters division would give the proposal to the appropriate field office for negotiation. The field office would administer the financial and management aspects of the contract; the Washington division would evaluate technical performance and accomplishment.[63]

Warren's achievements and the continuing efforts of Ralph P. Johnson, MacNeille, and others in the division of research gave Pitzer a running start on his first assignment—to establish a system for direct research contracts. He took advantage of a meeting of the General Advisory Committee in Washington early in February, 1949, to discuss the subject. Taking a positive approach, he held that the time was right for negotiating direct contracts. He told the committee that MacNeille was already working on twelve such agreements. The arrangement with the Office of Naval Research could be phased out as the division built up its administrative machinery. Obviously pleased with the new policy, the committee had only one criticism. Pitzer appeared to assume that he should sit back and wait for proposals from the universities; the committee favored an aggressive effort to find projects worthy of Commission support.[64]

Moving rapidly, Pitzer completed a formal proposal in time for consideration by the Commissioners on March 14, 1949, when Warren's own paper was on the agenda. Following closely the procedures in Warren's paper, Pitzer suggested that the Commission support the physical sciences at an annual level of $10 million, the minimum recommended by the General Advisory Committee, and that in time the Commission might increase the amount toward the committee's goal of $30 million annually. Commission support of the Navy program was running at $4 million per year in 1949 and 1950 and presumably would phase out in 1951. Now that the Commission would provide most of the money, Pitzer thought the Commission should assume control of the projects as quickly as possible. In view of the Congress's continuing failure to act on legislation for a national science foundation, the Commission could wait no longer. As for the limitation on the division's authority in Section 2(a)(4)(b) of the Atomic Energy Act, the Commission's legal staff had concluded that Pitzer could legally participate in selecting and evaluating research projects as long as the Commission determined the total allocation for such research.[65]

Commission approval of the two proposals on March 14 marked the beginning of a new partnership between the Government and the universities

in the support of basic research. For many scientists in the universities, the decision seemed long overdue. For others in the Commission's headquarters, events of the previous two years had justified a cautious approach. Now the Commission could embark upon direct support of basic research with confidence that its criteria and procedures would withstand the challenge of Congressional or Executive examination.

A NEW SPECIES?

The new interest in direct research contracts did not mean that the Commission was neglecting the national laboratories in 1949. Pitzer made a tour of the laboratories one of his first activities and he returned to Washington impressed by the quality and morale of the scientists in the Commission's installations. In February the Commission approved the construction of facilities for the new Argonne laboratory, totaling more than $63 million. Even this astronomical amount would not provide all the buildings in the original plan in the face of rapidly rising construction costs. To this figure the Commission would soon have to add $19 million for the first step in constructing a permanent laboratory at Oak Ridge.[66]

High as these costs were, the vitality and activity of the laboratories seemed to indicate that the Commission was making a sound investment. Argonne, under Zinn's drive, was a beehive of activity, mostly in reactor development but also in the basic sciences. Oak Ridge was at last emerging from years of uncertainty and doubt. The laboratory still had no director, but Weinberg was becoming an effective spokesman for Oak Ridge interests. In March he declared to the readers of *Science* magazine that the Oak Ridge experiment had been a success. One year under Carbide management had demonstrated that a national laboratory could successfully blend the activities of an industrial research laboratory with those of a regional association of universities. A month later he illustrated both the depth and diversity of research at Oak Ridge, in a briefing before the General Advisory Committee in Washington. The laboratory could boast strong programs in chemical technology, reactor technology, basic research, isotope production, radiation protection, and education. Weinberg hoped that Oak Ridge could lead the South into the age of modern science. Just how Oak Ridge would develop in the future he could not tell.

The concept of the national laboratory was still developing. It might prove to be a new species of scientific institution which would bring new opportunities and strengths to research. The next task would be to devise a long-range plan for each of the national laboratories, particularly in the area of reactor development.[67]

Talk of long-range planning, however, assumed a certain amount of

stability, a solid base from which to project trends for the future. As 1949 wore into summer, new forces seemed once again to threaten the systematic development of research policy. International tensions were again taking their toll. A new wave of fear over communist espionage threatened to destroy the Commission's fellowship program, and an economy-minded Congress slashed the Commission's budget requests, particularly in "nonmilitary" areas such as research and development. A hostile attack on the very heart of the Lilienthal stewardship sapped the energies and morale of the Washington leadership. Finally, before the end of the summer, a startling achievement in the Soviet Union would turn most eyes from the peaceful atom toward the atomic shield. Would Weinberg's "new species," would the Commission's new approaches to a new age, have a chance to survive in a world of conflict?

COOPERATION WITH THE BRITISH: UNTANGLING THE ALLIANCE

CHAPTER 9

To most Americans, news of their nation's atomic energy effort had come from Truman's statement of August 6, 1945, that an atomic bomb had been dropped on Japan. Almost overlooked was the President's acknowledgement of British contributions to the weapon. Those few Americans who were aware of the details of the partnership must have watched the events of 1946 uneasily as Baruch sought international control in the United Nations, and as Congress framed the Atomic Energy Act. Somehow a policy had to be devised which would give the Baruch plan every chance to succeed, which would replace the former ties with Britain by a new understanding, and yet which would meet the determination of Congress to preserve American leadership in atomic energy. Reconciling these aspects of foreign policy and atomic energy was not solely the job of the fledgling Commission, but Lilienthal sensed that the issues were explosive.

THE WASHINGTON SCENE

Both houses of Congress met at noon on March 12, 1947. After sixteen minutes of desultory business the House of Representatives stood in recess, and the legislators nearest the front of the chamber moved back, leaving vacant the first rows of seats. Diplomats, reporters, and guests watched from the crowded galleries the unassuming and yet dramatic pageant taking place below. At twelve forty-five by the clock over the Speaker's desk, the sharp sound of the gavel filled the room as Joseph W. Martin, Jr., called the House to order. Briefly the rustle subsided; then from the back of the chamber the doorkeeper announced the President *pro tempore* of the Senate and the Senate itself. Down the aisle they moved, and as the senators settled into the chairs,

Arthur H. Vandenberg, their presiding officer, climbed the steps of the platform to take his place to the right of the Speaker. At twelve fifty-seven the doorkeeper announced the Cabinet. Led by Acting Secretary of State Dean G. Acheson and Secretary of the Treasury John W. Snyder, the cabinet members filed into the few remaining places reserved for them. Barely were they seated when, at one o'clock, the doorkeeper announced the President of the United States. Harry S. Truman, a black loose-leaf notebook beneath his arm, strode down the aisle and mounted to the rostrum as all in the chamber rose and applauded. Silence fell as the President opened the notebook, drank half a glass of water, and began.

"Mr. President, Mr. Speaker, Members of the Congress of the United States, the gravity of the situation which confronts the world today necessitates my appearance before a joint session of the Congress." Speaking slowly and forcefully, the flat tone of his voice carrying to the nation and the world
262 the accent of Missouri, Truman described the tragic condition of Greece. Only the United States could rescue the devastated and shattered nation; for Britain, exhausted by long years of conflict, could no longer carry the burden of financial and economic aid. Although spared from the havoc of war, Turkey also needed assistance to defend itself against hostile forces from outside its borders. Here too, Britain could no longer help. Almost casually Truman remarked that the United Nations was not equipped to give assistance of the type required. Asserting that a main goal of American foreign policy was to ensure the peaceful development of nations, Truman drew applause as he declared, "We shall not realize our objectives, however, unless we are willing to help free peoples maintain their free institutions and their national integrity against aggressive movements that seek to impose upon them totalitarian regimes." Twenty-one minutes after he had entered the House, the President left, having requested $400 million to aid the two troubled nations. The day had been gray when he arrived, but the sun had broken through when he departed for the National Airport and a few days of rest in Florida.[1]

Congress had listened intently and grimly to Truman, but with little surprise. Days before the joint session Truman had carefully briefed Tom Connally, Vandenberg, and other Congressional leaders. Secretary of State George C. Marshall, leaving for a meeting of foreign ministers in Moscow, had told reporters on March 4 of the critical importance of a stable Greece. In his speech Truman had not referred to the Soviet Union by name, but identifying the source of danger was hardly necessary. His allusions to Britain had been almost incidental, carrying no suggestion that the United States was coming to the aid of a partner.[2]

Yet the United States and the United Kingdom were still closely linked, even if the bonds forged during the war had loosened with the end of hostilities. Americans might find it difficult to understand how an electorate could exchange a flamboyant Churchill for a colorless Attlee, but at least the

transition had been made by peaceful ballot. Across the confused world, where new centers of power had not yet emerged to replace the old, the interests of both states were mutually involved, often with the same ends, seldom with the same means. Differences existed over Palestine, China, and India, but although disagreements between the United States and the United Kingdom were inevitable, a break between the two was unthinkable.

Vandenberg, Connally, and Bourke B. Hickenlooper were members of the Committee on Foreign Relations as well as the Joint Committee on Atomic Energy. Better than most of their Congressional colleagues, they were aware of the ties linking the United States and Britain. But as they heard Truman speak on March 12, they did not know that in 1913 at Quebec, Roosevelt had agreed with Churchill that neither country would use the atomic bomb without the consent of the other. They knew nothing of the abortive efforts to dilute the obligation from "consent" to "consult," which had followed the November, 1945, meeting of Truman, Attlee, and Mackenzie King. Nor did they know that the British were receiving one half of the vital uranium ore from the Belgian Congo, and that the half going to the United States was not enough to keep the American atomic energy plants running at capacity. Nor was the President himself, as he spoke on March 12, completely aware of the agreements with Britain or their implications. Of those in the chamber who listened to Truman, probably Acheson was the best informed of the tangled relations.[3]

Lilienthal recognized the dangers in the situation, for Section 15 of the Atomic Energy Act required the Commission to keep the Joint Committee fully and currently informed. As the time had drawn near for the Commission to assume responsibility for the nation's atomic energy program, Lilienthal had appealed to Secretary of State James F. Byrnes on December 30, 1946. Recalling Section 15 Lilienthal had written, "Our problem in this connection will be obviated when the appropriate Committees of Congress are acquainted by the State Department with the status of these arrangements." There was, however, no result. Lilienthal turned to his friend Acheson, but again to no avail.[4]

There was some excuse for the delay. Byrnes was about to resign when he received Lilienthal's letter, and the approach to Acheson came during circumstances which might well have given the Under Secretary—an astute practitoner of the arts of Congressional relations—reason to pause. Matters involving the atomic bomb were obviously sensitive and required the highest consideration. Marshall, recently recalled from China to succeed Byrnes, had been in office a little more than a week when Lilienthal talked to Acheson. Immediately Marshall faced the Greek and Turkish crises, and prepared for the Moscow meeting. Nothing had been done to inform the Congressional committees as Truman spoke on March 12.

That the nation was entering a new phase of its history with the Truman doctrine was evident. If the fall of France and the attack on Pearl

Harbor had shattered the tradition of American isolation, the Truman doctrine marked the end of the dream that the great powers could work together in the United Nations for a world free from war. Now the policy was one of containing communism. Some—such as Walter Lippmann—did not accept the change without question. Lippmann saw containment as a fallacious and hazardous policy which might well make the United Nations a casualty of the cold war.[5] The danger was real. Suspicion and hostility between the two most powerful nations could hardly be reconciled with the idea of unity upon which the United Nations was founded. The plight of Greece was but one evidence of the incompatibility, and other signs were not lacking. Within the United Nations itself the hopes for international control of atomic energy had lost their promise. Near the end of 1946 an associate of Bernard M. Baruch, United States representative on the United Nations Atomic Energy Commission, surveyed the prospects, chomped on his cigar, and observed, "I am a stockmarket man, and this is a falling market."

THE U. N.: A FALLING MARKET

By the end of 1946, Baruch concluded that his work was nearly finished. He and his staff, many of whom were personal associates of long standing, had spent the summer and fall in a wearying number of meetings with the representatives of other nations to develop the framework for international control of the new and dangerous source of energy. Under the driving pressure of Baruch and his team, the commission finished its first report on the last day of the year. Ten nations had voted their acceptance; two—the Soviet Union and Poland—had abstained.[6] In one sense, approval by the majority of the commission was little more than a token, for next would come consideration in the Security Council where substantive action required unanimity.

The first report did not attempt to present a complete plan for international control of atomic energy, ready for world-wide application, but confined itself to the scientific and technical aspects of control and the safeguards necessary to assure that energy from the atom would be used for peaceful purposes. Cautiously and tentatively the majority concluded ". . . we do not find any basis in the available scientific facts for supposing that effective control is not technologically feasible." An international authority would be needed with wide powers of inspection and management over uranium mines, processing and refining plants, and power reactors; for without such controls the majority could find no guarantee against clandestine diversion of atomic energy to military purposes. So crucial to the safety of the world was the work of the international agency that its operations were to be free from the veto of any government. Exemption from the veto was the

contribution of Baruch. Lilienthal doubted its value, but Baruch never wavered. In congratulating Lilienthal on his confirmation Baruch warned, "Don't let anyone weaken you on the position that the United States took—that there must be swift, certain and condign punishment set up for any violator of any treaty." [7]

Baruch resigned on January 4, 1947. With him went his brigade of associates, John M. Hancock, Ferdinand Eberstadt, Herbert Bayard Swope, Fred Searls, Jr., Richard C. Tolman, and Major General Thomas F. Farrell. Beneath the smooth surface of the polished phrases of Baruch's resignation ran countercurrents, for the silver-haired elder statesman who proudly bore the title "adviser to Presidents" had not found his relationships easy with Truman, Byrnes, or Acheson. He saw some organizational obstacles that made it awkward for him to remain on the United Nations commission. The permanent members of the Security Council—France, China, the Soviet Union, the United Kingdom, and the United States—were also members of the atomic energy commission. Alexandre Parodi, Quo Tai-chi, Andrei A. Gromyko, and Sir Alexander Cadogan served upon both the Security Council and the commission, but Baruch did not. Although Baruch was the American representative on the atomic energy body, Warren R. Austin spoke for the United States on the Security Council. Baruch thought the situation could only lead to confusion.[8] He had given his name and prestige to the American plan; now it was up to others to shoulder the burden.

Truman had appointed Austin in June, 1946, as American representative on the Security Council. Each had known the other well in the Senate, where the Vermont Republican had won the respect of the Missouri Democrat during hearings on civil aeronautics legislation. The Senate confirmed Austin on January 13, 1947, as Ambassador to the United Nations and United States representative on the Security Council. Four days later he became American representative on the United Nations Atomic Energy Commission. As 1947 began, Austin in the Security Council faced a Soviet attempt to circumvent the work of the commission. For almost a year the Russians had argued that prohibition of production and use of atomic weapons must precede international control, while the Americans saw effective security only in progressive stages of control leading ultimately to the destruction of the weapons. In October, 1946, Molotov had further blurred the issue by demanding that the Security Council take up general disarmament and arms regulation. The danger was that action in the Security Council on the Molotov resolution could undermine the atomic energy commission by merging disarmament and international control of atomic energy. Austin's mission was to prevent this from happening.[9]

A strong point in the American position, as far as world opinion was concerned, lay in the support which Baruch had coaxed, cajoled, and wheedled from the other nations. The difficulty was to preserve this strength against the Soviet lure of disarmament. On atomic energy matters the State

Department coordinated its guidance to Austin with the War and Navy Departments and the Atomic Energy Commission. The warm friendship between Lilienthal and Acheson must have eased consultation between the Commission and the State Department. Acheson confided his misgivings to Lilienthal on January 16, 1947. The Under Secretary did not like the course of events in New York. He was alarmed by Austin's optimism—a quality which others saw as the result of the Vermonter's success in getting to a first-name basis with Gromyko. Marshall explained the complexities of the situation in the Security Council to Robert P. Patterson and James V. Forrestal on January 29. The Secretary of State saw no hope of avoiding a discussion on disarmament, and any American move to do so would draw fire from the other Council members. The three secretaries agreed on strategy for Austin: He should recommend to the Security Council that a new commission handle arms regulation, that a committee drawn from the council members

delineate the jurisdiction between the new organization and the atomic energy commission, and that the council itself take up at its next meeting the report of the United Nations Atomic Energy Commission.[10]

These three points, aimed at skirting the hazards of conflict between international control and arms reduction, Austin introduced to the Security Council on February 4. Gromyko opposed the move, finding no need for a committee to define the work of the two commissions and declaring that Austin's proposal was inconsistent with the instructions of the General Assembly. The arguments of Paul Hasluck, of Australia, illustrated the dangers that the Americans saw from Soviet strategy. Hasluck believed that negotiations on atomic energy were deadlocked, and to waste time in breaking the stalemate would jeopardize chances for disarmament. At his suggestion, the council spent the next three days informally searching for a compromise. Failure of the quest was evidenced in a draft resolution containing two diametrically opposed versions of a single paragraph; one restricted the authority of the new commission, the other did not.[11]

On February 11 the debate in the Security Council began, with Austin arguing that the mandate of the atomic energy commission must be preserved, while Gromyko as vigorously insisted that the activities of the new commission must not be limited. The next evening, after seven grueling hours of almost continuous discussion, the tired and hungry delegates began to vote, paragraph by paragraph, on the resolution. As the roll was called the results were clear. The United States and eight other nations voted to exclude atomic energy from the jurisdiction of the new commission. The Soviet Union and Poland abstained. Austin and Gromyko shook hands. It was a courteous gesture and about the only warmth within the building, for someone had turned off the heating system.[12]

Austin had won a skirmish in a long campaign. Although the Security Council was to discuss the first atomic energy commission report, Gromyko announced on February 11 that he reserved the right to raise again the need

for a convention to ban atomic weapons. Austin faced the dilemma of how to keep the council focused on the commission's report rather than wasting time on the issue of prohibiting atomic weapons before agreeing on control. As the State Department saw it, Austin should try to get council approval of the report. Realistically there was little hope of success, yet he was to get what agreement he could and to have the points of difference referred back to the United Nations Atomic Energy Commission.[13]

Gromyko raised the veto issue on February 14. Exempting international control from the veto was contrary to Article 27 of the Charter, requiring unanimity among the five permanent members of the council. He was prepared nonetheless to offer amendments and counterproposals. These he embodied in twelve amendments which he introduced on February 16. Except in undefined instances, the operations of the control organization were to be subject to the veto. That organization would inspect, supervise, and manage all existing plants producing atomic material and assume these powers immediately upon concluding a convention.

Gromyko elaborated his proposals in a major speech to the Security Council on March 5. After a few words in Russian, he continued in English. The majority plan he rejected as an American scheme to perpetuate exclusive control of atomic energy, and again he asserted the need to prohibit atomic weapons. Declaring that the Soviet Union was not against effective inspection, he claimed that the majority plan would lead to intolerable meddling into national domestic affairs: "Only people who have lost their sense of reality can seriously believe in the possibility of creating such arrangements." Gromyko spoke for an hour and eighteen minutes, and as he ended it was plain that he offered no concessions. To their surprise, newspapermen covering the speech found that the Russians had taken the unusual step of making mimeographed copies immediately available. In interviews with delegates, the press discovered that the reaction was pessimistic; if Gromyko were stating a final rather than a bargaining position, hopes for international control were gone. On March 10 the Security Council asked the United Nations commission to continue its work by framing specific proposals on the functions and powers of an international control agency. The working committee, one of the subgroups of the commission, gave itself the task of studying the Soviet proposals.[14]

CONTINUING DEADLOCK

While the Security Council deliberated, Marshall made some organizational changes in the State Department. On March 3, he established an executive committee on the regulation of armaments, with representatives of the State, War, and Navy Departments and the Atomic Energy Commission to make

policy recommendations on international control and armament regulation. To serve as Austin's deputy on the United Nations Atomic Energy Commission, Marshall selected Frederick H. Osborn, a New York corporation executive who had directed the Army's wartime program on education and information. Dean Rusk, a quiet young Georgian, was named Director of the Office of Special Political Affairs, which had been established in 1944 to handle American participation in the United Nations. Broader in scope was Marshall's creation in May, 1917, of the policy planning staff to provide a philosophy and a perspective to American foreign policy so as to avoid piecemeal responses to critical situations. Marshall turned to George F. Kennan, recently returned from Moscow and currently at the National War College, to head the group. Understandably Lilienthal was interested in the changes. Kennan he found stimulating and intelligent; Acheson, bearing the responsibilities as Acting Secretary during Marshall's absence in Moscow, was exhilarated over the new leadership.[15]

Very early Osborn discovered two conflicting views. He had little more than accepted the position as Austin's deputy when he received an urgent call from Oppenheimer, requesting an interview. During the weekend at Osborn's country home the two men talked. Oppenheimer revealed that from his observation of Soviet conduct he had concluded that the Soviets would not lift the veil of secrecy that shrouded their territory. Obviously, the Baruch plan could not work and give security to all if one nation closed itself off from others. To continue negotiations in the United Nations would, in Oppenheimer's view, give the Soviets chances to stall, to seek compromises that would dilute the strength of the Baruch plan without yielding their own position, and to win propaganda victories. For all of these reasons Oppenheimer urged breaking off negotiations.

The second fact Osborn learned from canvassing the other delegates on the United Nations Atomic Energy Commission. They were resentful of the steam-roller tactics Baruch had employed. They felt they had been given no chance to assist in drafting the plan, and no opportunity to try their hand in negotiating with the Russians. To them breaking off was premature or worse. Osborn assessed the opposing views. The dangers that Oppenheimer saw were real, but so were the hazards from losing the support of the other nations on the commission. Weighing the alternatives, Osborn decided that to continue negotiations was best; with caution and shrewdness the risks could be limited.[16]

Except for Austin, whose hardy optimism remained unshaken, American reaction to the March 10 Security Council resolution was far from enthusiastic. Osborn discovered that Oppenheimer and Bacher believed it would be impossible to describe the functions and powers of an international control agency without getting into classified subjects. Forrestal feared that a slight conciliatory move by the Soviets could lead public opinion away from the real issue. Lilienthal warned the American delegates against the fallacy of

trying to distinguish between peaceful and military uses of atomic energy, an argument he felt certain would be used by those attempting to compromise national and international interests. Only when Osborn cautioned that breaking off negotiations would mean the loss of British, French, and Canadian support did he and Austin win reluctant acquiescence to continuation of the conversations in the United Nations. Eventually instructions for Austin and Osborn emerged: They were to make the record clear that Soviet intransigence prevented agreement on international control. If the working committee of the United Nations commission turned to drafting treaty clauses on the operations of an international agency, the American delegates were to try to steer the effort into unclassified areas.[17]

Austin's optimism stemmed from the stubbornness of a sincere man convinced of the necessity of the United Nations. The world scene itself was no source of hope. Marshall returned from the Moscow conference on April 26, his outlook somber on chances of working with the Russians and his mind searching for means to build stability in Europe. On April 29 Marshall asked Kennan to provide in two weeks recommendations from the policy planning staff. At that moment the staff existed largely on paper, but by May 23 Kennan had drawn together a memorandum concluding that the crises in western Europe resulted from spiritual and economic exhaustion rather than communism, and that the proper focus of American effort should be to restore the confidence and economic vigor of Europe. Although aid to Europe was foreshadowed by Acheson in a speech on May 8 at Cleveland, Mississippi, not until June 5 at Harvard did Marshall propose the course of action which was to quicken Europe. The Marshall plan and the Truman doctrine were two of the most important diplomatic moves the United States took in the immediate postwar period, and in neither did the United Nations have a real role.

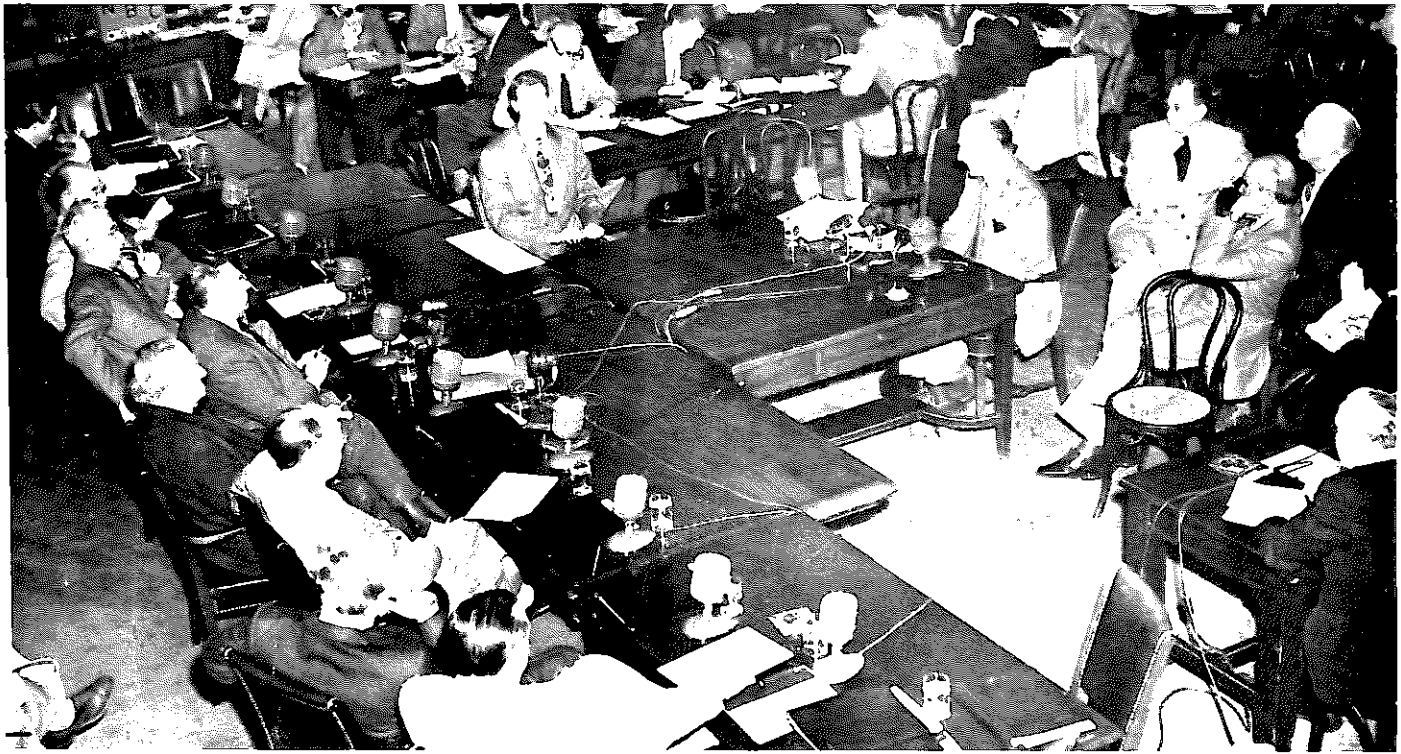
Inevitably the tensions between East and West were reflected in the United Nations Atomic Energy Commission, where working groups struggled doggedly to describe the functions of the proposed control agency. Osborn was convinced that the Soviet delegates were puppets, every move controlled by strings tightly grasped in Moscow. In early June he watched with interest as Gromyko, in a rare humor of geniality and cheerfulness, called for a full meeting of the commission. Briefly there was hope as the Soviet delegate on June 11 presented eight proposals. In essence they called for an international control commission which would assume authority simultaneously over all atomic installations, from mining operations to the production of fissionable material and the generation of atomic energy. Each nation could carry on its own atomic energy program, although the control agency would have access to the national installations, subject, however, to the veto. Organizational details would be determined after concluding a convention banning atomic weapons. Committee 2 of the United Nations commission considered the Soviet proposals for three days in August, 1947, and found them wanting. R. L. Harry of Australia thought the points vague and added, "A year ago

these same proposals might have been regarded as useful and hopeful." Only Ignacy Zlatowski of Poland found the Soviet offering a good basis for further discussion.[18]

FORMING A NEW POLICY

The goal of the commission was to submit its second report to the Security Council in September. Lilienthal asked Acheson on June 28 what the American course should be if there were no agreement. Acheson was weary. On July 1 he was returning to private law practice and in the meantime was preparing Robert A. Lovett to take over the position of Under Secretary of State. Acheson described a somber scene to Lilienthal: Czechoslovakia tottering,
270 France weak, and Britain impoverished. In the United Nations commission the British and French had never favored the American plan enthusiastically, and Acheson saw their support evaporating if there were no agreement in September. In what must have been one of his last acts before he left office, Acheson turned the question of the American position on international control of atomic energy over to Kennan and the policy planning staff. His own advice was to draw closely together Britain, Canada, the United States, and perhaps a few other nations which possessed uranium ore.[19]

Osborn discussed plans for the United Nations commission with his advisers on July 31. As he observed, whatever his advisers decided would probably become the policy of the United States. Osborn's idea was to continue elaborating the majority plan, working out administrative details of the control agency and the necessary steps to maintain the strategic balance during the transitional stages. James B. Conant was attracted to the proposal. Already he had concluded that industrial development of atomic energy would lead to a proliferation of installations requiring control. In his view, foreswearing industrial uses and leaving the uranium unmined offered the best hopes for international security. Osborn's proposal, Conant thought, afforded the chance to provide for the explicit destruction of nuclear fuel and nuclear plants. Tolman and Farrell were lukewarm, while Chester I. Barnard was skeptical. Firmly Leslie R. Groves opposed, arguing the impossibility of writing anything on strategic balance or transitional stages that would be acceptable to the United States and the Soviet Union. Listening to the contending views, Oppenheimer leaned toward Groves's reasoning, but a few days' reflection changed his mind. Conant's plan he disliked, but Osborn's proposal he thought dangerously unreal. Oppenheimer advocated that the United States record its willingness to resume discussions anywhere on the prevention of atomic war, and declare "in the present state of hostility between major powers, the future detailed elaboration of proposals seemed wrong to us in principle." [20]



WIDE WORLD

"INCREDIBLE MISMANAGEMENT" HEARINGS BEGIN, MAY 26, 1949 / Chairman Lilienthal is seated at the small center table. From left to right behind Lilienthal are Commissioners Gordon E. Dean, Lewis L. Strauss, and Sumner T. Pike. The members of the Joint Committee on Atomic Energy are at the long table; from top to bottom: Representatives Henry M. Jackson, Melvin Price, Chet Holifield, and Carl T. Durham, and Senators Brien McMahon, Tom Connally, Bourke B. Hickenlooper, Arthur H. Vandenberg, and William F. Knowland.

UNITED PRESS INTERNATIONAL

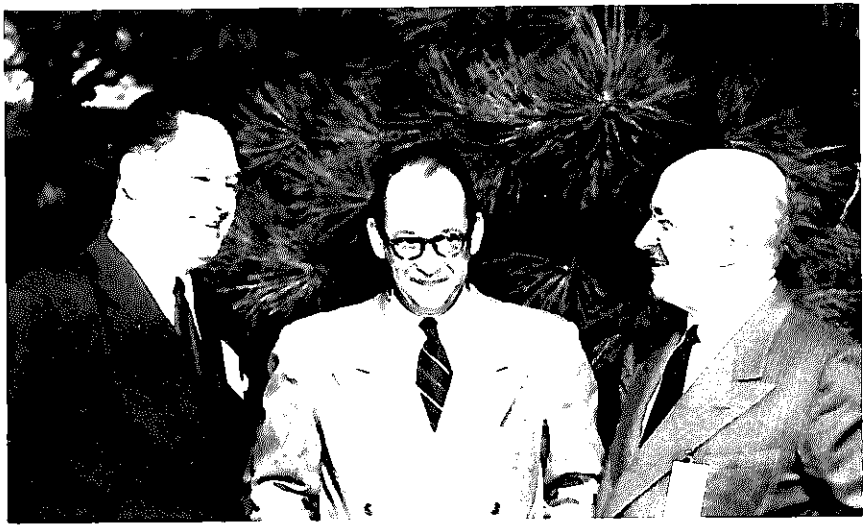
MILITARY VIEWS ON HYDROGEN BOMB DEVELOPMENT / Senator McMahon (center) chats with General Omar N. Bradley, chairman of the Joint Chiefs of Staff, and Robert LeBaron, chairman of the Military Liaison Committee, on January 20, 1950, as an executive session of the Joint Committee is about to begin.

UNITED PRESS INTERNATIONAL

LILIENTHAL WAVES FAREWELL, FEBRUARY 15, 1950 / Employees and the first Commission chairman say goodbye on the steps of the headquarters building on Constitution Avenue.

WIDE WORLD

THE COMMISSIONERS AND SENATOR McMAHON BEFORE A JOINT COMMITTEE SESSION, NOVEMBER 30, 1950 / Left to right: Thomas E. Murray, Henry D. Smyth, Senator McMahon, T. Keith Glennan, Gordon E. Dean, and Sumner T. Pike.



CHAIRMAN DEAN WITH A NEW COMMISSIONER AND GENERAL MANAGER / T. Keith Glennan (left), Gordon E. Dean (center), and Marion W. Boyer in Washington, November, 1950.

THE HEADQUARTERS STAFF AND FIELD PERSONNEL AT OAK RIDGE, MARCH, 1950 / Seated, left to right: Leonard E. Johnston, James C. Stewart, Wilbur E. Kelley, Richard W. Cook, Carroll L. Tyler, Carroll L. Wilson, Carleton Shugg, Frederick C. Schlemmer, and Alfonso Tammaro. Standing, left to right: J. Bion Phillipson, Samuel R. Sapirie, David Saxe, Walter F. Colby, Frank C. Watters, M. L. Black, Raymond Greenhalgh, Lindsley H. Noble, Walker E. Campbell, Fletcher C. Waller, Kenneth S. Pitzer, Francis J. McCarthy, Edward Diamond, Lawrence R. Hafstad, Henry B. Fry, Morse Salisbury, David B. Langmuir, Jesse C. Johnson, John A. Derry, James McCormack, Lawrence P. Gise, Thomas O. Jones, Charles F. Schank, John E. Greenhalgh, and James E. Travis.

By August 21, 1947, Kennan had completed his study of American policy. The analysis dismissed the fourteen months of talks in the United Nations as fruitless. The United States could not agree to destroy its atomic bombs without the guarantee of security, while the Russians would accept only the immediate destruction of the weapons, leaving security for later negotiation. Yet it was wrong to consider both positions as equally balanced, for time favored the Soviets. As sponsor of the majority plan, the Americans were committed, while the Russians were free to obstruct and delay, to confuse and obscure, as they gained time to develop their own atomic weapons.

From these narrow confines Kennan and his consultants sought to free American policy. They advised that the United States not break off negotiations in the United Nations commission; rather, a board of consultants should be gathered secretly to see if new technical data made it possible to modify the majority plan. If negotiations in the commission should near breakdown, a prominent American should travel to Moscow, talk to Stalin and the Politburo, and make sure that they understood the causes of the rupture. No longer should the main pursuit of American policy on atomic energy be through the United Nations. International control had lost none of its urgency, but grim reality was forcing a return to close relations with Britain and Canada. This shift in policy should be announced, perhaps when the United Nations sent its report to the Security Council. The best spokesman might be the President of the United States. These staff views Lovett accepted as a guide for planning.[21]

While Washington officials studied the advice of the policy planning staff, the several subgroups of the United Nations commission continued their efforts to describe the responsibilities of a future international control agency. From the subgroups flowed a stream of papers for each government to accept, reject, or modify.

Discussion of the reports by the Atomic Energy Commission and the State, War, and Navy Departments revealed that others in the United States Government were uneasy over the barren results achieved at the United Nations. Marshall met on September 8, 1947, with Secretary of War Kenneth C. Royall, Under Secretary of the Navy for Air John L. Sullivan, and Bacher from the Commission. Royall raised the basic issue: Why should the United States approve the documents, since the Russians obviously would not? Why not frankly admit negotiations were hopeless?

Sullivan agreed. He did not see how the Senate could possibly ratify a treaty on international control based on the work of the United Nations commission. Rusk and Edmund A. Gullion, a young foreign service officer handling atomic energy matters, replied that the reports under discussion reflected the American position. To repudiate them would only compound difficulties in achieving agreement and leave stranded those nations which had supported the United States. Royall and Sullivan accepted the reasoning.

Perhaps their concern was mollified when Gullion remarked that the policy planning staff was reviewing the American position.[22]

On September 11, Marshall, Forrestal, and Royall considered the recommendations with Kennan. No one took exception to negotiating with the British and Canadians. As Marshall pointed out, the raw materials situation called for action. Forrestal wanted clarification of the understandings with the British on the use of the atomic bomb. Royall saw no reason to continue what he called the Baruch policy. A different theme had captured Forrestal's interest: Suppose the Russians suddenly accepted the majority plan; what then would be the position of the United States? Marshall's reply was matter-of-fact; the negotiations that must follow would reveal clearly the Russian attitude.[23]

That same day General Andrew G. L. McNaughton of Canada, chairman of the United Nations Atomic Energy Commission, transmitted the second report to the Security Council. The United States and nine other member nations approved. The Soviet Union voted against approval while Poland abstained. One part of the report dealt with the authority of the international control agency over research and development, the production of nuclear material, and atomic energy installations ranging from mines to fabrication plants. The other described the deliberations on the Soviet amendments to the first report and on the proposals of June 11, 1947. Inevitably much of the work had gone into the dreary but necessary effort to define precisely such terms as "control," "establish," and "administer." Although there was no real progress in narrowing the gap between the minority and majority positions, the way was open for further discussion.[24]

There was little optimism as the General Assembly met on September 16, 1947, at New York. "The truth is," declared Oswaldo Aranha of Brazil, as he accepted the presidency of the General Assembly, "that the United Nations have been able to do very little since the last session." Marshall addressed the Assembly the next day. The list of failures was long: no treaty for Germany, Austria, or Japan; no order in Greece; no agreement on Palestine; no unification of Korea. And to the roll Marshall added the United Nations Atomic Energy Commission: "if the minority persists in refusing to join the majority, the Atomic Energy Commission may soon be faced with the conclusion that it is unable to complete the task assigned to it." [25] The efforts in the United Nations were to continue, even after the third report of May 17, 1948, which stated bluntly that the commission had reached an impasse.

The stage for negotiations among the Americans, British, and Canadians had been set in September, 1947. All three nations were represented on the Combined Policy Committee, established by Roosevelt and Churchill to coordinate atomic energy plans. It was natural to use the committee to discuss the highly sensitive subject of atomic energy and the relations of the three powers. The last meeting of the committee had been on February 3, 1947. Since then Lilienthal and his colleagues had been confirmed and the National

Military Establishment, with Forrestal as Secretary of Defense, had come into existence. In recognition of these changes, Truman on September 22, 1947, named the Secretary of State, the Secretary of Defense, and the Chairman of the Atomic Energy Commission as the American members of the Combined Policy Committee. The means for negotiating with the British and Canadians had been brought up to date. There was much to talk over.[26]

NEED FOR ACTION

As 1947 began, Roger Makins, British envoy extraordinary and minister plenipotentiary, was about to return to London. As deputy chairman of the Combined Development Trust, the American-British-Canadian organization responsible for uranium ore procurement, Makins was well aware of the complications irritating the relations between his country and the United States on atomic energy. On January 29, he called on the Commissioners, ostensibly to ask permission for his successor, Gordon Munro, to visit from time to time. After the customary pleasantries, conversation turned to restrictions on cooperation with the British imposed by the Atomic Energy Act. One Commissioner after another told Makins that the agreements on raw materials had to be revealed soon to the Joint Committee on Atomic Energy, if not during the confirmation hearings, then as soon after as possible. Strauss read parts of the Act to Makins, emphasizing that disclosure of the arrangements was a positive injunction upon the Commission.

The five Commissioners were unanimous in their position: However the British viewed the implications of the wartime cooperation, continuation of that partnership was forbidden by the Act. They advised Makins that in their opinion, the best course would be to consider the wartime arrangements ended and to negotiate new agreements for procuring and allocating raw materials. Yet, as Lilienthal summed up, these suggestions were merely "conversation." Only the Foreign Office and the State Department could negotiate.[27]

Under Secretary Dean Acheson was the official for Makins to see. Acheson was ill at home, but Makins, pressed by the approaching date of his departure, called nevertheless. London, he explained to Acheson, believed that the Americans were willing to cooperate on raw materials, where they had much to gain, but not on information exchange, which would benefit the British. Although not indispensable, the data would enable the British to save time, money, and effort in overcoming technical difficulties already solved by the Americans. Conceding the barriers raised by the Act, Makins wanted to explore two paths around the legal obstacles, emphasizing that both suggestions were his own and had not been approved by London. The first was to give Britain that information developed during the partnership before the Act

was signed. The second was to merge data on the atomic bomb with the exchange of defense information already taking place. To a query by Acheson, Makins replied that production of nuclear material and the fabrication of nuclear components of the bomb would be included under the enlarged defense information exchange.

Acheson refused to consider either course. However, he had overtures of his own to make. What did Makins think of erasing the wartime agreements requiring mutual consent before using the atomic bomb? The British diplomat saw no objection to recision as part of a larger settlement. Makins rose to leave. Clearly he had the elements of understanding to carry to London. For his part Acheson summarized the meeting for Lilienthal and Marshall; to both he wrote, "Some action is urgently needed." [28]

Although the exploratory talks at Acheson's home revealed the possibility of agreement, there was much to be done before negotiations could
274 begin. Marshall turned to Forrestal and Patterson for the military views on atomic energy facilities located in Britain. The Joint Chiefs of Staff, assuming that Britain would be an ally in a future war, thought atomic energy plants in the British Isles nonetheless would be detrimental to American security. They would be closer to a potential enemy and their operation would require stocks of uranium ore in Britain. For military purposes, it would be better if all the ore could be converted into fissionable material and made available to the United States and its allies for use in an emergency. Stocks of ore accumulating in Britain for use in future plants the Joint Chiefs believed inconsistent with this position.[29]

Although it was obviously necessary that the Joint Committee realize the need for a new understanding with the British and Canadians, as yet they had not heard of the old. The first step in their education came on May 5, 1947, when, at an executive session with the Commission, Carroll L. Wilson with a map and pointer described the nation's atomic energy facilities. The information was highly sensitive, and Lilienthal was concerned that only a drape-covered swinging saloon door separated the intently listening group from the public corridor. Inevitably the topic of raw materials supply came up. The facts jarred the Joint Committee. Pike warned that American and Canadian ore was not sufficient to operate the production plants; ore from the Belgian Congo was vital. Even more alarming was the disclosure that half of the Belgian Congo ore was going to Britain. Senator Connally was astonished to discover that the British knew how to make the bomb. Quickly Lilienthal seized the opportunity. The Joint Committee, he urged, should learn from the State Department full details of the arrangements with the British.[30]

Acheson appeared before the Joint Committee on May 12. He reviewed the wartime cooperation which led to the atomic bomb and he described the advantages that the mutual efforts of the three nations offered in obtaining raw materials. For the first time representatives of Congress learned that Roosevelt and Churchill had agreed that neither nation would use the atomic

bomb without the consent of the other. Hickenlooper and Vandenberg were shocked and outraged. Only a week had passed since they had learned of the ore arrangement; now they discovered that Britain held a veto over the most powerful weapon in the American arsenal. In the days that followed the two senators searched for a way out of the entanglement. Both urged Truman, Marshall, and Forrestal to act, suggesting that in return for financial assistance Britain give up her share of the Congo ore. Hickenlooper wrote to Marshall in August, "the present agreement, in view of all the circumstances, is intolerable." [31]

PREPARING A POSITION

As eager as the two senators were for swift action, it was not possible to move quickly. Aid to Greece and Turkey was still awaiting Congressional vote, the Marshall plan was in the early stages of framing, and negotiations were in progress in the United Nations Atomic Energy Commission. In the fall of 1947 the pace of events quickened. Marshall met with Royall and Forrestal on September 11 to consider the American policy on atomic energy. To Forrestal the main issue was whether the United States was bound by the Churchill-Roosevelt agreement on the bomb. Gullion skillfully broadened the question to include cooperation in atomic energy with Britain and Canada. In this context, Marshall explained the real problem. Granting that more uranium was essential to the American atomic energy program, should economic aid be used to bargain for uranium ore? Kennan set forth the State Department position: Aid to Europe must stand on its own merits. If aid were exchanged for ore, and if the barter became known, the outcry might destroy economic aid and ruin the chance for an agreement on uranium. The group agreed that the two matters should be kept separate.[32] One step forward had been taken; the Hickenlooper-Vandenberg idea had been considered and discarded.

For the Secretaries of State, War, and Navy, the issues were those of high policy, dealing with agreements made in secret by heads of state during time of war. For the Commission it was a cold matter of uranium ore. On September 18 and 25, the Commissioners talked over the ore estimates gathered by the staff. Neatly typed figures expressed American requirements from 1948 through 1952 against the total supply available from the free world. Although the preliminary totals were reassuring, they deceived no one at the table. Included in the total supply were stocks already in Britain and those which under present arrangements Britain would receive in the future. The total supply also contained estimates of available production from South Africa, although no agreement for the material had been negotiated and no technical process to separate uranium from the tailings of gold mines had been perfected. Subtract these amounts from the total and the results stood

clear and grim. Without the stocks in Britain, without that Congo production allocated to Britain, the American production plants could operate only at a fraction of full capacity. Lilienthal signed a letter to Marshall on October 1, 1947, requesting the American members of the Combined Policy Committee to plan negotiations with the British and Canadians.[33]

In preparation for the meeting the policy planning staff drew up a list of objectives which Marshall, Forrestal, and Lilienthal studied before they met on November 5. The proposals called for conversations with the British and Canadians with the aim of abrogating the wartime agreements on the bomb, continuing the Combined Policy Committee and the Combined Development Trust, and allocating a greater share of raw materials to the United States. However, increasing the share of future production of raw material was not enough: The British and Canadians were to be asked to give up their accumulated stocks in excess of their current industrial projects. Such action
276 by Britain and Canada would enable the United States to strengthen its atomic energy effort to the benefit of the mutual security of the three nations. In exchange, the Americans would offer to assist the others in developing atomic energy for industrial purposes. This offering was somewhat tentative since it appeared to contravene the McMahon Act, which prohibited giving information on industrial development of atomic energy to foreign nations. To meet this point the State Department was willing to ask Congress to change the law.[34]

Marshall began the discussion on November 5 by stating the importance of clearing away the misunderstandings and the antagonisms that had developed with the British, for which, he remarked, the Americans bore some responsibility. Unless the two nations were on common ground, he thought it possible that Belgium might succumb to pressure to sell the Congo ore elsewhere. Listening to the others give their opinions, Lilienthal found himself somewhat at odds. None knew better than he that British ore was essential. But based on his own recent and hard-won legislative experience, he believed seeking Congressional authority involved delay, uncertainty, and risk, with perhaps opening again to hazard the fate of the Commission itself and civilian control of atomic energy. Furthermore, he thought the proposals offered too much.

Others saw the issue differently. Forrestal's reasoning was complex. The United States did not want to see atomic plants in Britain. In his mind, giving information in exchange for raw material would not only ease the American uranium supply, but would keep the British from constructing their own facilities. The possibility that the British wanted the information to build the complex that Forrestal wished to deny them went unchallenged. Gullion found unresponsive the military contention that atomic installations in Britain were vulnerable, for an atomic energy program was a concomitant of a great power. Vannevar Bush pointed out that information exchange worked both ways; the American scientists needed to know what their British and

Canadian colleagues were doing. While all this might be true, Lilienthal wanted to treat information exchange and raw material requirements as separate problems. The meeting ended with the decision that the Commission should try drafting a more acceptable paper of objectives and strategy.[35]

Several factors troubled Lilienthal. Unlike Forrestal and Marshall, he was not the executive head of a department but only one of five Commissioners, and as Chairman possessed no special prerogative. He believed that Strauss found the idea of working with the British deeply disturbing. Nor were the legal grounds for cooperation clear. Section 10 required the Commission to control the dissemination of Restricted Data so as to assure the common defense and security. The statutory definition of Restricted Data covered atomic weapons and fissionable materials, and their use in the production of power. The section contained two opposing principles to guide the Commission. The first prohibited the exchange of information on the industrial uses of atomic energy until Congress declared that effective international safeguards existed. The second encouraged dissemination of scientific and technical data to promote the progress of science. The wording of Section 10 revealed an uneasy attempt to reconcile the flow of information required by science with the demands of national security. Of particular importance was the statement that the Commission should control the dissemination of Restricted Data in such a manner as to "assure the common defense and security."[36]

At the November 5 meeting Lilienthal and Herbert S. Marks, the Commission's general counsel, suggested that "common defense and security" offered the legal key. Marks argued that if it could be shown that exchanging information with the British advanced American security, then the grounds for cooperation were established under the law. That common defense would benefit, he added, was a determination which only the Department of Defense could make. Joseph A. Volpe, Jr., worked nights to draft a position acceptable to the State Department and the Commission.

As Volpe sought to enlarge the areas of agreement, a three-day classification conference with the British and Canadians began in Washington on November 14, 1947. Planned since summer, the gathering was intended to establish a common declassification policy among the three nations, each of which, to differing degrees, had helped to develop the atomic bomb. Without a common policy one nation might release information that another might think still classified. Wilson and James B. Fisk had helped plan the meeting for another purpose. Discreet sounding, without breaching secrecy, might reveal the areas in which the other two nations wanted information. The results were heartening. It appeared that the major subjects of interest were health and safety.

Wilson attended none of the sessions, but he did stop in at an after-work cocktail party. There he greeted Dean C. J. Mackenzie, president of the National Research Council of Canada, leader of his country's group,

and John D. Cockcroft, director of the Atomic Energy Research Establishment at Harwell and head of the British delegation. There was another member of the British party—a principal senior scientific officer at Harwell —whom Wilson had not met before. German-born, slender, wearing round spectacles, the stranger was introduced to Wilson. His name was Klaus Fuchs.[37]

The American members of the Combined Policy Committee considered Volpe's paper on November 24. In Marshall's absence, Lovett took the chair. He urged quick action; otherwise, Congress might move, and stir uranium, information exchange, and foreign aid into a hopeless mixture. With his best efforts, Volpe had not been successful in finding common ground. The Commission still felt constrained to treat information and raw materials as separate issues, a position which Gullion remarked would leave scant room for the State Department to maneuver. The compromise left unmentioned the
278 unresolved points. The raw materials position was unaltered; the areas and amount of information exchange were to be explored during the negotiations.[38] Perhaps part of the reason for wasting no further effort to remove the differences was the belief that the British and Canadian information requirements would not be hard to meet.

With an agreed position it was now possible to turn to the Joint Committee. It was high time, for there were signs of restlessness. Senator William F. Knowland lunched with Forrestal on September 26, 1947. The Republican senator had heard that the President was thinking of announcing in October an agreement with Britain and Canada which would cover all matters of atomic energy. If this were true and if the Joint Committee were ignored, Knowland foresaw a violent debate which might well affect the relations between the Congress and the Executive.

Hickenlooper and Vandenburg saw Forrestal and Lovett at the Pentagon on November 16. The two senators listened to Lovett explain the status of the American negotiating position. While Hickenlooper had little to say, Vandenberg was still playing with the idea of tying together economic aid and raw materials. Faced with the need of getting Congressional support for interim assistance to Europe, Vandenberg wanted to be able to say that in return for economic aid the United States would receive certain strategic materials. For the moment Lovett fended off the Michigan Republican, but at the close of the meeting the senator warned that he would raise the matter if the British were stubborn.[39]

Lovett had intended to discuss the negotiations with both Congressional committees on foreign relations. Up to that time only the Joint Committee members had gained access to Restricted Data, although members of that body also served on the foreign relations committees. For example, Vandenberg and Connally were, respectively, chairman and ranking minority member of the powerful Committee on Foreign Relations.

The process of informing the Joint Committee began somewhat uncer-

tainly. Because the committee's procedures for handling classified material were not settled, Hickenlooper decided that for the moment only he and Vandenberg would hear the plans. On November 26, Lovett and Kennan joined Forrestal, Bush, and three Commissioners to meet with the two senators at Blair House. The mansion, located across Pennsylvania Avenue from the Old State Department and near the White House, was often used for small meetings as well as a residence for visiting dignitaries. Lilienthal and Wilson presented the raw materials situation. Lovett stressed the strength of the British hand. Not only had they a part of the ore receipts since mid-1946, but their influence was strong in Belgium, which controlled the present source of ore, and in South Africa, which promised to be the main supply of the future. Nonetheless the Americans would strive to abrogate the wartime agreements, to acquire British ore stocks, to get a much greater share of Congo production, to restrict the storage of raw material in Britain to a minimum, and to obtain British and Canadian support for ore negotiations with South Africa. In return the United States would give some information. Hickenlooper was dubious. The proposals smacked of an alliance and he warned of the provisions of the Act. Vandenberg bluntly stated that he would accept no arrangement which required the United States to consult another nation on using the bomb. He did not see how the United States could give Britain financial help if the British did not recognize that the American proposals would benefit the security of all. The meeting ran on until eight o'clock in the evening.[40]

Lilienthal was elated. The calm agreement on the proposed position surprised him. His fears had proved shadows without substance. The Department of State, the military establishment, and now two Republican leaders had accepted cooperation with the British and Canadians. Only within the Commission itself was there doubt. Nor did the meeting with the full Joint Committee on December 5, 1947, cause Lilienthal to lose his optimism. So long as national security would benefit, the committee found no reason why negotiations could not touch upon information exchange.[41]

NEGOTIATIONS

The meeting was the last step in forming the American position. On December 10 the full Combined Policy Committee assembled for the first time since the previous February. The burden of presenting the American position fell upon Lovett, with Forrestal and Lilienthal ready to add their support. Lord Inverchapel, a career diplomat with years of service in Moscow and Peking, led the British group. Hume Wrong, an able diplomat whose background included more than one Washington assignment, headed a small Canadian delegation.

Lovett began by explaining that lack of progress in the United Nations called for resuming discussions among the three nations. Indeed, added urgency stemmed from Congressional interest in foreign aid; unless the three nations adjusted their relations they might be faced with Congressional intervention. Lovett suggested establishing two subgroups, one on information, the other on raw materials. To the information group Lovett named Fisk and Bush who, with the British and Canadians, would explore areas where information could be exchanged within the limits of the Act. Wilson, as American representative on the Combined Development Trust, was the obvious choice for Lovett to name to the raw materials group. Lovett emphasized the importance of raw materials to the United States; as a guideline he suggested utilizing all raw material in excess of current projects to increase the security of all.

Sir Gordon Munro of the British group asked about wartime agree-
280 ments on the bomb. With this question, all three issues—raw materials, information exchange, and now wartime agreements—were in the open. Lovett replied that bomb agreements should be swept away rather than continue to exist as a source of misunderstanding and controversy. The British and Canadians heard Lovett without surprise. They had been informed earlier of the trend of American thoughts. Roger Makins, John Cockcroft, and David E. H. Peirson, assistant secretary in the headquarters division of the Ministry of Supply, were expected to arrive from Britain the following day. From this group of technical advisers Inverchapel said he would draw his committee members. Wrong named Mackenzie and George Ignatieff, of the Department of External Affairs, for the Canadian representatives on the information committee, and for the raw materials committee, George C. Bateman, a mining expert, and Thomas A. Stone of the diplomatic corps.[42]

Fisk and Bush met with Cockcroft and F. Neville Woodward of the United Kingdom, Mackenzie and Ignatieff of Canada; by December 12 the subgroup on information exchange had completed its work. The subgroup listed nine areas within which cooperation was possible. Among them were the topics in the proposed declassification guide; others were health and safety, research uses of radioisotopes and stable isotopes, fundamental and extranuclear properties of all the elements, fundamental properties of reactor materials, extraction chemistry, the design of natural uranium power reactors, and research experience with specified low-power reactors. Each area was briefly described. Fundamental reactor materials, for example, dealt with solid-state physics and basic metallurgy, and also included moderators, fuel elements, structural material, and liquid-metal and other coolants, as well as other items.[43] Since the list of areas for cooperation was technical, the effort for information exchange became known as the technical cooperation program.

Raw materials offered more difficulties. Wilson and Volpe, with Bateman and Stone of Canada and Peirson and Arthur Storke of Britain, initialed on December 12, 1947, their agreement on estimated raw materials production. These estimates they matched against American and British requirements, acknowledging that Canadian needs would be small. The Americans submitted a high and a low set of requirements; the difference between the two lay in the varying operating levels of the gaseous-diffusion plants at Oak Ridge and the number of reactors operating at Hanford. For their part the British offered a single estimate, based mainly on a reactor program. No account, they pointed out to Wilson and Volpe, had been made for a planned gaseous-diffusion plant.

Putting together the combined requirements made a grim story. Available ore production for the period 1948 through 1952 could not support an American program operating even at the low level, as well as the British program. But if, in addition to the annual ore production, the accumulated stocks in Britain and the United States were considered, the picture changed somewhat. Operation of the two programs at the high level could continue until demand outstripped supply, by which time either technical improvement or new discoveries might restore the balance. Operation of the two programs on a low level could be carried on, provided that the British did not greatly increase their atomic energy effort. But for both cases the stocks in Britain were crucial to the Americans. In the immediate future the British, just beginning their program, would have more ore than they needed. In contrast the Americans were ore-poor. Neither their low nor their high requirements could be met unless the British agreed to accept less than half of the Congo production and to make available to the United States the supplies in Britain.[44]

The full committee took up the reports of the subgroups on December 15. It spent little time on the nine areas of information exchange. Lovett and Lilienthal stressed the interpretation that the list was only a beginning, that new areas would be added as necessary. Differences appeared over raw materials. Lord Inverchapel took an optimistic view, expressing the opinion that the estimates were unduly conservative. This might be true, Lovett admitted, but the fact remained that the subgroup found requirements greater than supply. Forrestal brought to bear his analysis of the world situation. The prospect was somber, and he concluded somewhat dogmatically that policy must not outstrip power, nor power outstrip fact. Canada, Britain, and the United States he saw as linked together in common cause. To deal with raw materials, Lovett called for a new group to attempt to reconcile uranium availability with demand. Kennan and Wilson were selected for the United States, Munro and Makins for Britain, and Wrong and Stone for Canada. Another subcommittee with Gullion and Volpe, Peirson and Donald D. Maclean of Britain, and Ignatieff and Stone of Canada, assumed the task of

drafting the principles of future cooperation. The Combined Policy Committee agreed that the documents would be entered in the minutes, to avoid the need of United Nations registration.[45]

The raw materials group met the next morning to begin working out an allocation of uranium which would satisfy all. Wilson and Kennan proposed an allocation for 1948 and 1949 under which the United States would receive all the estimated ore production, plus a considerable fraction of the British stockpile. The request was based upon the principle of matching requirements to supply. Under the American plan both nations at the end of 1949 would be in a similar position; the reserves would meet the expected requirements of each for about the same period of time. Makins and Munro, however, had authority to allocate only 1948 production, along with some ore in the Congo earmarked for Britain. The only principle that Wilson and Kennan could discern in the British proposal was that all stocks in the United
282 Kingdom should remain there. They saw no effort to reconcile supply and demand on an equitable basis.

The group met once more in the afternoon of December 16, and again for two sessions the following day. Accepting the fact that Makins and Munro were limited in their authority, the Americans presented a series of cases covering 1948. Underlying each illustration was the principle that both nations should have reserves lasting over equal periods of time. The Americans were seeking ore for the lower of the two cases of operation, and felt that the British should accept and support the effort on the grounds of mutual security. As the arguments grew increasingly complicated, John K. Gustafson and Cockcroft were brought into the meeting to explore some of the intricacies of timing of shipments and amounts of uranium in various parts of the production pipeline. So complicated had the discussions become that Makins and Munro refused to trust to cables to explain the American proposal. They saw no alternative but to return to London.[46]

As the Americans waited for word from Britain, Kennan was optimistic. The talks had been frank and pleasant. But if the two British diplomats could not persuade London on raw materials, Kennan foresaw Congressional intervention and appalling complications. During the interim, Lovett had Gullion brief Hickenlooper. Unexpectedly Gullion met Wilson at lunch and both saw the Joint Committee chairman. Hickenlooper listened to Gullion's account of the negotiations and to Wilson's explanation of raw materials allocation. The senator would have preferred an arrangement in which Britain kept no uranium, since he would not rule out the possibility that it might be bartered or surrendered during a crisis. Yet he agreed that this danger was small. In the main, Hickenlooper was contented. The British too, must have had some reasons for satisfaction. Lilienthal and Bush presented the nine areas of agreement as but a beginning. Lovett had spoken of cooperation as a continuing effort, and Forrestal had described the three nations as partners.[47]

There were other uncertainties beyond British acceptance of raw

materials allocation. Gullion was well aware that Forrestal desired to see no atomic energy installations in Britain, that Hickenlooper and Vandenberg were determined to rid the United States of the Roosevelt-Churchill agreement and to obtain the needed ore, and that Strauss was disturbed over the prospect of cooperating with the British. The question came up as to what to call the agreement. Gullion suggested *modus vivendi.* His British and Canadian colleagues demurred, for the term was most often used to describe the relations between adversaries driven by circumstances to get along together. To himself Gullion thought *modus vivendi* accurate.

THE MODUS VIVENDI

London accepted the raw materials allocation and removed the last obstacle to agreement. For 1948 and 1949 all Congo production was to go to the United States. If this amount were not sufficient, the deficit could come from the British stockpile of unprocessed and unallocated uranium ore. There were certain precautions. The American requirements were to be no more than the lower operating level postulated on December 15, 1947, and there were provisions for review and readjustment. Canadian requirements were to be met by the Americans, but in the form of uranium metal for their reactor work rather than ore.[48]

January 7, 1948, was a day full of meetings. The first began at ten-thirty in the morning when Lovett and Gullion, with John A. Derry from the Commission staff, met with Vandenberg and Hickenlooper at the State Department. Lovett showed the senators the three main documents: the *modus vivendi* and the agreements on ore allocations and information exchange. Vandenberg was relieved and congratulated Lovett. The *modus vivendi* erased the Roosevelt-Churchill agreement the senator disliked. Hickenlooper too was pleased, and was confident that the Joint Committee would be satisfied.[49]

The Commissioners themselves had not formally approved the three documents, steps which were necessary before Lilienthal, representing the Commission on the Combined Policy Committee, could join Lovett and Forrestal in meeting the British and Canadians. A few minutes after noon, the Commissioners took up the allocation of raw materials and quickly gave their approval. Information exchange and the *modus vivendi* were not so fortunate. Strauss was worried by the security implications. Information on health and safety, for example, was essential to the development of countermeasures against radiological warfare. Pike admitted the security aspects, but believed the possible benefits to peacetime medical research and to the protection of workers more important. Waymack offered the common-sense observation that the partnership with Britain must have some content. What Strauss was seeking was a method of control so that by approving the areas the Commis-

sion would not be signing a blank check. To meet his objections the Commission entered into the minutes its understanding of technical cooperation. The nine areas were general fields in which information exchange might prove beneficial. Implementation of any topic within the field would require the approval of the Combined Policy Committee. On this committee the Commission was of course represented. Volpe and Lilienthal also pointed out an additional safeguard. The Commission representative on the implementing subgroup would be instructed to bring before the Commissioners any proposed action. After more than two hours of discussion the three documents were approved. Lilienthal was to explain the Commission's interpretation to the Combined Policy Committee. It had been an arduous session: not enough copies of the papers for everyone at the meeting, not enough time for lunch, and no opportunity, said Strauss, for the Commission to work out its position at leisure.[50]

The meeting of the Combined Policy Committee which began late in the afternoon at the Blair House was anticlimactic. Lilienthal observed with amusement the scurry to find a green cloth, customary for such diplomatic occasions, to cover the table. Lovett, Inverchapel, and Wrong approved the three documents. To implement the areas of technical cooperation Lord Inverchapel proposed a standing subgroup of scientific advisers. Lilienthal took the opportunity to raise the point that had disturbed the Commission. Information exchange, he pointed out, would have to be carried out within the legal restrictions of the three countries; consequently it would not be possible to vest the American representatives on the subgroup with discretionary authority. Makins saw nothing unusual in the observation, for each representative, he observed, would be guided by the laws of his own nation. Inverchapel's proposal for a subgroup was accepted.[51]

The *modus vivendi,* with the agreements on ore allocation and information exchange, appeared to mark the end of confusion between the United States, United Kingdom, and Canada on atomic energy. Some of the ambiguities of the American position were the legacy of the secret diplomacy of the war, some of the ambivalence was the result of the desire for international control through the United Nations, and some of the indecision stemmed from fears of Congressional sensitivity. Whatever their source, the doubts seemed uprooted and the seeds of a bargain, planted almost a year earlier when Makins talked with Acheson, appeared to have grown naturally into fruition.[52]

COOPERATION WITH THE BRITISH: ANXIETY AND TENSION

CHAPTER 10

For at least one thing Lilienthal could be grateful during the first weeks of 1948: the *modus vivendi* had removed some of the uncertainties that had clouded British-American relations in atomic energy since 1945. The evidence of better understanding appeared on January 29, 1948, when Carroll L. Wilson called to order the first meeting of the Combined Development Agency —the new name for the Combined Development Trust. No longer was it necessary to give major attention to technical problems in estimating quarterly balances of ore reserves. Sir Gordon Munro was content to limit the discussion to financial arrangements. Since most of the ore was now to go to the United States, he could easily demonstrate the inequity of dividing the costs equally between the two countries, and the issue was settled quickly.[1]

Interpreting the *modus vivendi* would be more cumbersome, but James B. Fisk thought the two nations could begin at once to exchange technical information in a few of the prescribed areas. After checking with Vannevar Bush, who represented the military services on the Combined Policy Committee, Fisk proposed to the Commission on February 19 that the first areas be extraction chemistry, power reactor design, health and safety, and research experience on low-power heavy-water reactors. None of the topics involved sensitive subjects, and Wilson's plans for administering the exchange seemed sound. Armed with the Commission sanction, Fisk met with F. Neville Woodward of the British scientific mission on February 21. To start the technical exchange, the two agreed that Walter H. Zinn from Argonne, George L. Weil from the Commission's reactor branch, and Charles W. J. Wende, a General Electric engineer at Hanford, would visit British installations during the spring. Woodward, in turn, proposed that Compton A. Rennie, a Harwell theoretical physicist, visit Brookhaven.[2]

Within a few weeks the Commission had launched what promised to be a prudent but useful exchange of technical information under the agree-

ment. It was a good start, but would it be possible to avoid difficulties if the British proposed exchange in more sensitive areas? The *modus vivendi* was a fragile and untried craft; whether it could survive on the turbulent seas of international politics in 1948 was a real question.

NEWS FROM BRITAIN

Technical cooperation was less than a month old when Edmund A. Gullion, the executive secretary of the Combined Policy Committee, received a visit on March 19 from Donald D. Maclean of the British Embassy. Since Gullion often dealt with Maclean on official matters, the call was not particularly surprising. Nor was Maclean's message astonishing. For about a year and a
286 half, he explained, his government had been at work developing atomic weapons. Secrecy, however, was hampering the effort and the government was planning a casual announcement of the program. The purpose of Maclean's call was to alert the Americans. The Canadians too were being notified.[3]

Maclean was not the only messenger who brought the Americans news of the impending announcement. Admiral Sir Henry Moore, the military adviser to the British members of the Combined Policy Committee, breakfasted with James V. Forrestal on March 31, 1948. The Admiral had been charged by Lord Portal, the leader of the British atomic energy effort, to tell Forrestal that press rumors were forcing the government to announce a rearmament plan which included atomic weapons. To Forrestal the news of the rearmament effort might have been welcome. Only a few weeks earlier he had heard from General Lucius D. Clay that hostilities with the Soviets could come suddenly. After his breakfast with Moore, Forrestal learned that the Russians were about to impose restrictions on the movement of materials and personnel across the boundaries of the Western zone of Berlin. It was the beginning of the blockade.[4]

The promised announcement came on May 12, when Albert V. Alexander, Minister of Defence, rose to answer a parliamentary question on armaments. In a statement which he declined to elaborate, Alexander declared simply that research and development on all types of modern weapons, including atomic, were receiving the highest priority.[5]

If the British intended to announce their program to the world in a low key, they succeeded. No ripple of interest had stirred the American press when, on May 28, Zinn, Weil, and Wende arrived in London. Zinn was enjoying himself. For one thing he had won the toss of a coin for the hotel room with heat; for another he was looking forward to seeing friends whom he had met during the war. On the evening of May 30, the three Americans arrived at Harwell, in the Thames valley some 14 miles from Oxford. For the next few days Zinn, Weil, and Wende were busy in conferences and inspec-

tions of the research facilities at Harwell and the production headquarters at Risley. Zinn found Harwell most interesting. Four large hangars, once used by the Royal Air Force in the Battle of Britain, provided the main shop space and housed the two reactors: GLEEP for Graphite Low Energy Experimental Pile and BEPO—beautifully constructed, thought Zinn—for British Experimental Pile Operation.

With quickening interest Zinn listened to the British describe the technical characteristics of their planned reactors. It was clear to him that the design stressed plutonium production more than electric power generation. But if the British were interested in plutonium, why did they not use the proved Hanford reactor design instead of developing a new gas-cooled reactor? In explaining the technical reasons John D. Cockcroft admitted that the British were indeed interested in plutonium. To Cockcroft, who had taken part in the *modus vivendi* negotiations, the point may have been hardly newsworthy. But to Zinn the acknowledgement was startling.[6]

CHALLENGE TO COOPERATION

Strauss was astonished as he read the report of Zinn, Weil, and Wende. It was not the British intent that was alarming; the Commission had known that since Maclean's visit. It was the unwelcome possibility of accomplishment, for the three American visitors rated the capabilities of their hosts highly. Strauss had reluctantly approved the information aspects of the *modus vivendi.* Now he was convinced that he would have to reopen the question.

The opportunity came on June 30, when the Commissioners weighed the merits of fundamental properties of reactor materials as a topic for technical cooperation. Before his fellow Commissioners, Wilson, and other members of the staff, Strauss constructed his case. Three categories of information he saw as essential to the production of atomic weapons. These were fundamental nuclear principles, technological developments in equipment and production processes, and weapon design. The Smyth report, he thought, had gone far to declassify the first and the present proposal seriously breached the second. Strauss contended that the basis for technical cooperation was an equality of value in the information exchanged. What had the British to offer for information which, he asserted, would enable them to manufacture plutonium for weapons? For evidence of the British intention to produce plutonium Strauss pointed to the Zinn-Weil-Wende report.

Waymack admitted that Strauss had raised a point of substance. Bacher observed that the Canadians as well as the British needed the information on fundamental properties. All at the table recognized the point. The Canadians had no weapon program but would be able to provide the Americans with nuclear data from the Chalk River reactor. To Lilienthal there were

really two questions. One was whether information on fundamental properties of reactor materials was properly a part of the technical cooperation program. The second and more basic issue was whether the British interest in plutonium changed the basis of technical cooperation. The Commission could defer action on the present proposal, and in the meantime ask the Department of State and the National Military Establishment for their advice.[7]

The Strauss analysis Lilienthal and Wilson explained on July 6, 1948, to Robert A. Lovett from State and Donald F. Carpenter, chairman of the Military Liaison Committee and Forrestal's representative on atomic energy matters. Lovett found no reason to think that the principles underlying cooperation had shifted. He recalled that during the *modus vivendi* negotiations the Americans had assumed that the British would engage in weapon work. Moreover the British had told the Americans of their program on March 19. The British were keeping their part of the all-important raw
288 materials allocation and, from what Lovett had heard, their information provided through technical cooperation was judged valuable. Once Carpenter was assured that the British program made no difference in the division of raw material, he agreed with Lovett. Both admitted that weapons stockpiled in Britain were more vulnerable than those stored in the Western Hemisphere, but there was little that the United States could do about the situation. So far from accepting the Strauss contention, Lovett and Carpenter thought that a British proposal to expand the areas of information exchange should receive serious consideration.[8]

Strauss explained his arguments to Forrestal over breakfast on July 8. The Commissioner had no objection to the British possessing atomic bombs, but he was opposed to their manufacturing plutonium and fabricating atomic weapons. To Forrestal the matter was not so simple. Some consideration, he thought, should be given to the fact that it was in the American interest to restore and bolster British confidence. That this was a valuable goal Strauss agreed, but paramount was the danger to the United States that might come from leakage of information from Britain or from a surprise invasion which would capture British weapons and facilities.[9]

Later that day Lilienthal reported to the Commission the results of the July 6 meeting with Lovett and Carpenter. Strauss declared his surprise. Lovett and Carpenter were tacitly sanctioning the British weapons program, a position which Strauss could not reconcile with the practice of doling out information to the British piece by piece. He could not believe that George C. Marshall, Forrestal, and Truman realized the implications of the Zinn-Weil-Wende report. Lilienthal turned to the subject of approving information exchange on fundamental properties of reactor materials, which had been in abeyance since June 30. However the Commission decided, Lilienthal thought the Joint Committee should be informed, perhaps by a general report on technical cooperation which would include a summary of the British program.

Lilienthal, Pike, and Waymack approved the subject of fundamental properties of reactor materials for information exchange. Strauss dissented.[10]

The unity among the Commissioners that Lilienthal prized was broken again and once more Strauss stood apart. The debate continued in the days that followed. Lilienthal was disturbed by Strauss's intense emotion. Through memorandums and notes Strauss urged that Truman be consulted. Lilienthal and his other colleagues held that there was no evidence to show that the basis for technical cooperation had changed and that some of the alarm originated in a misunderstanding of technical matters. Reactors produce plutonium. Consequently control of plutonium manufacture was never, as Strauss so strongly asserted, in American hands. Besides, the British had gained sufficient knowledge during the war to mount an atomic weapon program independent of the Americans. Awareness of Strauss's attitude was not confined to the Commission. Lilienthal discovered that Lovett was worried lest the British learn of the division within the Commission and suspect that a policy change was in the offing.[11]

For some time the members of the Combined Policy Committee agreed on the wisdom of acknowledging publicly that Britain, Canada, and the United States had resumed limited cooperation in atomic energy. Selection of an opportunity and means to make the announcement proved surprisingly difficult. Eventually the committee chose the New York Golden Jubilee as the occasion and a major speech by Lilienthal as the device. Interrupting his vacation at Martha's Vineyard, Lilienthal flew down to New York on August 21, where he spent a crowded afternoon looking at the latest revisions of his speech and talking with Pike, Bacher, and Joseph A. Volpe, Jr., about the latest events in technical cooperation. At the Waldorf Astoria that evening, Lilienthal spoke of the wartime cooperation of the Americans, British, and Canadians and of the failure of the United Nations to control the atom. The three governments, Lilienthal said, "are continuing to utilize, in an expanded way, the cooperative principle in certain limited areas." There followed a torchlight parade down Lexington Avenue. Lilienthal enjoyed it all immensely. On the other hand, he had heard from Pike that technical cooperation was in deep trouble.[12]

BREAKDOWN

The proximate cause of the crisis in technical cooperation stretched back to the spring of 1948. Between sessions of the General Advisory Committee meeting of April 23–25, Fisk mentioned to Cyril S. Smith, a committee member who was a distinguished metallurgist, that among the topics considered for information exchange was the metallurgy of plutonium. Smith

listened with professional and personal interest. Plutonium underwent more phase transformations than any other metal and Smith, who had helped develop processes for preparing plutonium for weapon use, was thoroughly familiar with its fascinating characteristics. Furthermore, the British-born metallurgist was planning a trip to Europe with his wife and family. He offered to stop at Harwell and discuss plutonium. Although the major use of plutonium was in weapons, the element also offered promise as a reactor fuel. Neither Smith nor Fisk included weapon use in defining the "basic metallurgy of plutonium." Smith sailed for Southampton as Fisk began the procedures authorizing the discussions.

On June 9 all of the Commissioners except Strauss listened to Fisk propose exchanging information on the fundamental properties of reactor materials, one of the areas listed under the *modus vivendi.* The paper Fisk presented included in the area the fundamental chemical and physical properties of reactor and reactor auxiliary materials, such as natural and enriched uranium fuels, or fuels of other fissionable material. There was no mention of plutonium, although the element was defined as a fissionable material in Section 5(a)(1) of the Atomic Energy Act. One remark caught Lilienthal's attention. Fisk had just stated that he was assuming that the proposal now before the Commission was acceptable to the Department of Defense, since Bush of the Research and Development Board had helped define the areas of technical cooperation.

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This assurance was not enough for Lilienthal. Perhaps his thoughts ran back to the meetings of late 1947 when he and Herbert S. Marks had explained to Marshall and Forrestal that cooperation with the British and Canadians might legally be possible under the phrase "common defense and security" of Section 10 of the Act, provided that the military establishment—in particular, Bush—attest to the advantages which would accrue to the United States. At any event, Lilienthal asked Fisk to get Bush's views. On June 15 came the reply. Shorn of the wool of government phrasing, it informed Fisk that the Commission should handle nonmilitary sections of technical cooperation while the armed services would take care of the military areas. The answer was hardly satisfactory to the Commissioners, who saw technical cooperation as an effort in which both agencies worked closely together.[13]

The Commissioners were still withholding their approval of fundamental properties of reactor materials when Frederick T. Hobbs, the Commission staff member who handled routine matters in technical cooperation, received a letter from Alexander K. Longair of the British Scientific Mission. Longair requested, on June 22, authorization for Smith to talk to Harwell scientists on a number of topics. Hobbs studied the list. Noting that basic metallurgy of plutonium was among the items, he took a red pencil from his desk and checked the topic for Fisk's attention.

Buttressed with Bush's reply that military concurrence was not needed,

the proposal returned two more times to the Commissioners, on June 30, when Wilson and Fisk were absent, and on July 8, when the two men were present. Both meetings were tense, for Strauss was calling for Presidential review of the technical cooperation program. At the latter meeting, with Strauss in dissent, the Commissioners approved initiating information exchange on fundamental properties of reactor materials. At Lilienthal's request, the staff was to draw up a report on the decision and on the British production program for the Joint Committee. Fisk left the meeting with his paper approved, but neither he nor Wilson could have had any illusions about Strauss's position. Fisk, after consulting with Wilson, authorized Smith on July 26 to discuss the "basic metallurgy of plutonium." [14]

The Commission on July 30 sent Carpenter of the Military Liaison Committee a copy of the report to Hickenlooper. Carpenter scanned the report closely, for another factor was intruding. His recent conversation with Admiral Sir Henry Moore revealed that the British wanted to expand information exchange. Among the new areas would be atomic weapons. Carpenter summarized the conversation for Lilienthal, Lovett, and Fisk on August 3. The following day he received a request from Hickenlooper to call.[15]

The Joint Committee chairman had several things on his mind, among them the custody of weapons and the proposed Commission reorganization. He also wanted to talk about a report he was soon to receive from the Commission. Carpenter heard him without surprise, for with the close contacts between the Commission and the Joint Committee, Hickenlooper understandably could be aware of the report. More interesting was the senator's reaction. In ruminating on the direction of the British program, Hickenlooper was inclining toward the position that plutonium production was contrary to the spirit of the *modus vivendi.* Carpenter presented the opposing view. He was convinced that the British had intended to manufacture plutonium. This was nothing less than the Russians were doing.[16] Hickenlooper remained unpersuaded.

Carpenter sent his comments to the Commission on August 9, 1948. He thought too much importance had been placed on the Zinn-Weil-Wende report, but he was still troubled. In the memorandums passing between Strauss and the other Commissioners, Carpenter saw the differences of interpretation on technical cooperation. He had studied the documents on the *modus vivendi;* he had investigated the background of the negotiations; he had learned that the documents had been available to the Commissioners, and that at least Hickenlooper and Vandenberg had seen the papers. He also knew that Lovett had briefed the President. To Carpenter the record was clear. The British had not concealed their intent to produce plutonium, and none of the Americans privy to the negotiations had challenged that right. But if he had overlooked anything, he wanted to be corrected.[17] The report went to Hickenlooper the same day.

The Commission offices were unusually quiet. To escape the heat and

humidity of August, Lilienthal, Waymack, and Wilson were on vacation. Bacher was at Brookhaven and Fisk was on a trip which would take him to Berkeley and Los Alamos. Only two Commissioners were in Washington: Pike as Acting Chairman, and Strauss.

Hickenlooper read the report with increasing apprehension. The extent of technical cooperation was greater than he had realized. On the morning of August 11, he telephoned Strauss, asking for more details. Strauss gathered up a list of the original areas of agreement, a background memorandum to the American members of the Combined Policy Committee, and a summary of Commission actions on several of the areas. He sent the material to Hickenlooper, who received it the morning of August 12.

While Hickenlooper was reading the papers with dismay, Strauss was filled with consternation. Admiral John E. Gingrich, the Commission's director of security and intelligence, had brought him a copy of the Fisk letter
292 authorizing Smith's discussions with the British. For the first time a Commissioner saw the authorization containing the words "basic metallurgy of plutonium." Strauss reacted vigorously. He called Hickenlooper and hurried to Pike's office. Pike examined the letter. Strauss contended that even though the letter was dated July 26, 1948, there was still a chance that Smith might not have been to Harwell. Vehemently Strauss urged Pike to call Smith. Scenting trouble, Pike wanted further advice and telephoned Bacher at Brookhaven. After Bacher agreed that the authorization was injudicious, Pike began his efforts to reach Smith, first by transatlantic telephone, then by cablegrams. The time was now about eleven-thirty.

About a half hour earlier Hickenlooper and Vandenberg had walked into James V. Forrestal's office at the Pentagon. Hickenlooper promptly charged that technical cooperation had expanded beyond recognition. Bush retorted that there had been no expansion, but only a more clear definition of the topics within the areas. Hickenlooper turned to the British program. He had understood that the British were developing industrial power; now he learned their major goal was to produce plutonium. That, he declared, could only mean the production of atomic bombs. Carpenter and Bush repeated the oft-used arguments that the direction of the British program was not news. Hickenlooper shifted to the exchange of information on the basic metallurgy of plutonium. He had learned of the Fisk letter only that morning. Here Bush and Carpenter admitted an error.

Technical cooperation had advantages, but the question was how to regulate it. Carpenter said that he had already instituted procedures so that the Military Liaison Committee would know of all future contacts on information exchange. Vandenberg, the parent of the liaison committee, maintained it had a clear legal responsibility to control the procedures. Was it necessary, he asked bitterly, to double-check the Commission in all these matters? Forrestal still favored continuing the effort. His reasons were the same as they had been during the November 5, 1947, meeting of the American members of the

Combined Policy Committee: The United States needed ore and did not want to see a large-scale atomic energy complex in Britain; if these aims could be achieved and if the Americans could obtain useful information, then technical cooperation should continue. As he and the others saw it, perhaps the way out of the dilemma lay in persuading the British to make their bombs in Canada.

That afternoon at three o'clock Carpenter telephoned Pike to convey his objection to Smith's authorization. Pike replied that he was aware of the matter but so far had not been able to reach Smith. The Acting Chairman could give no assurance that Smith had not yet talked to the British. An hour later Strauss met with Forrestal and Carpenter.[18] It had been a busy day.

Smith was enjoying himself. He had been in no hurry to visit Harwell; indeed he had been back in the United States to attend a metallurgy conference. On his return to England he had rented a car and with his wife and family was touring Scotland and the lovely lake district of England. Pike's messages were raining upon the home of Smith's sister at Four Oaks, a suburb of Birmingham. On August 13, Smith returned from his tour and received a telephone call from Pike. To Pike's huge relief Smith had not yet been to Harwell. That visit did not take place until September 2. Not until much later did Smith learn of the embroilment which was to become known as the "Cyril Smith incident," but the effects in Washington were devastating. Strauss and Pike could never reconcile their accounts of the events.[19] The Joint Committee saw technical cooperation in the worst possible light. The program itself was almost in shambles.

THE BRITISH PRESS FORWARD

On August 16, Carpenter tried to explain to Woodward, the director of the British scientific mission, why technical cooperation could not include weapon information. Woodward was shocked. In view of the information his government had furnished, he could not conceive how the Americans could have failed to understand the British intention. Carpenter admitted that the Joint Committee was the obstacle, but Congressional apprehensions might be lessened if the British manufactured their weapons in Canada. Woodward retorted that much of British military opinion held Canada as vulnerable as Britain.[20]

Carpenter was surprised when the British in early September proposed exchanging information on atomic weapons. The background of the request Woodward explained to Carpenter on September 16. Woodward had sent the American views to London. Attlee had directed Sir Henry Moore to approach Forrestal, who had given the Admiral no intimation that the matter was improper or the timing bad. Carpenter thought otherwise and warned Woodward not to press for a quick reply. Carpenter went further, asserting that

there were those who thought American security depended upon keeping weapon information secret and that data given to Britain might reach Moscow. Vigorously Woodward rejected the imputation. More than once, he declared, the Americans had been invited to Britain to review security precautions and the invitation, as yet unaccepted, still stood. As for Carpenter's suggestion not to press for an early reply, Woodward pointed out the urgent need for a response.[21]

Forrestal had, as a matter of fact, suggested to Moore that the British not press for an answer before the approaching Presidential election. The Secretary of Defense, aware of Congressional sensitivity on the subject of security and atomic bombs, was bearing heavy burdens. Around Berlin the Russians were drawing the blockade more tightly. Marshall and Lovett on September 7, 1948, could offer the President and the Security Council only a gloomy report on negotiations at Moscow. From his office at Columbia
294 University, Dwight D. Eisenhower read the portents and concluded that the Russians in their confidence might push too far. Forrestal's thoughts turned increasingly toward the atomic bomb. The most secure bases from which to deliver the weapon lay in Britain. If the British would let the Americans provide the needed facilities for a small number of British airbases, then in an emergency hours might be saved. He recognized, however, that Britain might well ask in exchange for more atomic energy information.[22]

The views of the Joint Chiefs of Staff on expanding information exchange, Carpenter found, had remained essentially unaltered since early 1947, when Marshall had asked for their opinion on cooperation with Britain. Carpenter had sounded the Joint Chiefs on the recent British request. On September 29, 1948, they replied that on military grounds they could not justify expanding information exchange beyond the areas of the *modus vivendi*, and they saw cooperation on atomic weapons as a return to the partnership of the war. If the United States should offer such a close association, then Britain should agree to have neither stockpiles of raw or fissionable materials, nor plants to produce fissionable materials or weapons, within the home islands.[23]

As the Joint Chiefs deliberated, the British waited. On the last day of September, Sir Oliver Franks, the British ambassador, and Sir Gordon Munro, the British minister, called on Lovett at the State Department. Lovett openly related the obstacles. He described Hickenlooper's reaction to the "Cyril Smith incident." He explained the adverse feeling in military circles to an atomic weapons program in Britain. Along with Carpenter and Forrestal, Lovett counseled patience.[24]

Lovett might well have had another reason for suggesting caution. The day that Franks and Munro called, Truman was castigating big business, the National Association of Manufacturers, and the Republican Party before a crowd in Louisville, Kentucky. He had begun his campaign for reelection. Polls

and predictions favored the Republicans, and it was logical to assume that a new administration might have a different policy.

That reason for caution Truman removed on November 2, 1948. Not only did the Republicans fail to gain the Presidency, but they lost control of Congress as well. On the Joint Committee, McMahon replaced Hickenlooper as chairman. The auspices for cooperation must have looked somewhat better to Franks as he called on Lovett on November 16. The Under Secretary still saw a number of obstacles: Congress would need some months to organize; the Commission and the military were still divided over custody; and within the Commission itself were problems and uncertainties. Franks perforce agreed; perhaps it would be best to wait.[25]

FORMULATING A NEW POLICY 295

How much events of the summer had weakened the *modus vivendi,* Ralph P. Johnson, Fisk's deputy in the division of research, realized when he took over administration of technical cooperation. Faced with a prospective meeting of the Combined Policy Committee subgroup of scientific advisers, Johnson sought Commission guidance on October 15, 1948. Lilienthal recognized the need for clarification. He was troubled by the fact that Bush, the chief scientific representative of the armed services, was no longer the military representative on the subgroup. If Bush no longer attended the meetings, then, in Lilienthal's opinion, the inference was that the sessions were not significant to the military. Yet the legal basis for technical cooperation was that exchange of information would benefit the defense and security of the United States. Since this was not a matter for the Commission to judge, Lilienthal proposed a review of atomic energy relations with Britain.

Strauss heartily agreed. He pointed out that for some time he had advocated such an examination with a Presidential determination. Pike was less certain of the need to reopen the matter, for cooperation through easing the raw materials situation obviously benefited national security. Bacher's reasoning coincided with Lilienthal's views: it would be wise to see if military thinking had shifted. Johnson was to wait until the Commission had the advice of State and Defense.[26] Given the events of the summer, probably no other conclusion was possible. The matter was too important, and the Commission too vulnerable, to leave the issue suspended.

During November, staff members of the Commission, State, and Defense worked out the mechanism for analyzing the nation's atomic energy policy. Volpe reported the results to the Commission on December 9. The plan was for a general study of atomic energy policy by the American side of the Combined Policy Committee, with the advice and assistance of a panel of

leading public figures. The Commissioners disliked the idea. Strauss thought an advisory group would need too much time to grasp the complexities of the problem. Moreover, he saw policy development as the province of the State Department. Although Lilienthal was doubtful about a panel, he was not willing to leave policy formulation to the State Department alone. Neither were Bacher and Waymack; they saw the Commission and the Defense Department as having roles and responsibilities that neither agency could abdicate or delegate.[27]

Some way had to be found to bring order out of the chaos of divergent views. William Webster, who had replaced Carpenter as chairman of the Military Liaison Committee, saw the need to reach agreement among the Department of Defense, the Department of State, and the Commission. Carefully he prepared a position, and then suggested a meeting at Princeton where free from interruption the representatives from all three agencies could talk
296 over the problem. On January 4, 1949, he telephoned Wilson. The plan was for a group consisting of George F. Kennan, James B. Conant, and a few others to meet with Oppenheimer. Wilson and Volpe were to attend for the Commission. The numbers grew somewhat as R. Gordon Arneson and George Butler from State, and General Lauris Norstad and General Kenneth D. Nichols from the Department of Defense were added.[28]

With Oppenheimer as host the group spent most of January 24 and 25 at Princeton studying background material and weighing alternatives. The premise was that Russian possession of the atomic bomb would be detrimental to the interests of the United States. American military thought had been conditioned to the monopoly of the weapon, but that was a temporary advantage. American aid to the British would neither impede nor hasten the Russian achievement, although the assistance could speed British progress. As for raw materials, the production from the Congo, South Africa, Canada, and the United States would probably support the present American and British efforts, but with little to spare for the next few years, providing that the Redox process were successful in reclaiming uranium as well as plutonium from production reactors. American objections to a British program narrowed to three: British facilities were more vulnerable and their output consequently more easily lost; their plants would at first undoubtedly be less efficient in converting scarce uranium ore to fissionable material; and finally, their effort to duplicate American facilities would waste British technical and economic resources. Constructing the hypotheses was enough for one day, and the group adjourned to Oppenheimer's for dinner.

Discussion the next day revealed that no one favored continuing the *modus vivendi* or trying to block the British. Rather, the consensus was that the projects of the three nations should be closely coordinated to make the most effective use of resources, raw materials, and manpower. Fundamental to such tight integration would be a full and complete exchange of information on all aspects of atomic energy, including weapons, and acceptance of the

principle that all atomic facilities be located in accordance with strategic considerations. Insofar as practicable, the public should be aware of the cooperation and Congress should by some action give its sanction. Probably the arrangements should be related to, but not part of, the treaty linking together the North Atlantic nations.

Wilson and Volpe thought the conversations had gone with remarkable smoothness. Kennan, Arneson, and Butler had had little to say, and Nichols, Norstad, and Webster had been surprisingly accommodating. The reason for the harmony, the Commission representatives suspected, lay in the principle of strategic location of atomic plants. Through its judgment on strategic considerations, the Department of Defense would be able to exercise its influence. To Arneson, the degree of unanimity was unexpected and heartening. The discussion had been free and straightforward, and he thought the views of the group even though unofficial would have a great influence on forming policy.[29]

The Commissioners began their discussion of the proposed atomic energy policy on February 3. With great deliberation, almost as a professor lecturing to college freshmen, Lilienthal explained that the Constitution of the United States to a large degree placed responsibility for foreign policy on the President. Although the Secretary of State was the President's chief adviser on foreign relations, the Commission as well as other governmental agencies had a role. But once the President adopted a policy, the Commission and each individual Commissioner were bound by it. His presentation had been an unusual performance; but Lilienthal made it clear that, although the Commissioners might differ among themselves, he expected them to accept a decision with loyalty. Bacher suggested replacing the *modus vivendi* by a permanent policy. Lilienthal was not convinced, believing that the *modus vivendi* was broad enough to include cooperation in atomic weapons, yet in the interest of Commission harmony he would yield.

Strauss argued that technical cooperation should not be expanded while the policy was under discussion. Recent proposals for information exchange, he thought, entered the weapon category. Bacher and Pike pointed to past failure to draw a distinction between weapon and nonweapon information. Lilienthal proposed continuing technical cooperation during the interim, but exchanging no information in any area which any Commissioner thought improper. It would, he admitted, be necessary to inform all parties. Strauss, expressing his appreciation, refused the offer, adding that he preferred not to see a precedent established for an individual Commissioner to exercise a veto. There was no unity on the long-term policy. To Lilienthal's proposal that the Commission recommend to the Secretary of State a program of full cooperation with Britain and Canada, Strauss contended that no weapon data should be revealed until the role of each country had been established and Britain had agreed not to stockpile atomic weapons or materials.

This was the fundamental difference. Strauss wanted to impose qualifi-

cations as conditions which Britain must meet before reaching an agreement. Lilienthal saw these matters as important, but subordinate issues to be worked out after concluding an over-all arrangement. One further time Lilienthal tried for unanimity, but he failed. Under his new proposal, the Secretary of State would devise the procedures for interim cooperation, and for weaving long-term cooperation into the over-all foreign policy. Lilienthal agreed to take to the meeting of the American members the views of Strauss as well as those of the majority.[30]

The chairman of the American side of the Combined Policy Committee was no longer Marshall. Shortly after his victory at the polls, Truman asked Dean G. Acheson to call. One November afternoon Acheson dropped in at Blair House, where Truman was living while the White House was being restored. Little more than greetings had passed between the two men when Truman asked Acheson to become Secretary of State. The offer was com-
298 pletely unexpected and as Acheson hesitated, Truman went on to explain that Marshall was in the hospital. Because of ill health Marshall could not continue to serve, although Truman hoped for sentimental reasons that the military statesman could continue until January 21, 1949, which would complete two years in office and coincide with the beginning of a new administration.[31] On that date, Acheson began his duties as Secretary of State, and between the urbane Easterner and the spirited Midwest President, there grew a feeling of respect and friendship.

At Acheson's recommendation, Truman gave to a special committee of the National Security Council the task of casting the State Department and Princeton proposals into a form for his consideration. The composition of the special committee was the same as that making up the American members of the Combined Policy Committee: the Secretary of State, the Secretary of Defense, and the Chairman of the Atomic Energy Commission. Each member selected a small staff from his agency to serve on the special committee.

By March 2, Acheson, Forrestal, and Pike, as acting chairman in Lilienthal's absence, accepted the proposals worked out by the special committee staff. To the fullest extent practicable, large-scale atomic energy plants and weapon fabrication facilities were to be located in the United States and Canada. Nuclear components of atomic weapons were to be stockpiled in Britain only to the extent required by common war plans, with the United States taking the main responsibility for manufacturing atomic weapons required for joint defense. Because of American predominance in fissionable material production, Canadian and British atomic energy efforts should require no more than 10 per cent of the raw material available for the next five years. If the President approved the proposals, the next step Acheson saw would be conversations between Truman and leading Congressional figures. If chances of Congressional support appeared promising, informal discussions with the British and Canadians would follow, to sound out whether the proposed arrangements were suitable to them. Eisenhower, one of those

present at the meeting by invitation, volunteered to testify before Congress. He thought the arrangements would go far to restore trust and confidence among the three nations. Pike raised the question of continuing technical cooperation during the interim period. Any attempt at restriction, cautioned Acheson, could prejudice the policy being proposed to the President.[32]

In the afternoon Pike and Volpe reported Acheson's warning against restricting technical cooperation and Eisenhower's declaration of the need for trust and confidence. Bacher listened approvingly and remarked that the proposed policy seemed good. Strauss's reaction was cooler, but he found the policy at least an improvement. To his comment that it was too bad that the special committee had not heard his views, Wilson replied that they had been considered by the staff of the special committee.[33]

The policy paper sent to Truman on March 2 was the work of State, Defense, and the Commission, and as such represented a consensus for the President to follow. One of those who agreed was ending his career. Forrestal, wearied and exhausted from the burdens of office and stripped of the force needed for decisions, submitted his resignation to Truman on March 2. Boldly and vigorously Louis A. Johnson strode into the vacancy. His qualifications were good. He had served overseas as an infantry captain in World War I, as National Commander of the American Legion in the 1930's, as Assistant Secretary of War prior to World War II, and as the President's personal representative to India during the dark days after Pearl Harbor. Moreover, he was high in the councils of the Democratic Party.

MEETING AT BLAIR HOUSE

Truman read the report. That much Lilienthal discovered from casual remarks of the President at a meeting on April 14, 1949, with the Commissioners, Johnson, and Webster. A few days later Lilienthal learned that Truman had given his approval and wanted to know the best method of getting Congressional support.[34]

Congressional sanction was essential, but the timing was difficult. Congress was already heavily committed on foreign affairs, for Truman had sent the North Atlantic Treaty Organization pact to the Senate on April 12, and the Committee on Foreign Relations had begun planning for hearings. During the spring Acheson was in Paris attending a four-power conference on a German peace treaty. Possibly another factor was the long drawn-out sessions of the Joint Committee in which Hickenlooper hunted for evidence of "incredible mismanagement."

The British were also anxious for the Americans to settle on a policy. A few days after Truman received the March 2 policy paper, representatives from the British Embassy called on Arneson to find out if meetings with the

Canadians and Americans could begin soon. Later the British approached Kennan. They hoped that cooperation among the three states could be settled soon, for they could not hold off much longer decisions which would shape their own atomic energy program. On the other hand, the Hickenlooper investigation made them aware of the power of Congressional opinion and of the importance of Joint Committee support for any suitable agreement.[35]

Not until June did Acheson and Johnson meet with Truman to decide that the search for Congressional support should start with McMahon of the Joint Committee. Arneson met with McMahon and the executive staff director, William L. Borden, on June 30 to lay the groundwork for the Senate to meet with Acheson, Johnson, and Lilienthal. McMahon heard Arneson summarize the points of the new policy and remarked that offhand he favored persuading the British to stop all production of fissionable material in Britain. The goal should be that all production should take place in North
300 America. However, these were only casual views, and Arneson noted that McMahon listened to Borden's appraisal of the policy of partnership as "realistic."

On July 6 McMahon came to the State Department. Acheson outlined the tangled situation. More was involved than information exchange, for the raw material agreement was scheduled for renegotiation at the end of 1949. Also, conditions had changed since the *modus vivendi.* Not only were other nations embarking upon atomic energy programs and raising questions needing policy decisions, but Russia might have atomic weapons in 1950 or 1951. In any event Britain remained the most valued ally of the United States. Acheson rejected the old Congressional idea of using economic aid as a club to extort favorable terms in atomic energy. From this background Acheson presented the President's proposal. Johnson had nothing to add and Pike stressed the urgency of the raw materials situation.

McMahon did not like the prospect. He could see only a rough reception in the Joint Committee, and was troubled by legal and constitutional implications. Acheson tried to reassure McMahon by pointing out that much would depend upon the kind of understanding that would be acceptable to the British and Canadians. If there should be constitutional difficulties, perhaps they could be solved by an executive agreement sanctioned by the Joint Committee or by a joint resolution of Congress. Volpe pointed out that the Joint Committee had found no legal obstacles to accepting the *modus vivendi,* and the present proposals were based upon the same reasoning. McMahon replied impatiently that the mood of the Joint Committee now was far different. Hickenlooper, for example, might use the negotiations to strengthen his attack on the Commission. Yet McMahon unhappily recognized that his committee could not avoid its responsibilities. He was still turning over contingencies in his mind when Acheson skillfully dropped the suggestion that the President meet with selected Congressional leaders. Eagerly

McMahon accepted the idea, and added others to the names Acheson suggested.[36]

Truman held a press conference at four o'clock on July 14, and after reading an announcement that John Steelman would coordinate an effort to reduce unemployment, opened the session to questions. These ranged widely, covering topics from New York politics to an impending steel strike. One inquiry must have caught Truman by surprise: What comments did the President care to make on his invitation to members of the Joint Committee to meet with him at the Blair House at five o'clock? Truman replied there was no conference scheduled for that hour but he had invited some people to the Blair House that evening. He had, however, no further comments.[37]

Early that evening reporters gathered outside Blair House and waited in a heavy rain as cars began to draw up. W. Sterling Cole, Representative from New York and a Republican member of the Joint Committee, was the first to arrive. Somewhat later came Connally, then Acheson. Eisenhower arrived just before Lilienthal and Volpe. To the reporters Louis Johnson offered the same response that others had given, "No comment." In rapid succession followed Vandenberg, Rayburn, Carl T. Durham, Democratic representative from North Carolina and vice chairman of the Joint Committee, McMahon, and Millard E. Tydings. No sooner had Tydings hurried up the steps than the big black limousine carrying Vice President Barkley pulled up to the curb. Hickenlooper was among the last. Two of those who came to Blair House the newsmen could not identify. The one carrying a dispatch case was Arneson; the other, in a green raincoat, was Webster.[38]

It was a small room for such a gathering, Lilienthal thought as he cast his reportorial eye around the group and caught such incongruities as Vandenberg sprawled upon a sofa beneath a portrait of Franklin Roosevelt. Truman, looking somewhat tired, opened the meeting by reading from his notes. Arneson glanced at his watch: it was eight-fifteen. He listened intently. The preceding day at Acheson's request, Arneson had prepared a single typewritten page of remarks for Truman. The young State Department official noticed that the President had accepted the ideas, but recast them into his own words. Truman covered the same points: the common history of Britain, Canada, and the United States in developing the atomic bomb, and the need to review the raw materials agreement. Once the Congressional leaders understood, Truman concluded, they would recognize that there was no alternative to the policy they were about to hear.

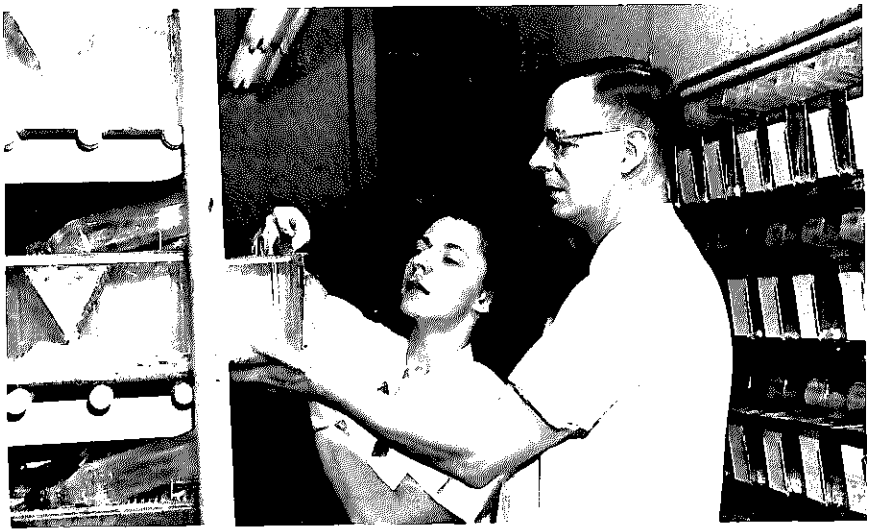
From this introduction, Acheson took over, and with much the same approach he had used with McMahon, summarized the situation. He turned to Lilienthal, who stated that to meet the weapon goals set by the Joint Chiefs of Staff, the Commission facilities would have to operate at 100-per-cent capacity. Johnson and Eisenhower took up the case from the military point of view. Once again Johnson had little to say, other than acknowledging agree-

ment with Acheson's analysis. Eisenhower elaborated on the need for close relations with the British, a subject on which, he pointed out dryly, he had some reason to be expert. So closely mixed were the military fortunes of the two countries that he saw no sense in cooperating in all save atomic energy. With the testimony of Lilienthal and Johnson to support him, Acheson read of the aims of the policy.

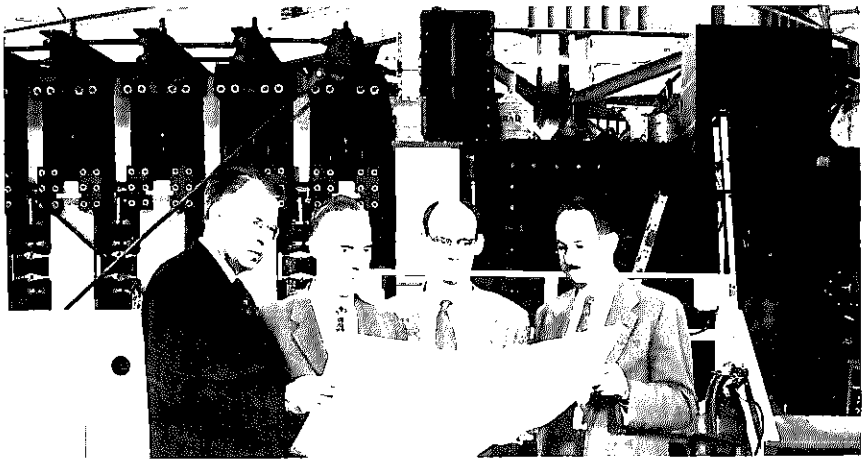
With the case of the Executive Branch set forth, attention turned to the reaction of the Legislative Branch, particularly Vandenberg. The Michigan senator was not pleased. He thought the proposals Acheson had just read amounted to bailing out the British yet again. Certainly he was not, he explained, able to decide such a matter at once. Lilienthal, Acheson, Eisenhower, and Webster joined forces to try to reassure Vandenberg that the proposals did not mean giving up the secret of the bomb; that in fact there was no secret about the bomb; that indeed from their work during the war
302 the British knew how to make an atomic bomb. The senator was stubbornly unconvinced. Was it not possible, he asked, to work out some arrangement whereby only the United States made the weapons and earmarked a certain number for British use? Completely unrealistic, was Acheson's verdict. Vandenberg turned to Hickenlooper. The Iowa Republican observed that the decision to talk with the British and Canadians seemed pretty well decided. For himself, he thought the proposals were contrary to the Act. Nor did Hickenlooper think the raw materials situation was as serious as was claimed. Lilienthal interrupted to declare that if the equal allocation of the Congo raw material were restored, weapon production would slow down within three months and large numbers of men at Hanford and Oak Ridge would be laid off. Eisenhower looked at Hickenlooper and asked, "And who would take the responsibility for explaining *that* to the American people?"

The meeting ended inconclusively with general agreement that the sooner the matter came before the Joint Committee, the better. McMahon accepted the argument that it would be premature to decide the type of Congressional action required before the conversations with the British and Canadians revealed the terms of an agreement. Personally, however, he doubted the President's proposal was legal under the Act. As the meeting was about to break up, Truman warned of the need for secrecy. Arneson looked at his watch: it was ten-thirty.

Outside the reporters waited. Tydings, who was suffering from a heavy cold, had left early. To the barrage of questions he replied that if the newsmen knew the subject of the conference they would not, for the good of the country, print the story. When the others at Blair House came out they took their cue from Barkley: the grim-faced Vice President was asked what had been discussed. "Not a damn thing," he replied. Eisenhower observed to the press that "It's a hot evening and rainy." Last to leave were Acheson and Johnson. The two secretaries talked for a few moments in the doorway with Truman. As Acheson went down the steps he could not have been encouraged

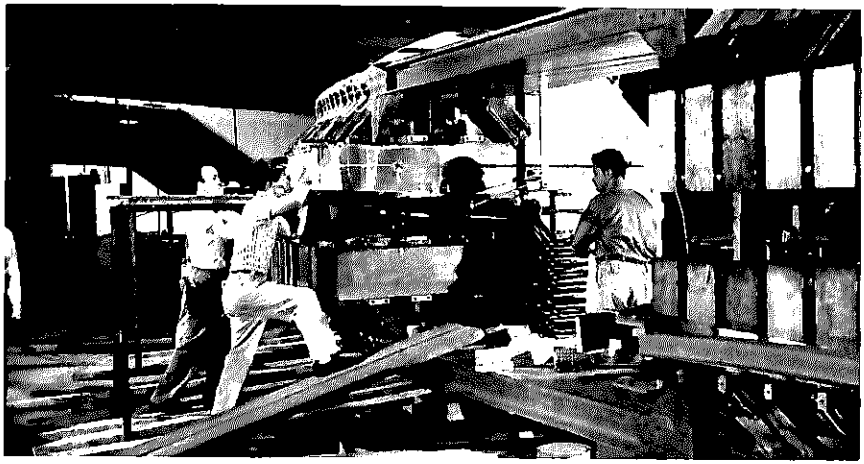


RADIATION GENETICS AT OAK RIDGE / William L. Russell and Liane B. Russell examine a mouse from one of the thousands of cages at the Oak Ridge National Laboratory. The bottles on top of the cages supply water for the mice.



LAWRENCE RADIATION LABORATORY

BUILDERS OF THE BEVATRON / Standing in front of the giant accelerator at Berkeley are the scientists principally responsible for designing and building it. Left to right: Ernest O. Lawrence, William M. Brobeck, Edward J. Lofgren, and Edwin M. McMillan.



BROOKHAVEN NATIONAL LABORATORY

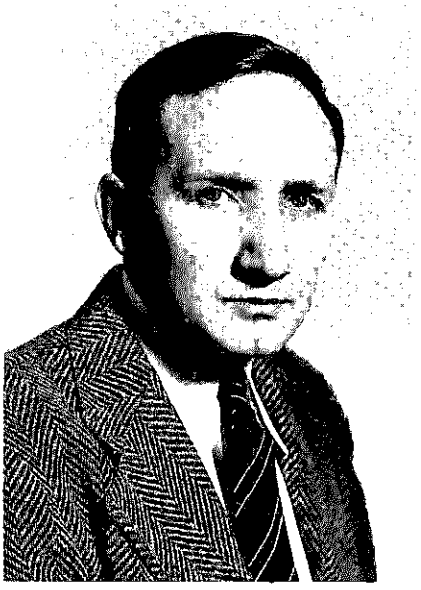
ASSEMBLING THE BROOKHAVEN COSMOTRON, 1950 / Workmen are installing a bundle of water-cooled, wound copper bars which form part of the magnet coil. The photograph shows the return winding on the outside of the magnet at the end of a quadrant.

BROOKHAVEN NATIONAL LABORATORY

CELEBRATING A MILESTONE IN CONSTRUCTION OF THE COSMOTRON / Members of the cosmotron team enjoying a moment of relaxation after succeeding for the first time in guiding a proton beam through one quadrant of the magnet in December, 1950. G. Kenneth Green stands in the center of the group. From left to right around the circle: Abraham Wise, George B. Collins, Charles H. Keenan, Gerald F. Tape, M. Stanley Livingston, Martin Plotkin, Lyle Smith (mostly hidden), Joseph Logue, and Irving L. Polk.

U. S. ARMY

THE NATIONAL SECURITY COUNCIL, JANUARY, 1951 / Left to right: Executive Secretary James S. Lay; W. Stuart Symington, chairman of the National Security Resources Board; W. Averell Harriman, Special Assistant to the President; Lt. Gen. Walter Bedell Smith, Director of Central Intelligence; General Omar N. Bradley, Chairman of the Joint Chiefs of Staff; Secretary of Defense George C. Marshall; Secretary of State Dean G. Acheson; President Truman; and Secretary of the Treasury John W. Snyder.



LOS ALAMOS SCIENTIFIC LABORATORY

FOUR LOS ALAMOS SCIENTISTS: Edward Teller (*top left*); Stanislaw M. Ulam (*top right*); Marshall G. Holloway (*bottom left*); Darol K. Froman (*bottom right*).

by the results of the meeting: Hickenlooper was opposed, Vandenberg was very doubtful, and McMahon was uncertain. The quest for Congressional support would not be easy.[39]

QUEST FOR CONGRESSIONAL SUPPORT

If Acheson had forebodings, they could only have been increased by a telephone conversation with McMahon on July 18. McMahon said Vandenberg was still upset over the Blair House meeting and had repeated his argument that after all the United States had done for Britain, the British should now do something for the Americans. Two members of the Joint Committee were thinking of resigning on the grounds that they could not accept the proposed policy. McMahon also said he had seen a resolution which would call upon him to declare to the Secretary of State that no negotiations should take place without the Joint Committee's having full information. The next day McMahon met with his committee to sketch the substance of the Blair House proposals. It was a rough session, some committee members taking the Vandenberg position, others wondering about the legality of the proposals, while the remainder were willing to see negotiations take place. It was clear that the Secretary of State could not expect an easy reception.[40]

The full Joint Committee gathered to hear the proposals on July 20. Acheson, with the support of Lilienthal and Johnson, was to present the case. Along with Lilienthal were four Commissioners, including Gordon E. Dean and Henry D. Smyth, who had replaced Bacher and Waymack. After the Joint Committee voted not to have a transcript, Acheson began. His strategy was the same as he had used earlier: describe the background, offer the testimony of Lilienthal and Johnson for justification, and finally read the aims of the proposed policy. He ran into heavy weather. Lilienthal had done little more than portray the need for raw materials when Millikin, Hickenlooper, and Knowland laid down a barrage of questions. Knowland, holding his temper with difficulty, demanded to know whether the Commission believed the proposals could be carried into effect without Congressional approval. Lilienthal replied that the Commission would be guided by the decision of the Executive Branch. But what if the Joint Committee disagreed? Then, Lilienthal answered, new legislation would probably be needed.

For a moment Acheson recovered control and returned to his basic strategy. Johnson was to testify, but he swiftly passed the issue to Eisenhower, who began to speak in favor of a policy which the Joint Committee had not yet heard. Badgered by questions from Vandenberg and others, Eisenhower found himself in difficult straits, particularly when the Michigan senator asked whether British manufacture of atomic weapons did not duplicate the

efforts of the United States. The question was important, for prevention of such waste was one of the objectives of the North Atlantic Treaty Organization for which Vandenberg was fighting. As Eisenhower groped for words to voice his thoughts, Acheson stepped in. His attempts to return to the planned procedures of exposition failed. Partial testimony had raised so many issues that a steady drumfire of questions prevented him from reading the prepared negotiating position. Finally he suggested another meeting. Johnson, sensing the angry temper of the session, quickly concurred, and soothingly added that the Department of Defense would review its position.

Johnson had calmed the committee, but had upset Lilienthal, Wilson, and Volpe. To them Johnson had not saved the policy for presentation another day. Rather, he had suggested that it was possible to chip away at the President's policy. Not all the difficulties were in the Department of Defense. When Hickenlooper asked if the entire Commission unanimously favored the
 President's policy, Strauss had replied that while he had been a minority of one in the past, with two new members on the Commission that position might change.[41] From the chaos of the meeting there was little reason for optimism for cooperation with Britain and Canada.

Lilienthal and Acheson planned the strategy on July 25 for the next meeting with the Joint Committee. Acheson reported that the President wanted a fair measure of Congressional approval. That same day Johnson advised Truman not to press the constitutional issue of Presidential power, but as a practical matter to concede that whatever arrangements were negotiated would be referred to Congress.

The meeting with the Joint Committee on July 27 Lilienthal found anticlimactic. Acheson told the Joint Committee that the President did not intend to press the issue of executive and legislative supremacy, since the support of both was necessary. The plan was to begin talks with the British and Canadians with the Joint Committee kept informed. McMahon summarized the results of the meeting in a press release, and on the following day Truman read a background statement at his news conference. Why were all the men who left the Blair House on July 14 so gloomy? he was asked. "It's a gloomy subject," answered the President.[42]

PREPARING FOR NEGOTIATIONS

Cooperation with the British was hardly an academic question. Zinn at Argonne refused to talk to any British visitor on classified subjects until the status of cooperation was clarified. Within the Commission itself there was debate on the legal issues. Volpe argued that the common defense and security clause of Section 10(a) authorized technical cooperation. In his mind, the fact that the Joint Committee had followed the conversations leading to the *modus vivendi* confirmed his interpretation. Dean did not agree. Perhaps it

could be postulated that giving certain data to Britain would benefit American defense and security. But if this information had industrial significance, its transmission contravened Section 10(a)(1), which forbade such action until Congress by joint resolution found that adequate international safeguards existed. To Dean the prohibition governed the policy statement. Dean did not question that the Commission was committed to the *modus vivendi*, but he was convinced that legal ambiguity must be removed.[43]

Lilienthal believed that the spirit of the negotiations with the British and Canadians was important. On August 16, 1949, he lunched with James E. Webb, who had replaced Lovett as Under Secretary of State and who was to conduct the talks. Lilienthal warned that narrow haggling was no way to achieve a broad and comprehensive agreement. Webb's response was not reassuring. While Webb agreed with Lilienthal, Johnson was charging that the *modus vivendi* was illegal, that the majority of the Commission supported Strauss, and that the Commission was inefficient. Uneasy at the news, Lilienthal the next day repeated his ideas to Clark M. Clifford and Sydney W. Souers, executive secretary of the National Security Council. Then, exhausted from the strain of the Hickenlooper hearings, he departed for the quiet of Martha's Vineyard.[44]

Across these doubts and hesitations came a new and startling event. In early September monitoring aircraft picked up airborne radioactive debris from a nuclear detonation. As Webb met with the American members of the Combined Policy Committee on September 13, 1949, to discuss the forthcoming negotiations, analyses were indicating with ever-greater certainty that the Soviet Union had successfully detonated a nuclear device. Pike expressed the Commission's hope that the British could be persuaded to manufacture and store atomic weapons only in the Western Hemisphere. Bush and Norstad believed the British would insist on a token weapon production effort. The question of psychological preparation for the negotiations was important but seemed to have no real answer. Norstad reported that his British contacts felt the American attitude on atomic energy prevented full military cooperation. Kennan added that failure to reach agreement could wreck the pattern of good will. To him the greatest stumbling-blocks were Congress and certain parties within the administration. Bush, well aware of the implications of the airborne debris, was confident that Congress would accept a reasonable partnership.[45]

NEGOTIATIONS—FIRST PHASE

Negotiations began in a full Combined Policy Committee meeting on September 20. Webb presented the American objectives and pointed out that a new long-range agreement would require Congressional sanction. Not unexpectedly Sir Oliver Franks described British experience with technical coopera-

tion as slow, cumbersome, and incomplete. Wrong saw room for improvement, although Canadian scientists had received considerable benefit. Both agreed to Webb's proposal that the talks be carried on by a subgroup on strategic and military considerations, another on raw materials supply and requirements, and a third on information exchange. Their findings the full committee would consider within a week.[46]

Within the less formal subcommittee meetings the differences were more sharply expressed. Sir John Cockcroft for the British described the annoyances and frustrations of dealing with the narrowing technical cooperation program. The Canadians too were critical. Bacher, now a Commission consultant, quickly turned the tables: Were the delegates saying that technical cooperation was not worth the effort? Cockcroft answered that the exchange of information had certainly been helpful, but the trend toward contraction bothered him. His government needed answers to two questions. Exchange of
306 information in some areas had never taken place, despite the fact that they had been approved. What were the chances that these areas could become active soon? What could the Americans do to quicken the administrative procedures? At a later meeting Bacher promised administrative improvements, but he and his colleagues and advisers in the Departments of Defense and State could not change the existing areas without the permission of Congress. The time was not ripe for this step.[47]

Thus far the subcommittee meetings had dealt with the failures of the past. On September 24, Cockcroft presented the British plan. In brief, the British wanted a complete, well-rounded atomic energy program. They wanted full cooperation with no bars to information exchange. Some facilities such as a weapon proving ground might be used in common. Dean C. J. Mackenzie of Canada wanted full cooperation except in weapons, an area in which his country had no interest.[48]

Lilienthal learned on September 29 from Webb and Kennan that the talks were going badly. Neither of the State Department officials thought that the Joint Committee would accept the British plan. Webb reported that Truman thought he could conclude an agreement which furthered defense and security; if the Act prevented him, then it was unconstitutional. Practically, Kennan saw no alternative to telling the British that their terms were unacceptable. Lilienthal saw the threatened impasse as the consequence of narrow bargaining. More important, he thought Kennan and Webb were too quick to foreclose the possibility of Joint Committee acceptance. After all, the British had stood by the raw materials agreement. Then too, the Russian detonation had destroyed the rationale for a policy which accepted secrecy as the means to preserve American defense.[49]

The Combined Policy Committee on September 30 did little more than accept the reports of its subcommittees on raw materials estimates and on information exchange procedures, and adjourned until each government could assess its position.[50]

INTERLUDE

During the interim Acheson summarized the negotiations for the Joint Committee. Although the problem of raw materials had not been settled, Acheson saw no great obstacles. On the long-term arrangements there were two courses: isolation or increased collaboration. With the Russian achievement it was obvious to him the second alternative was better. He sketched in the background of the basis for cooperation, the exchange of information and personnel, and acceptance of comparable standards of security. He did not minimize potential difficulties. All proposals for cooperation among the three nations were based on preventing waste and inefficiency. The British wanted a complete and well-rounded atomic energy program and might not accept the principle of the most efficient use of resources, under which they might have to give up part of their effort. Further discussions, he concluded, were clearly in order. Acheson's presentation had been strong, able, and skillful. Knowland, not an easy man to please, praised the Secretary of State. Hickenlooper too, was satisfied.[51] The spirit was much different from that of the stormy session of July 20, partly because committee sensitivities had been placated, partly because of the grim impact of the Soviet detonation.

Truman, too, was pleased at the attitude of the Joint Committee. He was convinced that he had the authority to reach an agreement with the United Kingdom and Canada on atomic energy without the approval of Congress. When he had expressed this position at a cabinet luncheon, Attorney General J. Howard McGrath and Vice President Barkley had suggested that such a course would be unwise. Some clarifying legislation might be helpful, but given the composition and spirit of Congress, neither of the cabinet members saw much chance of getting favorable action. Although Truman had accepted reluctantly the need for consultation, he did not intend to let Congress prevent him from reaching an agreement he believed necessary. As he remarked to Webb on October 1, he favored a partnership with Britain and Canada and if necessary he would go to the country if the matter became a partisan issue. The atmosphere of the October 13 hearing must have given Truman the feeling that he and Congress could probably act together.[52]

Acheson told the Joint Committee that the British were about to invite a small group of Americans to visit the United Kingdom. For two weeks Nichols, Arneson, and Weil were in Britain and on November 21, 1949, drew up their report. Two production reactors and their associated chemical processing facilities were so far along that stopping work on them would be unwise. Such, however, was not the case for the third reactor. Very little progress had been made on a gaseous-diffusion plant, but Nichols, Weil, and Arneson suspected that for political reasons the British would be reluctant to cancel the project. For the forthcoming negotiations the three men recom-

mended that the Americans press the British to stop work on the third reactor, limit the gaseous-diffusion work to a pilot plant, and cancel certain other facilities. A high opinion of British abilities came from Glenn T. Seaborg. At Wilson's request, Seaborg had agreed to visit Britain during a trip to Europe. His main interest, of course, was chemistry, and he saw several aspects of the British work that might interest the Americans.[53]

The Americans planned their strategy on November 22 for the next round of talks. Limiting the British production facilities was accepted. Nuclear components for British weapons were to be made in the United States. Only a limited number of weapons were to be stored in the United Kingdom, and these were for use only in accordance with common war plans. Particularly urgent was the need to come to an agreement on raw materials to replace the arrangement expiring at the end of 1949—now a little more than a month away.[54]

NEGOTIATIONS AGAIN

The first of the new round of meetings began on November 28. Adrian S. Fisher, now legal counselor at the State Department, presented the major topics, raw materials and long-range agreements. The British raised several questions. Roger Makins wanted to know whether the raw materials agreement was tied to the long-term arrangement. In his view the American principle that the most efficient use should govern the distribution of raw material among the three nations was too theoretical. Franks called for candor. The British were willing to integrate their atomic energy effort with that of the United States, but they wanted facilities to take advantage of future civilian uses. This, declared Franks, meant that Britain needed a small but complete program. A specific British proposal, added Makins, would be ready by the afternoon. At the end of the session Franks raised the crucial question: Would the Americans have to go to Congress for new legislation? The nature of the agreement would determine that answer, replied Fisher.[55]

That afternoon the Americans studied the British proposal. It was as Franks had foreshadowed. Assuming complete cooperation among the three nations in military aspects, the British would still want in the United Kingdom personnel and facilities engaged in manufacturing atomic weapons. A certain number of weapons, ready for use, were to be in British hands. Fisher, Wilson, and others gathered in Arneson's office at three o'clock. They saw the chances of agreement as slim. The proposal amounted to an alliance on the military aspects of atomic energy and left untreated other facets such as cooperation in the production of fissionable material. Fisher was pessimistic. If this were the firm proposal, there was little hope and the working groups

might as well return the issue to Acheson and Franks. Still, Wilson was to explore the British views.[56]

Wilson began a long day of negotiations at nine o'clock on December 2, 1949. He first met with the Commissioners and reported that agreement on raw materials seemed possible, but the British and Canadians wanted time to study the details. Of more immediate urgency was the long-term agreement. A memorandum of American counterproposals lay on the table before each Commissioner. If the Commission approved, Wilson would use them in his discussions with the British and Canadians at ten o'clock. The counterproposals contained the same underlying principles: The purpose of cooperation was to increase the collective security of the three nations within the shortest possible time. Such cooperation would entail complete information exchange and the integration of British and Canadian scientists in all parts of the American program. In return, the British were to be asked to limit their program to two reactors, chemical processing facilities, and a research effort at Harwell. Plutonium from the British reactors was to be exchanged for American weapons. So far there was nothing new, but the next point was obviously an attempt to bridge the gap between the positions of the two nations. The British were to be free to develop and manufacture in the United Kingdom any weapon component they desired, so long as their work did not prejudice the combined effort.[57]

The Commission reaction was cool. Lilienthal was pessimistic. The whole spirit of negotiations seemed to him deplorably narrow. The only proper course, he thought, was for Truman to seek authorization to negotiate on the broad grounds of increasing the national defense and security. Wilson and Volpe saw no reason to give up hope. Both pointed out that the British and Canadians had never heard the detailed American proposal, and that there was no reason to think that the British position was not subject to negotiation. Smyth and Dean doubted whether the contents of the memorandum were in complete harmony with the President's policy. Yet the differences seemed slight and both Commissioners thought the arguments pointing out the vulnerability of a British program were the most persuasive. The memorandum received the lukewarm approval of the Commissioners at nine fifty-five.[58]

Five minutes later Wilson, General James McCormack, and Volpe entered the State Department where they, with Fisher, Arneson, Nichols, and Webster, met with the British and Canadians. In a general meeting, and later in a smaller group, Wilson, McCormack, and Nichols argued that the British proposal to have all the facilities needed to make atomic weapons in the United Kingdom did not take advantage of the increased scientific knowledge or greater production facilities in the United States. William G. Penney of Britain agreed the proposals were logical if the two countries were one, and Omond McK. Solandt of Canada thought the plan was reasonable if war were

assumed possible in the next few years. The two great imponderables, Franks observed, were the American Congress and British public opinion. Was a binding agreement really possible? Cockcroft asked. The Americans repeated the earlier response: It depended upon Congress, and Congressional reaction was most likely to accept a combined effort which made the greatest contribution to the atomic weapon stockpile. It was past noon when the session adjourned. Cockcroft and Penney agreed to discuss the American ideas with Franks and meet later in the day in Wilson's office.[59]

A few minutes before five o'clock Cockcroft and Penney entered Wilson's office. There were two major points upon which the two Englishmen wanted clarification. One was the exchange of information and personnel, and here Wilson was able to assure them that there would be no closed areas. The other was the effect of integration upon a British weapon program. Accepting the American plan would mean that Britain would have to postpone its own weapon plans. Although this was conceivable for some time, Cockcroft and Penney warned that eventually Britain would want its own weapon establishment. To Wilson this point did not pose an insurmountable obstacle. He explained that a British weapon complex could be a part of the joint effort. Cockcroft and Penney were about to return to London with the American proposals; how soon did Wilson need an answer? Congress was scheduled to meet on January 3, 1950, the general manager replied, and he hoped to report to the Joint Committee before that date. Cockcroft and Penney thought they could meet the deadline.[60]

The reply and counterproposal arrived from London and, on December 29, 1949, Franks sent the documents to Acheson. Copies were circulated to the American working groups. The British accepted the principle of complete collaboration among the three nations in all aspects of atomic energy, including weapons, research, production of fissionable materials, and the development of military and peaceful applications of atomic energy. They were willing to accept a production complex limited to two production reactors and a low enrichment gaseous-diffusion plant, although they wanted the freedom to vary their program as they desired within the limits of the raw materials allocated to them. They were willing to integrate their weapon program and personnel with those of the other two countries so that the combined efforts of all might result in the maximum number of the most advanced atomic weapons during the critical period of the next three years. They were willing to accept a formula under which they would receive weapons up to a limited number for stockpile within Britain in exchange for plutonium from their reactors. Weapons in excess of the stated number would be held in Canada at the disposal of the United Kingdom.

A few points bothered the Americans. Some thought the period of three years indicated a feeling that after that date the British would be less interested in an integrated effort and more concerned with applying the results of the collaboration to their own weapons. The British, too, reserved

the right to continue their own weapon development in any area they chose so long as their effort did not interfere with sending adequate personnel to the United States. And nothing was said about the use of bombs in common war plans.

The Commissioners' opinion was unfavorable. They discussed the British proposals with Wilson and Volpe on January 5, 1950. Lilienthal was displeased for several reasons. He had not liked the operations of the working group and he thought the papers clearly vindicated his warning that major negotiations could not be carried on by working groups. What was needed was Presidential intervention. Strauss pointed out the lack of reference to common war plans, Smyth was worried about the significance of the three-year period, and Dean wondered how cooperation on developing reactors for civilian as well as military uses could be justified to American industry.[61]

On January 18, Fisher and Arneson summed up the status of the negotiations in a memorandum to Johnson. The two State Department officials saw the need for talks among Acheson, Lilienthal, and Johnson to establish a firm administration position. Fisher and Arneson believed the British had come close to the American position on weapon research and other military arrangements. Storage of weapons and the length of time of the agreement were potential points of differences, but appeared negotiable. They saw only two major problems. The first was the British desire to be free to build additional production facilities if these did not affect the allocation of raw materials or require the services of personnel needed in the joint weapon program. Fisher and Arneson suspected that since the United States already had large production plants, British personnel would not be needed for this purpose. More important was the fact that the British had the uranium ore and were in a position to call the tune. The real issue was whether additional production facilities would be built in the United Kingdom or not at all. Since the number of weapons in existence at the outbreak of hostilities was what mattered, the State Department was inclined to think that production facilities in Britain was not a real point of dispute.

As far as civilian applications of atomic energy were concerned, these were in the future. Information exchange was, of course, important and could lead to development of civilian uses. Fisher and Arneson touched the sore point of the past two years of technical cooperation when they wrote: "Information is valuable only if the recipient is in a position to use it and it is not much of an informational exchange which says to the British: 'We will give you information concerning industrial use but you must not construct facilities to assure you an adequate supply of uranium 235 for use in any practicable benefit which might be obtained in the industrial field.' " [62]

For the moment the negotiations were in abeyance, but on raw materials the situation was clear once more: All the ore from the 1950 production of the Congo was, with certain reservations and limitations, earmarked for the United States.[63]

FUCHS AND FAILURE

Wilson arrived at his office on February 2, 1950, at eight-fifty-five. He was caught up almost immediately in the preparations for the morning Commission meeting. Carleton Shugg, McCormack, Lawrence R. Hafstad, Walter J. Williams, and Kenneth S. Pitzer came into the office to discuss the hydrogen bomb program, a major topic on the agenda and on which each might be questioned. For over thirty minutes the group talked, and after they departed Ralph P. Johnson entered on a matter of a Belgian request for information. This too was to be considered by the Commission. Wilson could give the problem only a few minutes and then, gathering up his papers, he hurried from his third-floor office to the Commissioners' conference room on the floor
312 below.

The conference room door to the corridor closed behind him. Outside waited a few staff members who, at the proper time, would be summoned into the meeting for their advice or background information on matters on the agenda. Wilson glanced around him as he settled into his chair at the large triangular table and arranged his papers before him. The five Commissioners were present, and seated near Wilson were Volpe; Roy B. Snapp, the secretary; and Snapp's young assistant, Philip J. Farley. The opening was not very different from those of the 362 previous meetings. The rustle of papers subsided, and at a nod from Lilienthal, discussion began. The first topic dealt with weapon development plans. As the discussion neared conclusion, Wilson glanced at his papers for the next item of business, but before Lilienthal could make the transition, Strauss interrupted. He asked for an immediate executive session for the Commissioners alone. Wilson was astonished, curious, and disturbed. He, Volpe, Snapp, and Farley left. The time was ten-thirty.

Fifteen minutes later Lilienthal and Strauss left the room and Wilson and other members of the staff reentered. Strauss returned soon after the meeting resumed. Under discussion was the exchange of information with the British on the preparation of hafnium-free zirconium, a metal of promise in reactor work. Although the Commission approved the exchange, Strauss remarked that the action was tantamount to declassification. Another subject was the foreign travel of an individual who had admitted earlier to Communist Party membership and who at one time had been part of the Manhattan project. Smyth was inclined to think that the application for a visa should be granted, since a number of years had gone by. Strauss demurred: where there was an element of risk the doubt must be decided in favor of the Government. Near the end of the meeting Lilienthal reentered. He waited until there was a pause and then called for an executive session. Wilson, he said, could remain if he desired. Wilson stayed.

He heard that at the earlier session Strauss had revealed direct

information from the Federal Bureau of Investigation, that Klaus Fuchs, a British scientist, had confessed to espionage. The man had been a member of the British team working on weapons at Los Alamos during the war. His capabilities were high and he had risen to a responsible position at Harwell. Nor was that all. Strauss had gone on to point out that British members of the Combined Development Agency had offices in the Commission headquarters; that they possessed passes issued under Wilson's direction enabling them to enter the building at will. At twelve-fifty-five Wilson strode back to his office, furiously angry at his exclusion from an executive session, and at the implication of negligence in granting passes.

As always happened when he was away from his desk, several matters had piled up for his attention. A few scheduled meetings he was able to cancel, but the one with the Military Liaison Committee he could not postpone. Nonetheless, he found time to ask for a check of the Commission minutes. Not too long ago, he remembered, he had called to the Commission's attention an FBI letter which stated that the British were working on a case of atomic espionage. Farley found the reference. The date had been November 2, 1949. Pike, Smyth, and Dean had been present; Lilienthal and Strauss had been absent. In the afternoon, while Wilson was at the liaison committee meeting, Lilienthal was seeing Truman. The chairman and the general manager saw each other again late in the afternoon. Lilienthal, a few days away from private life, suggested that Pike receive the reports which would be coming on Fuchs. The day had been long and hard, and a grim change from the gaiety of the last evening when members of the staff had given Lilienthal a farewell party.

The next morning began in confusion. Lilienthal arrived at the office, having understood that there would be time for the Commission to prepare a public statement which would be released simultaneously with the one by the British. But there had been a misunderstanding and the British had already acted. Hurriedly the Commissioners scanned a draft and, making only a few revisions, gave their approval. Then Wilson brought up the events of yesterday's executive session. Resentfully he spoke of his exclusion. Barring him from a meeting dealing with espionage he called an intolerable reflection upon him. Strauss, unsuccessful in calming the general manager, explained that he had received the information with the request that knowledge of the case be limited to the Commissioners. Wilson went on to the matter of issuing passes to British members of the Combined Development Agency. This action, he declared, had been taken after consultation with Lilienthal as chairman, or Pike as acting chairman. Neither Pike nor Lilienthal recalled having been consulted. Lilienthal, however, observed that the action appeared within the authority of the general manager. Strauss promptly disagreed. In his interpretation Wilson had exceeded his powers and had failed to keep the Commission informed.

Feelings were still taut when the meeting adjourned and the Commis-

sioners and a few members of the staff left for the Capitol and a meeting with the Joint Committee. McMahon called the session to order at ten-thirty. Reading aloud some of the newspaper stories, he remarked, "Apparently we are in a hell of a mess . . ." Lilienthal made no attempt to hide the gravity of the situation. Fuchs had done great damage. Of that there was no doubt. But what must not happen, Lilienthal warned, was an orgy of witch-hunting. A brazened, unreasoning hue-and-cry raised against scientists might be even more devastating to the nation's atomic energy effort. All in all, the Joint Committee took the news well. The members recognized the seriousness of the perfidy but they indulged in no recriminations.[64]

Whatever hopes had existed for a tightly integrated program with the British and Canadians died with the Fuchs revelation. Yet even without Fuchs the chances of close cooperation were problematical. Probably the Cyril Smith incident had increased the Joint Committee's distrust of the

Commission on international matters and made more powerful the voice of the military. On the other hand, the Soviet nuclear detonation that shook the sands of Central Asia also shattered many preconceptions, among them the myth of American technical supremacy. The British had demonstrated to Forrestal their steadiness during the siege of Berlin, and their partnership in the face of the Soviet nuclear achievement might have been welcomed. But this course no longer existed as Fuchs stood in the dock at Old Bailey. The Lord Chief Justice might know little about the abstruse principles of nuclear weapons, for these were new to the world's history. But treachery was familiar; its history was far older than the age recalled by the medieval scarlet and ermine of Lord Goddard's robes. Nevertheless, cooperation would continue in one way or another, for as old as treachery was the need for allies in a troubled world.

sion would not be signing a blank check. To meet his objections the Commission entered into the minutes its understanding of technical cooperation. The nine areas were general fields in which information exchange might prove beneficial. Implementation of any topic within the field would require the approval of the Combined Policy Committee. On this committee the Commission was of course represented. Volpe and Lilienthal also pointed out an additional safeguard. The Commission representative on the implementing subgroup would be instructed to bring before the Commissioners any proposed action. After more than two hours of discussion the three documents were approved. Lilienthal was to explain the Commission's interpretation to the Combined Policy Committee. It had been an arduous session: not enough copies of the papers for everyone at the meeting, not enough time for lunch, and no opportunity, said Strauss, for the Commission to work out its position at leisure.[50]

The meeting of the Combined Policy Committee which began late in the afternoon at the Blair House was anticlimactic. Lilienthal observed with amusement the scurry to find a green cloth, customary for such diplomatic occasions, to cover the table. Lovett, Inverchapel, and Wrong approved the three documents. To implement the areas of technical cooperation Lord Inverchapel proposed a standing subgroup of scientific advisers. Lilienthal took the opportunity to raise the point that had disturbed the Commission. Information exchange, he pointed out, would have to be carried out within the legal restrictions of the three countries; consequently it would not be possible to vest the American representatives on the subgroup with discretionary authority. Makins saw nothing unusual in the observation, for each representative, he observed, would be guided by the laws of his own nation. Inverchapel's proposal for a subgroup was accepted.[51]

The *modus vivendi,* with the agreements on ore allocation and information exchange, appeared to mark the end of confusion between the United States, United Kingdom, and Canada on atomic energy. Some of the ambiguities of the American position were the legacy of the secret diplomacy of the war, some of the ambivalence was the result of the desire for international control through the United Nations, and some of the indecision stemmed from fears of Congressional sensitivity. Whatever their source, the doubts seemed uprooted and the seeds of a bargain, planted almost a year earlier when Makins talked with Acheson, appeared to have grown naturally into fruition.[52]

THE ART OF ADMINISTRATION

CHAPTER 11

The Commission was to be something new in American government. This was Lilienthal's aim and the lure that had attracted many of the staff. Decentralized administration was to be the touchstone of future Government practices. That there would be difficulties in winning recognition for the new art of administration was evident. The civilian management of the atom had to show that it could convert the successes of the Manhattan project to a continuing and stable program based on sound financial practices, that it could devise and administer standards to measure the reliability of thousands of people who needed access to Restricted Data, and that it could foster industrial relations which would allow contractors and unions to exercise their rights, so long as vital plant operations never stopped. Congress—including such old and well-established groups as the appropriations committees, as well as the new Joint Committee on Atomic Energy—had to be convinced that decentralization was not a cover for weak and slipshod management. In 1948 the Commission could expect its practices to be scrutinized closely. According to the Act, the preliminary terms of the Commissioners would end, and the President would have to submit his nominations to the Senate. The fact that deliberation over the nominations would come during a Presidential election year was an added hazard. The years of 1948 and 1949 were to be a time of challenge to the Lilienthal Commission.

THE LILIENTHAL-WILSON APPROACH

Thursday, December 4, 1947, was a day Carroll L. Wilson had long anticipated. Despite the continuing crises of administration and inertia in the Commission's program, he had resisted the temptation to postpone this first

meeting with the managers of the field offices. To make the best use of the three days available Wilson had scheduled the meeting to begin promptly at nine o'clock in the Commissioners' own conference room on the second floor of the headquarters building. All the managers were there when Wilson arrived—Carroll L. Tyler from Los Alamos, John C. Franklin from Oak Ridge, Wilbur E. Kelley from New York, Alfonso Tammaro from Chicago, and Carleton Shugg from Hanford. All had now been on the job long enough to know at first hand the difficulties they faced. Collectively they could bring to the Commission's business an impressive record of management experience and talent. The task facing them would demand every bit of that and more. The kind of organization Lilienthal and Wilson were building demanded imagination and creativeness.

These qualities could be fostered best under decentralized administration. The five managers gathered in the room had been given broad powers
316 and reported directly to Wilson. Each manager, within certain wide limits, was free to hire and fire his personnel, and to issue his own directives on how Commission goals should be met. Each manager, depending upon the type of operation he supervised, could negotiate contracts, ranging from $2 million to $5 million per contract, to carry out Washington-approved projects. Perhaps the measure of the managers' independence was the requirement that they need report only those matters involving policy or other operations offices. The authority running directly from Wilson to the managers meant that the Washington office had no line responsibility.

The headquarters staff could be divided into two groups. The program directors—James McCormack of military application, Walter J. Williams of production, James B. Fisk of research, John K. Gustafson of raw materials, and Shields Warren of biology and medicine—watched over projects which were integral parts of the Commission's program. Roger S. Warner's division of engineering, while considered a program division, suffered from having a poorly defined mission. As Wilson's staff, the program directors could deal directly with key field personnel. In the second category were the management offices. Rear Admiral John E. Gingrich of security and intelligence, Donald E. Bostock of organization and personnel, Morse Salisbury of public and technical information, Herbert S. Marks as general counsel, Paul M. Green as controller, and Paul W. Ager as chief budget officer could contact their opposite numbers in the field offices. Like the program directors, the heads of the management offices reported to Wilson. If decentralization were to work, Washington headquarters had to be informal, flexible, and free from the incubus of cumbersome staff.[1]

Much of what Wilson had to say on the second day of the meeting dealt with Washington techniques to achieve coordination. He admitted that communications between headquarters and the field had been poor, but he saw improvement. He thought the managers would soon notice the effect of the program council. Although it had been in existence for only three months,

Wilson found that the council was helping the headquarters staff in examining issues cutting across the interests of several divisions and in formulating recommendations for the Commissioners. In fact, no major issue reached Wilson's desk without council consideration. Under David B. Langmuir as executive secretary, the council's operations had become routine; it met at least twice a week with Wilson or, in his absence, with a division director as acting chairman. To provide balance, the acting chairmanship was rotated every two months.[2]

Wilson pointed to the secretariat as another element of growing importance in Washington. After a weak and faltering beginning, the secretariat within the last few months had become an effective force. The credit for this improvement Wilson gave to Roy B. Snapp. The function of the secretariat was to prepare, coordinate, and organize staff papers for Commission action; the format and procedures Snapp had used in the office of the Joint Chiefs of Staff during the war. His task was complex, for he had to be aware of the interests and idiosyncracies of five Commissioners. He had to know the strengths and weaknesses of the divisions and their directors, to be certain that the views of all were obtained and—no mean task—to see that papers and recommendations for the Commissioners were succinct and clear. His familiarity with the atomic energy program had begun in April, 1946, when he became special assistant to Groves; he had served Wilson in the same capacity when the Commission replaced the Manhattan Engineer District. Snapp became acting secretary on October 1, 1947. Quickly the headquarters staff noticed his influence as he moved to organize and codify the paper work. Necessarily some of the instructions were painfully precise, and perhaps reflected Snapp's legal training, but to Wilson the organization which Snapp brought to the secretariat was an enormous help.[3]

The initial reactions to Wilson's remarks were bland and cautious. Nearly all of the managers called for better communication with Washington. They wanted more information and a greater role in formulating decisions. They felt overwhelmed with requests from headquarters for reports. Not until Fisk outlined on the blackboard the Commission's programs and responsibilities did discussion focus upon specifics. The interests of the operations offices overlapped. Tyler was, of course, primarily concerned with weapons, but he had two reactors for research and a community to manage. Shugg watched the activities of General Electric at Hanford. However, the company also administered the Knolls laboratory at Schenectady, which involved Shugg with research and the intermediate-power-breeder reactor project.

Tammaro's responsibilities were even more widespread. Through his Chicago office funneled reports from three university contractors—the new laboratory at Argonne, the laboratory at Ames, Iowa, and the radiation laboratory at Berkeley. The Berkeley-Brookhaven competition for the high-energy synchrotron made Tammaro in this matter a rival of Kelley. The New York manager not only represented the Commission at Brookhaven, but was

also responsible for procuring uranium and other urgently needed metals. Franklin at Oak Ridge was surrounded by perplexities. Labor difficulties involving the production plants and the laboratory were troubling. Further, the unhappy situation was complicated by a change of contractor for the laboratory. The transfer was to take place by January 1, 1948. It was now December 5 and little had been done. Franklin declared, "I am going to do something. I can't wait for the resolution of a lot of problems by Washington as to some of the intangibles of this problem." Time pressed hardest upon Franklin, but Shugg, Kelley, Tammaro, and Tyler also had their difficulties.

That same afternoon Lilienthal interpreted his philosophy of contractor relations. Under the provisions of the Act, the Commission could have chosen to operate its installations directly. That course was not chosen, partly because government operation offered less chance to tap the best skills of industry. Admittedly the approach had its dangers. Contractor operation
318 implied contractor responsibility, but unless the Washington staff and the managers of operations were constantly alert, government monopoly of fissionable material and ownership of facilities, along with the necessarily close association between Commission and contractor personnel, could dilute this responsibility. That must not happen. From family experience Lilienthal drew an analogy: Like a wise parent who hesitates to help a child, the Commission must refrain from trying to solve the contractors' problems. Lilienthal promised that the Commission would back the delegation of authority to its managers. That was the TVA way; after fourteen years Lilienthal was convinced that it worked. He admitted that the Commission form of organization offered grave difficulties. "When I first read this law, I described it to a gentleman who was discussing the situation with me as an 'administrative monstrosity.' " Lilienthal did not say so, but the gentleman to whom he had described the law as a "monstrosity" was the President of the United States.[4]

To Lilienthal and Wilson decentralization was more than a slogan. The philosophy, triumphantly proclaimed by Lilienthal at TVA, offered hope to those alarmed by the growing centripetal force of Government. Students of business administration could point to General Motors and du Pont as successful examples of decentralized authority. To operate under this principle required personnel of the highest caliber—not only in the field, but in Washington. In their search for highly qualified men, in their efforts to free the Commission from the trammels of Civil Service, the Commissioners and Wilson showed they understood this need. If it took people of outstanding competence to work under decentralized authority, it was also true that the best hope of attracting such rare individuals lay in granting them powers unusual in other organizations. To Wilson, with little administrative experience, the philosophy must have been strongly attractive. It fitted his personal predilection; moreover, Lilienthal's reputation was an earnest that the approach worked. A new and powerful instrument of Government charged with developing a new source of energy for peaceful uses and defense was an

exhilarating combination. It must have seemed one of those rare times when theory and reality met in benign conjunction.

APPROPRIATIONS—BUSINESS AS USUAL

In the crowded three days of the Washington meeting, Wilson, the Commissioners, the staff, and the field managers tried to cover all the facets of the Commission's program. Joseph A. Volpe, Jr., deputy general counsel, spent his allotted half hour explaining Congressional relations. This was a subject, Lilienthal declared, of tremendous importance to the Commission.

Congressional relations encompassed more than the status of ties with the Joint Committee, for the Commission, like most other agencies, depended upon Congress for appropriations. Because of the importance of financial legislation, and the constitutional primacy of the House of Representatives in fiscal matters, few Congressional committees had more prestige than the House Appropriations Committee. Few congressmen possessed more influence than the chairman, New York Republican John Taber, sixty-eight years old in 1948, and a veteran of twenty-five years in Congress. To handle the large volume of business, Taber appointed subcommittees, one of which—that on independent offices—heard the Commission defend its estimate of financial needs. Subcommittee chairman Richard B. Wigglesworth, Representative from Massachusetts since 1928, was not the man to allow his group to be overshadowed by a new agency, even if it was the custodian of so vital a source of national strength as atomic energy.

In dealing with the Commission, Wigglesworth faced an unusual situation. Most agencies appearing before the appropriations committee had already presented their request to the scrutiny of another committee for authorization. After authorization, a step usually involving lengthy hearings and a detailed examination of budget items, the appropriations committee set to work. From this procedure the McMahon Act had excepted the Commission, allowing it, because of the highly classified nature of atomic energy operations, to present its request for funds directly to the appropriations subcommittee.[5] From Wigglesworth's point of view, his subcommittee was the only means by which the House of Representatives could assure itself that the Commission handled its operations prudently.

Evidence of careful management Wigglesworth sought unsuccessfully in the testimony the Commission presented in 1947. Dissatisfied with the financial data presented by the four-month-old Commission, frankly skeptical of the explanation that the poor information reflected inadequate records kept by the Manhattan District, Wigglesworth claimed he could find no basis to judge the request. He suspected that the amounts of $250 million for cash expenses and $250 million for contract authority were excessive. He recom-

mended a reduction of $75 million from the cash request, pointing out that when Congress convened in January the Commission could return with better information to show the need for the larger amount. Taber approved his lieutenant's action by declaring on the floor of the House, "If they do come back, I hope they come back with some figures that some committee or somebody in Congress can understand and get in shape." The reduction was approved by the Senate Appropriations Committee.[6]

The imputation of carelessness rankled Lilienthal. Prior to the meeting the Commission had conferred with Taber, and at his request the Commission agreed to submit only unclassified data. But it was apparent during the first session that Wigglesworth's committee was dissatisfied with the procedure. The Commission therefore returned with classified information, a course which Wigglesworth found no more helpful than the first. Lilienthal knew that the financial data presented to the committee were poor. The criticism,
320 however, did not explain why this situation existed: that because of secrecy, the magnitude of the effort, and the pace of events, the Manhattan District had been unable to keep the precise financial data of an old-line Government agency. Nor did the committee refer to the Commission's exceptional steps to give the information required. To Lilienthal, the committee actions were unfair and dangerous, and could shake Congressional and public confidence in the Commission.[7]

Under the best of circumstances budget preparation was a time-consuming business. First, Ager and his small budget group prepared the detailed estimates. These could be broken into two main categories: one to cover the Commission's direct expenses, the other to meet already authorized obligations to contractors. After careful study by the Commissioners, Wilson, and the principal staff, the estimates went to the Bureau of the Budget for measurement against the President's budget policy. The Commission's program, spanning the gamut of industrial-type operations from raw materials to complex production and fabrication facilities, also included such esoteric fields as physical and biological research and more mundane affairs like community management. Adding to these ingredients a generous measure of security sometimes produced unexpected results. Williams could testify on the need for millions of dollars for production facilities, and find no committee member interested in challenging his carefully compiled justification. But a comparatively small sum for road construction at any of the three communities could produce hours of wrangling.

Lilienthal thought that the Commission showing in the 1948 appropriations hearing would be better, a confidence he manifested in talking to the President on November 25, 1947. Few people pored over the Government's budget with more zest and enthusiasm than Truman, who prided himself on his mastery of the intricacies of the fiscal system. He had studied the Commission's request which, to cover the period ending June 30, 1949, totaled over a billion dollars. Was the amount enough? Could the Commis-

sion use more? Lilienthal replied that the estimates were an honest judgment of the requirements. The next day he assured James E. Webb that the unhappy experience with Wigglesworth would not be repeated, for now the Commission had more experience and better information.[8]

Truman submitted his budget to Congress on January 12, 1948. For the year ending June 30, 1949, he estimated total Government expenditures of $39.7 billion. The Commission's share was $625 million.[9] For the Commission the next step was to appear before Wigglesworth's subcommittee to justify the amount. But this was not all. The earlier reductions and new construction, mainly at Hanford, required more money than had been appropriated to cover the year ending June 30, 1948. The amount needed to make up the deficiency in addition to the $625 million had been in Truman's mind when he asked Lilienthal if a billion dollars were enough. As 1948 began, the Commission faced two sets of appropriations hearings, one on the deficiency, the other on the amount needed for fiscal year 1949.

Lilienthal's chance to demonstrate his confidence in the Commission's fiscal estimates came when the deficiency hearings began on February 28, 1948. He had tried to pave the way. On Senator Hickenlooper's advice, Lilienthal had explained the Commission's goals and difficulties to H. Styles Bridges, chairman of the Senate Appropriations Committee and a useful ally should the House committee cut the request.[10] Moreover, Lilienthal could point to progress in building an accounting system designed to meet the needs of the Commission. To show the completely inadequate financial system which the Commission inherited from the Manhattan District, Lilienthal could offer reports made by five public accounting firms on contracts used during the war. Although varying in details, the reports unanimously concluded that the contracts did not provide sound financial controls.

In Green and Ager, the Commission had officers who understood the need for strengthening the financial procedures. Many of their staff had come from the Office of Price Administration, where they had become familiar with industrial control systems. Lilienthal himself had fought successfully in TVA for freedom from the detailed, item-by-item scrutiny of Government auditors. Little more had been done so far in the Commission than data-gathering and planning, but Lilienthal promised that by July 1, 1948, the Commission would have the elements of an accounting and auditing system that could provide management information for Congress.[11]

The deficiency hearings passed smoothly. Perhaps better fiscal data were the reason; perhaps the presence of the five managers of operations to testify on the program requirements was a help. On the other hand, the deficiency hearings were perhaps not the real test of the Commission's relation with the House Appropriations Committee. That trial would come during the regular appropriations hearings.

In preparation, Wilson and the field managers explained the basis for the financial estimates to the Joint Committee on May 27 and 28. Only on one

matter did the committee members raise a strong objection. Wilson had asked for the committee's support for removing the salary limitation imposed on nontechnical and nonscientific personnel in the 1948 budget. He had argued that the discharge of the Commission's heavy responsibilities required exceptional personnel, and that individuals of high caliber were difficult to recruit under a salary limitation of $10,000. Hickenlooper dismissed the topic as one suitable for the appropriations committee to decide. Lilienthal intervened to warn that the Commission was dependent in Congress upon the Joint Committee. "It seems to me that if we can't look to the Joint Committee as having been given the legislative responsibility for this undertaking, then we are in a quite impossible situation. The over-all policy rests under this law, as we understand it, with this Committee." [12]

The hearings began a few days later. The relative calmness of the deficiency hearings had vanished. The technique of having Kelley, Tyler,
322 Franklin, Shugg, and Tammaro testify now proved confusing. Too often the questions from the subcommittee members went into peripheral areas which required mastery of minute detail to answer. Inevitably some of the replies were lame and halting. Furthermore, each manager had under his supervision several segments of the Commission program. Research, for example, was fragmented in the field among the five managers, and divided in headquarters between Fisk for physical research and Warren for biological and medical research.

Some fireworks resulted when Wigglesworth asked Lilienthal and Wilson to arrange their projects into categories of priority. Lilienthal and Wilson refused, asserting that atomic energy was such a new field that it was impossible to list the relative importance of the several projects. Unforeseen developments might make any one of them critical to national security. Furthermore, the Commission had already combed out the nonessentials and the result was a carefully integrated program. Wigglesworth refused to accept the explanation. If the committee recommended a reduction, he was certain that the Commission could discover some relative priority among the projects which must absorb the decrease. The real issue, as Lilienthal saw it, was that in such circumstances the Commission and not the subcommittee would decide where the blow must fall.

Wigglesworth also attacked the organization of the Commission. He expressed astonishment at the vast powers given to the field managers. He speculated, in view of the field managers' activities and Wilson's responsibilities, on the function of the Commissioners. Their role, replied Lilienthal, was to keep aloof from the administrative detail and try to find "answers to some of the questions which are so complex and new in American society." [13]

The rather pompous tone of the reply suggested that Wigglesworth and Lilienthal were speaking for the record. The chairman was describing his management philosophy; the Congressman was asserting his claim that the organization was weak and the administration lax. With a program wrapped

in secrecy and security, Lilienthal welcomed the hearings as a forum, even if the preparations were time-consuming.[14] And, without detracting from the importance of the sessions, the exchange of views often appeared more dramatic in cold print than in actuality. The fact that both knew the House committee actions could be appealed to the Senate appropriations committee allowed a certain freedom to declaim and maneuver.

Wigglesworth recommended cutting the request, but with the proviso that the reduction was to be absorbed so as not to affect the Commission's military program. Determined to cut the appropriation, and faced with Lilienthal's and Wilson's refusal to rank their projects in priority, Wigglesworth had no other recourse. The Senate restored the cut and eventually the bill was to pass, appropriating the amounts requested by the Commission but not removing the salary limitation. As far as the House Appropriations Committee was concerned, the Atomic Energy Commission was no different from any other Government agency. John Phillips of California, who had heard Wilson and Lilienthal testify, recited doggerel on the floor of the House on June 9. The Congressman suggested his verses might be called an "Ode to the Appropriations Committee" by the Commission. The concluding lines were:

> Our testimony's vague but calm,
> Your job's the budget; ours, the bomb;
> We walk on clouds (of radiation);
> You save the cash; we'll save the nation.[15]

THE SPECIAL RELATIONSHIP

In the House debate on the 1949 appropriations bill, Wigglesworth on June 9, 1948, accused the Commission of lavish expenditure. House members of the Joint Committee quickly entered the discussion. James E. Van Zandt of Pennsylvania and W. Sterling Cole of New York—both Republicans—appeared inclined to accept some of Wigglesworth's description, while Chet Holifield, Democrat from California, took on the role of defender. Holifield remarked that he had attended every session of the Joint Committee at which the Commission had appeared, and in no instance had he heard a charge of general extravagance. In the other wing of the Capitol a similar pattern appeared as Senator Brien McMahon castigated the attempts of the House to limit funds for research, an action he described as an uninformed, unconsidered, reckless exercise of power.[16] The debate in both Houses was languid, for the Commission was but one of five agencies covered in the bill, and the others—among them the Veterans Administration—were far more attractive for Congressional oratory.

Had the attack been serious, Lilienthal could have looked to the Joint

Committee for support with some hope of success. The amount of authority which that committee possessed was unusual among Congressional organizations. Unlike most committees, it was established by statute and had the right to consider all atomic energy matters introduced in either House, and to undertake continuing studies of Commission activities and atomic energy problems. This mandate gave the members a greater sense of cohesiveness than ordinarily prevailed in Congressional committees.[17]

Under Hickenlooper's leadership, the Joint Committee stressed security. By the end of 1947 the committee staff numbered fourteen people working under the immediate direction of two former intelligence officers, Fred Rhodes, Jr., and David S. Teeple. The committee's first report to Congress, issued on January 30, 1948, reflected this preoccupation. Adequacy of plant protection, efficiency of the guard force, and means of visitor and document control were significant, but the committee felt it must watch
324 closely the type of person engaged in the atomic program. "It is the opinion of the committee that the matter of security of personnel is of extreme importance in the over-all problem of the protection of the vital aspects of this program." [18]

Others felt the same way. The House Un-American Activities Committee under J. Parnell Thomas had found headlines in its search for Communists in Hollywood. Rumors that Thomas might again seek to dig into the past of some of the people working in atomic energy alarmed Hickenlooper. To find out how vulnerable the Commission would be to such an attack, he called a special meeting of the Joint Committee on November 28, 1947. What the committee learned was not reassuring. Gingrich explained that investigation of Manhattan project employees who had remained with the Commission had uncovered some doubtful cases. In some instances the decisions to issue clearances were hard to defend; in others the procedures had been so cumbersome that no determination had yet been made. Wilson, however, had something positive to offer. The Commission planned to establish a temporary personnel security review board which would examine some of the doubtful cases and provide advice and precedents which could be used to develop uniform procedures and standards.[19]

The work of the board would not be easy. Somehow personnel security standards had to be devised to allow for the frailties of those who judged and those who, with their future and families, lay in the balance. Formal Commission approval of the five-man board on December 4, 1947, Waymack warned the staff, did not mean that the Commission was abdicating its responsibilities. Much to Lilienthal's delight, he was able to persuade Owen J. Roberts, former associate justice of the Supreme Court, to accept the chairmanship. The group was given considerable freedom to establish its own internal procedures, conduct hearings at its discretion, and initiate what inquiries it deemed necessary; it was also to have access to Commission personnel and records.[20]

The House Un-American Activities Committee justified the Joint Com-

mittee's concern on March 1, 1948. In the afternoon the Thomas committee released to the press a report that Edward U. Condon, director of the National Bureau of Standards, appeared to be "one of the weakest links of our atomic security." A physicist, Condon had engaged in weapons work at Los Alamos during the war; later his position had brought him into social contact with officials of communist countries. Furthermore, he had been the target of earlier attention of the House group.[21]

To the Joint Committee the Thomas charges cut close. Not only was the Bureau of Standards described as one of the nation's major defense research institutions, but throughout the report the ties between Condon and atomic energy were proclaimed. Not omitted was the fact that Condon had served as consultant to the Special Committee on Atomic Energy which had drafted the Atomic Energy Act. The implication of the Thomas report was clear. On security and atomic energy the House Un-American Activities Committee had set itself up as a higher authority than the Joint Committee on Atomic Energy. Even more was at stake. The Un-American Activities Committee had asked Secretary of Commerce W. Averell Harriman for the complete text of a normally confidential report on Condon from the FBI. In the name of security and loyalty Thomas and his committee were challenging Truman and the whole Executive Branch.

Hickenlooper reacted cautiously. The day after the committee release, he announced to the press that the Joint Committee had no plans to ask Condon to testify, although that situation might change if the House committee documented its charges. That afternoon Hickenlooper had scheduled a meeting with the Commission to examine the Oak Ridge labor situation. He used the occasion to raise the issue of the Condon case. Wilson explained that the Bureau of Standards was performing certain routine analytical work for the Commission and that Condon as bureau director had a clearance. By no stretch of the imagination, however, could Condon be considered in the center of the atomic energy program. Volpe set forth the administrative complexities of the case. As director of the bureau, Condon had been appointed by the President and confirmed by the Senate; he reported to the Secretary of Commerce. For the time being the Commission was waiting for the outcome of an investigative board appointed by Harriman.

The findings of the Harriman board, whatever they might be, were in the Joint Committee's opinion no answer to the immediate question: Did Thomas have new information on Condon which he was about to exploit? Until this point was established, the Joint Committee had no intention of following Thomas's lead. As Congressman Holifield remarked, "Unless the thing is clarified and the man given an opportunity to protect his name, this Committee should not lend itself to further condemnation." In Senator Edwin C. Johnson's opinion, the Condon case appeared to be a good one to send to the Roberts panel. Wilson accepted the idea, adding that a meeting between the panel and the Joint Committee might prove helpful to all.[22]

Before the panel met with the Joint Committee, Truman took steps to

meet the Congressional challenge. On March 13, 1948, he issued an executive order that no one in the Executive Branch, save from his office, was to release personnel records. While this blocked Thomas, it also broke off Joint Committee access to the personnel files of the Commission's employees. The committee heard on April 1 Roberts's report on the panel's goals and methods, but the real interest lay in the executive order. Pike related that the Commission had opposed its inclusion in the directive, "feeling that the relationship between the Committee and the Commission is unusual and unique. . . . We got a bloody nose trying to get this exception." [23]

Truman's refusal to exempt the Joint Committee from his executive order was placing heavy strain on the prized special relationship. On April 8 Lilienthal and Adrian S. Fisher, the Commission's new general counsel, met with Attorney General Tom C. Clark and hammered out the basics of a procedure which would make personnel records, including FBI reports, available to the Joint Committee on terms acceptable to the Department of Justice. That afternoon Lilienthal checked with Clark M. Clifford in the White House to obtain Truman's consent. The timing was fortunate. Shortly before, Hickenlooper had telephoned Truman and had asked for a modification of the directive. The President had refused. Now, however, the Attorney General was with Truman and explained the arrangements reached during the morning. To Lilienthal's relief, Truman accepted the procedures and the special relationship remained intact. As Lilienthal confided to his journal, it had been a close call to a bad row.[24]

REAPPOINTMENT—A QUESTION OF STRATEGY

Toward the middle of March, 1948, Lilienthal was weary and looking toward the time he could exchange the raw humidity of Washington for the warmth of Florida. Others too, were tired. Waymack found the heavy burden of work sapping his health and Bacher wanted to return to physics. To both Lilienthal had pointed out the inferences which would be drawn if two of the five Commissioners resigned during an election year.[25] Moreover, Lilienthal was loath to lose them, although he could sympathize with their desires. With a robust sense of the comic, Waymack had often used humor to ease the tensions of Commission business. Bacher's vacancy would be particularly difficult to fill. By his skill in unraveling tortuous technical and scientific problems he had won the respect and confidence of his colleagues and of officials in other parts of the Government who dealt with the Commission.

Personal interests were not the only source of thoughts about departure. Under the provisions of the Act, the terms of the Commissioners expired on August 1, 1948. From that date was to begin a system of staggered five-year terms, arranged so that each year only one Commissioner need be

replaced. To put the system in operation, the terms beginning on August 1 each had to be of different duration, descending in annual decrements from a maximum of five years to a minimum of one year. Bacher and Waymack, if they could not resign on August 1, at least wanted the shorter terms.

Lilienthal with his political instinct knew that reappointment held all the seeds of a struggle as bitter as that waged over confirmation. Even before Waymack and Bacher had talked to him, Lilienthal urged on Clifford the need to plan the strategy of reappointment—if indeed Truman intended to renominate the Commissioners. Lilienthal had no reason to think that Truman would not. The realities of politics made it unlikely that the President would propose to change the membership, an action liable to the interpretation that the Commission was a failure.

The four Commissioners—Bacher was in the West—filed into the President's office on March 19. Truman told them that all had done a fine job and all should be reappointed. In fact it would look bad if they did not continue. Although he would like to send their names to the Senate as soon as possible, the political opposition he faced was so strong that confirmation seemed doubtful. However, he had a plan. He could submit their names after Congress had adjourned, which it was certain to do during the summer so as to leave the fall free for campaigning. Of course, the Commissioners would be serving under interim appointments, but at least the maneuver would carry them past the campaign season. When the new Congress assembled, confirmation hearings could be held.

Lilienthal persuasively presented another course. Submitting the nominations as early as possible would give the Senate a chance to deliberate and would preserve the original nonpolitical spirit of the appointments. Attempts to block confirmation would leave the opposition open to the charge of injecting politics into the nation's atomic energy program. Interim appointments, on the other hand, would only postpone the battle and create uncertainty in the Commission's operations. Truman was noncommittal, but the idea seemed to have had appeal. Recognizing that he might be the storm center, Lilienthal proposed that he take the one-year term. The struggle might not be so difficult if the opposition knew that in a year it could focus on him alone as it had during the 1947 confirmation hearings. Lilienthal was pleased that Truman rather casually brushed the suggestion aside.

A few days later Lilienthal left for his vacation, knowing that all the names of the Commissioners would be submitted for reappointment. Waymack had made it clear to Truman that he and Bacher would serve longer, but neither felt a moral obligation to remain much beyond reconfirmation. When the President would send the names to the Senate Lilienthal did not know. Away from Washington he found his thoughts returning to the idea of a one-year term for himself. Within the Commission he saw signs of a growing competence which, he felt, would enable him to leave at the end of the term without compunction.[26]

Senator Hickenlooper would have disagreed with Lilienthal's optimistic appraisal. Over lunch with Secretary of Defense James V. Forrestal on February 24, 1948, the Joint Committee chairman spoke freely. He distrusted the philosophy in the Lilienthal speeches. Beneath the promises of atomic power for industry, under the appeal for public understanding of the atom, Hickenlooper found intimations of a Lilienthal who felt himself indispensable and who was promoting a philosophy of statism. Except for Strauss, Hickenlooper was not impressed with the practical abilities of the Commissioners; however, he thought Bacher a good scientist.[27]

Hickenlooper faced a political situation growing daily more complex. As a Republican, he had hopes for his party's victory in the coming Presidential election and an end to the long sojourn in the desert of political opposition. Along with others, he watched Thomas E. Dewey, Harold E. Stassen, and Robert A. Taft battle in the primaries for the party's nomination.

He also speculated on the possibilities that his Senate colleague on the Joint Committee, Arthur H. Vandenberg, might emerge as the party choice. On atomic energy matters there was a wide difference between Taft and Vandenberg. Few people knew better than Hickenlooper the damage that the delay in confirmation had done to the nation's atomic energy program. It was obvious to him that if Truman renominated the Lilienthal Commission there was every likelihood that the drama of 1947 would be replayed, but with even more bitterness because of the intense emotion of an election year. However, it was possible to reduce the hazard. If Truman did not renominate Lilienthal, the forces of controversy might never gather.

THE PRESIDENT ACTS

Hickenlooper was astonished to read on the morning of April 19, 1948, that, according to the New York *Herald Tribune*, nominations for the Commission would soon go to the Senate. If the story were accurate, Lilienthal had wanted the one-year term, but had been overruled by the other Commissioners. Shortly after Hickenlooper finished the newspaper account he read a broadtape reporting that the nominations would be sent to the Senate that week. No mention was made of terms.

Hickenlooper acted fast. He called the White House at nine o'clock for an appointment. Two hours later he finally reached Matthew J. Connally, Truman's appointment secretary. Connally replied that because of the crowded calendar Hickenlooper could not see Truman that day. Hickenlooper had no choice but to accept an appointment for the next day. Even that might be too late. In the afternoon an uncompromising Taft left a session of the Republican Policy Committee, remarking to reporters, "There is a growing feeling among Republican senators that no one nominated should be confirmed regardless of the job."[28]

With all the signs of a first-class fight in the offing, Hickenlooper turned to Forrestal. Over the telephone Hickenlooper explained the situation —the surprise that the nominations had been sent up so early, the lack of any notice. What was Truman trying to do? Was he trying to "push us around"? That seemed to be the reaction of some Senators, a group from which Hickenlooper carefully disassociated himself. His own desire was to see the atomic energy program continue with a minimum of friction. A few minutes' conversation with Truman to explain the Senate feeling might be helpful. But in the light of the White House action, was it any use for Hickenlooper to see Truman? Forrestal urged Hickenlooper to keep the appointment, and on this note the conversation ended. As Hickenlooper could have expected with reasonable certainty, Forrestal sent a brief note and a transcript of the telephone conversation to Truman.[29]

Events of the next day could not have encouraged Hickenlooper. At ten-thirty in the morning Charles G. Ross, Truman's press secretary, announced to the reporters the nominations of the Commissioners. Lilienthal was proposed for five years, Pike for four, Strauss for three, Waymack for two, and Bacher for one. An hour later, Eben Ayers, Ross's assistant, told the reporters that the names would not yet go up to the Senate. In another fifteen minutes a stenographer added the name of Senator Hickenlooper to the list of visitors expected that day at the White House. Linking the delay in sending the names to the Senate to the Hickenlooper visit was an easy deduction for the press corps.

That afternoon at three-fifteen Hickenlooper saw Truman. The Joint Committee chairman proposed that Truman lessen the chances of controversy by nominating Lilienthal for the one-year term. Truman was cordial but avoided a commitment. After a quarter hour Hickenlooper left. On his way out he told reporters that he had talked atomic energy matters with the President, and he admitted that he had requested the visit. His car had barely left the White House grounds when Ayers reentered the press room and redistributed the morning's announcement, remarking that the nominations would reach the Senate in about five minutes.

Hickenlooper had just returned to the Senate chamber when the presiding officer announced that nominations for the Commission had been received. The Presidential brusqueness irritated the Senator. Truman later told Forrestal that his conversation with Hickenlooper had been pleasant enough but he saw in it an attempt by a Republican Congress to prevent the President from exercising his functions as chief executive.[30]

BATTLE AVOIDED

Hickenlooper and Lilienthal talked about reappointment on April 21, when Lilienthal went to the Senator's office to report on the *Sandstone* weapon test.

With a quiet sincerity which Lilienthal found impressive, Hickenlooper explained how events of the last few days had left him little room to maneuver. His soundings of senatorial opinion led him to believe that a one-year term for Lilienthal offered the only means for averting a clash. For his part, Lilienthal recognized the dangers of a struggle and the merits of the argument that the chairman of so important an organization as the Commission should offer to resign at the end of an administration. However, he pointed out, Truman had left him no choice.[31]

Taft, now waging a primary campaign in Ohio, left no doubt where he stood. In a radio interview in Cleveland on April 23, the Senator stated bluntly that he and several of his colleagues objected to Lilienthal as chairman. Candidly Taft admitted the influence of an election year: "I'm inclined to think the Senate will look very critically at any nomination for terms that run beyond the present Presidential tenure." How much, however, did Taft
330 speak for himself and how much for the Republican Party? Waymack asked the question. He himself was a registered Republican; Strauss proudly identified himself with the Hoover philosophy; Pike leaned toward the views of Stassen or Wendell L. Wilkie; Bacher, whose career in science had left him little time for politics, had voted Republican; while Lilienthal called himself an independent. Moreover, Waymack observed shrewdly, Dewey, Stassen, and Vandenberg were not excited over reappointment.[32]

Battle lines were not yet completely drawn. Taft intimated to the press that Lilienthal would be acceptable for the one-year term. From Vandenberg, Lilienthal learned that Hickenlooper was working on a compromise in which the terms of all the Commissioners would be extended by one year. Lilienthal was not impressed: the one-year extension he saw as holding no advantage over interim appointments. Neither would give the Commission operations that certainty which would follow from putting into effect the provisions of the law without evasion or postponement. With this analysis Vandenberg disagreed, possibly favoring the compromise because it required positive Congressional action in the fairly near future. Whatever his reasoning, he turned to the subject of Hickenlooper. The Joint Committee chairman, warned Vandenberg, was dubious of the abilities of the Commissioners and was still smarting under Truman's discourtesy. Without going into the merits of these matters, Vandenberg made it clear that if a fight developed, he would support Hickenlooper.[33]

Lilienthal had suggested to Vandenberg that Hickenlooper's doubts about Commission competence could best be answered by consulting with the various advisory committees. Perhaps as a result of the idea, Hickenlooper unfolded his compromise to Karl T. Compton, Vannevar Bush, Oppenheimer, Isidor I. Rabi, and Lee A. DuBridge at an executive session on April 28. They favored the Presidential course, but Hickenlooper warned of the political dangers. His plan, developed further since Lilienthal had seen Vandenberg,

called for an extension of the terms of the entire Commission to June 30, 1950. With this two-year extension Hickenlooper thought he could avoid a struggle. Reluctantly the scientists agreed. For the record they drafted letters, and checked them with Truman, who proved understanding. "A week of idiocy," grumbled Oppenheimer.[34]

Truman put his case before the public at his press conference on April 29. Reading slowly from his prepared statement, he declared that a year and a half had passed since the Commissioners had assumed direction of the atomic energy program. He had sent the nominations to the Senate as the law required. There were no political motives behind the timing; all that he was doing was giving the Senate a chance to deliberate. As for the choice of terms, that matter had been decided by the Commissioners themselves.[35]

The reference to the Commissioners choosing their own terms intrigued Hickenlooper, and perhaps gave him hope that the selection of Lilienthal for the five-year term was not unalterable. The day after the press conference he called Waymack. Warily the two Iowans fenced with each other. Finally Waymack admitted that the President's statement was not inaccurate. The terms assigned to Lilienthal and Pike, the Senator remarked, were receiving the most adverse comment. Once criticism began there was no telling where it would stop; perhaps the civilian-military control issue would break open again. Hickenlooper suggested that the two-year extension was really a vote of confidence. When Waymack could not follow this interpretation, Hickenlooper thought that a commendatory statement by the Joint Committee would reassure those who doubted. At any event, he did not see how Truman could veto the extension.[36]

That afternoon the bill was introduced into the House and Senate. In mid-May the Joint Committee reported the bill. The majority argued that the original intent of the McMahon Act was to provide a two-year trial period for the first Commission before putting into effect the system of staggered terms. Because of the delays in confirming the first Commission, the trial period had been seriously abridged. All that the compromise was trying to do was to restore this period. The minority—McMahon, Connally, Lyndon B. Johnson, Carl T. Durham, and Holifield—accused the majority of politics. To buttress their charge, they cited Taft's campaign remarks. For evidence of achievements they pointed to the recently concluded weapon tests.

The extension bill reached the floor of both houses only two days before adjournment. There were no new arguments. The most significant fact was that Vandenberg announced his approval of the Hickenlooper compromise as the best way to avoid controversy. McMahon argued that evasion of debate was a poor reason to confirm the Commissioners. If there were cause why any of the Commissioners should not be reappointed, the possibility of a fight and the near adjournment of Congress were hardly good excuses. In the orotund manner he loved so well, McMahon declaimed, "God in his heaven

did not ordain that this Congress should end tonight. That determination comes from the majority leadership." The bill passed the Senate on June 19, the last day of the Congressional session.

Truman was left with two choices: sign the measure, or veto it and name the Commissioners to interim appointments. What Truman would do Lilienthal did not know, although he hoped the President would yield. To Lilienthal's relief, Truman signed the bill on July 3, 1948.[37]

Truman really had no alternative. To veto the bill would have gained him little. As a political device, interim appointments could hurdle over the campaign season, but the Hickenlooper compromise accomplished the same purpose and for a longer period. In the scrambling and maneuvering of an election year, Hickenlooper had neatly removed the fuse from an explosive issue. He had not achieved this result alone; he had been favored by gaining Vandenberg's support. If atomic energy were to become a campaign issue, it

was less likely to be charged with the emotional tensions that seemed to cling to Lilienthal. In this instance, averting conflict was victory. The Senator's effort did not mean that he found the Lilienthal Commission any more acceptable. His doubts and reservations remained.

DECENTRALIZING SECURITY

Responsibility for plant protection, missing documents, classification, and personnel security Admiral John E. Gingrich assumed as director of security and intelligence in August, 1947. He found his task one of appalling magnitude. He discovered there were no maps of security boundaries of Commission installations or of the location of facilities to protect against sabotage, fire, and other hazards. He had to develop procedures for security inspections, and to plan with the military the defense of vital plants. Above all, he had to build up an effective staff. A skilled seaman, Gingrich compared his assignment to that of a captain conning a ship on a tight course while the engines were being replaced, the crew changed, and new officers assigned.[38]

His greatest headache was personnel security. Requests for clearances poured into headquarters from the field. Gingrich's division did the necessary processing and sent the cases to the FBI for a background investigation. After a lapse of weeks, the FBI submitted the information it had developed. Gingrich's staff evaluated the data. In most cases, clearance was routine. However, occasionally the investigation turned up character traits or habits which, while not involving security, cast doubt on whether the individual would be a satisfactory employee. In these instances, called "invite" cases, the contractor was invited to view the information and decide whether to hire the person. Another category was the "hold" case, involving security doubts. The term stemmed from the procedures under which the staff held the case for

Gingrich's decision and, if he were uncertain, for Wilson and the Commissioners.

Requests for clearances were coming in faster than they could be handled. Looking over the statistics in November, 1947, Gingrich found he had over 6,000 requests for investigations in the hands of the FBI, and almost 7,000 completed investigations awaiting review by his staff. And more requests were flooding in. Somehow he had to step up the clearance process. One way to keep headquarters from being swamped was to give the field offices authority to analyze the data from the background investigations and to issue clearances where there were no doubts. Uncertain cases could be returned to headquarters. But if such a system were to work, the field offices would need help on recognizing the signs of security risk. Counting on the Roberts board to help, Gingrich and his men formulated criteria. If all went well, Gingrich planned that by July, 1948, they would have sound criteria and procedures. Then would come painstaking instructions so that the field offices could assume their responsibility.

To Wilson this was not fast enough. Looking at the increasing costs of administration as 1948 began, he saw possible savings if decentralization of security could be speeded up. Gingrich hastened his efforts. Instructions went out to the field on March 30. A final conference with the field security officers on April 8 and 9 checked the new system, which went into effect on April 15. The criteria for determining a security risk were far from perfect, but even here Gingrich had made a beginning.[39]

The new system applied only to those seeking jobs. Reinvestigations of personnel from the Manhattan project fell into a different category. These individuals already had access to Restricted Data and some had skills which would be difficult to replace. New procedures issued on April 15 gave the employee the right to appear before an appeal board. The use of a board in such instances was not original. The Army, Navy, and other defense agencies had boards of appeal, although regulations governing them were not standard. Under the Commission's procedures, the field manager was authorized to establish a three-man board to hear a case. Membership was not confined to Commission or contractor employees, but only to persons with a clearance. This provision allowed the selection of board members with the same speciality as the individual in question. By the end of April experience was showing that character and associations were most often the subjects involved at the local hearings.[40]

The members of the Roberts board studied the experiences to which Wilson referred. They examined cases, spent two days in Oak Ridge to gain field perspective, and heard more than once from Gingrich and his staff. The Roberts group recommended on June 7, 1948, withholding a decision on Condon until it was certain that the House Un-American Activities Committee had no new information to exploit. The Commission, assured that Thomas was raking over old coals, agreed that Condon should retain his clearance.

The action was perhaps somewhat more rapid than Roberts thought wise, but he made no strong objection when Lilienthal telephoned him before issuing a public statement.[41]

In late June, 1948, Roberts reviewed draft criteria for determining eligibility for clearances. He found the definition for loyalty satisfactory, but not the definitions covering character and associations. These were important, for character traits such as carelessness or personality difficulties could lead to security risks. As for associations, the terms were surely broad enough to include husband and wife. An applicant denied employment, Roberts was inclined to think, should have no right to appeal. After all, private industry did not tell a person why he was not hired, and there was no reason for the Commission to do differently. Yet Roberts recognized that denial of a job with the Commission did imply a slur on loyalty. As a solution, the board suggested consolidating applications and security forms into one document which would have in bold print a statement that aptitude, training, past experience, and employment history, as well as character, associations, and loyalty would be considered.[42]

The Roberts board, its task nearly completed, had proved helpful, and the earlier moves investing field managers with limited authority to grant clearances were working well. But the administrative burden was still heavy. As the Commission rebuilt old installations and constructed new ones, the need for emergency clearances increased. By June 1, 1948, Gingrich had personally signed more than 1,500 emergency clearances. On July 22, the Commission found even further decentralization necessary. If an individual were essential, if there were insufficient time for a complete FBI investigation, and if preliminary checks revealed no derogatory information, the manager could issue an emergency clearance.[43]

Since January, 1948, the Commission had done much to decentralize administration. Was security weakened? That question worried Gingrich. It also bothered Hickenlooper.[44]

CONSTRUCTING FINANCIAL CONTROLS

Decentralization of security was only one aspect of the Lilienthal-Wilson approach of meeting difficulties by granting authority to the field offices. If these offices were to fulfill their role, Washington headquarters had to have information to make sound policy decisions. Construction of a system of financial controls was a major means of providing the necessary data.

After a long and careful search, Wilson selected Paul M. Green as controller. At the time of his appointment on April 17, 1947, Green was virtually unknown to any of the Commissioners or the staff. However, his name ranked high on the list of candidates proposed by an advisory commit-

tee. His credentials were good. From an academic background at the University of Illinois, he had moved into the Office of Price Administration during World War II. Impressive to Wilson was the high praise Green had won from those in industry who had dealt with him.[45] He had been about to return to his university when Wilson offered him the controllership. Green found the offer attractive. As one who saw accounting as a strong instrument for creative management, he had been appalled at the inefficiency and rigidity of traditional Government accounting procedures. He saw the Commission as a new and important agency which by example might serve the cause of reform of accounting and auditing practices in the Government. The new controller studied the financial records and contracts from the Manhattan project. He did not like what he saw.

In the press of war there had been little uniformity of contracts or consistency in defining fees or overhead costs. Moreover, the system of paying contractors was cumbersome. Contractors met from their own funds the cost of work performed for the Commission, a practice which often led to haggling over minor and vaguely defined items. Reimbursement followed a check of vouchers, once in the field, once in the Commission offices, and once again in the General Accounting Office. Above all, the system did not provide data for efficient management.

The new controller warned that the Commission was vulnerable as long as it did not have a sound policy for reimbursing the contractor. Lilienthal's reaction to Green's ideas seemed disappointingly cool. Uncertain that his message had been understood, Green wrote to Wilson, "I predict that the cost policy will not only be attacked directly but will be used as a point against which to launch attacks that are designed to break the fundamental activities of the Commission." It was time to raise defenses. Impressed, Wilson scheduled another session with the Commissioners. Warned that he had only an hour in a crowded agenda, Green rehearsed carefully. At the meeting he finished his presentation to the minute, and looked up to face a grinning and converted Lilienthal.[46]

Accounting under the Manhattan District had been centered at Oak Ridge, but as soon as he could, Green moved the central office to Washington and increased the responsibilities of the other field offices. Not until October, 1947, was his office sufficiently staffed so that he could turn with some confidence to revising the accounting practices used in the Manhattan project. His first assignment to his staff was to prepare a comprehensive analysis of the obligations and expenditures from July 1, 1946, to November 30, 1947. From these data would come the information needed to give an intelligent review of the Commission's budget and to provide a basis for a sound accounting system.[47]

Green's goal was to establish industrial accounting and auditing procedures in place of the Government practices encrusted with tradition and custom. Each major contractor would be required to maintain a distinct set of

accounts on the work performed for the Commission. No longer would the contractor spend his own funds and apply for reimbursement. From financial reports submitted monthly the Commission would advance funds to the contractor. From monthly financial reports the Commission would at last be able to learn the amount invested in the atomic energy program, the cost of operations, and the composition of its assets. Eventually the term "integrated contractor" would come to describe the close bookkeeping relations between the Commission and its contractors.[48]

Lindsay C. Warren, Comptroller General of the United States, approved the Commission system of advancing funds to contractors on June 15, 1948. His action was an important step in providing the basis for financial management. Green himself recognized that certain factors had favored him. The Commission's endeavor to break away from old Government practices, with their emphasis on cash disbursements and obligations, came at a time
336 when the Hoover commission on organization of the Executive Branch was calling for reform. The Joint Committee had listened to Green sympathetically. In this favorable climate Green and his staff had built well.[49]

REORGANIZATION

Wigglesworth was not the only one to question the Commission's organization. Although less outspoken, men with decades of management experience looked with skepticism at the administrative structure Lilienthal and Wilson had created. Robert M. Underhill, business manager of the University of California, began to doubt in September, 1947, whether the Commission and the general manager could effectively delegate contract authority to the field managers. The actual effect of decentralization, he feared, was that headquarters would still have the ultimate responsibility for decisions but would not have the understanding with which to act wisely.

Donald F. Carpenter, vice-president of the Remington Arms Company, shared the same concern. Carpenter's doubts were raised when, as a member of the Commission's industrial advisory group, he visited the field offices and the laboratories. Although the purpose of the group was to see how participation in atomic energy by industry could be increased, the Commission had also asked for comments on its organization. Carpenter was more interested in this aspect of the Commission than he was in its relations with industry. His main criticism was the concentration of authority in the general manager. In Carpenter's view an intolerable number of individuals overburdened Wilson with so many details that he could not give time to serious matters. Perhaps the program council alleviated some of the pressure, but Carpenter doubted it. In his opinion, the most effective way of freeing Wilson was to interpose between the general manager and the staff a layer of administrators

with carefully defined authority. Carpenter thought the division directors could fill these key positions. Transferring the program directors from a "staff" to a "line" position and giving them the responsibility to coordinate and supervise the field offices was a major part of his plan. Authorizing the assistant general manager to handle routine administration would also improve management.

Carpenter's recommendations were part of a preliminary report to the Commission in early June. Wilson and the staff concentrated their criticism on Carpenter's ideas. In the margin of one copy Wilson saw six bold question marks, the scrawl "no understanding of the Program Council," and opposite the suggestion that field managers report to a division director, the word "impossible." The spirit of the two-hour session with the Commissioners on the afternoon of June 3, 1948, was consequently somewhat cool.[50]

The General Advisory Committee meeting in Washington the next day thoughtfully studied the proposals. In most instances the committee members had had more experience in the management of atomic energy than had the Commissioners and Wilson. Moreover, with the terms of Rabi, Hood Worthington, and Cyril S. Smith about to expire, the original advisory committee was coming to an end. Under the circumstances it was natural for the members to review their experiences with the Commission. The fact that the Commission was about to reorganize reactor development—an area of great interest to the committee—was another cause for considering the Commission's structure. In his references to reorganization, Wilson had said nothing about rearranging staff and line functions: key points in Carpenter's proposals. Setting up a new division, not in itself a bad idea, did not reach the heart of the matter.

James B. Conant, DuBridge, and Hartley Rowe, at the request of Oppenheimer left the meeting to draw up a statement on the Commission's organization. They labored well, and while they had captured the spirit of the committee, the tone of the comments was undeniably sharp. Eventually the committee decided that in a session with the Commission, Oppenheimer could act as spokesman and pave the way with a few introductory remarks.

At four-thirty on June 5, Oppenheimer and the committee entered Lilienthal's office. All unsuspecting, Lilienthal, Waymack, Bacher, and Strauss waited. Oppenheimer minced no words. He declared that the General Advisory Committee from the beginning had approached its job with high spirits and hopes of contributing to a unique public enterprise. This enthusiasm had grown dim as the Commission failed to attack with imagination the difficulties of security, laboratory administration, and reactor development. Awareness of the Commission's shortcomings was not confined to the committee. Oppenheimer warned that the entire scientific community was losing confidence.

From this introduction, Oppenheimer turned to the statement. Although it was informal, the Commission must make no mistake: The statement accurately reflected the opinion of the entire committee. The burden of the

argument was that the Commission was unable to make good use of the advice offered it. For this condition the committee blamed the Commission's organization. The decision to decentralize they branded as wrong and proposed an organization—very similar to the Carpenter plan—calling for five key positions. Four of these would be the directors of research, weapons, reactors, and production. The fifth would be an over-all administrative officer. The committee recommended that the directors assume line responsibility and direct the activities of the field offices. The proposed pattern was similar to the relations existing between McCormack and Tyler in weapons, the one area in which the Commission had achieved any measure of success. Oppenheimer read the final devastating conclusion: "We are afraid we can be of little use to the Commission under the present organization. We despair of progress in the reactor program and see further difficulty even in the areas of weapons and production unless a reorganization takes place." [51]

338 Lilienthal was dismayed. Of course there had been failures, but the Commission organization was not the cause. Perhaps the committee did not realize that several enterprises operated successfully in this pattern.

Shrewdly, Oppenheimer suspected that Lilienthal's reaction might be defensive. On June 18 Oppenheimer wrote Lilienthal that the criticism was no light and casual matter. The committee members were as unanimous on the shortcomings of the Commission as nine people could ever be on a single subject. If the committee, composed of individuals familiar with the Commission's problems and sympathetic with the Commission's goals, was so discontented, Lilienthal must realize that in industry and in the scientific community, disenchantment was even greater. Nor should Lilienthal discount the views on the grounds that the committee's role was primarily to offer technical advice. Most of the members in the pre-Commission days had administered atomic energy activities and faced similar problems. The committee had hoped the Commission would manage the atomic energy program so as to combine responsibility with candor, guidance with a minimum of control. The committee had hoped to find a willingness on the part of the Commission to correct its errors, to admit them publicly, to give leadership in questions of secrecy and security, and to furnish a unity of purpose and understanding on the various aspects of atomic energy. It was not wrong to hope for these things, Oppenheimer continued, nor was it wrong to continue to hope for them. However, unless the Commission moved to fulfill these expectations it would be hard in the future to argue the need for the Commission. On June 25, Oppenheimer telephoned Lilienthal from the West Coast. Confessing regret for the anguish the committee had caused, Oppenheimer admitted that perhaps it was unfair not to have referred to the difficult environment in which the Commission lived. Although he tried to soothe the hurt feelings, he withdrew nothing from the catalogue of deficiencies.

The Lilienthal-Wilson approach was a failing. That was the verdict of

Carpenter, familiar with large corporations, and of Oppenheimer and the General Advisory Committee. From his vantage point as Secretary of Defense, Forrestal was thinking of more drastic changes: Perhaps Herbert Hoover's commission on organization of the Executive Branch should look into the Commission; perhaps one Commissioner should be a military man.[52]

Within the Commission, discussion of reorganization took on a new sense of urgency. Wilson talked individually with the Commissioners, to explain the proposed reassignment of functions and his progress in recruiting for the new positions. He also met with Carpenter, now chairman of the Military Liaison Committee. With Fisk, Wilson found he had some friendly philosophic differences, and together the two men flew to Maine to discuss organization with Oliver E. Buckley, once of the industrial advisory group, now a member of the General Advisory Committee. At Los Alamos, John H. Manley, executive secretary of the advisory committee, was curious to learn of the outcome of the meeting with Buckley. He had heard what he hoped was an incorrect rumor that Wilson had resigned. On July 29, 1948, Wilson and Lilienthal spent over three hours with Hickenlooper, Rhodes, and Teeple, to explain what the changes would be. Lilienthal believed Hickenlooper understood and approved the reorganization, except for changes in security, which would decentralize some of the authority in that area, and for the salary of the new position of deputy general manager. A few days later Hickenlooper repeated his main concern to Carpenter: Decentralization might weaken security.[53]

On August 5, 1948, Wilson issued a statement for the managers of operations and the principal Washington staff. Although many of the details of the reorganization were not settled, he was able to block out the major changes. Executive responsibility for production was now assigned to Williams; for research, to Fisk, who was about to leave for Harvard; for reactor development, to a new director; and for military application, to McCormack. Under Williams's purview would come all production, from raw materials to fissionable material, which would include Gustafson's division of raw materials and the managers of the New York, Hanford, and Oak Ridge offices. The director of reactor development would have authority over Argonne and Schenectady. Stripped of reactor work, the division of research would focus on the physical sciences and biology and medicine. The director of military application would obviously be responsible for Sandia and Los Alamos. In addition to the four divisions which then possessed line authority, there were five with staff functions—security, personnel, information, finance, and general counsel. Under the new plan, budgeting, accounting, and auditing would all be part of the finance division.[54]

The more complicated structure also reflected the growth of personnel at headquarters. Wilson had hoped that the small size of the headquarters building on Constitution Avenue would keep the Washington staff small.

However, from a total of 361 in August, 1947, the number a year later came to 699, many of whom were housed in a temporary building several blocks from the Washington headquarters on Constitution Avenue.

Wilson chose Shugg for the position of deputy general manager. From the first interview with Shugg to offer him the job of manager of Hanford operations, Wilson had been impressed and nothing in the succeeding months had changed the initial opinion. For his part, Shugg felt that he had always been given backing by Wilson. When Wilson first telephoned the offer, Shugg hesitated. Washington atmosphere might call for tact, diplomacy, and patience—qualities he obviously and somewhat proudly lacked. On the other hand, he felt his staff was now at a stage where he could leave. In David F. Shaw, his second in command, he had a man who could assume the duties at Hanford, although, as Shugg suspected, Washington would think him too young and bring in someone else. Then too, flood waters of the Columbia
340 River had recently swept away his home and he was living in temporary quarters. Adding it all up, Washington did not look too bad.

AN OCCASION FOR COURAGE

Organization was only one subject which the General Advisory Committee criticized at the meeting. Equally caustic were its views on the Commission handling of secrecy and scientific research. Glenn T. Seaborg returned to the chronic problem at the June 6, 1948, session. He saw security as putting a strain on the ties between the Commission and the scientific community. The chorus of agreements Oppenheimer with his usual skill blended into a summary. There were many roots to the trouble: obscure policy, uninformed public opinion, poor provisions of the Act, timid or unimaginative security personnel, and unsound relations with Congress. What was needed, Oppenheimer thought, was a new approach, one which would not get bogged down in routine investigations, but focus upon individuals who could be dangerous. Furthermore, a true security system would hardly bend to Congressional judgment on individual cases. Enrico Fermi declared that security had become a ridiculous fetish. He suspected that a statistical analysis of the employees who had been discharged, denied clearances, or suspended on security grounds would reveal the inadequacy of the present system. Oppenheimer delivered the fundamental criticism. There should exist, he remarked, enough courage to take a reasonable risk in favor of an individual.[55]

The need for courage Lilienthal recognized, and not long after the General Advisory Committee adjourned, he discovered an occasion for boldness. An applicant for a grant in the fellowship program, designed to provide advanced training in the biomedical and physical sciences, had a record of membership in the Communist Party. Lilienthal saw an opportunity to drama-

tize the issues of personnel security. The Commission itself provided the funds for the fellowships. The National Research Council performed its familiar role in selecting the fellows. They were not employees of the Commission; their areas of research were not secret; they had no access to Restricted Data, and hence were not subject to FBI investigation. True enough, there was the hope that those who received training would be interested in jobs in atomic energy, but the fellowships were intended to increase the numbers of technically proficient personnel in the nation, not simply to train future employees. Lilienthal saw the question broadly: So long as Restricted Data were not involved, should a qualified person be denied Government assistance in education on the basis of political belief?

Lilienthal placed the question before Pike, Bacher, and Waymack on June 17, 1948. They agreed that the Commission should grant the fellowship. Lilienthal knew that the gesture would be dangerous and provocative unless the Commission made clear the reason for its stand. Otherwise the battle would take place in the shadows of innuendoes and half-truths. Perhaps the first move in setting the stage was to have the research council raise officially with the Commission whether clearances for fellows were required. Lilienthal was heartened to see that Wilson, Fisk, and Williams recognized the significance of the issue.

Strauss agreed that the matter was important, but he saw another aspect. Absent from the June 17 meeting, he read the minutes with growing concern. As he understood it, the Government was spending money to educate people who might later be eligible for Commission employment. If this were so, he thought the Commission should determine whether applicants were qualified before committing public funds for their education. Moreover, the number of fellowships was limited. Why should a person receive a grant—if he could not be cleared—and so deprive someone else who was acceptable? Hickenlooper was also disturbed, for without the safeguard of an investigation the Commission might find itself spending Government funds to educate a potential subversive. On July 30, 1948, he asked for an explanation of the Commission's policy.[56]

Even before the Hickenlooper letter arrived, Strauss had asked for a legal study on the applicability of other statutes. On September 17, 1948, the Commissioners received the report. The general counsel found that there was no legal requirement to clear an individual so long as he had no access to Restricted Data. Further, the study contained the opinion of Detlev W. Bronk, chairman of the National Research Council, that imposing a clearance to qualify for a grant to pursue academic study and research could damage the tradition of freedom in American education.[57]

For Lilienthal, however, events presented another forum. The American Association for the Advancement of Science in Washington heard President Truman on September 13 assert the need to press ahead with research. Adequate funds and facilities were of course to be provided, but also neces-

sary was an atmosphere in which scientists could work free from unjustified suspicion and politically motivated attacks. Three days later Lilienthal put the argument to the association even more strongly. He denied that American leadership depended upon a secret formula locked in a safe. The true source of strength was knowledge. Ominously, the Commission was experiencing increasing difficulty in persuading outstanding people to serve in the Government. The reason was their reluctance to expose themselves and their careers to misunderstanding. For its part, the Commission was working out procedures which would safeguard the decent and ferret out the bad. In the final analysis nothing could replace common sense and good judgment. These qualities Lilienthal thought had not been lacking in the nation's history.[58]

On October 11, 1948—seventy-three days after his request—Hickenlooper received a statement of the Commission's policy on clearances for the fellowship program. The letter was long and contained several administrative
342 details on procedures. It also acknowleged that after careful consideration, an applicant whose background contained derogatory information had been assigned to work in a hospital where no possible question of security could arise. On the broad issue, the Commission asserted that if no clearance were required so long as Restricted Data were not involved, the balance between security and scientific freedom was maintained. There, for the moment, the matter rested.[59]

LABOR RELATIONS

Organization, finance, and security were undeniably important, but they did not directly affect the production of fissionable material. Labor disputes, as events at Oak Ridge in 1947 showed, could conceivably cause plant shutdowns.

The settlement without a strike of the dispute between the United Gas, Coke, and Chemical Workers (CIO)—representing the production plant men—and Carbide in December, 1947, had not brought labor peace to Oak Ridge. One of the thorny complications centered around the laboratory where eighteen local unions affiliated with the AFL had a contract which in some respects was superior to that won by the CIO. When Carbide assumed management of the laboratory in early 1948, the company took the position that all of its employees, whether in the production plants or in the laboratory, had to receive similar treatment. For their part, the AFL unions were determined to keep their advantages. The CIO was pressing for the right to oust the AFL so that only one union would represent the Oak Ridge facilities. The situation was not without precedent, but what made matters even more awkward was the fact that, in the final analysis, the Commission was responsible for seeing that vital plant operations were not interrupted.[60]

Senator Hickenlooper, looking at the Oak Ridge situation, wondered whether atomic energy labor relations required special legislation. Cyrus C. Ching, veteran labor negotiator and director of the Federal Mediation and Conciliation Service, who had played a role in settling the 1947 troubles, was leaning toward some form of compulsory arbitration.[61]

The Commission was reluctant to see special legislation or compulsory arbitration. Its long-term goal was to weave the traditional rights of labor into a pattern of an atomic energy industry which, although now consisting of Government-owned, contractor-operated plants, might eventually be owned and operated by private industry. More immediately, the Commission had to avoid a strike which might interrupt plant operations. This overriding consideration deprived labor of its ultimate weapon: the right to strike. The ban had broad ramifications, for conceivably a strike in a distant supplier plant, of which the Commission might be only one customer, could halt production. Still, Lilienthal and Oscar S. Smith, the Commission's director of labor relations, believed that the just claims of the Commission, labor, and contractor could be met if the three could agree upon the limits of the bargaining process. Within these boundaries labor and management could seek their own solution to disputes.[62]

Of the Commissioners, Lilienthal had the most practical grasp of labor matters and an understanding of the labor point of view, qualities which came in part from his TVA experience. His years in the Tennessee valley had won him a good reputation among labor leaders and gave him a confidence he showed in participating directly in labor negotiations. Smith had come to the Commission in November, 1947, after a decade of service with the National Labor Relations Board. As many others recruited for the Commission, Smith had given up an opportunity in private industry because of the lure of a new and powerful Government agency.

Other Commission installations were not free from labor tension. Oak Ridge was the only facility at which unions had been recognized. Whether the ban on union activity could be lifted depended in part upon events at Oak Ridge, and in part upon compliance with the non-communist affidavit provisions of the Taft-Hartley Act. Under the law, union officials were required to file affidavits stating that they were not Communists, communist-influenced, or members of other groups seeking to overthrow the Government. Unless these affidavits were filed, the union had no status under the law, and could claim no protection from the National Labor Relations Board. At Chicago the United Public Workers were seeking recognition from the University of Chicago to represent Argonne National Laboratory, while at Schenectady the United Electrical, Radio, and Machine Workers of America (CIO) had a contract with the General Electric Company. Officials of both unions were alleged to be Communist or communist-influenced and had not filed affidavits.[63] The UEW at Schenectady posed the most serious problem. Since the union had a contract with General Electric that covered several plants, the

UEW was likely to argue that it had the right to represent the labor force in the Commission-owned, General Electric-operated Knolls laboratory.

Taking steps against the UEW was not so simple. Smith was surprised to find that the National Labor Relations Board was helpless. While the Taft-Hartley Act was the law, its provisions on unfair labor practices did not apply to labor contracts in existence at the time of passage. Consequently the UEW officials did not yet need to file affidavits. Indeed, by not filing, the union deprived the board of the right to intervene on the grounds of communist influence. On the other hand, Smith found, among the national officials of the CIO, recognition that the Schenectady union was vulnerable. Furthermore, there were other provisions of the Taft-Hartley Act which could be used, among them the section prohibiting guards from belonging to the same union as the plant working force. Under Commission prodding, General Electric declared to the UEW that as of April 1, 1948, the guards had to be members of a separate union. The action became effective on schedule and with no untoward incident.[64] It was a first step toward making Knolls suitable for union activity.

OAK RIDGE AND TAFT-HARTLEY

At Oak Ridge the labor situation became tense as Carbide assumed management of the laboratory on March 1, 1948. The AFL unions at the laboratory threatened a strike if they did not receive certain wage increases and other benefits. The company, in turn, was anxious to convert the labor contract made by the previous operator—Monsanto—into terms similar to the agreements which Carbide had for the production plants. To Lilienthal, a strike in the laboratory would not be immediately crippling, but a stoppage of any long duration could slow down the atomic energy program. On March 5 Truman, invoking the emergency provisions of the Taft-Hartley Act for the first time, established a board of inquiry and asked for the company and the unions to maintain the *status quo* until March 19. To bring as much of the matter before the public as possible, Hickenlooper held several days of open hearings; not, he assured the Commission, contractor, union, and other witnesses, to propose a solution, but simply to explore the need for new legislation. In light of the tense situation at Oak Ridge, it was inevitable that the testimony of all would have been cautious. Yet there was agreement that the continuity of operation must be safeguarded, and that perhaps the Commission should draw a statement of labor-management bargaining rights. In the union point of view, Lilienthal's philosophy of contractor responsibility coupled with a prohibition of strikes loaded the dice against labor.[65]

The March 19 deadline passed with no settlement. Truman took the next step under the Taft-Hartley Act and called for an eighty-day injunction

during which negotiations would take place with the aid of the Government. However, if no agreement were reached by the end of this period, the men could strike. The President, in turn, had to submit a full report to Congress along with his recommendations.

Some preparations were needed against the chance of failure. In January, 1948, the Commission had sent to the Joint Committee a report on labor problems and the need for continuity in the operation of the Commission plants. Building upon this report and upon advice from labor and company officials, Smith and the labor relations staff constructed a plan. They proposed a master agreement defining the areas of responsibility among the Commission, contractors, and unions. Lilienthal did not like the plan because it undermined contractor responsibility. But if new legislation were necessary, the proposal offered a foundation.

In this spirit Lilienthal presented the plan to the Joint Committee in a closed session on May 6. Grimly the committee heard Lilienthal, Wilson, and Franklin describe events at Oak Ridge. Hickenlooper saw no clear answer to the dilemma of continuity of production and the right to strike. Realistically, Holifield observed, "We, as legislative bodies, are too frequently prone to believe we can write out a simple formula in the form of a law to end controversy." [66]

Through May there was stalemate at Oak Ridge. Lilienthal found himself agreeing with Carbide, but sympathizing with the unions. The time to maneuver was drawing to an end. On June 3, the executive council of the AFL pressed Lilienthal closely on what he would do if there were a strike. Almost angrily he replied, ". . . those plants must be operated, and whatever it takes to do it, that's what we must do." That same day he heard the news from Oak Ridge: the Carbide offer had been rejected by a vote of 771 to 26. On the other hand, the executive council, convinced the Commission meant to stand firm, put pressure on the locals at Oak Ridge. The injunction was discharged on June 11, and negotiations continued with no letup for meals or sleep. On June 15 the break came. The unions accepted the terms of a new contract.[67]

There had been no strike, but the margin by which it had been avoided was uncomfortably thin. On June 18 in a special message to Congress, Truman called for a commission. It should study ways to adopt the best of labor relations experience to the new and vital field of atomic energy. It should submit its report as soon as possible.[68]

SCHENECTADY AND TAFT-HARTLEY

The fact that there had been no strike at Oak Ridge showed that it should be possible to recognize union activity at Chicago, Hanford, and Schenectady, providing the communist issue could be resolved. Further steps toward that

end followed on June 1, 1948, when the National Labor Relations Board found that journeymen plumbers working on the Commission's Knolls laboratory could be represented by another union than the UEW. From the Commission's point of view, General Electric had not helped matters greatly by signing a new UEW contract, which became effective on June 11. It was, of course, the company's prerogative to contract with a union for its own plants, but covered in the contract were 250 men working on atomic energy projects. The Commission could not tolerate a situation in which union officials of suspected loyalty could exercise discipline over members working in atomic energy. As the Commission saw it, General Electric as contractor had the responsibility for correcting the situation.[69]

To Smith, the major step in solving the Schenectady problem was to make certain that the rank-and-file membership were aware that the issue was the possibility of communist influence and not the presence of unions.
346 Visiting the company offices on June 17, he found General Electric willing to withdraw recognition of the UEW for atomic energy work, providing the Commission gave its cooperation and open support.[70]

By September the company felt that the Commission would have to take the initiative in withdrawing recognition of the UEW as the bargaining representative for Knolls. Harry A. Winne believed that the General Electric-UEW contract prevented the company from acting by itself. Other officials pointed out that the company had no knowledge of its own that the union leaders were under communist influence. Also, withdrawing recognition at Knolls did not strike at the heart of the matter, for the employees could still associate with the suspected officials.[71]

Events now moved swiftly. On September 23 the Commission approved opening Argonne and Hanford to union organization, and agreed that General Electric should be directed to withdraw recognition. Smith turned to the task of preparing the necessary notifications and correspondence for publication. His letters were ready for Lilienthal's signature on September 27, and sent to the University of Chicago, General Electric, and the chairman of the National Labor Relations Board. Two days later they were released to the press.[72]

Hearing from a New York *Times* reporter that Philip Murray of the CIO was about to challenge the Commission, Smith called Murray's office for an appointment on September 30. In the meantime, Albert J. Fitzgerald, general president of the UEW, publicly accused Lilienthal of unjustified action. At two o'clock in the afternoon, Smith talked with Murray and Arthur J. Goldberg, the CIO general counsel. The spirit of the meeting was friendly and frank. Murray was worried that the Commission's action might affect the West Coast shipping strike, where communist influence was also apparent. Neither Murray nor Goldberg showed any sympathy for the particular UEW officials, but both thought the Commission could have used other means. Murray thought he should have been consulted. Nonethe-

less, Smith left the CIO office, feeling that Murray would not issue a statement to the press.

Smith was wrong. That evening he heard from a reporter the text of an open letter which Murray was releasing to the press. The CIO president charged that the Commission was blacklisting unions affiliated with the CIO without consulting any of the responsible officials. He asserted that the Commission was unilaterally denying unions their rights. Furthermore, the Commission was prejudicing the merits of the union's legal case challenging the constitutionality of the noncommunist affidavit provisions of the Taft-Hartley Act.[73]

The Commission offered to explore the loyalty question, providing that the UEW officials would give complete information on communist ties. Fitzgerald rejected the offer, and on November 1, 1948, the Commission ordered General Electric to withdraw recognition. The next move of the UEW was to file suit against the Commission and General Electric for breach of contract, a move which Smith and Adrian S. Fisher, the general counsel, had foreseen. On April 25, 1949, Judge F. Dickinson Letts of the United States District Court for the District of Columbia dismissed the case, with the finding that the Commission had exercised its authority according to the Atomic Energy Act.[74]

THE DAVIS PANEL

Truman established on September 3 the labor study panel he had promised Congress after the Oak Ridge dispute. Under its leader, William H. Davis, formerly chairman of the National Defense Mediation Board and the War Labor Board, the panel completed its study in April, 1949. The three members had written two reports, one to the Commission and the other to the President. In the Commission's report, the Davis panel pointed out that the responsibility of the Commission was perfectly apparent to all parties to a dispute, and therefore negotiations often tended to maneuver the Commission to one side or another, and to uncover the Commission position. Probably the best way around this stubborn fact was to establish and publish general principles for labor-management relations in atomic energy.

In the report to the President, the Davis panel urged that management and labor accept their special responsibility in atomic energy, that security matters be left to the judgment of the Commission, that so far as possible normal collective bargaining processes be utilized, that all disputes be settled without interrupting plant operations, and that the Commission establish a labor relations panel of three members appointed by the President. The task of drawing up the general principles called for in the report to the Commission took longer. An interim statement was issued on April 29, 1949, but

difficulties in getting agreement among the contractors, unions, and Commission staff in headquarters and the field made it impossible to draw up a final statement.[75] The result over the years was a series of modifications elaborating the interim statement.

That there would be labor-management disputes in the future was undeniable. But events at Oak Ridge and Schenectady, and the conclusions of the Davis panel, gave confidence that disagreements could be handled within the framework of collective bargaining, security, and uninterrupted plant operations. Probably it would never be possible to consider atomic energy as a normal industry, but the presence of labor unions was a healthy step in that direction.

348 *DEMOCRATIC VICTORY*

The Presidential campaign of 1948 virtually ignored atomic energy. Only once was this welcome state of affairs threatened. At Phoenix, Arizona, on September 23, Dewey paid tribute to the atom, demonstrably terrible in war, potentially a blessing in peace. Full benefits of atomic energy could not be harvested by the heavy hand of Government monopoly. More participation by industry was needed.

Lilienthal thought Dewey's remarks were unexciting. At various times since he had become chairman, Lilienthal had talked with the New York governor. From his impressions Lilienthal discerned no fundamental cleavages which would make it impossible for him to continue on the Commission if the Republican won. Nonetheless, it was possible to view the Dewey speech as an opening gambit to which Truman should reply. Clark M. Clifford, traveling with the Truman campaign party, called Lilienthal from Oklahoma and found him lukewarm to the idea of bringing atomic energy into the campaign.

McMahon, however, was eager to accept the challenge. To provide ammunition, the senator sent Truman a draft of an article soon to appear in the *Bulletin of the Atomic Scientists*. McMahon proposed to refute Dewey by pointing out that the Government had developed the atomic bomb, that he was ignorant of the role played by industry in atomic energy, and that his speech was injecting atomic energy into politics.[76]

Truman did not reply to Dewey until October 14. Speaking at Milwaukee, the President recalled his efforts to gain international control and the many achievements of his administration in atomic energy. The absence of any plank on atomic energy in the Republican platform Truman interpreted as evidence of an intent to turn over to private industry the source of energy developed by the Government. For the rest of the campaign, Truman made only casual references to atomic energy. Dewey too, kept the peace. Both

parties apparently felt that the Taft-Hartley Act, housing, and inflation had more political appeal.[77]

Like many Americans, Lilienthal awoke on November 3, 1948, astonished to find Harry S. Truman elected President of the United States. The Democratic victory would mean a recasting of the Joint Committee. Not until Congress convened in 1949 would Lilienthal know all of the changes. McMahon would replace Hickenlooper as committee chairman. Senator John W. Bricker, Republican from Ohio, would lose his place on the committee to Senator Millard E. Tydings, Democrat from Maryland. On the House side of the committee there would be two changes. Lyndon B. Johnson, Democrat from Texas, as a result of a victorious senatorial campaign, and James T. Patterson, Republican from Connecticut, because of the change in the party balance in Congress, left the Committee. In their places, Speaker Rayburn would appoint two Democrats: Paul J. Kilday of Texas and Henry M. Jackson of Washington.

Lilienthal interpreted the surprising Democratic victory as heartening evidence that his political philosophy was deeply rooted. He and others could enjoy the discomfiture of the professional pollster with his cold calculations and see in the election results a vindication of the citizen exercising his power in the privacy of the voting booth. However, an unexpected victory contains along with triumph some elements of danger. Those who counted upon a Republican president and Republican Congress found themselves again denied, and the cup of victory dashed from their lips. Upon these citizens lay a heavy responsibility. Once more they had to assume the role of the opposition, acting within the framework of the democratic system.

THE ULTIMATE RESPONSIBILITY

Toward the end of 1948, Lilienthal was disturbed by signs of weakness in the Commission's administration. Some of his awareness came from Shugg's abrupt tactics to cut debate and force action. Lilienthal admired Shugg's decisiveness, but uneasily recognized that the Commissioners and their policy-making function might be bypassed.

Theoretically the Commissioners should formulate policy and leave the operations to the general manager. In actuality the line between the two functions was hard to draw, for operational decisions created the environment in which policy was made. The Commissioners' need for information had to be met in some way which did not infringe upon the authority of the general manager. Somehow a balance had to be established between the strategy and the tactics of management. In the final analysis the five men who sat at the conference table and listened to the staff proposals bore the ultimate responsibility for the nation's atomic energy program.[78]

Lilienthal was particularly concerned about the Commissioners' need for information during contract negotiations. Since the Commission depended so heavily on private industry, the contract was a major administrative tool. Obviously no single type of contract was applicable in all circumstances. For certain matters, such as procurement of common materials or simple construction jobs, it was possible to seek competitive bids for a fixed-price contract. More often the unique character of the Commission's operations made such a course impracticable. Open bidding was not always possible because of the urgent need to get a project started or the imperative demands of security. Fixed-price contracts were often unacceptable to business leaders, who found it impossible to calculate costs and profit margin for constructing or operating unique installations of unprecedented complexity and involving unusual hazards. The result was that the Commission was usually forced to use a cost-type contract in which the Commission paid the costs and an additional
350 amount for the contractor's management skills. Contract negotiations clearly involved the general manager and the Commissioners: Wilson because his staff negotiated and administered the contracts; Lilienthal and his colleagues because the contract set policy and because they would be held responsible for poor contractor performance.[79] Strauss thought precise definition was the way to separate policy and management functions, but others were not so certain. Lilienthal felt that rigid delineation might destroy initiative. To him the answer was better reports, more frequent briefings, and easier access of the staff to the Commissioners.

More than once at the end of 1948, Lilienthal discussed administration with Wilson, Shugg, Fisher, and Green. Unless they found some means to make information available, Lilienthal did not see how the Commissioners could meet their responsibility. If the staff could not find a solution, then the Act ought to be changed. He did not believe that so drastic a solution was the answer. The Commissioners were only trying to keep up with developments; they were not attempting to abridge the staff's authority. At the final session, Shugg agreed to work out some system to meet Lilienthal's demand for early discussion of contracts. But, Shugg remarked, it was contrary to his eighteen years of business experience. Still, he admitted, conditions were different in Government.[80]

Lilienthal was disturbed by another weakness—the failure of the Commission to gain public understanding. He did not attribute the lack of success to Morse Salisbury, the director of public and technical information. Salisbury, with an extensive background in information services in the Government, had joined the Commission in September, 1947. His division as approved by the Commissioners on October 15, 1947, provided information as well as a declassification service. Salisbury had a complete printing establishment at Oak Ridge capable of issuing all reports from the most highly classified to those intended for public release. A small declassification branch monitored the activities with a consulting group of engineers and

scientists who provided advice on material submitted to them for declassification. The public information branch was the Commission's routine contact with the press.

The problems which Lilienthal saw were of a different magnitude. At home on the first day of 1949, Lilienthal set down his thoughts on public understanding and the Commission. He remembered that when the Commission assumed its responsibilities, one of the crucial issues was the need to overcome the irrational attitude on secrecy and security, to remove the feeling that atomic energy was surrounded by an impenetrable aura of mystery, and to create confidence in the civilian leadership. The obstacles were formidable —the reservations of the Joint Committee, the sharp scrutiny by the military, and the tenseness of the international situation. That these barriers remained largely unchanged he felt was not the fault of Salisbury, but of the Commission's failure to work out an effective approach.

Lilienthal saw no solution within the framework of the Commission structure. What must be found was a bold, imaginative individual who, reporting directly to the Commission, could devote all of his abilities to this matter. Lilienthal wrote his memorandum with a feeling that time was running out. "If my antennae about public opinion are working at all well (and they have been fairly sensitive in the past) we are approaching a situation—in say 3 to 6 months—in which our initial large credit balance with the public may be gone." [81]

GATHERING CLOUDS

Somewhat grimly, Lilienthal concluded that 1949 would be better, a cheerless optimism based on the somber analysis that things could not get much worse. He could also see evidence of progress. Shugg had begun a vigorous campaign to cut down administrative expenses. In the difficult area of personnel security, the Commission published on January 5, 1949, criteria for clearance eligibility. With this step at least something had been done to bring into the open the factors used in deciding whether to grant a clearance. Furthermore, during a hurried visit to Oak Ridge, Lilienthal was encouraged by the healthy spirit he found in the laboratory, a far cry from the despondency of the year before.[82]

Almost as soon as Lilienthal returned to Washington from Oak Ridge, he was confronted by virulent attacks. On January 11 and 12, 1949, Fulton Lewis, Jr., the radio commentator, stridently accused Lilienthal of poor judgment—or worse—in issuing a clearance to Frank P. Graham, president of the University of North Carolina. As head of the Oak Ridge Institute of Nuclear Studies, Graham required a clearance. During his active career he had, however, joined several organizations, some of which were alleged to be

communist-influenced. His membership in these groups, according to Lewis, made Graham a security risk.[83]

Hickenlooper raised another aspect of personnel security on January 12 when he questioned granting fellowships to applicants whose background contained derogatory information. Using public funds to educate a communist was indefensible, the Senator warned, and could lead to justified criticism. In the preceding June, Lilienthal had seen the issue as one which would serve to clarify the security problem, providing that the matter could be debated publicly. A suggestion to Hickenlooper that the subject be considered at a meeting with the Joint Committee drew no immediate response.[84]

The fifth semiannual report to Congress, an unclassified publication required by the Act, Lilienthal saw as a step toward a common-sense view of security. At a press conference on January 28, 1949, he proudly displayed the green-covered 152-page report. It was the first attempt to present an unclassified, comprehensive account of the Commission's operations. There were flow diagrams of various processes and several illustrations, among them photographs of the gaseous-diffusion plant at Oak Ridge and a production area at Hanford. Lilienthal promised future reports would cover reactors for nuclear power and for airplane propulsion. A third report was in preparation on the effects of nuclear weapons. The press accounts which followed tended to focus on military aspects. A cautious, carefully worded few sentences reporting improvements in weapon development were seized upon as an admission that the Commission had achieved a startling advance.

The Joint Committee viewed the report with some concern. On February 2, 1949, Lilienthal explained his philosophy that in a democracy an agency of the Government must insofar as possible make all of its actions public. Connally rejoined angrily, "Why is it necessary, because you spend public money, to go out and blah, blah all over the country about these bombs?" Senator Tydings declared that a photograph of the model of a proton synchrotron planned for Brookhaven should never have been published. Hostile military experts could reap too much information from the picture. The comment that a 420-foot tower at Brookhaven was the tallest structure on Long Island was another instance in which the Commission was imparting significant military information. It might be well, thought Tydings, for the Commission to clear its future reports with CIA and the military. In rebuttal, Holifield pointed out that the photographs had been published earlier.

McMahon broached a startling idea: Wouldn't it be well to study whether the number of atomic bombs could be released to the public? Carefully he defined his suggestion. Emphatically he was not talking about bomb technology, but only about the size of the stockpile. Others, McMahon pointed out, were suggesting that the information was needed by a democracy. In talking with Lilienthal on February 9, Truman ruled out the size of the stockpile as a matter for debate. Lilienthal probably expected no other

reply. More importantly, he learned that Tydings and Connally had complained to Truman about the amount of information on atomic energy being published.[85]

Lilienthal must have been discouraged. The reception of the semiannual report by the Joint Committee had not been what he had hoped. To Rayburn, Speaker of the House, Lilienthal confided that the Joint Committee as a means of keeping Congress informed was a failure. Within the Commission, the wrangling over technical cooperation was destroying the spirit of free and easy camaraderie that Lilienthal cherished. Waymack had resigned on December 21, 1948, and Bacher was soon to follow. Good relations with Truman was a matter upon which Lilienthal prided himself, but he could not learn who would be named to the vacancies. With some misgivings he had heard mention of Gordon E. Dean, a man whom Lilienthal had never met and whose main qualification seemed to be a former law partnership with McMahon. Lilienthal noticed that Wilson too, was worried and weary. At the close of one arduous day, the chairman of the Atomic Energy Commission telephoned the general manager and sang discordantly, "Don't let the bastards wear you down." [86]

HANFORD OVERRUN

Lilienthal escaped to Florida for a vacation on February 17. A few days later Bacher left for a western swing which would take him to Hanford, Berkeley, and Los Alamos. Returning first, Bacher alerted his colleagues to the fact that Hanford was in trouble. As part of the effort to move production operations out of Los Alamos, Hanford had begun to build plutonium fabrication facilities. General Electric and Commission people from Hanford had visited Los Alamos and had come away believing that it would not be too hard to take the laboratory technique and convert it to a production process. But General Electric had encountered one difficulty after another in developing the new process. The toxicity of plutonium required stringent safety precautions, particularly the provision of adequate ventilation and controlled air pressures throughout various parts of the building. Fred C. Schlemmer, who had replaced Shugg as the Commission's Hanford manager on September 15, 1948, uneasily watched the cost estimates mount from nearly $9 million to over $20 million. He had constructed Fontana Dam in the Tennessee Valley, but there he had been in direct command. Hanford he found vastly different. It was baffling and frustrating to have to delay construction as design changed and changed. Bacher did not find it hopeful that Schlemmer seemed to have trouble in prying information out of the company.

Bacher's news was not completely unexpected. Wilson on February 19 had warned the company officials about their excessive rate of spending.

Williams was worried. To the Commissioners' pointed questions on controls over expenditures of Government money he could give no satisfactory answer. He called Schlemmer on March 7 for a detailed report on each Hanford project. Wilson decided that to get the facts he needed a strong team to go to Hanford. He assigned Williams, Green, and Fisher to the task.

By the time Lilienthal returned it was possible to assess some of the causes of the Hanford overrun. From Wilson's and Shugg's account, Lilienthal judged that estimates had been badly bungled but that there was nothing scandalous in the situation. At Hanford, Williams telephoned Shugg on the difficulty of clearing away confusion and getting to the facts. However, there was no doubt that there had been inefficiency and a diffusion of responsibility. Less apparent was where the blame lay. Commission officials both at Hanford and Washington had accepted the faulty estimates. Lilienthal was despondent. The Commission could not compare with the TVA in management, although
354 he recalled that the latter agency began poorly organized. For his own sake, he was grimly determined to keep out of administrative details, no matter what happened.[87]

A MOMENT OF CALM

Lilienthal found no reason for cheer on security matters. Poor handling of Congressional relations in selecting a site for the reactor testing station brought a session with the Joint Committee. At the close of the meeting, which had gone reasonably well, Lilienthal had a few minutes' conversation with Senator Millikin on the Graham case. The Senator had no doubts of Graham's integrity, but because of Graham's associations, he thought the Commission had acted unwisely in overruling Gingrich and the Roberts board and granting a clearance. Millikin feared the action would throw doubts on the Commission's judgment. It would be wiser to deny a clearance to a person—even if no question of his loyalty existed—than to undermine public confidence. At least, remarked Lilienthal, it was a clear-cut issue.[88]

The Military Liaison Committee met alone in executive session with the Joint Committee on March 16, 1949, the first time the two groups had met together for about two years. Most of the session dealt with the relations between the military services and the Commission. Skillfully Major General Kenneth D. Nichols related the arguments for military custody of atomic weapons. In his opinion, the armed services should have responsibility for the design, production, and custody of the weapons. The military would be, after all, the user, and from this vantage point could contribute more to improving the weapon. Probably the main reason for Commission opposition to the transfer stemmed from the feeling that the weapons were not in condition to

turn over to the military. Cooperation with General McCormack was ideal, and the military's relations with the Commission were generally good. Nichols, head of the Armed Forces Special Weapons Project, and member of the liaison committee, found that working with the Commission was a slow and time-consuming process. On production of fissionable material the Commission was doing well; on reactor development the pace was exceedingly slow. Again, limiting himself to his own views, Nichols would also like to see the armed services directly represented on the Commission.[89]

The next day Lilienthal had a chance to refute charges of disclosing military information. To the Joint Committee he demonstrated that photograph after photograph in the fifth semiannual report had been published earlier—in some instances, under the Manhattan project. Even so he found the reaction disappointing.[90]

Oppenheimer and the General Advisory Committee presented a different perspective to the Joint Committee on April 6. In calm phrases Oppenheimer spoke of his committee's satisfaction with the Commission's performance. More progress had been made on weapons than the advisory committee would have believed possible. Firmly he defended the release of the photographs. McMahon's support for the need to disseminate unclassified information Oppenheimer skillfully sought by regretting that there was to be no opportunity for public debate on the size of the stockpile. Of course, releasing information raised perplexities; he was not even certain that the military had enough data to draw up sound war plans.[91]

NEW CRISES

No doubt Oppenheimer's support was welcome to Lilienthal but the relief was short-lived. On April 13, the Commissioners heard formally that fissionable material was missing from Argonne. Again unravelling the facts revealed laxity. Argonne employees on February 7 during the course of events discovered that a bottle of some 289 grams of uranium was missing from a storage vault. On February 14 the Commission security officer at Argonne was notified. Believing that the bottle had been misplaced, or perhaps emptied into a metal recovery can with other material, the Chicago office assigned a technician the task of finding the material. The job was not easy, for only precise and careful laboratory analysis could reveal whether the missing uranium had been mixed with the same material of a different enrichment. On March 21, the Chicago office notified Washington and seven days later asked the FBI to investigate. On April 27 the Commission notified McMahon of the disappearance.[92] Seventy-nine days had elasped since the absence of the bottle had been discovered.

Already a new crisis was in the making. On April 25, Senator Clyde Hoey of North Carolina wrote Lilienthal, asking if it were the Commission's policy to grant fellowships to Communists. According to the Senator a professed Communist at the University of North Carolina had been granted an award. Fulton Lewis, Jr., began a new series of attacks on May 12. That same day Senator Hoey called for an investigation, and the Joint Committee held hearings on the nominations of Gordon E. Dean and Henry DeWolf Smyth as Commissioners.[93]

The biographical facts for Dean were simple: born December 28, 1905, in Seattle, Washington; public school education; graduate of the law school at Duke University; an attorney from 1934 through 1940 in the Department of Justice; special executive assistant to Attorney General Homer Cummings and his successor, Robert H. Jackson; a law partnership with Brien McMahon; service in the Navy during the war; assistant to Jackson during the Nuremberg trials; and finally a professorship in law at the University of Southern California and private law practice. There was nothing in the terse summary to indicate a shrewd, pragmatic individual, endowed with a mind capable of drawing its own conclusions and a tenacity in expressing them.

McMahon had intended to hold confirmation hearings on Dean and Smyth together, but family illness prevented Dean from appearing on May 12. Smyth, however, was present. Unlike Dean, Smyth had a national reputation. McMahon quickly drew out the essential data: born May 1, 1898; educated and taught physics at Princeton; consultant to the Manhattan project. To most people, his name was familiar as that of the author of the Smyth report, the earliest unclassified account of the nation's wartime atomic energy program.

After McMahon's brief questioning, Hickenlooper explored with Smyth the subject of security. All went smoothly until Hickenlooper turned to the fellowship issue. The senator could not accept the idea of training a Communist with public funds. Smyth expressed his dislike of that aspect, but even more distasteful to him would be a procedure investigating students, a practice which might penalize young people with inquiring but as yet unsophisticated minds. Again Hickenlooper returned to the main point: Private foundations could, within reason, educate anyone they chose; the Government could not. If students were not employable in the atomic energy program, they should not be given public aid to study atomic energy. The senator and the prospective Commissioner touched on the issue circumspectly and amicably. There was no doubt that Smyth and Dean would be confirmed and there was no uncertainty as to where Hickenlooper stood on the fellowship matter.[94]

Although Smyth had emerged untouched, Lilienthal recognized that the questions on fellowships were a storm warning. He had been too long in Government, exposed to too many crises, not to see the signs of impending danger.[95]

THE STORM BREAKS

At first matters did not go too badly. At the opening hearing of the Joint Committee beginning on Monday, May 16, Lilienthal tried to place the fellowship issue in the context of Government intervention in education, an old and honored standard around which to rally. Applying a loyalty test to students not engaged in classified work, he saw as tantamount to such interference. On Tuesday, Detlev W. Bronk, chairman of the National Research Council, and Allan Gregg, head of the Commission's advisory committee on biology and medicine, testified. Bronk in particular, Lilienthal thought, had made a strong impression. At the end of the long day, Lilienthal was encouraged.[96]

The next morning headlines in the New York *Daily News* screamed, "Atom Bomb Uranium Vanishes." As soon as Lilienthal reached his office he called Shugg for details. In a few minutes the deputy general manager had the information. The copyrighted story, appearing over the name of William Bradford Huie, a free-lance writer, was broadly correct. Under the circumstances the testimony before the Joint Committee that morning by the North Carolina student was anticlimactic. The committee was focusing on an afternoon executive session at which Lilienthal, Wilson, and a few key staff members would explain the Argonne affair.

At four o'clock Wilson began. He said that most of the material had been recovered, but something over four grams and the bottle itself were still missing. Williams explained the accountability procedures and, with Wilson, assured the committee that nothing had been stolen. Relieved by the factual recitation, McMahon remarked that no harm had been done. Quickly Knowland caught him up. The California senator could not understand how anyone in the Commission could be certain of the whereabouts of any material. Representative Cole found the time lag from discovery to action inexcusable.[97]

The missing uranium was additional grist for Senator Joseph C. O'Mahoney's subcommittee on appropriations. The O'Mahoney group was in a strong position, for it could write into legislation stipulations that students receiving Government financial aid must meet certain criteria. The Argonne revelation had already damaged the Commission as Lilienthal, Pike, Strauss, and Wilson settled into their chairs on May 19 to hear O'Mahoney call the meeting to order.

A trying period lay ahead for the Commission witnesses. The brooding presence of Senator Kenneth D. McKellar as a subcommittee member must have brought back bitter memories of the 1947 confirmation hearings. The questions were sharp. Lilienthal's argument that the fellows were selected under contract by the National Research Council was brushed aside as an evasion. His warnings that loyalty oaths and background investigations

threatened academic freedom fell flat. Vainly Lilienthal called for perspective, asserting that one communist student could hardly overturn the Government of the United States. O'Mahoney and his subcommittee were immutably entrenched behind the proposition that Government funds must not be used to educate subversives.

For two more days in open session, O'Mahoney delved into the matter of the missing uranium. Lilienthal was clearly on the defensive. He could only admit that far too long a time had passed until the FBI was called; he could only acknowledge that the Commission had been guilty in moving too slowly; he could only agree that the criticism was merited. Of the ultimate results there could be no doubt. O'Mahoney was going to write controls into the legislation.[98] And there was no indication that the storm had played itself out.

INCREDIBLE MISMANAGEMENT

There was no letup. On May 22, 1949, Senator Hickenlooper demanded Lilienthal's resignation. Each day the senator had found new evidence of "incredible mismanagement." Lilienthal was still on the defensive. No longer could he rely on Vandenberg, so often a source of strength in the past. The senator felt that Lilienthal's position on the fellowship issue was weak and his attitude toward security loose. The charge was too broad, yet rang true enough to Vandenberg to make him think that Hickenlooper was performing a useful role. On the other hand, Truman exuded confidence. The attack, he thought, was political; Hickenlooper had an election campaign to fight in 1950.[99]

As comforting as Truman's assurance was, Lilienthal was greatly worried. But the very broadness of Hickenlooper's accusations gave him a chance he quickly seized. At home on May 25, he pounded out on his typewriter a challenge to investigate the Commission's—with his keen sense of language he skillfully selected the word—"stewardship" of weapons, production, research, and security. Lilienthal denied that the country was weak in atomic weapons or atomic material. He asserted, "It can be stated categorically that the record in this respect is a proud one." The facts should not be difficult to find. There were the many reports over the years to the Joint Committee. Moreover, the committee could call before it those competent to judge: scientists, industrialists, and members of the advisory committees. At his office he hurriedly polished phrases, seeking the tone he wanted. His first idea had been to issue the statement as a press release, but McMahon objected on the grounds that the Joint Committee was the proper forum. Lilienthal recast the statement into an open letter. The form did not matter to Lilienthal; what did was that he was taking the offensive.[100]

The issue was joined as the first of a series of hearings began on May

26. Through the long, hot days that followed Hickenlooper sought to establish a pattern of maladministration. His aim was narrowly focused. "This is an inquiry into the administrative direction and policies of Mr. Lilienthal as Chairman of the Commission itself." To make his case he added item to item and instance to instance. In the klieg-lighted, marble-paneled caucus chamber in the Senate office building, Lilienthal, his colleagues, the Commission staff, and witnesses faced Hickenlooper who, from the recesses of an inside breast pocket, drew recipe cards from which he read question after question. He compiled for the record a list of key individuals who were no longer with the Commission. The number of resignations after short terms of service he saw as evidence of dissatisfaction by highly qualified people with Lilienthal's management. He pointed to the alarming number of emergency clearances. Hickenlooper accepted the General Electric explanation of the Hanford overrun; his interest was in the system that permitted the cost to run so long a time unnoticed. Some of the meetings, particularly those dealing with personnel clearances, were held in executive session.

Hickenlooper hoped to prove that the Lilienthal Commission was guilty of lax security standards, and he sought to bring into the open specific cases, with names replaced by letters and with marks of identification omitted. As a device it was a failure. It proved impossible to drain an individual of his identity and transform him into a hypothetical figure illustrative of poor security practices.[101]

There were some flashes of humor. In presenting statistics on the Commission employment turnover, Lilienthal observed that some had left for maternity reasons: "This may be evidence of incredible mismanagement, but not on the part of the Commission." Laughter welcomed the comment, but such occasions were rare.

Despite attempts to work out in advance an agreement upon a line of questioning, there was no certainty as to how each session would develop. Division directors in their offices sat with briefcases packed with charts and records, gathered in hope that they might supply the answer to a Joint Committee question. Not until the cavalcade of cars departed for the Senate office building did the key staff know whether they were to spend the day at their desks or at the witness table. For many, the nights were spent in preparing testimony for the next session. For others, whose positions had not involved them in policy matters, the hearings were a source of bewilderment.

Repercussions in the field were not as great. Walter H. Zinn recognized that probably some people would always believe the loss of uranium was the result of espionage. The education of Congressmen, he told his staff, was a duty that no one should avoid. At Oak Ridge one scientist asked to be relieved of all duties relating to plutonium recovery. The reason was not the health hazard, as serious as that was, but the danger to name and reputation through working in the area.[102]

Interest in the hearings lagged as they continued. The press turned to

the sordid revelations of the Judith Coplon case and the mysterious and perplexing net that linked Alger Hiss and Whittaker Chambers. Neither Lilienthal nor Hickenlooper attended every session. Other duties sometimes accounted for sparse attendance. The hearings on the controversial B-36 bomber took some committee members away, and drew from the irascible Connally the pungent comment at the final session on August 25, "Well, this started out like a B-36, but wound up like a single-seater, didn't it." [103]

The committee majority submitted an eighty-seven-page report in vindication of the Lilienthal Commission. As substantial achievements, the majority pointed to the growing stockpile of atomic weapons and to the successful tests of improved weapon designs at Eniwetok in 1948. Far too long a time had elapsed before the Hanford overrun had been discovered, but this could be attributed in part to developing a new partnership between industry and Government. The likelihood of a recurrence would diminish as
360 the Commission continued to implement its industrial-type cost accounting system. In other areas—production, reactors, and research—the Commission had much of which to be proud. The export of isotopes, the majority concluded, had taken place without objection from the Department of State, the Department of Defense, and the Military Liaison Committee. After hearing Oppenheimer testify on the matter, the majority of the Joint Committee did not believe that the Commission had violated the Atomic Energy Act. The dissent of Strauss was accepted as evidence of a healthy spirit. An analysis of the specific cases about which there were alleged security doubts revealed no cause for condemnation of the Commission's security procedures.

Hickenlooper in a three-page minority report declared otherwise. Based upon secret information and testimony, much of which had been gained over the years of the committee's existence, the minority found that the Commission should have made greater progress in weapons. In certain areas the Commission's actions had been leisurely and characterized by indecision. Security had been loosely administered, and Commission management inadequate.[104]

It was possible to look at the issues separating Lilienthal and Hickenlooper in broad philosophic terms. To the Commission chairman, atomic energy was a power to be brought into the life and understanding of the people as soon as possible. To the Senator, atomic energy was the great bulwark of the nation, and factual information was to be guarded zealously. The closer Lilienthal came to his goal, the more Hickenlooper was disturbed. The minority and majority reports could not conceal the anguish the hearings held. As they were centered upon Lilienthal, so he felt them most deeply. The way in which the proceedings often mired down in petty detail he found revolting; that a man as eminent as Zinn should have to lecture upon the contents of a bottle was distressing and worse, a waste of time and talent. Lilienthal could only feel that his entire career, and all that he stood for, was

in pillory. He found no victory, snatched from the jaws of defeat, as had been so exhilarating in the days of TVA. He found no occasion for eloquence, as he had during the confirmation hearings. There was only detail after detail, a seemingly endless erosion of the principles and reputation of years.

In the public view Hickenlooper had lost the verdict. But Lilienthal was exhausted and wounded, the Commission confused and cautious. That spirit which made it possible to speak of a Lilienthal Commission was shattered. In the quiet of Martha's Vineyard, where he sought rest, Lilienthal may have realized that his public career was over.

DECISION OF DESTINY

CHAPTER 12

The United States Senate set a new record for short sessions on Saturday, September 3, 1949, when it succeeded in assembling and adjourning in forty seconds. Like many Washingtonians, the senators were anxious to leave the Capitol for the Labor Day weekend. Much to the satisfaction of F Street merchants, there was a rush of "back-to-school" buying during the day, but by late afternoon most of the central city was deserted. Even the traffic on Pennsylvania Avenue in front of the White House had subsided to an occasional streetcar and a few automobiles. On G Street, just west of the Executive Mansion, the office buildings were empty except for a few guards and an unlucky group of Air Force officers and enlisted men who had drawn duty on the last holiday of the summer. As the slanting rays of the afternoon sun pierced the clouds, the staccato rhythm of a teletype broke the drowsy tedium. No one could yet suspect the report sputtering from the machine would set in motion a chain of events placing on the Commission and the Administration a burden of extraordinary decisions. For the tangle of events of the next five months recorded more than a political struggle; they seemed to involve the very destiny of man.[1]

SHOCK FROM THE EAST

The teletype report alerted the headquarters of the Air Force's Long Range Detection System that a WB-29 weather reconnaissance plane on routine patrol from Japan to Alaska had picked up some measurable radioactivity. A filter paper, exposed for three hours at 18,000 feet over the North Pacific east of the Kamchatka Peninsula, had produced slightly more than the number of radioactive counts per minute necessary to constitute an official "alert." The

report required attention but did not justify alarm. In more than a year of operation the Long Range Detection System had registered many such alerts, none of which had proved to be the result of a nuclear detonation, and this one barely qualified under the criteria. In any case, its significance would be unknown until scientists could analyze the samples. By Monday morning, however, there was enough information to spoil the holiday for most of the Long Range Detection staff. A second filter paper from the same aircraft produced a substantially higher count. Additional measurements seemed to indicate that the activity came from fresh fission products in the atmosphere. Were they from bomb debris or from some accidental release? [2]

The first measurements of radioactive decay in the samples were not very revealing. On the chance that a Soviet nuclear test had produced a radioactive air mass, the Air Force dispatched several special flights to filter the air in different portions of the Pacific. Even before these flights were completed, other routine missions reported picking up radioactive samples, one with twenty times the count rate of the original. By Tuesday positive interpretations were coming in from the special flights and from ground stations in the detection system. By three-thirty on Wednesday morning, laboratory analysis revealed the presence of fission isotopes in the first samples. This fact showed nuclear fission to be the source of the radioactivity, perhaps in a test weapon, perhaps in a reactor accident. Which had produced the radioactivity was the all-important question. To find that answer and the exact location of the radioactive air mass, the Air Force dispatched every available plane to the area with instructions to pick up as many samples as possible.

William Webster, deputy for atomic energy to Secretary of Defense Louis A. Johnson, was among those who now thought it conceivable that the Soviet Union had detonated a nuclear test device, if not a weapon. Early Thursday morning he called on Carroll L. Wilson to discuss these preliminary results with the general manager. Webster was concerned that, no matter how many samples the Air Force collected, the final determination of whether or not the Russians had succeeded in developing a nuclear weapon would rest on a highly sophisticated interpretation of these facts. For one thing, the Russians had apparently caught the United States off guard by breaking the American atomic monopoly months earlier than most experts had predicted. Some people might find that fact hard to accept. For another, everyone might not interpret the indirect evidence the same way. To avoid this difficulty, Webster suggested appointing a committee of outstanding scientists to examine the evidence. Wilson agreed that Vannevar Bush would be a natural choice as chairman of the panel. The venerable scientist was again a private citizen, having returned to the Carnegie Institution after almost a decade of Federal service. Bush's views were likely to be acceptable to both the military and the Commission. Wilson agreed to sound out the Commissioners on the idea. After Webster left, Wilson called in Spofford G. English, an experienced

radiochemist in the research division, and asked him to examine the technical evidence being gathered by the Long Range Detection System. Then he asked Walter F. Colby, the Commission's new director of intelligence, to gather what information he could through intelligence channels. Wilson thought the Commission should make every effort to satisfy itself that the reports were accurate.[3]

By Friday noon Wilson had made some progress. The three Commissioners present had reacted favorably to the proposal for the Bush panel, and over lunch Wilson discussed the panel's assignment with his former mentor. English reported that he was satisfied with the evidence the Air Force had collected so far. But before the end of the day there was a new crisis. Just before five o'clock, Bush phoned to ask Wilson to call the Air Force at once. Within twenty minutes the military and civilian chiefs of the Long Range Detection System were in Wilson's office. The radioactive air mass had
364 crossed the North American continent and was headed out over the Atlantic. Would it be possible, the Air Force officials asked, to alert the British to collect samples as the air mass passed over? [4]

This was a sticky matter for Wilson. To alert the British might constitute a technical violation of the Atomic Energy Act, an unhappy prospect so soon after the "Cyril Smith affair" and the criticisms of the technical cooperation program which that incident generated. But to withhold the information even for twenty-four hours might preclude the possibility of obtaining British samples. Perhaps he could justify the action under the technical cooperation program, but there was no time to find out. Wilson picked up the telephone at six o'clock and called Alexander K. Longair, the British representative on technical cooperation in Washington. Longair, who had just reached his home, hurried to the Air Force office on G Street. He understood the situation at once and thought he could get prompt action in London. An Air Force car sped him to the Pentagon, where he spent most of the night in classified teletype conversations with ranking officials in London. He assured himself before going home in the early morning hours that the British would be collecting samples that day.

Few persons outside the Commission and the Air Force yet had any intimation of a possible Soviet test, but those who did had plenty to do. As additional filter samples came in, radiochemical analysis began to give the first indications of the time of the event and the composition of the test device. English, working with the Long Range Detection staff, arranged for independent radiochemical analyses at Commission laboratories. By Wednesday, September 14, most of those in the know were convinced that a Soviet test had occurred. A notable exception was Secretary Johnson, who despite Webster's argument that 95 per cent of the experts accepted the fact, preferred to side with the 5 per cent who doubted the evidence. For the Commission, Johnson's uncertainty expressed itself in an unwillingness for the moment to consider any announcement of the evidence, even within the

Government. At a meeting on Wednesday afternoon Pike made clear the Commission's growing impatience over the lack of any movement toward a decision to announce the Soviet accomplishment. So many people, including the British, had already heard the news that it seemed impossible to avoid a leak of information eventually. Truman himself had known the facts for only a few days, but the Commission had no desire to arouse the displeasure of the Joint Committee by neglecting to keep them "fully and currently informed" about so sensitive a matter. The very significance of the question, however, made it all the more important to verify the facts. Both Webster and Wilson thought the Commission should delay any announcement until more solid evidence was in. Reluctantly Pike, Strauss, and Dean agreed.[5]

The implications of a probable Soviet test undoubtedly colored the Commission's discussion that same afternoon of the draft report to the President on expansion of production facilities. Presidential appointment of the special committee of the National Security Council, consisting of Secretaries Johnson, Dean G. Acheson, and Lilienthal, had assured the Commission a voice in policy decisions concerning nuclear weapons. Staff officers of the three agencies had hammered out a draft report which came to the Commission for discussion. On September 14, Wilson stressed at the outset that the report was mainly the work of the military establishment. The conclusion of the report, namely that the substantial increase in the production of nuclear weapons would be in the interest of national security, came from the Department of Defense alone. Neither the State Department nor the Commission's representatives had seen evidence supporting this position. They had merely examined the foreign policy and the technical aspects of the proposed expansion. Commissioner Dean summed up the Commission's position by suggesting that the report specifically call these limitations to the President's attention. For obvious reasons the draft report could make only one cryptic acknowledgement of the Soviet accomplishment, but events of the previous few days had provided an impressive new argument for the expansion proposal.[6]

On Monday morning, September 19, Robert Oppenheimer, a member of the Bush panel, met Wilson at his office and they joined Pike for the short ride to the Air Force detection headquarters on G Street. There the other panel members, former Commissioner Robert F. Bacher and Admiral William S. Parsons, were assembling with General Hoyt S. Vandenberg and other high-ranking Air Force officers, a dozen scientists from various laboratories, and a British delegation under William G. Penney. Bush began the meeting with a brief introduction, and the British and American officials exchanged information about their national detection systems. Then the panel got down to questioning the scientists who had collected and analyzed the data from the suspected nuclear detonation. Wilson stayed until the lunch break. Although the panel had not yet started drafting its report, he had no doubt that the scientists would conclude that the event had been a Soviet nuclear test. The

internal consistency of the reports was evident. The hundreds of samples collected across a broad portion of the northern hemisphere showed good correlation in the composition and age of the fission products, and their wide dispersal led to the conclusion that they had come from a single, large fission reaction. It was still not possible to fix the exact time and location of the detonation, nor to determine conclusively the composition of the device, but there was no reluctance on the part of the panel to accept the conclusion in Oppenheimer's draft that the observed phenomena were "consistent with the view that the origin of the fission products was the explosion of an atomic bomb" on August 29.[7]

INFORMING THE PUBLIC

Shortly after three o'clock on September 19 Pike and Bacher returned to the Commission's headquarters on Constitution Avenue. There was a brief meeting with Strauss, Dean, and Wilson. All agreed that the panel's unanimous finding made it all the more important to make the Soviet achievement public as quickly as possible. The only way to guarantee a decision was to bring Lilienthal back to Washington to see Truman. Within an hour General James McCormack was on his way to the airport to leave by military aircraft for Lilienthal's vacation retreat on Martha's Vineyard. Late that evening when Lilienthal returned to his summer residence, he found McCormack waiting for him. On the plane back to Washington early the next morning Lilienthal had an opportunity to learn from McCormack the succession of events during the previous weeks. The panel report was convincing. If Bacher and Oppenheimer saw no reason to doubt the occurrence of a Soviet test, Lilienthal could accept it as fact. He called his old friend, James E. Webb, now serving as Under Secretary of State. Webb ruled out any immediate announcement of the discovery. After weeks of crisis the announcement of the devaluation of the British pound the day before had left the world's financial centers too near panic to sustain the news the President was withholding. Lilienthal could appreciate this point of view, but he also understood the deep concern of the Commissioners, Bacher, and Oppenheimer. Bacher feared that with three hundred people knowing the facts, a leak would be inevitable. He thought the Government should take the initiative in announcing the facts rather than trying to shore up a leak.[8]

A call to Admiral Sidney W. Souers, executive secretary of the National Security Council, brought an appointment with the President that same afternoon. Truman told Lilienthal he always believed in giving the people the facts, but crises all over the world, the British devaluation, and the threat of strikes made him pause. Although Lilienthal made a plea for a forthright announcement, Truman wanted to wait until the immediate crises

had passed. He was not even certain the Russians had the bomb. Lilienthal did his best to convey the convictions he found in the detection panel's report, but Truman was still inclined to delay. He had heard most of Lilienthal's arguments the previous evening in discussions with Secretary Johnson, General Omar N. Bradley, and the Joint Chiefs. He did not intend by an immediate announcement to make things more difficult for the United Nations General Assembly, then meeting in New York.

In a way Lilienthal was disappointed. He thought the President had made a mistake, but he accepted the fact that the decision was the President's responsibility. This was the point he made later in discussing the meeting with the Commissioners, Bacher, and Oppenheimer. Oppenheimer especially found the news upsetting. He deplored the decision as missing an opportunity to get atomic energy out of the miasma of secrecy in which it had been caught. This was another case of trying to keep a secret when there was none. Lilienthal agreed with Oppenheimer, but there was little more he could do. He stopped off for a drink at Pike's apartment and then headed back to Martha's Vineyard by military plane.

Although Lilienthal did not find his conversation with Truman encouraging, Pike detected the possibility of quick action when he called Admiral Souers at the White House the following morning. Souers was certain the President understood the difficult position in which he had placed the Commission, but he intended to take full responsibility for withholding the news from the Joint Committee until the time was right. Secretary of State Acheson, presumably after conversations with British Foreign Minister Ernest Bevin and others at the United Nations, did not think that time had yet arrived, but Souers thought the President would act before the end of the week. Truman had made it clear the decision was now in his hands; the Commission would simply have to wait for him to act.[9]

Perhaps Souers was being less than candid in an effort to protect his chief; for Truman was already beginning preparations for an announcement. After a full-dress review of the evidence with the Joint Chiefs on Wednesday, September 21, he called Senators Brien McMahon and Bourke B. Hickenlooper as chairman and ranking minority member of the Joint Committee, and invited them to the White House the following day. Hickenlooper was out of town, and McMahon came alone. Truman showed him the Bush panel's report and told him he would announce the detection of the Soviet test at the regular Friday meeting of the Cabinet the next day.[10]

Early Friday morning, before the Cabinet meeting, Webster rode to the Capitol with Generals David M. Schlatter and Albert G. Wedemeyer. Oppenheimer, who was in Washington for the regular meeting of the General Advisory Committee, and Commissioner Pike joined them in the hearing room with as many members of the Joint Committee as McMahon had been able to assemble on short notice. There was little time to brief the committee before the Cabinet announcement, but Webster observed ruefully that he

could not say much more than that the United States had picked up evidence of a Soviet detonation. As courteously as possible, he fended off questions about the detection system until the telephone calls came from the White House reporting the Presidential announcement. While the President was informing the Cabinet, Charles G. Ross gave the press a written statement. The President's reference to a nuclear explosion rather than a weapon perhaps reflected his reservations about the panel report, but Lilienthal thought the release showed some effects of his plea for a frank report to the nation. To the terse statement the President had considered earlier in the week, Truman had added a paragraph putting the Soviet accomplishment in context. Scientists had known since 1945, he reminded the American people, that the United States monopoly of the weapon was temporary at best and that the basic facts of nuclear fission were available for all nations to exploit. The Russian explosion demonstrated that fact and stressed once again "the necessity for
368 that truly effective enforceable international control of atomic energy which this Government and the large majority of the United Nations support." [11]

If the Joint Committee reflected public opinion, Truman had wisely added the paragraph as a device to avert public anxiety. The committee's first reaction was one of shock and alarm. Why had the United States been caught unawares and how dangerous was the threat of a Soviet attack? There was even vague talk of the possible need for military reprisals. Despite Webster's efforts to put the event in perspective, clouds of anxiety gathered in the hearing room just as storm clouds outside piled up over the capital city. When a clap of thunder startled the legislators in their seats, someone exclaimed, "My God, that must be Number Two!", and laughter swept away the tension of the moment. The meeting adjourned on a reasonable note, but there was no doubt that the news of that morning would influence the politics of atomic energy for many months to come.

Oppenheimer appreciated this fact when he returned to the meeting of the General Advisory Committee at the Commission's headquarters. The committee had discussed the news the previous day and had already recognized the possible impact on the production of weapons and fissionable material. Commissioner Smyth also saw the possibility of more interest in civil defense and public pressure to concentrate on weapons at the expense of fundamental research. To Glenn T. Seaborg, the Russian accomplishment demonstrated the futility of secrecy, which seemed to hamper the exchange of information among American scientists and with the British rather than to impede Russian progress. Although the security of information was still vital, as Oliver E. Buckley reminded his colleagues, Oppenheimer summed up the committee's attitude in the hope that the Russian achievement would result in a more rational security policy in the United States. Beyond this general observation, the committee had not yet had time to consider the implications of the President's announcement. For the moment it was more profitable to evaluate the premises in the proposed report to the President on the expansion

of production facilities, to explore ways of increasing plutonium production at Hanford, to spur the development of better weapons, and to examine the need for more production reactors. Oppenheimer scheduled the next meeting for early December, but he and his associates would be on call should the Commission need them sooner.[12]

Elsewhere in Washington the President's announcement had generated a new sense of urgency. Just down the hall on the second floor of the Commission's headquarters building, Dean, after a telephone conversation with McMahon, was dictating a memorandum pointing out the need for some tangible response to the Soviet challenge. At the Pentagon, General McCormack was involved in an all-day session with Edward Teller, John von Neumann, and key members of the Los Alamos staff. The meeting, scheduled early in August to discuss the need for tactical as well as strategic nuclear weapons, seemed more to the point after the White House announcement. After the meeting Teller called Oppenheimer to ask what he could do to meet the Soviet challenge. Oppenheimer's advice, Teller later recalled, was: "Keep your shirt on." That was perhaps good advice for the moment, but it could not long curb Teller's restless imagination.[13]

FIRST REACTIONS

The weekend gave the nation a chance to adjust its thinking to the new facts of world power. By Monday, September 26, it was clear that the Administration had succeeded in its efforts to announce the event without causing public alarm. Most newspapers reported the facts without sensationalism and many chose to quote General Bradley, the chairman of the Joint Chiefs, and General Groves to the effect that the news was not alarming. There was a consensus in the press that the Russians had accomplished their feat about two years earlier than intelligence sources had predicted.[14]

Within the Commission the news had stirred new efforts going beyond the production expansion plans already on the drawing boards. At a special meeting of the program council on Monday morning, each division director outlined the possible implications for his activity. In some respects the session was merely an exercise; but, as Commissioner Dean had wisely suggested on Friday, the public and the Joint Committee would expect the Commission to respond to the new Soviet threat with specific proposals even though, as Dean believed, the Commission was "in an unusual state of readiness." The proposed report to the President would commit the Commission to constructing the waterworks for operation of the new DR replacement reactor recently completed at Hanford and a third addition, K-31, to the gaseous-diffusion plant at Oak Ridge. General McCormack suggested bringing more scientists into weapon development, transferring nonnuclear components of weapons to

the military, speeding up the change of contractors at Sandia, and increasing the production of nonnuclear components. Walter J. Williams, the director of production, proposed to speed up the construction of the K-29 diffusion plant, already delayed by a lag in Congressional authorization, some changes in weapon specifications, and greater emphasis on Redox. The need for larger amounts of uranium ore was obvious, and John K. Gustafson, the director of raw materials, planned to meet that requirement by stepping up deliveries from the Belgian Congo and the Colorado Plateau. Lawrence R. Hafstad, the director of reactor development, was already thinking of new reactors to generate large quantities of neutrons for producing plutonium or even tritium for thermonuclear weapons.[15]

Lilienthal, just back from Martha's Vineyard, had his first opportunity on Tuesday morning, September 27, to judge the draft report to the President. He found no difficulty in accepting the proposals for expanding production facilities, but the premises of the report bothered him. He had hoped that appointment of the special committee of the National Security Council would permit the Commission and the Department of State to participate in any recommendations to the President on military aspects of the atomic energy program. He thought a full and frank discussion of views within the three agencies would more likely lead to a balanced and forthright analysis of the issues for the President. As it now stood, the draft report did not represent a group judgment but rather was a composite of agency views; it accepted without explanation the statement of military requirements by the Joint Chiefs. Secretary Johnson clearly had no intention of admitting State Department or Commission officials to the inner circles of military planning. He had told Webster that he would not permit the Commission, as the "producer" of nuclear weapons, to participate with the military, as the "consumer," in determining weapon needs for the same reason that he was opposed to having the Department of Defense certify the need for additional Commission facilities.[16]

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If Lilienthal now saw little chance of asserting the Commission's influence in military planning, he still hoped that he and his associates could present to the Joint Committee a balanced response to the Russian accomplishment. He told the committee on Wednesday, September 28, that the Commission saw the need for greater speed and higher priorities in producing nuclear weapons; but he maintained such action would mark no departure from the principle upon which the Commission had operated since 1946, namely, that the nuclear superiority of the nation's defenses always came first. He appreciated Congressional interest and support, but he implied in his statement that committee backing on such mundane matters as removing the construction rider recently attached to the Commission's appropriation would do more good than some hasty and dramatic declaration of Congressional intent. Getting down to practicalities, Lilienthal said the Commission would need as much as $30 million to construct the DR waterworks and as much as

$350 million for K-31. Should the President decide to seek immediate appropriations for these projects, Joint Committee support would surely be important. No less vital, Lilienthal said, was removal of the appropriation rider, which forbade the start of construction without accurate estimates of total cost. Williams argued that instead of starting construction when plans were 15 per cent complete, contractors would have to wait until 80 per cent of the drawings were finished. This limitation would cost the Commission at least five months in starting construction of the Redox plant.[17]

The committee's reaction was not very encouraging. Few members seemed convinced that the rider really hampered the Commission. More fundamental was McMahon's inability to agree that the situation demanded nothing more than speeding up the existing program, as Lilienthal contended. McMahon read into the record a letter he had written to Secretary Johnson on July 14. That letter, clearly reflecting the thinking of William L. Borden, the committee's staff director, started from the assumption that strategic bombing with nuclear weapons had become the nation's first line of defense. From this proposition McMahon was prepared to argue that the nation could never have enough atomic bombs. Borden and the committee staff had been cataloguing every conceivable measure for maximizing the nation's nuclear strength. He invited the Commissioners to come back the next morning to discuss the staff report.

That same afternoon the Commissioners had an opportunity to check their stance with the Military Liaison Committee at a regularly scheduled meeting. The service representatives confirmed their support of the draft report to the President as a sound and practical response to the Soviet threat. General Kenneth D. Nichols, chief of the Armed Forces Special Weapons Project, suggested a few measures to speed the conversion of the nuclear stockpile to newer models, but he agreed there would be little advantage in advancing the date of the next weapon test, scheduled for early 1951.[18]

On Thursday morning, September 29, McMahon began the hearing by reading Borden's staff report on increasing military strength. In writing about requirements, Borden did not miss the opportunity to raise again the question of the committee's access to weapon stockpile information. Without that information, McMahon added, the committee would find it difficult to share with the Commission the enormous responsibility of assuring the nation's defense in the atomic age. Even so, Borden found much in the existing situation to cause alarm. Production goals, Borden guessed, were probably not based on the assumption of a Russian detonation in the summer of 1949. He saw no reason to believe that the Russian effort would be limited by a shortage of raw materials or that it would be any smaller than the American program. Since World War II, the United States had devoted no more than one-thirtieth of its military budget to nuclear weapons. Did that seem sufficient? Did existing requirements for nuclear weapons contemplate bombing military as well as industrial targets in the Soviet Union? Borden had other

questions, but the facts he had led him inexorably to the conclusion that there should be a substantial increase in the requirements for nuclear weapons and a new, concerted effort to develop the ultimate weapon system—the thermonuclear weapon carried by a nuclear-powered airplane.[19]

Lilienthal had Wilson and all the division directors present so that they could describe the steps already being taken to accelerate production. Although this discussion took several hours, the staff members had to do little more than repeat their presentations to the program council on Monday. The only new topics were the possibility of strengthening Los Alamos and building a thermonuclear weapon. On the first point, Wilson held that Los Alamos was making the best use of the "great men" of nuclear physics through consultantships and summer employment at Los Alamos. Teller had made it a practice to spend the summer with the theoretical division at Los Alamos after he joined the faculty at the University of Chicago. Lilienthal feared that
372 recruiting men like Eugene P. Wigner, Oppenheimer, Teller, and Leo Szilard for Los Alamos would undermine the morale of the excellent staff already there, by implying that it was not equal to the job. Pike suggested that Oppenheimer's talents would be better used if he were consulted on special problems rather than put to work full time at Los Alamos.

As for the thermonuclear weapon, Wilson described the Commission's plans for testing the principle of fusion. McCormack added that there seemed to be general agreement that development would be a major endeavor over a period of years. Such a weapon might be practical in sizes as large as one million tons of TNT. But no one yet knew how to obtain, even with a fission explosion, the temperatures and pressures necessary to trigger the thermonuclear reaction even if it could be triggered. Furthermore, it hardly seemed possible to carry such a weapon in an airplane; delivery by railroad train or by ship seemed more likely. In any case, thermonuclear weapons would probably require large amounts of the heavy-hydrogen isotope, tritium. Quantity production of that material would require reactors producing far more free neutrons than any facility then built or planned for plutonium production. McCormack suggested the possibility of starting development of such reactors at once, even though the scientists would not be able to answer many of the theoretical questions about the thermonuclear reaction before the 1951 weapon test series.

For the moment Lilienthal was concerned about closer cooperation with the British and better public understanding of civilian defense against attack with nuclear weapons. He acknowledged that the Government had supported some technical studies, but he thought there had been a lack of open consideration of general policy issues. Technical cooperation was now an urgent matter, and he accepted McMahon's invitation to discuss it with the Joint Committee early the following week. Shortly after noon as the Congressmen hurried to the floor, Lilienthal left the Capitol for lunch with Acting Secretary of State Webb, who told him that there was little hope of closing the

gap between the British and American positions on the exchange of technical information. The stimulating conversation with Webb and George F. Kennan quickly dispelled his reflections on the morning's frustrations. On the plane that afternoon, returning to Martha's Vineyard, Lilienthal was preoccupied with the issues of international affairs. The grubby problems of production and weapons seemed suddenly far away.[20]

THE QUANTUM JUMP

The other Commissioners could not so easily escape the operating details on which the expanding production of weapons would depend. That same afternoon, Pike, Dean, and Strauss studied John K. Gustafson's plans for negotiations with the South Africans in November, the construction of a natural gas line at Oak Ridge, and the possibility of testing a new weapon model early in 1950. After the staff had left, the Commissioners came back to the matter of an appropriate response to the Soviet threat. Was the planned expansion of production facilities large enough or would some extra effort be necessary? Strauss, recalling earlier discussions, was leaning toward developing the thermonuclear weapon. Dean thought some extra effort was called for, but he had not yet decided what it should be. Pike as yet had come to no conclusions.

The discussion apparently clarified Strauss's views. The next morning he dictated a draft memorandum to his fellow Commissioners. The Commission had long held, he wrote, that the United States had to maintain its lead over the Soviet Union in atomic weapon superiority. Until September 23, the United States had enjoyed an absolute superiority; now it had only a relative advantage which would surely diminish. The nation should if at all possible regain the absolute advantage, and that could be accomplished only by a "quantum jump" in weapon technology such as the thermonuclear weapon promised. He urged the Commission to consult the General Advisory Committee on the subject.[21]

But how could Strauss persuade his associates and the Administration to accept his views? When he showed his draft to Pike and Dean on Friday, September 30, he found them open-minded but not convinced. He had no reason to believe that either Lilienthal or Smyth would accept his proposal. Without the Commission's support there would be little chance of bringing the issue to the President. He did not want to go to the President directly, but he was thinking of approaching Admiral Souers, whom he had come to know in the Navy during World War II. From his own experience Strauss knew how hard it was for a minority of one to carry an issue in the Commission, but in this instance he would have had reason to expect help. Teller and some of the scientists at Los Alamos were interested in the "Super." McMahon and

Borden were looking for ways of adding to the nation's nuclear strength, and their views might influence Dean. Another likely source of support was Ernest O. Lawrence and the scientists at the Berkeley laboratory, who had made it a tradition to meet every challenge in a national emergency. It had been a busy and somewhat confusing week, but the nation's response to the Soviet threat was beginning to emerge, at least in the form of alternatives. If Strauss could make those alternatives clear, he might be able to carry the decision.

When Lilienthal returned from Martha's Vineyard the following week, his thoughts showed how far Strauss was from his goal. Still struggling with philosophical issues rather than operating decisions, Lilienthal chose Wednesday, October 5, to discuss with the Commission the proposed report of the special committee of the National Security Council. He still saw the issue largely in terms of civilian-military control, but he had given up any hope of basing the report on broad considerations of national security or military

strategy. With reluctance he was willing to send the report to the President as the best the Commission could do under the circumstances. This concession hardly sounded like the man who six months earlier had championed the Commission's right to participate in all discussions of national policy involving nuclear weapons. Somehow, the weeks of seclusion had failed to restore the energy and taste for a challenge which had always marked Lilienthal's career.

If the report were to go to the President essentially as it stood, the Commission could consider the mechanics for launching the construction of new production plants. The first step was to ask the President for a supplemental appropriation so that the Commission could negotiate contracts. Rather quickly the discussion descended into a morass of details concerning construction schedules, budget estimates, and obligational authority. For Strauss, still hoping that the Commission would find a bold and imaginative response to the Soviet threat, the discussion was a disappointment. There was no occasion to discuss the superweapon, or to present the memorandum he had drafted the previous week. Rather than force the issue, Strauss chose to wait until after the meeting to send Lilienthal a copy.[22]

Strauss found an occasion to unburden his concern that noon over lunch with Admiral Souers. The more he thought about it, the more he believed the Super was vital to the national security. The Commission was not prepared even to discuss the subject. Was the President aware of the possibility of a thermonuclear weapon? Souers did not think so. Strauss went on in a general way to explain the technical difficulties in developing such a weapon. These were formidable, but Strauss guessed they could be overcome. Clearly impressed, Souers urged Strauss to prod the Commission toward a report to the President. Later Souers found that Truman seemed to know nothing about the Super, but showed an immediate interest. Truman wanted Strauss to force the issue up to the White House and to do it quickly.

Just how Strauss was to accomplish his task was not at all evident. On

Thursday and Friday the Commissioners were preoccupied with the appropriation request for the new production plants, especially after they learned that the President did not intend to send Congress a supplemental request in the closing days of the session. Truman had concluded that a last-minute request would not only be bad legislative strategy but would also tend to exaggerate in public eyes the Administration's reaction to the Soviet accomplishment. Carleton Shugg and Wilson pointed out the danger of embarking on a construction program on the strength of informal and confidential assurances of Congressional support. On Friday Lilienthal stayed home to work on a speech while the rest of the Commissioners spent the day debating the issue with officials from the Bureau of the Budget.[23]

If Strauss had no further opportunity that week to advance his proposal, he might have taken comfort in other developments. On Thursday, the day after Strauss sent his memorandum to Lilienthal, Lawrence met Wendell M. Latimer, the dean of chemistry, at the faculty club in Berkeley. Latimer, long dissatisfied with the Commission's efforts in building a nuclear stockpile, was more worried than ever about national security after the Russian accomplishment. He felt certain that the Russians, spurred by the United States lead in producing fission weapons, would try a short cut to superiority by pushing development of a thermonuclear weapon. Lawrence was not easily swayed by new ideas, but he would not let technical difficulties stand in the way once he had decided such an idea was vital to the national interest.

Half-convinced by Latimer's plea, Lawrence headed back up the hill to the Radiation Laboratory, where he dropped in on Luis W. Alvarez, who was still directing the linear accelerator project. Alvarez was surprised to see Lawrence, but he soon understood the reason for the unusual visit. Alvarez agreed that the thermonuclear weapon would be an effective response to the Soviet threat. The obvious first step was to raise the question with the Commission in Washington. It so happened that Lawrence was to be in Washington over the weekend on another matter. He decided to take Alvarez with him to help arouse interest in the proposal. Recalling that Teller had for years been intrigued with the possibilities of the thermonuclear reaction, Alvarez suggested that they go east by way of Los Alamos, and the two scientists left San Francisco by plane that evening.

Teller had been more than interested when Alvarez called on the telephone, and he was eagerly awaiting the two Berkeley scientists when they arrived at Los Alamos on Friday morning, October 7. Only then did Teller realize he had made a tactical error; he had neglected in his excitement to inform Norris E. Bradbury of Alvarez's call. Annoyed that Teller had appar-

ently gone over his head to discuss his pet idea with Lawrence, Bradbury asked John H. Manley, an associate director at Los Alamos and executive secretary of the General Advisory Committee, to sit in on all the discussions.

Alvarez and Lawrence also talked with the Los Alamos scientists who had been studying the thermonuclear reaction since 1947. If Teller had provided inspiration during his summer sojourns on the mesa, J. Carson Mark, leader of the theoretical division, had borne the daily responsibility for pursuing the idea. Working under Mark were several gifted physicists and mathematicians, including G. Foster Evans and Stanislaw M. Ulam, a protégé of John von Neumann, the mathematical genius who was dividing his time between Los Alamos and the Institute for Advanced Studies at Princeton. Late in 1947 Ulam had concluded that the best approach would be to develop some kind of probability theory to describe the interactions of protons, deuterons, tritons, and other heavier nuclei in the thermonuclear process. By
376 the spring of 1948, Ulam and his associates, with von Neumann's help, had established the boundaries of the calculation, which would involve use of the Monte Carlo probability theories and the new electronic computer which von Neumann was developing at Princeton. Other scientists in the theoretical division at Los Alamos were also studying the fundamental physics of these very light particles. During the summer of 1948 Teller, in working on new weapon designs, had begun to think about using one of them to test thermonuclear reactions. That autumn Ulam began a study with Evans and George Gamow to describe such reactions in quantitative terms. By early 1949 with von Neumann's help, Ulam had completed a general description of the computations. Actual work on the computations could not begin until von Neumann had completed his computer at Princeton and a duplicate machine was built at Los Alamos, but Ulam and his group had plenty to do in developing plans for programming the computer once it would be available.[24]

This was the situation Lawrence and Alvarez found at Los Alamos. Mark, Ulam, von Neumann, Teller, and others had made important strides in defining the problems they faced, but they were obviously still a long way from knowing whether man could produce the thermonuclear reaction, and even farther from knowing how to do it. No matter how much they wished to accelerate work on the superweapon, Lawrence and Alvarez must have seen that actual design of the weapon itself would have to await the outcome of Ulam's calculations and the experiment with a thermonuclear system, which Teller was proposing for the weapon test series in 1951. How, then, could the impatient Californians occupy themselves in the meantime? What basis was there for an immediate, all-out effort on the superweapon? Teller provided the answer that evening in the hotel in Albuquerque. A thermonuclear weapon seemed certain to require large quantities of tritium, which in turn would call for plenty of irradiation space in a reactor with a relatively large supply of free neutrons. Lawrence and Alvarez could be of greatest help by convincing the Commission to support immediate construction of a produc-

tion reactor which would use heavy water instead of graphite as a moderator.

Now the two scientists understood their mission. The long flight east put them in Washington shortly after noon on Saturday, October 8. Within the hour they were in the Commission's headquarters, where they discussed their ideas with General McCormack, Kenneth S. Pitzer, and Paul C. Fine, a physicist who specialized on weapon and production problems. On Sunday a meeting of the radiological warfare panel at the Pentagon gave Lawrence and Alvarez an opportunity to talk with Robert LeBaron, a chemical engineer who had succeeded Webster as Secretary Johnson's deputy for atomic energy and chairman of the Military Liaison Committee. Lawrence in his customary way was explaining his exciting new idea to those who might be able to lend support.

On Monday morning, October 10, Latimer joined Lawrence and Alvarez at the Commission's headquarters for further discussions with the staff. So far, no one they had seen had opposed their proposal with sufficient zeal to dampen their optimism, but they did not yet have any measure of Congressional opinion. That deficiency disappeared when Alvarez called Carl Hinshaw, a California Congressman who had been consulting him on air-safety systems. Hinshaw, a member of the Joint Committee, was pleased to learn that Lawrence was in Washington and promptly invited the two scientists to lunch with McMahon. The outcome was predictable: The legislators and the scientists were more than ever convinced that the superweapon might well save the nation from the Soviet threat.[25]

That Monday morning the Commissioners struggled with the President's refusal to consider a supplemental request for funds. Most of the discussion in the long meeting revolved around the danger of being placed under a special requirement without having the financial means for carrying it out. Late in the morning, however, Pitzer found an opportunity to mention his conversations with Lawrence and Alvarez. Smyth thought Berkeley's enthusiasm and experience in doing big jobs quickly might be useful, but he doubted that the laboratory's knowledge of reactors was sufficient for designing the big production units it was proposing. Pitzer replied that Lawrence intended to draw on Walter H. Zinn's experience with heavy-water reactors at the Argonne laboratory and that of the Canadian group at Chalk River. Both Smyth and Lilienthal hoped Lawrence would defer his proposed trip to Chalk River because the weapon implications of the project were too sensitive for discussions with the Canadians under the technical cooperation program.[26]

Later in the afternoon Lawrence and Alvarez returned for conferences with the Commissioners individually. For both sides the discussions with Lilienthal were most memorable. Alvarez found Lilienthal uninterested and almost repelled by the proposal. Lilienthal later recorded how distasteful he found the two scientists' ardor for weapons which could singly devastate a vast area. But neither the Commissioners nor Pitzer were able to deter Lawrence from his intention of visiting Chalk River. Moving north from

Washington, Lawrence and Alvarez stopped in New York to sound out Isidor I. Rabi, a member of the General Advisory Committee. Rabi welcomed them warmly and seemed pleased that they were taking an interest in the superweapon. When they were unable to obtain space on a plane to Ottawa, Alvarez returned to Berkeley and Lawrence to Washington, where he sought Nichols's aid in initiating in the Joint Chiefs of Staff a requirement for the superweapon.[27]

OPPENHEIMER WEIGHS THE ISSUES

By the time Lawrence returned to Washington, Lilienthal had already called Oppenheimer to arrange a special meeting of the General Advisory Committee. Presumably the committee of eminent scientists would be able to place in proper perspective the proposals generated by the enthusiasm of Teller, Lawrence, and others. Because Enrico Fermi was in Italy, Oppenheimer could not schedule the meeting before the last weekend in October. Even then, Seaborg, the young chemist at Berkeley, would be in Sweden and unable to attend.[28]

Faced with far-reaching policy issues, Oppenheimer began at once to seek expert advice. Von Neumann, who lived in Princeton, was immediately available. Although he had followed the theoretical work at Los Alamos closely, he could give Oppenheimer a detached view of the chances for success. Bradbury and Manley, who arrived in Princeton on the evening of October 20, presented a more cautious (Teller would have said negative) view of the situation. They recognized that the Los Alamos effort had not been geared to an assumption of Russian success as early as 1949 and that the laboratory program required reevaluation in the light of that accomplishment. Reactions at Los Alamos ranged all the way from an all-out effort on the Super to something approaching business as usual. It was not yet clear where the proper balance lay, but at least Manley was convinced that it would be unwise to choose a single course of action.[29]

Oppenheimer was careful not to commit himself during the meeting, but he put down some of his thoughts the next morning in a letter to James B. Conant, who had been his mentor in national policy matters since 1942. The Super, Oppenheimer wrote, was fast becoming a relevant alternative as a response to the Soviet threat. The technical prospects for the Super were not much better than they had been seven years earlier, but "two experienced promoters" like Lawrence and Teller were bound to change the climate of opinion. They had already had some effect on competent scientists, but they had made the greatest impact on members of the Joint Committee and the Joint Chiefs. The Joint Committee, "having tried to find something tangible to chew on ever since September 23rd, has at last found its answer. We must

have a super, and we must have it fast." A subcommittee was heading west to investigate the prospects for the Super at Los Alamos and Berkeley. Oppenheimer confided to Conant that he was not concerned about the technical problem because he was not sure "the miserable thing" would work, nor that it could "be gotten to a target except by ox cart." He was worried that "this thing appears to have caught the imagination, both of congressional and of military people, as *the answer* to the problem posed by the Russian advance." He conceded "it would be folly to oppose exploration of this weapon," but he feared the nation's commitment to it "as the way to save the country and the peace." [30]

Oppenheimer had an opportunity to judge the military position for himself at a luncheon that noon with McCormack and LeBaron. There was very little time for all the items LeBaron wanted to discuss, but Oppenheimer probably noted LeBaron's interest in the Super. Later in the afternoon Hans A. Bethe and Teller arrived. Oppenheimer had been looking forward to this meeting because he knew that Teller had been trying to convince Bethe to return to Los Alamos to work on the Super. Bethe's acceptance of the offer would surely boost Teller's hopes of establishing an intensive effort on the Super at Los Alamos. During the meeting Bethe seemed to be leaning toward acceptance, but he was still undecided. Oppenheimer, still skeptical, was reserving judgment. None of the events of the past two days, including the meeting of the Emergency Committee of Atomic Scientists convening in Princeton for the weekend, could have helped to dissolve the reservations he had expressed in his letter to Conant.[31]

How the rest of the General Advisory Committee would react to the Super, Oppenheimer could only guess. He knew that Conant was dead set against any all-out effort that would disrupt weapon development at Los Alamos. Seaborg, who would not be able to attend the meeting, had written Oppenheimer a cautiously worded letter which seemed to come out somewhat reluctantly on the side of the Super. Manley, as executive secretary, would undoubtedly bring something of Bradbury's measured response to the meeting. Perhaps the balance of opinion would rest with Fermi, who would not return to the United States until a few days before the sessions in Washington.[32]

Almost as important would be the reactions of the Commission and its staff. Once back in Berkeley, Alvarez found a heartening response from Washington. Hafstad arrived in Berkeley on Friday, October 14, to discuss a possible site for the heavy-water reactor. The following Monday Hafstad and Zinn called Alvarez from Chicago to report that they were sending some reactor experts to Berkeley. The Commission officials did express some reservations about Lawrence's suggestion that the new reactor could be simply a scaled-up model of the experimental heavy-water reactor at Chalk River, but Lawrence felt confident enough to appoint Alvarez director of the new project. Not until the third week in October did Alvarez detect a note of

caution in his telephone conversations with Hafstad and Pitzer. He concluded that Zinn and Alvin M. Weinberg, two leaders in the Commission's reactor development effort, were worried about Lawrence's "quick-and-dirty" approach to the Berkeley reactor design.[33]

Within the Commission itself there seemed to be little inclination to concentrate all additional resources on the Super. Although Senator McMahon on October 17 had requested a special report on the Commission's efforts to develop the Super, the Commissioners were necessarily preoccupied with the expansion program, which the President formally approved on October 19. At the President's insistence and much to McMahon's disappointment, the Commission would have to undertake the project initially with $30 million from current appropriations. Getting work started on the new Hanford and Oak Ridge production plants certainly took precedence over plans for a new type of weapon which would not be available for years, if ever. Even so, the
380 Commissioners saw a much broader purpose in the meeting of the General Advisory Committee than did Teller or Alvarez.

In the Commission's formal statement of the subject for the special meeting, Acting Chairman Pike wrote Oppenheimer that the Commission was interested in the broad question of "whether the Commission is now doing things which might well be curtailed or stopped, and also what further things we ought to do to serve the paramount objective of the common defense and security." Plans for civilian defense and the expansion of production facilities were the first order of business. As for the superweapon, the Commission wanted to know whether the nation would use such a weapon if it could be built, and what its military worth would be in relation to fission weapons. Aside from the Super, Pike expressed the Commission's keen interest in immediate expansion of heavy-water production and in a reactor which would generate excess neutrons as well as plutonium. The tentative language of the Pike letter would have profoundly discouraged McMahon, Teller, and Alvarez, who saw the specter of a Russian hydrogen bomb hanging by a thread over a defenseless America.[34]

TIME FOR DECISION

During the last week in October, 1949, both Teller and Lawrence were on the move. Teller had been on hand at the Chicago airport on October 24 to greet Fermi when he arrived home from Italy. Tired and benumbed by the trip, Fermi had scarcely reacted to Teller's excited recitation of recent developments in his crusade for the superweapon. Teller hoped to see Fermi again before the General Advisory Committee met, but he would have to leave almost at once for Los Alamos to greet Congressmen Chet Holifield, Melvin Price, and Hinshaw, all members of the Joint Committee who were interested

in the pace of weapon activities at the laboratory. Thus Teller could not be present when Alvarez and Lawrence arrived in Chicago to discuss reactor design with Zinn and his Argonne staff; it was more important to introduce the members of the Joint Committee to the crucial need for the Super. Robert Serber, carrying instructions from Lawrence, had gone off to Princeton to present the case for the heavy-water reactor to Oppenheimer.[35]

In Washington Manley was already at work, with the help of the Commission's staff, in collecting pertinent information for the meeting of the General Advisory Committee. The broad policy issues to be discussed required an unusual number of technical papers and staff studies. In addition to Pike's letter to Oppenheimer and McMahon's letter to Lilienthal on the need for increasing the nation's atomic might, Manley selected staff papers on a possible test of a new weapon design in 1950, the Commission's activities in civilian defense, the Commission's 1951 budget, and the recently approved plans to expand production facilities. There were also special reports from the Commission's staff on the superweapon, the expansion program, and reactor development. Manley himself added a paper on the Super, which repeated his earlier conviction that Los Alamos should not place all of its resources on a single effort. Looking over Manley's collection of documents, Wilson saw little possibility that the advisory committee could come to any conclusions even over a long weekend. He suggested to the Commissioners that they convene a panel which could devote several weeks to studying the issues. Dean liked the idea and urged the Commission to include in the panel military and outside experts as well as its own staff. Manley thought it might be appropriate to suggest the panel to the committee, and the Commission agreed that Lilienthal should present the idea.[36]

The complexity of the issues facing the committee had already forced Oppenheimer and Manley to revise the schedule for the meeting. The first session would now take place on Friday, October 28, to provide more time for the informal exchange of ideas. At two o'clock on Friday afternoon Oppenheimer arrived at the Commissioners' conference room overlooking Constitution Avenue. With him was George F. Kennan, counselor of the State Department and adviser to Secretary Acheson. Manley's staff was distributing the folders of background papers as the members arrived—Fermi, Rabi, Buckley, Cyril S. Smith, and Lee A. DuBridge. Only Seaborg, Conant, and Hartley Rowe were absent. For almost an hour Kennan drew on his knowledge of the Soviet Union in answering the committee's questions about the world situation. There was only a momentary break in the discussion when Kennan left and Rowe arrived. The world scene and the place of atomic energy in it was the topic of conversation until four o'clock.[37]

For the remainder of the afternoon the committee heard Bethe and Serber discuss some of the alternatives the Commission faced in weapon development. Bethe, after soul-searching discussions with Teller and Oppenheimer, had decided some days earlier that he would not participate in the

project Teller was trying to form. The probable effects of the Super had convinced Bethe that even for the victors the world would not be worth preserving after a war with such weapons. On this occasion, however, he confined his remarks to the technical feasibility of the Super. Serber spoke for Lawrence. Carefully limiting his comments to an appeal for action and to the advantages of a large neutron-producing reactor, Serber disassociated himself from Teller, Alvarez, and the Super. Already convinced that the Super as then conceived would never work, Serber was pleased that he did not have to discuss the subject. Fermi concentrated on the Berkeley reactor proposal, which he challenged on the grounds that Lawrence and his staff lacked sufficient experience with reactors. Serber replied that Lawrence was primarily interested in action and would be happy to have another laboratory undertake the project. It was difficult to tell what effect the discussion had on the committee, but Serber left the room feeling that neither the Super nor the

Berkeley proposal would win the committee's approval.

The meeting in the Commission's headquarters building broke up before the dinner hour, but the discussion probably continued in hotel rooms during the evening. By the time the committee reassembled on Saturday morning, there was general agreement that the Super would be a key factor in evaluating the broad questions the Commission had raised.[38] This point decided, the committee turned to the impressive list of witnesses scheduled for the morning session. Alvarez, unable to stay far from the scene, had stationed himself in the headquarters building, where he could watch the participants come and go from the conference room. The Commissioners arrived at ten with Wilson, Shugg, and the division directors. Lilienthal had a typed statement which he intended to use in presenting the idea of a panel to study the complex issues confronting the Commission. The division directors were available to answer questions about the background material. Alvarez was impressed when the Joint Chiefs of Staff arrived at eleven with LeBaron, Generals John E. Hull and Lauris Norstad, and Admiral Parsons. Beyond the obvious fact that the military implications were discussed, the only incident anyone recorded of the meeting was General Bradley's statement that the principal advantage of the Super would be psychological.[39]

At noon, after the military contingent had left, the committee members and the Commission participants went off to lunch in small groups, Lilienthal with Strauss and Oppenheimer with Alvarez and Serber. In a small restaurant near the headquarters building, Oppenheimer explained his reservations about developing the thermonuclear weapon. Such an effort, he said, would likely cause the Soviet Union to do the same, with possibly disastrous results for mankind. When Alvarez saw that Serber agreed with Oppenheimer, he realized that the proposal to build a heavy-water reactor on the shores of San Francisco Bay within sight of the Berkeley laboratory was dead. Profoundly disappointed, he returned to Berkeley without waiting for the end of the meeting.[40]

The General Advisory Committee had scarcely begun its deliberations. On Saturday afternoon there was a long session with the Commissioners and their intelligence staff. On Saturday evening the positions of individual members began to emerge. Early Sunday morning Oppenheimer presided as the members orally formulated the general outlines of their report to the Commission. Then Lilienthal and the other Commissioners arrived for two hours of discussion. There would be a general report from the committee, plus supplementary statements from two groups of members. The committee agreed to let the Commission make any use of the report and statements it wished. The committee would not discuss the results in public until the Commission approved, and individual members would refrain from commenting personally for one week.[41]

After lunch on Sunday, Oppenheimer and Manley set to work on the committee's report. They could check drafts with the other members, who were reviewing sections of the report and the supplementary statements. By three o'clock the three documents were complete. The first section of the report, compressed into less than two typewritten pages, spoke to the questions raised in the Commission's formal request for advice. The committee was not satisfied with the existing production of fissionable material. The Commission should put high priority on studies of costs, yields, and time required for building additional facilities. Cost should be estimated but it should not be a factor in determining whether or not to build new plants. The committee gave equally high priority to developing atomic weapons for tactical purposes and building a reactor generating a large amount of free neutrons. The reactor could not only produce tritium, as Lawrence had suggested, but also such vital materials as plutonium, uranium 233, and polonium. The Commission should ask the Argonne laboratory, the Commission's reactor center, to expedite the design of the new reactor.[42]

The second part of the report, devoted to superweapons, received almost the same amount of space. After long consideration, the committee had decided that it could not endorse high-priority development of the superweapon, mostly for technical reasons. A successful Super would likely require large amounts of tritium, and thus great reactor capacity. The fundamental theoretical studies of the thermonuclear reaction were not yet complete, and even if they proved promising, they would have to be substantiated by carefully instrumented tests. Only then could the Commission begin to consider the formidable engineering problems involved. Predicting the outcome of such an effort was impossible, but the committee believed that "an imaginative and concerted attack on the problem has a better than even chance of producing the weapon within five years."

If the weapon *could* be built, the next question was whether it *should* be. Here the committee found of paramount importance the fact that a superweapon could be of unlimited size. Once the reaction was initiated, it could be sustained, theoretically, simply by adding more heavy hydrogen.

Load limitations in military aircraft would probably hold airborne Supers to not more than one hundred times the power of existing fission weapons, but delivery by ship or submarine would remove this limit. Clearly the use of such a weapon could not be restricted to military targets and would make possible extension of "the policy of exterminating civilian populations." Each member of the committee, the report stated, put stress on a slightly different combination of considerations, but there was general unanimity in the hope that development of superweapons could be avoided. All were agreed that it would be wrong at that moment to commit the nation to an all-out effort in this direction.

Just how the Government should proceed to forswear the development of the Super was not resolved, as the appended statements indicated. The first, which Conant, Rowe, Smith, DuBridge, Buckley, and Oppenheimer signed, proposed a complete and unconditional renunciation. So tremendous would
384 be the power of the Super that its blast and radioactive effects would make it "a weapon of genocide." The existence of such a weapon would be an intolerable threat to the future of the human race. Development of the Super would not deter the Soviet Union from doing the same, and even if the Russians used such a weapon, the United States would have a sufficient stockpile of fission weapons for an adequate reprisal.

The second appended statement presented the views of Rabi and Fermi. Likewise starting from the extraordinary power of the Super, the two physicists concluded that the weapon entered the range of "very great natural catastrophies" and could not be justified "on any ethical ground which gives a human being a certain individuality and dignity even if he happens to be a resident of an enemy country." Its unlimited destructive power made the Super "necessarily an evil thing considered in any light." Fermi and Rabi thought the United States should invite the nations of the world to join in a pledge renouncing the Super. In their opinion, a pledge would be acceptable even if not guaranteed by an effective international control system, and like the rest of the committee they believed the nation's stockpile of atomic weapons would provide adequate means for military retaliation. What the course should be if other nations would not make such a pledge, Fermi and Rabi did not specify. Presumably they would then reluctantly favor development of the Super.

The only other opinion was that of Seaborg, who had sent his thoughts to Oppenheimer in a letter two weeks earlier, before his departure for Sweden. Offering more questions than answers, Seaborg summarized his position by saying that "I would have to hear some good arguments before I could take on sufficient courage to recommend not going toward such a program." Whether Oppenheimer discussed Seaborg's letter with the committee was never clarified.[43]

After the committee formally adjourned, Oppenheimer and Manley cleaned up the drafts for the typist. It had been a long, grueling weekend, one

charged with emotion and not lacking implications for the future. Oppenheimer had enough experience in Government to know that the opinions of scientists were not always heeded, but at least the committee had expressed itself forcefully and directly.

By four o'clock the drafts were in good enough form to leave the finishing touches to Manley. Oppenheimer left with Serber for a meeting of educators at the Statler Hotel. Late in the afternoon he was back at Commission headquarters for a brief conference with Joseph A. Volpe, Jr., the general counsel, and with Herbert S. Marks, now in private law practice in Washington. Before leaving to catch the evening train back to Princeton, Oppenheimer stopped in to see Lilienthal. The committee, Oppenheimer thought, had done a good job, but he was worried about the Commissioners and particularly about Lilienthal. As often in the past, Oppenheimer could not be sure the Commissioners would be able to carry forward the committee's ideas or even, for that matter, fully understand the issues. Certainly Lilienthal knew what was at stake, but Oppenheimer was no longer sure that Lilienthal had the necessary energy and resiliency to carry a tough decision through the Commission.[44]

ALTERNATIVES TO THE SUPER

Lilienthal himself found the weekend's development encouraging. He thought the General Advisory Committee's report might help to prevent a precipitous reaction to the Soviet threat. He could not forget the feeling that a substantial minority of the committee might have favored the Teller-Alvarez proposal on Saturday. Despite what Lilienthal considered the "bloodthirsty" attitude of some scientists, the committee had found its way to a unanimous recommendation against the superweapon. On Monday morning, October 31, he called Conant to congratulate him on the outcome. Without Conant's unswerving opposition to the proposal, he thought the committee's report might well have favored it.

The report had pleased Lilienthal; but, as he told Secretary Acheson on Tuesday morning, the idea of forswearing the Super did not by itself seem a convincing response to the enormous pressure which had built up for the weapon. Lilienthal was searching for some way to tie the renunciation of the Super to a broad statement of national policy, such as only Acheson or Truman could proclaim. He hoped the Commission would have time to formulate such a policy, something broader than the committee's recommendation, which he and Acheson could take to the President. The difficulty was that there was at least a 50–50 chance of developing the Super, and the Joint Committee was determined to have it. On Monday afternoon the Commission had discussed the committee's report with McMahon. The Senator's reaction

discouraged Lilienthal. McMahon, in Lilienthal's words, saw war with Russia as inevitable. The Super was the only sure defense against such an enemy. McMahon was writing to Truman asking for a chance to be heard should the President be inclined to accept the committee's recommendation. Acheson could see that the Commission might have trouble holding off the Joint Committee while it explored policy issues.[45]

Manley, sensing the danger of indecision within the Commission, heard Oppenheimer confirm his fears in a telephone conversation on Monday morning, October 31. Oppenheimer's description of his talk with Lilienthal convinced Manley that he should stay in Washington for a few days to see that the committee's report was not lost in the confusion of other matters. He found that Pike shared some of his impressions of Lilienthal's fatigue. Pike saw a striking contrast to the courageous leadership Lilienthal had exhibited at the confirmation hearings in 1947, and some of the headquarters staff were
386 nervous that Lilienthal would see that others had noticed the change in his demeanor. If Lilienthal could not act, Manley hoped that someone else would. Frustrated at finding in headquarters the feeling that the committee report was too sensitive for staff discussions, he turned to Volpe and Frances Henderson of Lilienthal's staff. Together they saw Wilson about preparing a staff paper that would translate the committee's report into some concrete proposal for Commission action.[46]

Lilienthal had time during the middle of the week to think about these issues away from the pressure of Washington. Shortly after noon on Tuesday, November 1, he left on the Commission's plane for speaking engagements in the Chicago area and a visit to the Argonne laboratory. On the plane flying back to Washington on Thursday morning he began putting his thoughts on paper. He was pretty much convinced that the Commission should advise Truman against proceeding with the Super. But, recalling his discussion with Acheson, he was looking for something more than a negative recommendation. Tentatively he thought of a new high-priority effort toward producing fission weapons, with special stress on developing tactical weapons, which would reduce the possibility of indiscriminate bombing of civilian populations. The President, Lilienthal speculated, might announce the nation's intention to refrain from developing the Super, and at the same time propose a "Plan for World Survival," which would control weapons of mass annihilation.[47]

The Commission met as soon as Lilienthal reached his office on Thursday afternoon. Following Lilienthal's statement proposing flat renunciation of the superweapon, the other Commissioners presented their views. Smyth said that after examining the military, psychological, and international factors he had concluded that the military value of Supers for the United States would be doubtful even if the Russians did develop them. He also agreed with Lilienthal that the issue provided an excellent opportunity to

reopen discussions of international control, and he argued that these discussions would have greater chance of success if the United States announced in advance that it did not intend to develop the Super. Although Smyth admitted that the chances of success were small, he wanted to reserve the right to reverse a decision against the Super within six months or a year.[48]

Lilienthal was surprised to discover that Dean had now taken a firm position against the advisory committee's report. Dean opposed the idea of "renounce and announce." It would have a bad effect on the American people and Western Europe and would not impress the Kremlin. He thought it also unwise to renounce the weapon without announcing the decision, mainly because the secret could not be kept; the United States would then lose the opportunity for international negotiations. Dean suggested instead that the President through regular secret diplomatic channels inform the Kremlin that the United States did not want to develop the Super if there were any hope of international control and the elimination of weapons of mass destruction. If this approach failed, the President could then make the decision solely on the military and psychological value of the weapon. Pike had not yet made up his mind on the subject.[49]

Strauss began by asking whether the chances of successful development of the Super were good enough to warrant the diversion of the necessary talent, material, and funds from other projects. If the odds were good, Strauss said he would then want to know how much tritium would be required and what the explosive yield of the Super might be. Th re was wide difference of opinion on both these points, and even after they had been settled the military services would have to determine the value of the weapon. In fact, Strauss noted, the Commission did not even know whether the military wanted the superweapon. As for the effect on Western Europe of any of the courses of action proposed, Strauss thought only the State Department was competent to judge. On the purely technical and economic questions which were within the Commission's competence, Strauss said he failed to see the consistency in a position which advocated developing more efficient and more powerful fission weapons but rejected the Super.[50]

The broad range of opinions led Lilienthal to suggest that the Commissioners not seek any one position on which they could all agree but rather offer the President conclusions reflecting disagreements in principle or emphasis. Strauss, following his earlier reasoning, doubted that the Commission should submit any report to the President without first consulting State and Defense. Wilson was more concerned with technical matters; he thought the staff should investigate the possible consequences of using the Super. For example, was it possible that explosion of superweapons would dangerously increase the amount of radioactive carbon 14 in the atmosphere? Could the existing plants produce enough tritium to make a superweapon practicable? Answering these questions would not delay a policy decision, but Strauss's

suggestion surely would. The only consensus of the meeting was that the staff should draft a statement which might later be sent to the President or to the Secretaries of Defense and State.

By this time, new pressures were beginning to mount. Teller had impressed the delegation from the Joint Committee with his descriptions of the Super during the visit to Los Alamos in late October. On Wednesday, November 2, he had arrived in Washington to see McMahon, despite a suggestion from Manley that the meeting would only confuse the situation. Several weeks earlier Teller had arranged to see McMahon about Los Alamos activities. Although Fermi had refused to break his pledge of silence concerning the General Advisory Committee's report after his return to Chicago, Teller had gathered that the report had not been favorable. McMahon confirmed his suspicions. The report, McMahon said, made him sick. In a few days he expected to leave Washington for a swing through the Commission's
388 western facilities, including Los Alamos, to check the facts for himself.[51]

Lilienthal used Friday morning, November 4, to explore the possibilities of advancing the proposal he had sketched out on the plane the day before. Oppenheimer called early Friday morning to tell him that he had an appointment with Acheson that afternoon. That seemed a good opportunity to suggest the peace plan. The similarities to the struggle in which the three men had been engaged in early 1946 were too obvious for them to miss. Perhaps this was one last chance to save the world from a senseless drift into mass suicide. At least Webb was reassuring. He told Lilienthal that Acheson had raised the question of the Super with the President as a problem with the broadest domestic and international ramifications. Webb agreed with Lilienthal that the Commission should not try to clear its report to the President with State and Defense; Kennan was already examining the issue from the international perspective.[52]

A RECOMMENDATION TO THE PRESIDENT

The Commissioners were no closer to agreement on Friday afternoon than they had been on Thursday. Now that Dean had joined Strauss in a firm position against Lilienthal and the General Advisory Committee's report, there was little possibility of agreeing on a single recommendation to the President. But could Oppenheimer use the great power and prestige of the advisory committee to break the deadlock? It would not be the first time the committee had unceremoniously reversed a Commission decision. Such thoughts might have been in Lilienthal's mind when, at an appropriate time in the discussion, he mentioned that Oppenheimer had asked him whether, under the circumstances, the Commission would object if the committee took the question of the Super directly to the President. The suggestion presuma-

bly reflected Oppenheimer's concern about Commission initiative and all but forced the Commission's hand. If the Commission did not act, it surely could not keep the advisory committee from going to the President. The obvious recourse was for the Commissioners to meet with Oppenheimer and the committee in an effort to reach a position all the Commissioners could accept. The meeting ended with a decision that the Commission would ask as many of the members of the committee as possible to meet in Washington on Monday, November 7. Unfortunately Strauss was leaving for Los Angeles that same day, but all the other Commissioners would be present.[53]

At ten-thirty on Monday morning the Commission met to frame its questions for the afternoon session with the General Advisory Committee. Lilienthal had to leave the discussion shortly before noon for an appointment with the President. This was a day he had long anticipated. He was submitting his resignation as the Commission's chairman after nineteen years of Government service. That thought filled his mind as he entered Truman's office and a feeling of remorse swept over him. Truman understood his reasons for wanting to leave, but he hoped Lilienthal would stay until he found a suitable successor. Truman said he wanted someone who would let neither the Joint Committee nor the military run away with the project. The President also made a solemn reference to the decision on the superweapon. Lilienthal said the Commission was trying to get up a paper on the subject before McMahon and the scientists tried to "blitz" the White House for a quick decision.[54]

On such short notice only Oppenheimer, Conant, Rabi, Fermi, Smith, and Manley were able to attend the meeting with the Commission that afternoon. Somehow the opening discussion was labored and artificial, and Lilienthal probably welcomed an interruption by Bernard Baruch, who dropped in to say "hello." Lilienthal's second start was not much better. To Manley's disappointment, he seemed full of questions rather than answers. How urgent, Lilienthal asked, was a decision on the Super? What advantages did the committee see in a public announcement of the nation's intentions? Would a decision not to proceed with the Super be irrevocable? How sound were the technical estimates of the time scale and chances for developing the Super in the Soviet Union and the United States? There were awkward pauses in the discussion, and Smyth, who had been away on business during the committee's meeting in late October, found the discussion no clearer than the committee's report. Dean was equally disenchanted, but for another reason. As the discussion continued, he got the distinct impression that the purpose of the meeting was not to explore the issues, but to persuade him to accept the committee's recommendations. His annoyance growing as the meeting wore on, Dean did his best to disguise his feelings. Perhaps Lilienthal sensed the tension in the room; perhaps, as Manley concluded, he had lost all stomach for a fight. Despite Conant's call for the Commission to seize upon the occasion to reassert the principle of civilian control, Lilienthal was careful not

to push the discussion to any conclusions. Oppenheimer and Manley had failed to spur the Commission to action, but Manley took some comfort in the fact that the committee had at least had an opportunity to present its views in person. The meeting broke up after six o'clock on an amicable note, and Lilienthal took the trouble to thank Oppenheimer and Conant for their efforts before going home.[55]

By the time the Commission met on Wednesday morning, November 9, to consider the draft report to the President, both Strauss and Pike were in California. Dean had reported to Strauss by telephone the events of Monday, and Strauss was elated to learn that Dean was swinging away from the position of Lilienthal and the advisory committee. Although Pike and Smyth seemed opposed to an all-out effort on the Super, they did not necessarily agree with the General Advisory Committee's report or any other fixed position. It seemed doubtful that the Commission could ever reach a firm
390 position on which all members could agree. In any case, Lilienthal had no thought of trying to delay the report to the President until the Commissioners had defined and resolved their differences.[56]

The reason for haste was clear on the first page of the draft report. A group from the Joint Committee had recently visited Berkeley and Los Alamos. "They," the draft read, "came away with enthusiasm for an immediate program, at highest priority. Several scientists have become missionaries for the project." McMahon had announced that he planned to call a special executive meeting of the full committee within a few weeks. The Commissioners were convinced that public discussion of the Super "probably very soon, is inescapable, is necessary, and is desirable." As background for the Commission's opinion, the report presented eleven technical considerations, including the fact that the Super could probably be developed, but not in less than three years. It would have unlimited power and the primary explosive would be relatively inexpensive and plentiful. The general principles of the reaction were well known, and the Russians were equally capable of developing such a weapon. General considerations included the facts that the Super would be a weapon of mass destruction, and that beating the Russians in the race for the weapon would require an all-out effort which would disrupt existing projects and could not be kept secret.[57]

From these considerations, the report stated, Lilienthal, Pike, and Smyth recommended against development of the Super at that time. They thought the President should make this decision public, with Smyth adding the suggestion that the President use the announcement to propose renewed negotiations for international control of atomic energy. Dean and Strauss, the report read, recommended an approach to the Soviet Union by secret diplomatic channels to explore the possibility of international control. If that approach failed, the President, with the Defense Department's approval, could announce his decision to proceed with the Super.

To the report the Commission attached the views of the individual

Commissioners. Lilienthal chose to take the broad view that development of the Super, which he saw as a weapon of mass destruction without any apparent peaceful applications, would convince the world that the United States had resigned itself to war. In this sense, development of the Super would not be in the interests of national strength and security. Dean and Smyth added their comments, which contained only minor changes from what they had said on November 3. The two absent Commissioners would be free to send the President their individual views later. To these attachments the Commission added a historical summary of scientific interest in the thermonuclear reaction since 1939 and the General Advisory Committee's report of October 30.

Late on the afternoon of November 9, Lilienthal took the Commission's report to the White House. Unexpectedly Matthew J. Connally, the President's appointment secretary, waved him into Truman's office. The President was in a good mood, having just learned that Herbert H. Lehman had won the New York seat in the Senate from John Foster Dulles. Truman had a few moments to talk about the report and Lilienthal's successor. When he left, Lilienthal was convinced the report had struck the right note. If he had stopped the onrush to seek national security in weapons of mass destruction, his three years of turmoil as the Commission's chairman would be worth the price.[58]

THE CASE FOR THE SUPER

The report to the President by no means settled the fate of the Super. If anything it strengthened the determination of those who believed its development was vital to the national security.

In the solitude of a hotel room in Beverly Hills, California, Strauss was trying to draft his own views on the question in a letter to the President. Initially disheartened by his failure to win his colleagues' support for a "quantum jump" in nuclear armaments, he found new hope in reports from Washington that the Commission had not given rubber-stamp approval to the recommendations of the General Advisory Committee. The opportunity for the Commissioners to submit individual opinions opened a way to offset the awesome weight of the advisory committee's views. Even more encouraging was a surprise visit from McMahon, who stopped in Los Angeles to discuss with Strauss his plans for bringing the question of the Super before the Joint Committee and the President. McMahon had described his reaction to the General Advisory Committee's report and his letter to Truman on November 1. His meeting with Teller on November 2 had strengthened his determination to speed work on all types of nuclear weapons. He was about to begin a tour of the Commission's major facilities in the West, including Los Alamos and

Hanford. Sharing the same concerns about the urgency of the Super, the two men came away from their meeting with renewed conviction. It was just possible that the future of the nation might hang on their ability to rally support for a truly convincing response to the Soviet threat.[59]

Ironically, McMahon's principal host at Los Alamos would be Manley, one of the most eloquent opponents of the Super. While in Chicago on his way home, Manley had received a telephone call from Wilson requesting him to show the General Advisory Committee's report to some of the leaders at Los Alamos and Berkeley in preparation for McMahon's visits. Manley, however, was scheduled to serve as acting director of the Los Alamos laboratory during Bradbury's absence the following week. The assignment would prevent Manley from going to Berkeley and would place upon him the responsibility for briefing McMahon and Borden on November 15.[60]

After two weeks' absence Manley was anxious about the situation at Los Alamos. Arriving too late on Friday, November 11, to accomplish anything, he waited until Saturday morning to arrange a meeting with Bradbury and Carroll L. Tyler, the Commission's local manager. The three men spent all afternoon discussing the General Advisory Committee's recommendations and the Commission's report to the President. On Sunday morning Manley invited both Mark and Teller to read the report. At first Teller made no comment and only after some prodding admitted his extreme disappointment that the distinguished scientists on the committee had not suggested a more imaginative response to the Soviet challenge. In similar discussions during the next three days Manley found enough diversity of opinion to suggest the possibility of winning support for the committee's position if enough people understood the context of its opinion. Whether Manley could provide that understanding was a question. Stanislaw Ulam probably reflected the attitude of many scientists at Los Alamos in a letter to his friend, John von Neumann. Referring to the General Advisory Committee's report, Ulam wrote of the "weird and unnatural things going on in Washington." In the long run, he thought the report would merely mean a loss of time and did not represent a final decision against the Super. He claimed the results of the Washington meeting had been completely predictable, but he suggested that some of the opposition to the Super might have been a reaction against Teller's insistent advocacy of the new weapon.[61]

Manley's supreme test as advocate for the General Advisory Committee came on Tuesday, November 15, when McMahon and Borden arrived for their briefing. In the first few minutes Manley saw that he would have trouble focusing the discussion on technical as opposed to policy issues. As Manley recorded the conversation, McMahon denounced the committee's recommendations as a suicidal response to a challenge by an immoral and implacable enemy. He accepted Manley's observation that this opinion amounted to a "war-now" philosophy; the only alternative McMahon could suggest was to announce as an ultimatum that the United States would proceed to develop

the Super until the Russians "behaved." For much of the morning, Manley kept the conversation on technical developments in the laboratory, but the tone shifted again at noon, when Robert LeBaron, chairman of the Military Liaison Committee, and General Schlatter joined the group for lunch. Manley's spirits sank as McMahon and LeBaron found themselves in general agreement on the potential value of the Super. As the group walked back to the laboratory after lunch, Manley began to understand the depth of the convictions on which McMahon and LeBaron based their opinions. In a frightening and dangerous age, the Super might well offer the nation a measure of security no other weapon system could provide.[62]

The technical discussions during the afternoon session centered on new weapon designs. Teller gave a balanced appraisal of the Super. He stressed that all the studies to date had been theoretical and that no one could be sure whether a thermonuclear reaction could be propagated. He described plans for initial experiments during the 1951 weapon test series; and he cautioned that, even if successful, the experiments would not prove that a weapon was possible. In the end, however, Teller could not conceal his personal commitment to the Super. Despite the unknowns, he believed the chances for success better than 50 per cent. To Manley and others at Los Alamos, the statement was another example of the way Teller's enthusiasm for the Super ran counter to his judgments as a scientist.[63]

That evening Manley had some encouraging words to report to Oppenheimer by telephone, but he could not disguise his concern about the course McMahon was pursuing. However superficial his reasoning might seem to Manley, McMahon appeared to be driven by convictions strong enough to carry him over any obstacles. That afternoon he was off to Hanford for a tour of the plant, more discussions, and a press conference. The following weekend in Los Angeles he began revising Borden's draft of a letter for the President. "The profundity of the atomic crisis which has now overtaken us," the final version read, "cannot in my judgment, be exaggerated. The specific decision that you must make regarding the super bomb is one of the gravest ever to confront an American president." These were the opening sentences in a five-thousand-word letter refuting the arguments of the General Advisory Committee.[64]

McMahon admitted the horror of the superweapon, but he suggested that the same horror might save the nation from enemy attack. He challenged the argument that the military value of the Super was dubious, by suggesting that even if there were only a few targets for superweapons, their availability would release for other use a large number of fission weapons. The Super, McMahon contended, would produce more damage for less cost than fission weapons and might well prove decisive against isolated tactical targets as well as large centers of population. Furthermore, McMahon could see "no moral dividing line . . . between a big explosion which causes heavy damage and many smaller explosions causing equal or still greater damage." In the

face of Russia's great manpower, the United States had no choice but to rely on strategic air power, which with the Super would guarantee victory over any enemy. "If we let Russia get the super first," McMahon concluded, "catastrophe becomes all but certain—whereas, if we get it first, there exists a chance of saving ourselves." He urged the President to take the entire question to the people of the United States and the world. The people had a right to know what great danger threatened them, and perhaps public opinion could force the Kremlin to accept a sane control plan.

AN ISSUE FOR THE ADMINISTRATION

Even before McMahon had finished his letter, the Super had come close to being a public issue. Three days earlier, on November 18, Alfred Friendly had reported in a feature article in the Washington *Post* a fact that official Washington had apparently missed. Friendly claimed that Senator Edwin C. Johnson had mentioned the Super on a television program in the course of castigating the scientists for security leaks. Broadcast on a local New York station on November 1, the Johnson statement had escaped newspaper comment until Friendly obtained a transcript. Apparently alarmed that the Super might become a subject of public debate, Truman summoned McMahon and Attorney General J. Howard McGrath to the White House on November 26 and told them he wanted the security leaks plugged. After reading McMahon's letter, Truman may have had more reason to be concerned about McMahon's ability to keep the debate out of the press than about Johnson's statement, but the Colorado senator bore the brunt of the press criticism.[65]

If Truman's quick action prevented the debate over the Super from becoming a public issue, key members of his Administration were already embroiled in the subject. On November 18, Truman told Lilienthal that he was again calling on the special committee of the National Security Council, consisting of Secretary Johnson, Acheson, and Lilienthal, to evaluate the Super in terms of political and military as well as technical factors. In one sense, Truman's decision could not have displeased Lilienthal since it offered a way to delay a decision on the superweapon, but it did indicate that the President was not ready to accept any recommendation against the Super without more study. Now it would be necessary once again to appoint a working group from the staff and begin the long process of developing a position with State and Defense.[66]

In the closing days of November, there was a chance to tie up some loose ends. For the Commission that meant announcing Lilienthal's resignation and, in very general terms, the plans for major plant additions at Oak Ridge and Hanford. Lilienthal also completed the Commission's record on the

Super by forwarding to the President the individual views of Strauss and Pike.[67]

Both statements were largely a summary of earlier opinions, but Strauss now was willing to advocate the Super explicitly. In his opinion, it would be unwise to renounce unilaterally any weapon which an enemy could reasonably be expected to possess. He urged the President to direct the Commission "to proceed with the development of the thermonuclear bomb, at the highest priority," subject only to the judgment of the Departments of Defense and State. To his letter, Strauss appended a memorandum setting forth the reasoning behind his recommendation.[68]

General Bradley had already clarified the position of the Joint Chiefs, in a letter to Secretary Johnson. After studying the implications of developing the Super, the chiefs had concluded that Soviet possession of the weapon "without possession by the United States would be intolerable." It was imperative to determine the feasibility of the thermonuclear explosion both for defense planning and for formulating international policy. If the Super were feasible, it seemed evident to the Joint Chiefs that the weapon might act as a deterrent to war and would provide an offensive weapon "of the greatest known power possibilities." The cost of the weapon seemed within the capabilities of both the United States and the Soviet Union. The Super also promised, in the chiefs' opinion, a more efficient use of uranium ore in larger weapons. The considerations decisively outweighed the possible social, psychological, and moral objections to the Super.[69]

On November 30, Smyth described the first meeting of the working group of State, Defense, and Commission representatives. Once again Secretary Johnson's representative, this time LeBaron, was asking the Commission for data without any preliminary discussion of the broad issues the special committee presumably was evaluating. Lilienthal hoped to avoid the procedure of the previous summer, when communication in the working group had been almost entirely in one direction, from State and the Commission to Defense. Late that afternoon he went to the State Department to urge Acheson and Webb to arrange a meeting of the special committee itself to clarify the ground rules for the report. Acheson readily agreed that the report should not just state the conclusions of the special committee but should also lay before the President the facts and premises bearing on those conclusions.[70]

A QUESTION OF MILITARY VALUE

The General Advisory Committee at its regularly scheduled meeting in Washington that weekend confirmed Lilienthal's conviction that the special report should be more than an exercise leading to a predetermined conclusion. On

Saturday afternoon, December 3, Oppenheimer told the Commissioners that the committee had carefully reexamined its decision on the superweapon and that no member wished to change his views in the October 30 report. To give some indication of the range of factors considered during the meeting, the committee sent the Commission four papers expressing the individual views of three members and the executive secretary. In a succinct, one-page letter, Rowe had argued that the public would consider the Super an absolute weapon and hence would be lulled into a false sense of security by its existence. He held that the dubious value of the Super as a retaliatory weapon would not outweigh the danger of diverting valuable resources from fission-weapon development, helping the Russians to develop such a weapon, and undermining the nation's moral values.

Fermi and Manley both directed their attention to the possible military value of the Super. Manley concluded that its advantages over fission
396 weapons were not sufficient to justify its development. Fermi's letter was less argumentative than Manley's memorandum, but it approached the same conclusion. The Super, in Fermi's opinion, would have a peculiar advantage in destroying heavy structures over a large area; but the number of suitable targets was limited, and the tactical value of the weapon needed further investigation.

The fourth attachment to the committee's report was a long letter from Buckley. He held to his opinion that the Commission should not immediately undertake an "all-out" effort to develop the Super. This conclusion he supported with arguments similar to Rowe's. Buckley did not think, however, that the United States should publicly forswear the investigation of thermonuclear reactions. He favored a thorough and detailed study of the design, methods of delivery, and possible effects of the Super. Careful research by the best scientists and mathematicians available would provide a sound base for policy decisions "without accepting the severe penalties of an hysterical all-out development and production of a weapon of which we know little." The following week DuBridge added his views in a strong letter challenging the military, psychological, and diplomatic value of the Super.[71]

In succeeding weeks the question of military value became the principal concern of the Commission members of the working group. Paul Fine, from the Commission's division of military application, analyzed this question in a lengthy study paper. Fine began by describing the characteristics of the thermonuclear reaction in terms of the materials and conditions required. He summarized the probable effects of the weapon in terms of blast and radioactivity. He appraised the technical problems, including the ignition of the light elements, the production of tritium, and ordnance engineering. Fine was most helpful in his estimates of costs of an all-out effort on the Super. Such an enterprise would surely slow up the development of lighter and smaller fission weapons. It would take at least three years and would require

the recall to Los Alamos of some of the talented scientists who had worked there during World War II.[72]

An important consideration, in Fine's opinion, was the tritium requirement. He thought existing facilities could probably produce enough tritium for a test of the thermonuclear principle in 1951. No one could yet guess how much tritium might eventually be needed for full-scale production of superweapons, but Fine estimated that even to produce test quantities of tritium by 1952 might require new reactors costing $150 million and consume large quantities of uranium which might otherwise be used in fission weapons. Likewise, existing heavy-water plants at Trail, British Columbia, and the Wabash Ordnance Works in Indiana would meet test requirements, but if the Commission decided to build heavy-water-moderated reactors to produce tritium, it would have to build a new heavy-water plant costing at least $4 million. Fine concluded that, unless the superweapons were very large, the damage area resulting from their explosion would scarcely exceed that of the fission weapons which could have been produced with the same materials and facilities. And were there, he asked, enough targets for weapons of that size? 397

This was the sort of question that preoccupied Manley, whom Lilienthal had asked to serve as a member of the working group. Manley was suspicious of the military leaders, who he claimed had seen no need for a superweapon before September 23. The Defense members of the working group were still saying that they did not know what the military value of the Super would be, but Manley thought Fine's detailed analysis made that position untenable. He predicted that the military would continue to avoid precise estimates of military worth; it was the Commission's job to force LeBaron and his associates to realistic evaluation. Both Manley and Smyth noted that the military continued to have complete access to the Commission's technical information but gave the Commission almost no information on military estimates. In the absence of a military study, Manley embarked himself on an analysis of military worth. The study, running to twenty-three pages, included technical considerations such as time scale, ordnance engineering, readiness, military use, and the costs of tests, as well as the political and psychological factors which the General Advisory Committee had considered.

By the middle of December Manley was getting discouraged. He thought the Defense representatives were still using evasive tactics; the State representatives had shown no inclination to take any part in the study. In an almost querulous note to Lilienthal, who was attending a meeting of laboratory directors in Chicago, Manley began raising fundamental questions. What was the special committee to decide? Was it to determine whether the United States should develop the Super, or was it whether the nation should build such weapons if they could be developed? A subsidiary question was whether, having decided to do the first, the nation could avoid doing the second.[73]

Manley's note snapped Lilienthal's thoughts back to the Super. With his departure from the Commission resting on completion of the special report, Lilienthal had personal as well as official reasons for wanting to finish the job. A quick check showed that the Defense representatives expected to have some sort of study paper completed soon. Kennan relieved Lilienthal's mind by telling him in confidence that State had been studying the issue and had a draft on the subject. He hoped he could discuss it with Acheson and have it ready for the special committee the following week. Even so, Lilienthal saw little chance of completing the report by December 31. He told Truman on December 21 that he would stay on until February 15 in order to finish the job. This, Lilienthal thought to himself, would give him plenty of time and take some pressure off the President, who was faced with the resignations of Souers, Clark M. Clifford, and probably Strauss within the next several months.[74]

Now Lilienthal could focus on the meeting of the special committee, which Acheson had helped to arrange. On Thursday morning, December 22, Lilienthal and Smyth joined Secretary Johnson, General Bradley, and LeBaron in Acheson's office. Lilienthal admired the way Acheson skillfully steered the discussion toward a broad consideration of policy issues. This approach did not bother Johnson, who seemed completely relaxed. Lilienthal began by remarking how much the situation reminded him of the issues facing the State Department board of consultants almost four years earlier. The fundamental issue was international control, not development of the Super. Johnson disagreed by making the observation that only if the Soviet Union accepted international control could the Defense Department consider foregoing the Super. Bradley assured Lilienthal that proceeding with the Super would not foreclose a move toward peace; in fact, the general suggested, the deterrent effect of the Super might in itself be a move in that direction. When Johnson and LeBaron insisted that the decision was simply a technical matter with no necessary relevance to the broader questions, Lilienthal could not restrain himself. The whole purpose and course of mankind was tied to this decision. To leave out what Johnson called "the philosophy" was to beg the question entirely.[75]

The discussion came to no conclusion, a development which in a way pleased Lilienthal because it meant the question was not yet closed. He had no reason, however, to be hopeful. Smyth had shown him the Defense Department's first draft of a working paper. Rather than provide a detailed analysis of the issues, the paper did little more than repeat the broad conclusions which the Joint Chiefs had expressed just a month earlier. During that month the military had chosen not to elaborate on the general proposition which Karl T. Compton had stated in a letter to the President on November 9, in which he held that in the absence of international agreement the nation had no choice but to proceed with the Super. And there was nothing to suggest the possibility of international agreement in the foreseeable future.[76]

Perhaps sensing that Bradley might be less dogmatic on the subject than his civilian associates, Acheson and then Lilienthal attempted to arouse in Bradley some consideration of the larger issues. Acheson told Lilienthal on December 29 that he had made some progress in a long discussion with Bradley. The next morning Lilienthal and Smyth found him in a reflective mood, but his conclusions were hardly encouraging. Bradley could see the inconsistency in supporting a policy which advocated the elimination of atomic weapons through international control at the same time the military was relying on these weapons as the only means of defense in Western Europe. There seemed, however, no other military solution at the moment. Perhaps, Lilienthal suggested, the United States should withdraw its proposal for international control and admit the nation was in a nuclear arms race with the Soviet Union. That suggestion was hardly more realistic than the first. Certainly there were no easy answers, and the first week in January left little time to think about them. Not until he reached the balmy shores of Captiva Island in Florida did Lilienthal have an opportunity to reflect again on the role of the Super in the lives of men and nations.[77]

NEW INITIATIVES

As 1950 opened, Lilienthal had all but retired from the scene. For all routine Commission business Pike was serving as acting chairman. Months of unremitting controversy had stunted the flexibility of Lilienthal's thinking, the openness to discussion, and the patience with differing opinions so necessary in formulating policy. Lilienthal's insistence upon seeing development of the Super largely as a moral issue had destroyed the very climate for decision-making he had set out to create in 1947. By opposing the Super on other than technical grounds, some of the Commissioners and members of the advisory committee had sacrificed their immunities as technical advisers in the policy debate and were now subject to political attack.

At that very moment, and not by accident, another group stepped into the breach. Since the October adjournment, the members of Congress had been able to get away from Washington and gain new perspectives. Members of the Joint Committee on Atomic Energy had been able to visit Commission installations, talk with military leaders, and take the pulse of the nation. As they returned to Washington in the first week of January, 1950, McMahon and his associates were psychologically prepared to face the awesome issue of the superweapon in a way Lilienthal could never hope to do again. Dean must have sensed this when Borden called him on January 10 to describe an executive session of the Joint Committee the previous day. McMahon had reviewed for his returning colleagues the course of events in the nine closing weeks of the old year. He read aloud the report of the General Advisory

Committee, including the views of individual members. With many interruptions, this process took several hours, but it helped to orient the members in the complex of issues surrounding the Super. Then McMahon read his letter of November 21 to the President, which drew warm approval from Senator Knowland and most of the other members. The discussion drifted toward the conclusion that the committee should submit to the President a recommendation on the subject, but probably only after hearings with Defense representatives, the Commission, and members of the General Advisory Committee. Whatever was done would have to be done quickly. Despite Truman's warning, scraps of information about the Super were already beginning to appear in the press with the inevitable distortions and inaccuracies. To alert the Administration to the committee's intentions, McMahon sent copies of his November 21 letter to Lilienthal and Secretary Johnson.[78]

Johnson was quick to respond to indications of Joint Committee
400 interest in the Super. He asked LeBaron on January 11 to convey to McMahon the essence of the paper which the Joint Chiefs were just completing on the issue. LeBaron suggested that he and Bradley brief the committee on the substance of the paper without providing a copy. Johnson agreed, but stressed the importance of getting the Joint Chiefs' views to the committee. Since the President had warned McMahon about the importance of security, it would be safe to talk.[79]

The Joint Chiefs' study, which Bradley sent to Johnson on January 13, was primarily a critique of the General Advisory Committee report of December 3. The chiefs saw no need for a "crash" program to build the Super, but they urged immediate determination of its technical feasibility, studies of delivery vehicles and ordnance, and some planning for production. The Super, in the chiefs' opinion, would serve as a deterrent against Soviet aggression and to that extent would strengthen the defenses of the nation. Production of the Super would place additional burdens on material and manpower resources, but would be within the nation's capability without dislocating the existing defense effort. The Joint Chiefs opposed forswearing or renouncing the Super. The American people and the people of the free world expected the United States to develop the most effective weapons against communist aggression. As for moral issues, the chiefs voiced the responsibility of the United States to assert its moral and physical leadership. It was folly to argue in war that one weapon was more moral than another.[80]

In his regular Sunday evening broadcast on January 15, Drew Pearson reported that the question of whether to develop the Super had engrossed the Capital. With less accuracy he described the dispute between Lilienthal and Strauss over the subject, the firm position of Secretary Johnson, and the mixed feelings of Acheson. More comprehensive than the Pearson broadcast was James Reston's page-one article in the New York *Times* two days later. Reston saw the issue not as the simple question of whether to develop the Super, but rather as whether the United States should make one last attempt

at international control before proceeding. In general outlines, at least, Reston had a reasonably accurate picture of the situation. Facts he had not yet snared were Dean's growing disagreement with the General Advisory Committee's position as evidenced in his sharp criticism of DuBridge's individual views on the subject, and the new initiative which the Defense Department and the Joint Chiefs had taken on the issue. But the Reston article made the Super headline news. In the glare of the public spotlight the Administration could not long postpone a decision. Fearing a sudden change in the situation, Lilienthal's staff sent him an urgent telegram to return to Washington.[81]

Dean, through his frequent telephone conversations with Borden, had some idea of the Joint Committee's activities. Bradley and LeBaron were scheduled to appear on Friday, January 20. Borden did not yet know whether the Commissioners would be called to testify, but he was arranging to have Hafstad appear to discuss reactor development. Speaking before a subcommittee on January 18, Hafstad began with a general summary of the Commission's reactor program with special attention, perhaps at Borden's suggestion, to aircraft nuclear propulsion as a solution to the difficulty of delivering a superweapon. More immediately relevant were Hafstad's comments on tritium production. He told the Congressmen that since Lawrence and Alvarez had first presented their proposal in October, the Commission's staff had been studying the best way to produce the hydrogen isotope. One way was to modify a Hanford reactor by replacing the natural uranium slugs with fuel slugs of uranium 235 and target slugs of lithium, in which the tritium would be formed. A second possibility was to build a heavy-water-moderated reactor along the lines of the Canadian installation at Chalk River. A third approach was to build a modified version of the materials testing reactor. Staff studies had indicated that the first had advantages for producing test quantities of tritium; the last for production quantities. To check these conclusions, the Commission had asked several contractors to study the three approaches to a neutron-producing reactor. The committee's frequent references to possible costs of tritium production and talk about a "crash" effort suggested an assumption on the Hill that development of the Super was already an accepted fact.[82]

Explicit discussion of the policy issues came in the full committee's session with Bradley and LeBaron on January 20. Bradley began with an extensive summary of the Joint Chiefs' written report, with stress on the inevitability of scientific development, the implacability of the Soviet Union, and the absurdity of calling the Super an immoral or unconventional weapon. Millard E. Tydings, also a ranking Democrat on the Senate Arms Services Committee, concentrated the discussion on the production of tritium for a test of the thermonuclear principle as well as for quantity production of the Super. McMahon, Holifield, and other members who had visited Los Alamos during the recess could assure the committee that the Super was at least

theoretically feasible. Teller had dispelled any doubt on that point. McMahon expressed his conviction that the United States' nuclear superiority was the only thing keeping Russia from sweeping across Western Europe; to permit the Soviet Union to get the Super first was inviting national disaster. From this premise the committee had little difficulty moving to the conclusion that the United States should begin to build additional production plants for the Super even while the feasibility tests were under way. The only sensible plan was to throw a tight net of security around the project and push ahead with the Super as quickly as possible.[83]

Still to be reckoned with, however, were the strong reservations of some scientists as expressed in the report of the General Advisory Committee. McMahon volunteered the opinion that Oppenheimer and his associates had gone far beyond their area of competence in opposing the Super on moral and political grounds and for that transgression they would suffer in the judgment of history. But both Congressmen Hinshaw and Henry M. Jackson, who had recently been in Los Alamos, remarked that the scientists' reservations sprang from deep convictions. Even Teller had expressed concern over proceeding with the Super without considering how or when the new weapon might be used. One way to avoid the moral issue, as Teller had suggested, was to announce the decision to proceed with the Super as an ultimatum to the Russians; if they did not move in the direction of international control, the United States would have clear moral justification for proceeding. Knowland feared the Russians would buy valuable time by keeping negotiations going interminably. McMahon dismissed the moral twinges as simply an emotional reaction to a difficult question. The nation would have to face the reality that "total power in the hands of total evil will equal destruction."

McMahon recognized the committee was so close to agreement that it could have sent the President a recommendation that very day. He also perceived that such an action following a hearing at which only representatives of the military were present could have profound repercussions. Even to admit officially that the committee had discussed the Super might be dangerous. He proposed to tell the press only that the committee had discussed matters of national defense. By holding rigidly to this position, McMahon succeeded in avoiding a major press reaction. Except for some speculations in a Washington tabloid, the major newspapers gave the meeting only a few inches on inside pages.[84]

Lilienthal had no way of knowing what had happened in the Joint Committee hearing room that Friday morning, but before the day was over he had a good idea of General Bradley's position. That afternoon, after the hearing, he received a copy of the Joint Chiefs' comments on the General Advisory Committee's report from James S. Lay, who was preparing to replace Souers as executive secretary of the National Security Council. Lilienthal immediately called Smyth with the idea that the Joint Chiefs' reply

should be sent to Oppenheimer and the committee. After consulting Dean, who opposed the idea, Smyth suggested that Lilienthal talk with Lay. Then Lilienthal called Oppenheimer in Pasadena to inform him that the paper existed and that he was seeking permission to distribute it. By the time Lilienthal reached Lay late on Saturday afternoon, it seemed too late to bother the President. On Monday noon, January 23, Lay called back to report that Truman considered the report "confidential advice to the President." Lay guessed that Lilienthal could appropriately show the report to his fellow Commissioners but should distribute it no further. Now, as McMahon had suggested on Friday, the General Advisory Committee was effectively removed from further consideration of the Super.[85]

THE TIDE OF OPINION 403

As the week wore on, it became ever clearer that the tide of opinion was moving in favor of the Super. The Defense Department and the Joint Committee were now fully committed to the Super, and Acheson and the State Department were leaning in that direction. A special working group under the direction of R. Gordon Arneson had at last completed a study paper for Acheson. Carefully balancing the opinions of the Commission and the Joint Chiefs, Acheson found general agreement that the Commission could undertake a concerted but deliberate effort to determine the feasibility of the Super within three years without seriously handicapping existing weapon activities. If the Super proved feasible, it would be hard to stop further work while the extremely complex issues related to production and stockpiling of the new weapon were debated. But Arneson could find little reason to believe that the Soviet Union would not press ahead with the Super, and he admitted that sole possession of that weapon by the Soviet Union "would cause severe damage not only to our military posture but to our foreign policy position." Neither did the State Department believe that an appeal to the Soviet Union was likely to produce an acceptable plan for international control of atomic weapons. Arneson concluded that the President should direct the Commission to determine feasibility of the Super at a rate and scale to be set by the Commission and the Department of Defense, with concurrent work in Defense on ordnance and carrier development. The President would defer any decision on producing superweapons beyond the number required to test feasibility, until State and Defense had completed a full-scale study of national policy. Arneson also recommended that the President announce that the United States intended to continue to explore feasibility of the thermonuclear weapon.[86]

On Thursday afternoon, January 26, Lilienthal stopped by Acheson's office to discuss Arneson's paper. The Secretary had his office windows open

and seemed to be enjoying the unseasonably warm weather, as if the hostile attacks upon him for refusing to denounce his former associate, Alger Hiss, bothered him not at all. Acheson appeared to agree with Arneson's conclusions but on somewhat more pragmatic grounds. There was now, Acheson thought, so much pressure built up for a decision that any delay would hardly provide the atmosphere for the deliberate evaluation of policy issues that Lilienthal advocated. Lilienthal still had reservations; the Presidential directive would confirm a wrong policy and lend credence to the myth that weapons of mass destruction provided national security. He reminded Acheson that if the Commission had supported the Super in November, there would have been no consideration at all of the fundamental issues. There was no question, Acheson admitted, that in a democracy strategic bombing would be no more effective as an instrument of national policy than would preventive war. But the continuing Soviet threat and the collapse of the Nationalist

government in China made it hard to counter the demand for bigger weapons.[87]

Lilienthal, with only a few days left to serve as chairman, was already looking at such issues with the perspective of an outsider. Having all but lost his campaign for a full-scale debate on the Super, he did not look forward to the hearing before the Joint Committee on Friday morning, January 27. Under the circumstances there was little for him to say. He made a few innocuous remarks about the background of the situation and turned the session over to Smyth, who, with support on details from Paul Fine, reviewed the technical considerations involved in developing the Super.[88]

Then without warning the direction of the discussion changed. Congressman Charles H. Elston asked Smyth whether the Commission had taken any official position on the Super. Since Lilienthal had already left for a meeting with the President, Smyth turned to Pike as the senior Commissioner present. Cautiously Pike skirted the edges of the question. Pike said the Commissioners had sent some tentative views to the President, but they had done this with the full realization that they did not yet have all the facts on which to base a decision, particularly the views of State and Defense. Smyth and Dean agreed the Commission had been unanimous in the opinion that the decision rested with the President, but Dean made it a point to say that on other questions there was wide divergence of opinion. Dean went on to summarize his individual position and Strauss read most of his letter to the President.

For a few minutes Smyth was able to steer the discussion in other directions, but Elston was not to be denied. Two Commissioners, he observed, disagreed with the General Advisory Committee's report. What did the others think? Feeling the growing pressure of Elston's prodding, Smyth tiptoed into his answer. He found so many factors involved in the decision that he had opposed going ahead with the Super "at that time," namely in November,

1949. He had not thought any agreement with the Russians was possible, but he had seen the need for a careful study of the issues. Now, three months later, he thought his position had been correct. The Commission now had a much better understanding of the question, and work on the Super at Los Alamos had not been seriously delayed. Pike said that his indecision had caused him to agree with Smyth. Then Senator Knowland asked the final question: How had Lilienthal voted? Pike's answer put on the record the fact that three of the Commissioners had opposed all-out development of the Super in November, 1949. Beyond this point, neither Smyth nor Pike was willing to commit himself. What their views on the question now were, they could not say; the decision was now in the hands of the President.

The Joint Committee had carried the day. The Commissioners were no longer prepared to defend the position of the General Advisory Committee. All that remained was for the Joint Committee to decide what course it would follow. McMahon and Holifield led the majority who believed the committee had a responsibility to report its views to the President; Hickenlooper and Millikin thought a recommendation would be gratuitous without a request from the President. McMahon, however, was unwilling to surrender the initiative. The committee would meet on Monday morning, January 30, to draft its recommendation to Truman.

While McMahon was consolidating his victory on the Hill, Lilienthal was discussing with Truman the desirability of appointing Pike as acting chairman after his own departure on February 15. Eventually the discussion turned to the Super. Lilienthal told the President he was still trying to complete the report by the special committee, although a meeting for that afternoon had been canceled. Truman hoped he would have the report soon. Baruch had just announced his support of the Super, and now everyone, including the Joint Committee, would be demanding action. That afternoon at his weekly press conference Truman told the reporters that he would have nothing to say on the subject until he had made a decision. With that statement the President formally acknowledged that the issue existed.[89]

As Truman predicted, the day's events touched off a wave of newspaper stories about the Super. H. Styles Bridges, a member of the Senate Armed Services Committee, told reporters after the President's press conference that responsible military leaders had convinced him that development of the Super was necessary for national self-preservation. Carl Vinson, chairman of the parallel committee in the House, took a similar view. Most newsworthy of all was Harold C. Urey's outspoken speech in New York that evening in support of what Lilienthal now called the "E. O. Lawrence-Strauss line." As an acknowledged leader of American science, Urey made clear that not all his colleagues agreed with the General Advisory Committee. The question which had been debated within the Administration since October 5 was now a public issue.[90]

PRESIDENTIAL DECISION

Thoughtful deliberation in the blinding glare of public opinion was now out of the question. Furthermore, the months of debate and the course of events had all but settled the issue. Formally, there remained the task of drafting a recommendation for the President's decision. Actually, the only function left for the special committee was to prepare a record to support the only decision possible under the circumstances.

This tacit understanding among the participants explained the perfunctory tone of the special committee's meeting on the second floor of the Old State Department Building on Tuesday morning, January 31. Lilienthal came with Smyth; Secretary Johnson with Under Secretary Stephen Early,
406 LeBaron, and General James H. Burns; Acheson with Arneson and Adrian Fisher; and Souers with his replacement, James Lay. Acheson moved into the question with few preliminaries. He proposed to start the discussion by presenting Arneson's study paper, but to save time he would read only the conclusions. This done, he distributed a draft statement for the President to release with the decision. The short first paragraph alluded to the need in a democracy to inform the people of important decisions. The second embodied the key recommendation in Arneson's draft, directing the Commission to continue with the development of all forms of atomic weapons, including the hydrogen bomb. The third and longest paragraph warned the nation against relying on any single weapon and reasserted the nation's dedication to freedom and peace.[91]

Secretary Johnson suggested two changes. The first was to delete from Arneson's recommendations the clause committing the President to deferring any decision on producing the Super until feasibility of the weapon had been determined. The second was to substitute for the public statement a much shorter version which announced the decision, in the absence of agreement on international control, to proceed with the Super under a cloak of "top secrecy." [92]

Acheson was not disposed to argue. He accepted the deletion in the Arneson draft and turned to rewriting the public statement. Early favored playing down the statement as much as possible by making it a press handout rather than a personal announcement by the President. Johnson agreed and in the same vein suggested deletion of the long third paragraph in the State draft. Lilienthal suggested two changes to make clear that the nation would continue to examine all factors affecting peace and security and also that work on the Super would be a continuation of that already started. These small concessions Acheson and Johnson were ready to accept.

The task was done, but Lilienthal requested the minority's privilege of

a final statement. He began by mentioning his efforts to have the Commission function "in the spirit and the letter of a law providing for civilian control of atomic weapon development." At no time since 1947 had the Commission received information supporting the weapon requirements which the military establishment had recommended to the President. Except in the abstract, this had not been a serious issue until the spring of 1949. At that time the President had directed the special committee to examine the assumptions underlying the proposal for expanding the Commission's production facilities. The move to examine the military assumptions had not succeeded. Lilienthal was now willing to forget that issue, but he thought the question of the Super presented a clear case for examining the underlying assumptions "if there was to be any substance to the principle of civilian control of atomic weapons by the Commission." He admitted that in recent weeks the special committee had begun to examine the military assumptions, but he still thought it important to make "a real inquiry into the basic question: what is the best way to further our common defense and security?"

Lilienthal now thought the moral issues and the question of international control were relevant but not central. In fact, he said, the central question was not even whether or not the United States should build the Super but rather whether the special committee and the President should not first examine the fundamental weakness which Lilienthal saw in the nation's position: the complete reliance on weapons of mass destruction as an instrument of foreign policy. To proceed forthwith was to miss perhaps the last opportunity to reexamine and realign policy so that American security might be based upon something better than a headlong rush into war with weapons of mass destruction.

Acheson found little in the statement to disagree with, but it seemed to offer no appealing alternatives. The pressure for decision from Congress was so great that deferral was not feasible. Johnson agreed that they had to protect the President.

The discussion then turned back to the recommendation of a study of national objectives in peace and war and the effect of those objectives on strategic plans in a world of fission and superweapons. Acheson said that the draft omitted the Chairman of the Atomic Energy Commission from the group which would make the study. One reason for the omission was the obvious difficulty of working with a five-man Commission. Acheson also questioned whether it was appropriate for the Commission to participate on the level of a Department head. A third problem was the Commission's statutory obligation to keep the Joint Committee "fully and currently informed." Lilienthal thought the first two points were valid and he would not deny the validity of the third. Smyth agreed that it might be difficult to invoke Executive privilege if the Joint Committee had to be informed.

At this point Secretary Johnson recommended that the special commit-

tee go at once to the White House and get a decision. He already had an appointment with the President at twelve-thirty, and the group could use that. With all the heat Congress was putting on the issue, every hour counted.

Truman received the three members of the special committee with Souers and Lay at about twelve-thirty-five. Acheson handed the President the recommendation and said that Lilienthal had some comments on it. Knowing full well what Lilienthal had on his mind, Truman said he thought the United States should never use these weapons, but the Russians' behavior left no choice but to make them. Lilienthal summarized the statement he had just made to the committee: No matter how carefully worded or casually issued, the statement would confirm the present belief that atomic weapons were the nation's first line of defense. Truman interrupted to say that a quiet examination of the issues would have been possible if Senator Johnson had not made his unfortunate statement. Now there was so much excitement over the issue
408 that he had no choice but to go ahead.[93]

It was not yet twelve-forty-five when the group left the President's office. After lunch with an old friend, Lilienthal called McMahon, who had scheduled a meeting of the Joint Committee that afternoon to finish its recommendation. McMahon had hoped to complete it the day before, but the discussion in executive session had dragged on too long. Now the committee's action would be only academic. There was, however, still the question of the Commission's response to the President's directive, and McMahon wanted to use the hearing to discuss that subject with the Commissioners. Lilienthal asked to be excused on the grounds that he would be leaving the Commission in two weeks and would have no part in the matter.[94]

By this time the White House had announced the decision. Lilienthal called Lay to work out some details on the President's directive to the Commission. Next he called Smyth to tell him about the arrangements for the afternoon hearing. Shortly before three, he dropped in on the General Advisory Committee, which was holding one of its regular meetings in Washington. Kenneth S. Pitzer, who was explaining the Commission's fellowship program, left with the staff. Lilienthal told the members what had happened. The decision itself was hard enough to take; even harder was their duty to remain silent in the face of public discussion. Some of the members thought they should resign, but Lilienthal urged them not to leave so quickly that their resignations would be considered a protest.

Soon the Commissioners returned from the Hill, and there was a short meeting to discuss the hearing. The session had gone well. Smyth had been able to soften some of the demands for a "crash" effort at Los Alamos by reminding the Joint Committee of the danger involved in sacrificing development of improved fission weapons until the scientists knew whether the Super would work. He had held that the program Los Alamos had proposed for 1950 was about the most the laboratory could do under the circumstances. McCormack had already sent Bradbury a telegram directing him to proceed

at once with the plan without waiting for formal approval, which would probably come in a few days.[95]

END OF AN ERA

In the long months of argument, cajolery, and self-examination it had seemed to Lilienthal that the agony of indecision would never end. Now suddenly the wheels of time were turning once again. Strauss, now satisfied that development of the Super was safely under way, had announced that afternoon his decision to resign. The next evening the staff gave a farewell party which easily tapped the deep pool of sentimentality in Lilienthal's personality. The remaining days of routine swept by almost unnoticed. February 15 was a warm springlike day. The buds were already bursting on the trees as Lilienthal turned in his badge for the last time in the front lobby of the Commission's headquarters building, stepped into the sunshine to greet the employees assembled on the steps and waving from the windows, and set off into the world a free man.[96]

Certainly Lilienthal took with him something of the spirit and style which the nation had come to associate with the new agency. He had brought to the fledgling Commission in 1946 many of the strengths often attributed to youth: an unconquerable idealism, a relish for challenge, a driving energy, and a deep personal commitment. Some observers close to the scene thought they also detected in Lilienthal some of the common failings of youth: an impatience with detail, a fascination with glittering generalities, and a strong emotional reaction to events. A full appraisal of Lilienthal, however, had to go beyond personal traits. Taking command of a decaying wartime enterprise in 1946, he had built it into an effective, modern institution of government, which in many ways was setting new trends for the Federal service. Equally important, he had given Americans some sense of the promise of atomic energy, something to displace the grim specter of Hiroshima. Had an international agreement on atomic energy control been possible, Lilienthal might have realized his dreams for the peaceful atom. His tragedy, epitomized in the Hickenlooper investigation, was that of a man forced by circumstances to assume a task his spirit would not let him accept. Without him, the Commission would perhaps take on some of the sturdy qualities of middle age. It might seem more predictable, more practical, more business-like but would it be as imaginative and as stimulating?

TWILIGHT ZONE, FEBRUARY-JUNE, 1950

CHAPTER 13

President Truman's announcement of the decision to accelerate the development of a thermonuclear weapon had been brief. As he later acknowledged to a reporter, he did not intend to elaborate on the issue. For the moment the nation's spokesman on the hydrogen bomb was Brien McMahon. In a ringing Senate speech on February 2 McMahon assured his audience that the President had made the right choice. The new weapon in theory possessed unlimited power. But if the United States were the first to build the bomb, the nation could protect the free world from aggression while its leaders attempted through the United Nations to save mankind from the scourge of nuclear war.[1]

Certain realities McMahon did not touch. The hydrogen bomb was not, as he suggested, a piece of hardware nearly ready for production. The bomb was an idea, tentative and glimmering—its theory based on bold thought reaching to the stars, and its slender stock of data largely unconfirmed by laboratory experiment. Despite McMahon's confidence, there was no assurance that Los Alamos could produce a thermonuclear weapon.

The impact of these events on the Commission's research and development activities was difficult to measure. On March 11, 1950, Congressmen Melvin Price and Carl Hinshaw, representing the Joint Committee, questioned Walter H. Zinn and his staff in the ugly, gray Quonset huts at Argonne National Laboratory. "Supposing," Hinshaw asked Zinn, "today at twelve o'clock noon the President announced a state of national emergency, with some very important events in mind," what changes would Zinn make in his reactor program at Argonne? Zinn did not hesitate for a moment. He would cancel everything except the development of a new production reactor and the submarine propulsion plant.[2]

The President, however, had declared no such emergency. In a full

crisis the nation would have no choice but to forego long-range plans and focus on immediate needs. The nation was in a difficult twilight zone between peace and war. The Soviet detonation had spurred the nation one step closer to war; but in the first half of 1950 the Commission would have to keep its balance, ready to move either toward more terrible weapons of destruction or toward the human benefits the atom promised. Greater effort on thermonuclear research, raw materials procurement, and larger and more efficient production reactors was clearly in order. At the same time it would be prudent to maintain the vitality of the national laboratories, the university research teams, and the industrial groups which were developing the nonmilitary uses of atomic energy.

INTERPRETING THE DECREE 411

As McMahon was speaking in the Senate on February 2, 1950, the Commissioners were discussing the Presidential directive with the Military Liaison Committee. Now that Lilienthal had all but formally left office, the burden of carrying the Commission's position fell on Sumner Pike as acting chairman. Uneasy in his new role, Pike merely stated the substance of the directive. The Commission was to determine the technical feasibility of the thermonuclear weapon; the Commission and the Department of Defense were to fix the scale and rate of effort.

Robert LeBaron, chairman of the Military Liaison Committee, insisted that the Department of Defense had to have a decisive role in interpreting the directive. He believed the Commission and the military together had to draw up a plan for developing and testing a thermonuclear weapon. Only then would the specific tasks of each agency fall into place. Nor, in his view, should the two agencies restrict their efforts to developing a weapon. The Commission should not limit the production of tritium to the amounts needed for tests. If the tests proved a hydrogen bomb feasible, there should be sufficient tritium on hand to fabricate the weapon at once. If the Department of Defense were to fulfill its responsibilities, LeBaron believed that his committee had to understand all phases of the undertaking. The committee could best visit Los Alamos and talk directly to the laboratory personnel. Perhaps, suggested LeBaron, the Commissioners could join the committee.

A constant theme in LeBaron's remarks was the need for urgency. Troubled by this insistent note, James McCormack asked if the committee thought the Commission could move faster. Although LeBaron disclaimed this opinion, he admitted he had heard criticism that the tritium program lacked energy and that the planning was unrealistic. Stung by this comment, the Commissioners demanded to know who was suggesting they could not meet

their commitment to the President. LeBaron replied that several scientists, among them Ernest O. Lawrence at Berkeley, had expressed doubts.

Pike began his presentation by asking whether the military had actually established a requirement for a thermonuclear weapon. Not yet, replied LeBaron, because the Pentagon was waiting for an analysis of the cost in money, men, and materials, and the effect on the production of fissionable material. Walter J. Williams set forth the Commission's need for facts in order to set production schedules; McCormack pointed out the necessity to give Los Alamos guidance; and Henry D. Smyth declared the importance of defining production amounts and rates, and establishing military requirements. Bluntly Carroll L. Wilson asked if the Commission's program and approaches were satisfactory. LeBaron replied he could not answer until the roles of the Commission and the Department of Defense were defined. Close cooperation was necessary, but as Pike observed, it had to work both ways.[3]

As Wilson returned to his office after the meeting a new concern filled his thoughts. That morning he and the Commissioners had learned of the treason of Klaus Fuchs. While at Los Alamos during the war, Fuchs had discussed American speculations about a thermonuclear weapon. It was too early to say what the ramifications of the betrayal would be. At the moment it was simply another factor in a complex situation. McCormack's arrival reminded Wilson that he should inform Norris E. Bradbury of the impending visit by LeBaron's group. A glance showed the time was 6:25 P.M. Since Los Alamos was two hours behind Washington, probably Bradbury was still in his office. McCormack placed the telephone call. Necessarily the conversation was guarded; but Bradbury, generally aware of the circumstances and skilled at handling visiting dignitaries, understood enough.[4]

The next morning Wilson still thought the meeting with the liaison committee had been useless. Williams, the tough and shrewd director of production, agreed the session had been barren. Yet there was another chance to explain the Commission's position to the committee. The day before, McCormack had had to plan the Los Alamos visit with the military committee. As it happened, LeBaron was absent when McCormack arrived at the Pentagon, and he took advantage of the situation to speak to those present as one military officer to another. He explained that Los Alamos was ready to begin development work and the Commission was planning to give the laboratory the needed tritium. Establishing production schedules for thermonuclear materials, however, was difficult in the absence of military requirements. As for manpower, the Commission had begun to recruit scientists.

The committee members added little to their position of the previous day. They reasserted that the Commission should plan to produce tritium, interfering as little as possible with the plutonium effort, and on a scale that would leave some of the thermonuclear material after a test. Probably the Commission would find it necessary to build more production facilities and in

the committee's view, du Pont should construct and operate them. In a casual mood, the group adjourned with the understanding that the Los Alamos trip would take place sometime during the week of February 20.[5]

McMahon and the Joint Committee were also anxious to learn the details of the Commission's plans. On February 10, armed with Truman's permission, Pike opened the hearing by reading the January directive. He made it clear that the Commission was planning a production program which would go beyond the needs for testing. Strictly speaking, the Commission was stretching its assignment a little, but Pike thought the approach made sense. The main features he described as research and development, production of thermonuclear materials, and certain ordnance and delivery problems which were matters for the military. Pike admitted that the relations between the Commission and the Department of Defense were not clear, but the visit of the liaison committee to Los Alamos should be helpful. McCormack explained that the Commission program was vigorous but "somewhat short of flat out if you consider flat out to mean devil take the hindmost," and he had no doubts about Los Alamos enthusiasm. He and Pike agreed, however, that the thermonuclear effort would hit certain projects hard. Probably the intermediate-power-breeder reactor at Schenectady was the most vulnerable, for the skills of the General Electric scientists would be needed in the thermonuclear effort.

The committee members did not welcome the prospect of cutbacks. Chet Holifield warned against pursuing a thermonuclear weapon with a single-minded zeal which would exclude delivery problems and neglect promising refinements in fission weapons. In Carl T. Durham's opinion, the submarine reactor had a military use and should not be touched. The hearing had been good; the questions were of high caliber and revealed an awareness that the quest for the hydrogen bomb would require sacrifices.[6]

As an acute and perceptive observer of the political currents that swirled around the thermonuclear program, McCormack knew how important it was for Los Alamos to make a good impression on the liaison committee. He warned Carroll L. Tyler that the laboratory had to be ready to discuss accelerated schedules and had to remember that LeBaron's committee spoke for the Department of Defense in determining the scale and rate of effort. McCormack saw the visit as a superb opportunity for Los Alamos to make certain its needs and problems were understood. To prepare the committee for the visit, Wilson sent LeBaron an account of the steps the Commission was taking to see that Los Alamos would have thermonuclear materials for a test sometime in 1952. That requirement would have an impact on the production directive signed by Truman in October, 1949, and some amendment might be required. Although the Commission was studying several ways of manufacturing stockpile quantities of thermonuclear materials, it was too early to discuss the need for new facilities. Wilson stressed the importance of guidance from the Department of Defense; he hoped the Los Alamos visit would be useful.[7]

LOS ALAMOS SELLS A PROGRAM

There was crispness in the air at Los Alamos as Bradbury welcomed the Military Liaison Committee into his office. Because of the pressure of budget hearings, Smyth was the only Commissioner present as the two-day meeting began on February 23. After a few brief remarks, Smyth turned the meeting over to Bradbury. With a sure hand the Los Alamos director sketched the laboratory plans. Los Alamos would place its maximum effort on the thermonuclear weapon, but would continue developing some fission weapons which were too promising and too near completion to be dropped. He thought that as a whole, the laboratory personnel were in fair agreement, although there were individual differences on certain points.

From fission weapons, Bradbury turned to the thermonuclear effort. Incisively he stated the problems, the tentative solutions, the probable requirements, and the possible schedules. The crucial question was whether a thermonuclear reaction could be achieved. Success depended upon finding some way to release energy by fusing the heavier isotopes of hydrogen. The most promising isotope was deuterium, which existed in water. Isotope-separation techniques developed during World War II offered to make deuterium available cheaply in almost limitless quantities. However, fusion of deuterium would be theoretically possible only if its temperature could be raised to about 400 million degrees. This temperature was above that reached by an atomic bomb. Somehow the laboratory had to achieve the higher temperature. The best chance seemed to be through a fusion of a mixture of tritium and deuterium. The hydrogen isotopes would react at a lower temperature and would release energies which might initiate fusion of deuterium.

The uncertainties were staggering. Bradbury warned against pursuing the search for a thermonuclear weapon if the laboratory could find no way to reach the stellar temperatures. He thought that those working on the atomic bomb in 1940 were more sure of success than those now embarking on the quest for a thermonuclear weapon. The endeavor would be costly. Concentrating the abilities of Los Alamos upon the thermonuclear weapon might mean sacrifices. Promising areas of research might lie neglected and new ideas pass unrecognized because of the exclusive devotion to a single purpose. For the nation's only atomic weapon laboratory, the thermonuclear effort raised grave risks which Bradbury felt could only be justified if the hydrogen bomb were needed in the near future. He could not say when a thermonuclear weapon could be produced, but he hoped for a test of thermonuclear principles in the spring of 1951. It was difficult to predict the speed of the effort. In the early days, the laboratory had been working under the pressure of war; now it was not. For another thing, some physicists had moral reservations about the effort, and others felt that the main difficulties were engineering rather

than scientific, a misconception Bradbury was finding hard to correct without violating security regulations.

Those listening to Bradbury had come to hear facts and not to offer challenges. There was a feeling that the laboratory plans were as sound as possible, under the circumstances, and LeBaron was anxious to find out how his committee could help. Edward Teller described various experiments needed to acquire data. He agreed with Bradbury that Los Alamos could set no timetable and would face recruiting difficulties. Although the laboratory had been successful in getting some bright young scientists, the hesitation of older leaders to commit themselves had deterred others. For about half an hour LeBaron and his group met alone, and then joined the others for lunch. By the end of the day LeBaron announced, with satisfaction, that Los Alamos had "sold a program." [8]

CLARIFYING THE DIRECTIVE

Los Alamos had given LeBaron a feeling of assurance that the laboratory had set a course, but his doubts about the Commission's production plans remained. The production of Supers would probably require large amounts of tritium. Exposing lithium to neutron bombardment was the most practical way to make tritium, a fact which caused the planners at Washington to look to Hanford. Using Hanford reactors to make tritium meant a decrease in plutonium production. Even more unfortunate, the number of neutrons required for tritium was more than that needed to make an equal amount of plutonium. Another important fact for those who plotted production curves was that the half-life of tritium was little more than twelve years, only a small fraction of that of plutonium used in fission weapons. The obvious solution was to call upon Hanford for a limited amount of tritium until new sources of neutrons could be developed.

As Wilson had written LeBaron just prior to the Los Alamos visit, the Commission was looking at four ways to obtain neutrons. Three of the approaches depended on reactors: a modified materials testing reactor, a heavy-water-moderated production reactor, and a modified Hanford-type reactor. The fourth possibility was Lawrence's idea of a linear accelerator. With the dynamic energy characteristic of Berkeley, a laboratory group was already engaged in feasibility design studies.[9]

To LeBaron, the importance of these efforts had been overshadowed by the revelation that Fuchs was a spy. The liaison committee chairman asked Generals Kenneth D. Nichols and Herbert B. Loper for an evaluation of the significance of the disclosure. Their analysis showed that the information Fuchs possessed could significantly increase the Russian capabilities. The possibility that the Russians were much closer to the Americans in the race

for the hydrogen bomb than had been believed was the alarming thought that LeBaron carried to Louis A. Johnson, Secretary of Defense. Johnson sent the appraisal to the White House and, on February 24, buttressed by a recommendation from the Joint Chiefs of Staff, he proposed an "all-out program" for the hydrogen bomb. Anything less, Johnson declared, imperiled the security of the nation.[10]

For resolution of such fateful questions, Truman would again call in the special committee of the National Security Council. As the Commission's representative, Smyth gained a better sense of the course he should follow in a meeting with LeBaron's group on March 1, 1950. Some of the Commission's proposals would affect the established production goals. Before changing the goals, the Commission had to inform the liaison committee even if, observed Pike, the committee could not always speak for the department. Promptly LeBaron responded that he knew Secretary Johnson and the Joint Chiefs
416 considered the thermonuclear effort of such importance that they would accept sacrifices in fission weapon production. Perhaps the military services, suggested Admiral Tom B. Hill and Admiral Ralph A. Ofstie, could lighten the burden on Los Alamos by taking on some of the laboratory projects.[11]

Losing no time, Smyth joined LeBaron and R. Gordon Arneson of the State Department in a meeting of the working group that same afternoon. Smyth said the Commission was moving as fast as it could on production and knew of no recent intelligence information to warrant a reexamination of the scope of the thermonuclear effort. The special committee, however, could clear away the ambiguity in the January directive by recommending to Truman that he make explicit the Commission's responsibility to prepare for stockpile production of thermonuclear materials. In the discussion of costs, schedules, and manpower, Smyth declared that no one on the Commission staff or on the liaison committee had yet suggested how to speed up the effort.[12]

From production matters, Smyth suddenly found himself plunged into Los Alamos affairs. Shortly after noon on March 3, Wilson came to him with the unexpected news that Teller was about to appear before the Joint Committee. Neither the Commissioner nor the general manager knew that Teller had dined the previous evening with William L. Borden, executive director of the Joint Committee staff and McMahon's closest adviser. Vividly impressed by a portrayal of the urgent need for scientists at Los Alamos, Borden had asked Teller to talk to the Joint Committee. Smyth was the only Commission representative present as the hearing began. Teller explained that work on the thermonuclear weapon had lagged after the war because so many people, himself included, had left Los Alamos. Somehow those lost years had to be made good. He saw no need to strip the research centers of their talent, but in some way the reluctance of the scientific leaders had to be overcome. Of course there were doubts of success which he himself shared, but on balance Teller believed a thermonuclear weapon was feasible. High-caliber people

were essential. He would not rule out resuming cooperation with the British, despite Fuchs. Teller could think of several British scientists whose help he would welcome.[13]

On March 10, Truman accepted the special committee report which more clearly defined his earlier directive to the Commission and the Department of Defense. By his action he instilled greater urgency into the thermonuclear effort, instructed the Commission to prepare for quantity production of thermonuclear materials, and approved a feasibility test of thermonuclear principles. Together the Department of Defense and the Commission were to establish the scale of effort needed to produce thermonuclear materials, particularly tritium, and to estimate the impact of that effort on existing production goals. The report informed Truman that there was no way to hasten the schedule for the essential tests and, perhaps most important, that there was no guarantee of success. Even if the tests were failures, the President could find consolation in the statement that the proposed production facilities could be used for making fissionable materials.[14] Smyth must have been pleased that the thermonuclear effort now had greater clarity.

That same day before the Joint Committee, Smyth came back to the question of scientific manpower. He read an impressive list of those who were joining the effort at Los Alamos: John A. Wheeler of the Palmer Physical Laboratory at Princeton from a sabbatical in Europe; Emil J. Konopinski, from Indiana University; and Marshall K. Rosenbluth from Stanford.

This was interesting, but McMahon had other matters to discuss. So far, he told his colleagues, the Joint Committee had confined its attention to the Commission. What about the Department of Defense? Did Secretary Johnson believe that the nation was spending enough on atomic energy? The members of the committee listened to McMahon propose that Johnson and the Joint Chiefs of Staff present their separate opinions on the adequacy of the resources allotted to atomic energy.[15] From the committee's approval it was clear to Pike and his colleagues that the Joint Committee was claiming a vigorous and dynamic role for itself in the hydrogen bomb effort. It did not intend to see the program suffer because of hesitancy or lack of initiative.

REACTORS FOR DEFENSE

By March, 1950, most of the reactor development groups at the Commission's national laboratories were already working on military projects. At Argonne, seventy scientists and technicians were directly involved in research on the submarine thermal reactor. Many others, including half the metallurgy division, were performing research related to the Navy project. Design of the materials testing reactor, which would contribute directly to the naval and aircraft propulsion projects, still took most of the time of twenty members of

the Argonne staff. Almost as many were investigating the possibilities of modifying the design of the materials testing reactor for use as a plutonium producer. Purely nonmilitary projects, such as the experimental breeder reactor and a new research reactor for Argonne, commanded only a few scientists.[16]

The submarine reactor, without question, was the center of the laboratory's effort in the first months of 1950. The naval reactor branch, under Harold Etherington's direction, had spent most of the preceding six months preparing a reference design for the submarine propulsion plant. The report, completed on March 1, 1950, established the general specifications which Argonne and the Westinghouse Electric Corporation would follow in designing and developing components for the Mark I reactor, a land-based prototype to be built at the Idaho test station, and Mark II, the first plant to be installed in a submarine. Months of study had confirmed the tentative decision
418 that the reactors would use pressurized water as both moderator and coolant. Extremely sensitive and flexible controls would be necessary for submarine operation, and special provisions would be needed to override the poisoning effect of the fission product, xenon 135, in the period immediately following a reactor shutdown. Extensive exposure of fuel element samples in the Hanford and Oak Ridge reactors had also confirmed the selection of zirconium as a cladding material. Oak Ridge had been successful in devising a process for separating zirconium from hafnium, a strong neutron absorber, but the production of large quantities of acceptably pure zirconium was still uncertain, despite the efforts of the Foote Mineral Company to perfect the process.[17]

So far almost all of the burden for design had fallen on Etherington's group at Argonne. Westinghouse had a few engineers in training at the laboratory, but the company could do little more than some experimental work on zirconium and some small pump development in the old hangars at Bettis Field near Pittsburgh, until permanent buildings were completed in the summer of 1950. Etherington's relations with Westinghouse were good, and Zinn and Captain Hyman G. Rickover had come to an understanding about the responsibilities each would have. Rickover unmistakably represented the Navy and the Commission, but Zinn, who could be as strong-willed as Rickover, had insisted on giving orders for all work at Argonne, including that on naval reactors. Rickover as always impatiently demanded progress. For the difficult task of coordinating and scheduling the activities of the three organizations, he had established a policy board consisting of Zinn, Charles H. Weaver of Westinghouse, and himself.

Etherington, a good administrator as well as a good engineer, gave the Navy project at Argonne a clear sense of direction. Westinghouse was beginning to add its support, and Rickover had already clashed with Leonard E. Johnston and his staff at the new Idaho operations office over plans for building the Mark I plant. Development so far had been technically sound, and there seemed every reason to believe that the combined Commission-

Navy-Westinghouse task force could build a useful submarine propulsion system. The big question was time. To have a nuclear submarine at sea by January 1, 1955, as the Navy had requested, would mean having Mark I in operation by May 1, 1952. On that time schedule, Mark I would have to be similar enough to Mark II so that no major development would be required to build Mark II. At the same time, Mark I would also have to include experimental features essential in determining the final design of Mark II. Another complication was that Etherington would have to freeze the design of Mark I before Argonne could obtain results from a critical assembly of the reactor core, then under construction at the laboratory.[18]

The materials testing reactor at Idaho would neither produce plutonium for weapons nor propel a naval vessel, but it would be able to speed the development of reactors of either type. Under the agreement Zinn had made with Alvin M. Weinberg of the Oak Ridge National Laboratory, John R. Huffman and his staff at Argonne were developing the basic design for all of the plant outside the reactor tank. By March, 1950, they had provided the Blaw-Knox Construction Company with 90 per cent of the data the company would need for detailed engineering design of the reactor and service buildings, the plugs for the experimental ports in the reactor, the coffins for transporting radioactive materials, the storage basin for irradiated fuel elements, and the retention basin for cooling water from the reactor.[19]

Coordination with Oak Ridge was still the responsibility of Stuart McLain and the steering committee. Now that McLain had moved to Argonne and would soon go to Idaho, Marvin M. Mann was directing the work at Oak Ridge. Developing the fundamental design of the reactor involved more than forty men in a variety of activities, including estimates of radioactivity induced in reactor materials and cooling water, fabricating and testing fuel elements and control systems, and preparing final drawings for Blaw-Knox. This work centered around the mock-up of the reactor core which the group had built at Oak Ridge. Most of the tests of hydraulic and control systems had been completed in 1949, and in January, 1950, Mann had started the experiments which would bring the mock-up just to the point of criticality. The critical experiments inspired new confidence in the design at Oak Ridge.[20]

Second only to the testing reactor in the Oak Ridge priority list was the work on aircraft propulsion. Scarcely two years earlier Weinberg and his staff had considered the project technically unsound; but as Weinberg explained to Hinshaw and the reactor subcommittee at Oak Ridge on May 5, 1950, the laboratory had changed its mind about aircraft propulsion. The Lexington report in the fall of 1948 had indeed sounded a pessimistic note in suggesting that it would take fifteen years of vigorous development and more than $1 billion to put the first nuclear-powered aircraft aloft. Estimates of the potential value of the propulsion system in long-range bombers, however, seemed to justify spending $200 million on research and development over the next three to five years. Impressed by this recommendation, the Commis-

sion in December, 1948, had decided to finance its own feasibility studies at something approaching $3 million annually for two or three years. At the same time, the Commission asked the National Military Establishment to determine whether the very much larger expenditure in materials, money, and talent would be justified in comparison with other military requirements. Lawrence R. Hafstad set up a joint effort which included the Air Force's NEPA project at Oak Ridge and the Lewis Flight Propulsion Laboratory of the National Advisory Committee on Aeronautics.[21]

The selection of Oak Ridge for the Commission portion of the aircraft project was inevitable after the collapse of centralization. Weinberg was looking for ways to bring reactor development back into the laboratory, and the proximity of NEPA in the K-25 area at Oak Ridge offered obvious advantages. Chronic organizational and personnel problems had continued to plague the Fairchild Engine and Airplane Corporation, the principal NEPA
420 contractor, but the technical competence of the NEPA group was gradually improving under the leadership of Miles C. Leverett, who had been a key man in reactor development in the Clinton Laboratories.

Technical progress by the spring of 1950 had led Weinberg from skepticism to real enthusiasm about an aircraft reactor. Working with NEPA, the laboratory had decided to use lighter shielding materials and to provide greater distance between the flight crew and the reactor. Separate shielding around both the reactor and the crew would make possible a great reduction in the dead weight of shielding, which would be a prime disadvantage in a nuclear-powered airplane. A variety of experiments sponsored by the Commission, Air Force, and NACA had helped to find materials that would resist both high temperatures and intense radiation. NEPA continued some of the earlier studies of air-cooled reactors, but their obvious disadvantage at very high altitudes convinced Weinberg that the greatest promise lay in reactors using liquid metals as the heat-transfer medium. Weinberg hoped that a technical advisory board visiting the laboratory during the summer of 1950 would be able to settle the question of reactor type so that the laboratory could begin the design of a small aircraft reactor experiment before the end of the year.

OAK RIDGE: A NEW KIND OF LABORATORY

Progress on the materials testing reactor and the aircraft project were only two sources of the general optimism which prevailed at the Oak Ridge laboratory in the spring of 1950. Two years under Carbide had convinced Weinberg and his associates that an industrial contractor could operate a research laboratory. Relations with Union Carbide had been good and those

with the Commission's staff at Oak Ridge even cordial. In January, Clarence E. Larson, a competent and personable engineer, had replaced C. Nelson Rucker as laboratory director. Since 1948 Larson had been director of the Y-12 plant, which housed the biology division and other portions of the Oak Ridge laboratory. He could work well with Weinberg, who became director of research for the entire laboratory. Aside from the retirement plan and the accounting system, the Carbide operation was effective and to the point. "As matters have turned out," Weinberg admitted in the spring of 1950, "Carbide has been an unsuspected source of strength in relations between the laboratory and the commission." [22]

The best hope for the laboratory's future was its new role as a center for reactor development. In Weinberg's opinion, reactor engineering was more properly done in an industrial than in an academic institution. He thought Oak Ridge was carrying the main burden for the materials testing reactor and had raised aircraft nuclear propulsion from an almost-certain death. Weinberg saw great promise for the homogeneous reactor experiment, which a small group intended to build at Oak Ridge during the coming year. It would be an *experiment* in every sense of that word, and not a complete engineering entity. A small reactor, it would generate only a few hundred kilowatts of heat and enough electricity to power a few light bulbs. But it would test the practicality of achieving a chain reaction in a water solution of uranyl sulfate circulated through a pressure vessel with the shape and size of a critical mass. Weinberg admitted that research on the homogeneous reactor had strayed from the original goal of developing a power breeder, but he felt certain that successful operation would represent a real advance in reactor technology. The best feature of the homogeneous reactor, in Weinberg's opinion, was its small size and relatively low cost. He thought the Commission might step up the pace of reactor development by authorizing a large number of small experiments of this type. A more aggressive, experimental approach might provide better reactors for both peace and war.[23]

THE FUTURE OF KNOLLS

For Harry A. Winne and the General Electric staff at the Knolls Atomic Power Laboratory, it was not so easy to adjust to the shifting uncertainties of early 1950. Although the Knolls laboratory could claim some part in naval reactor technology, General Electric was heavily committed to the intermediate-power-breeder reactor. Looking forward hopefully to the day of economic nuclear power, the company was reluctant to abandon the dream of a single plant which would both generate electric power and replenish its own fuel supply by the breeding process. The trouble was that by the summer of 1949

the dream no longer fitted reality. In order to keep alive any hope for breeding, Kenneth H. Kingdon and his laboratory staff had been forced to move toward higher neutron energies in designing the power breeder. At the upper limits of the intermediate range, the reactor would not be a good power producer.

Already worried about the growing divergence of the breeder and power capabilities of the reactor, Hafstad with the support of Carleton Shugg had decided to give General Electric no more encouragement than was absolutely necessary. In August, 1949, they had agreed to authorize $3 million for site studies at West Milton, New York, where the company planned to build the power breeder. But they refused to sanction actual construction until General Electric had completed a feasibility study of the reactor, which would contain detailed estimates of costs. When the report arrived just before the deadline on February 14, 1950, both Shugg and
422 Hafstad were disappointed. The report contained surprisingly few engineering details and the cost estimates were staggering—more than $36 million, plus a contingency of 15 per cent. Shugg saw no alternative to a full-dress meeting with the company's leaders in Washington. To assure Carroll Wilson's presence, Winne would not agree to schedule the meeting before March 17.[24]

The delay also gave General Electric time to muster support for the power breeder. As a result of several years of correspondence with Lilienthal, Philip D. Sporn, president of the American Gas & Electric Company in New York, had convinced the Commission to establish a small advisory committee of power utility executives to investigate the possibilities of developing a nuclear power industry. Winne invited Sporn and his committee to Schnectady on March 11 to discuss the power breeder. The following day Congressmen Price and Hinshaw arrived on the second leg of their tour of the Commission's reactor laboratories. The meeting was as congenial as that on the previous day. C. Guy Suits, Kingdon, and Winne all acknowledged the company's commitment to the production effort at Hanford, but they concentrated their attention on the power breeder.

Because Zinn had neglected to say much about his own breeder reactor in describing Argonne's work on military projects, the Congressmen shared for the first time at Schenectady a full understanding of the heady dreams of an infinite supply of fissionable material and electric power. The need to increase neutron energies for breeding did hurt the reactor's power capabilities, but Suits and Kingdon pointed to the superior qualities of liquid metal over water as a heat-transfer medium. Toward the end of the discussion Kingdon broached the subject of naval reactors. Hinshaw was surprised to learn that the Knolls laboratory had such a project. It was not yet, Kingdon admitted, clearly separate from the power breeder, but he claimed that development and construction of the West Milton unit would make possible a

sodium-cooled submarine reactor without any need for a land-based prototype. Because of its flexibility for experimental work, the power breeder alone might enable General Electric to build the first nuclear-powered submarine in history.[25]

Developments in Washington would certainly have cooled the enthusiasm at the conferences in Schenectady. Just two days earlier the President had approved the special committee's recommendation that the Commission prepare for quantity production of thermonuclear materials. Wilson's preoccupation with such matters was evident when he, Shugg, and Hafstad met with the General Electric group on March 17. The President's thermonuclear decision and the new requirements had placed heavy burdens on Los Alamos for weapon development, on Oak Ridge for uranium 235, and on Hanford for both reactors and the Redox process. The shortage of technical manpower left Knolls as the only source of additional help for Hanford.

Wilson found General Electric's study of the power breeder too sketchy to justify the start of construction. In fact, new uranium discoveries had made ore procurement a matter of economics rather than availability; breeder reactors had lost some of their earlier importance. Hafstad outlined the Commission's decision: The power breeder would be postponed indefinitely; Knolls would concentrate most of its efforts on Hanford problems; and the reactor at West Milton would be designed as a prototype for a submarine plant.[26]

But could the Commission make such a drastic decision stick? Shugg took no chances. The following week he sent Hafstad and Rickover to discuss the decision with McMahon. As Shugg expected, Rickover was extremely effective in making the point that the reorientation at Knolls would greatly strengthen the submarine effort there. Hafstad could also point to George L. Weil's pessimistic appraisal of the power-breeder idea and to Sporn's private opinion that the reactor had been overdesigned. To members of the General Advisory Committee, Hafstad stressed the deficiencies in the power-breeder design and the high cost estimates. Only after the advisory committee had endorsed the Commission's decision did Oppenheimer learn, much to his dissatisfaction, of the weight the Commission had given to military priorities in justifying cancellation of the power breeder.

On April 3, Rickover adroitly turned the Joint Committee's interest from the power breeder to the new submarine intermediate reactor. Sessions with Sporn's committee and Navy officials later in the week removed the last fears of opposition. Armed with Commission assurances of support for the submarine project, Rickover set off for Schenectady to nail down the new arrangement. On April 6, Winne agreed to transfer about half the Knolls staff to Hanford jobs; the other half would work on the submarine reactor. For Knolls the twilight had ended; military requirements had at least for a time completely obscured any glimpse of the peaceful atom.[27]

PRODUCTION: REACTORS AND AN ALTERNATIVE

Even before the President had clarified his directive on the thermonuclear effort, Wilson had begun to explore ways of providing the additional quantities of fissionable material or tritium which a larger arsenal of fission or thermonuclear weapons would probably require. On February 15, 1950, he established in the staff an *ad hoc* committee to consider which type of reactor would most efficiently produce tritium, given the uncertainties and the urgent schedule. By focusing upon reactors, the group did not mean to prejudice the Berkeley accelerator; the exclusion resulted from the lack of comparable data. To Weil of the division of reactor development fell the task of pulling together the information.

As Weil gathered data for his report, Wilson set about organizing his Washington staff to assure firm management of the thermonuclear effort and prompt mobilization of the nation's reactor experts. After talking with Shugg, Wilson decided that the two of them would take personal responsibility for the effort and would call upon the senior staff for advice. On March 21, after Weil completed his paper, Wilson asked Hafstad to invite Zinn, Weinberg, Suits, Eugene P. Wigner, and Chauncey Starr to serve as a review body. To strengthen the analysis, Wilson telephoned Oppenheimer to see if the reactor group of the General Advisory Committee would add its views. Oppenheimer promised to place Weil's paper high on the agenda for the committee's meeting in late March.[28]

As Wilson was making these arrangements, he began a series of gatherings in his office to study Weil's paper. Occasionally during the two days of discussions, Pike, Smyth, and Dean dropped in, but it was Wilson and his key staff who explored the possibilities. The goal was to obtain within two or three years the facilities to produce a large quantity of neutrons. Weil had tabulated the advantages and disadvantages of four reactor designs: a modified Hanford reactor by General Electric; a modification of the materials testing reactor by Oak Ridge and Argonne; a light-water-moderated reactor fueled with slightly enriched uranium, a comparatively new reactor approach by the H. K. Ferguson Company; and the heavy-water-moderated, light-water-cooled reactor based on the Canadian NRX at Chalk River, but with modifications proposed by North American Aviation, Incorporated.

One by one the possibilities for the reactor design narrowed. Hanford types were not completely excluded, but the group thought that building more units at that site would unduly concentrate production reactors. The better course would be to depend upon Hanford for the production of the essential thermonuclear materials until more efficient reactors at a new site came into operation. Certainly the light-water-moderated reactor was interesting, but the time for development seemed too great. The modified materials testing reactor

had a long history of design study and component development, but outweighing these advantages was a lack of flexibility. It would not be as good as the other alternatives for producing plutonium. The sessions ended on March 22, with the staff leaning toward the North American proposal.[29]

The sessions with the laboratory leaders beginning on March 30 focused attention on another possibility. Zinn had come to the meeting prepared to talk about a modified materials testing reactor, which Hafstad had asked him to study. Now he discovered that the Commission was primarily interested in a reactor which would be a good producer of plutonium in the event that the thermonuclear effort failed and the need for tritium lessened. For that purpose the modified materials testing reactor would have little value. Zinn also maintained that the North American design would not be the best solution. Without any opportunity to prepare a written proposal, Zinn persuasively argued for a reactor fueled with natural uranium but using heavy water for both moderator and coolant. The suggestion was a natural one for Zinn. Like a proposal he had submitted to Hafstad in October, 1949, the design would be an enlarged version of the CP-5 research reactor which Zinn planned to build at Argonne.[30]

Zinn did not stay in Washington for the meeting of the General Advisory Committee, but he could be confident that his proposal would receive attention. After considering the various possibilities, the committee agreed that the natural-uranium, heavy-water reactors were the most promising approach. The committee advised the Commission to ask du Pont to consider the heavy-water design for production reactors with the expectation that the company would undertake the design, construction, and operation of the new production units.[31]

A subject of great interest to the General Advisory Committee was an alternative to reactors, Lawrence's idea of building a huge linear accelerator which would generate a flood of neutrons for producing plutonium or tritium. The advantage of the accelerator was that it would not consume uranium 235, on which the fission process in production reactors depended. So convinced was Lawrence of the vital importance of the project that he was willing to delay completion of the bevatron and transfer the skills of his Berkeley group to the production accelerator. On February 8, 1950, the Commission had approved Lawrence's proposal to construct a linear accelerator to produce proton currents on the order of 50 milliamperes at an energy of 25 million electron volts (mev). The Mark I, as the accelerator was called, would make several radioisotopes of interest to the Commission.

Somewhat in parallel, design was proceeding on a much larger accelerator. At a total cost of about $65 million, Lawrence believed he could build a 350-mev accelerator. Its size would be immense. The Mark II was to be housed in a tank 60 feet in diameter and 350 feet long, and would require about 150,000 kilowatts of electricity. The technical challenges were severe. No vacuum had ever been achieved in so large a vessel, nor such voltage

gradients held between drift tubes. Lawrence was again pushing at the frontiers of technology, but this time for isotope production, not for research. Whether the supply of uranium would ever become so short as to make necessary a production accelerator was a question debated in Washington.[32]

RAW MATERIALS

The raw materials situation was still tight, although improving. Most deliveries still came from the Belgian Congo, with the United States and Canada ranking far below. Jesse C. Johnson's division of raw materials had mounted a vigorous prospecting and drilling campaign in the American West; but even if new sources were found, it was possible that all available uranium would be
426 consumed within a few years by the expanding production of fissionable and thermonuclear materials.

Foreign sources of uranium ore were equally uncertain in early 1950. At some time the Shinkolobwe mine in the Belgian Congo would become exhausted, and in all likelihood the main source of uranium would become South Africa, where the mineral was found in association with gold ore. Separating the uranium, however, involved severe technical difficulties on which several university research groups had been working for years. Even more perplexing were the political obstacles. After long and complicated negotiations, the Combined Development Agency in March, 1950, stood ready to draw up a contract with the South Africans. At this point Secretary of Defense Johnson acted abruptly. Deeply disturbed by Fuchs's treachery, Johnson saw in the event a warning that the United States must rely upon itself as far as possible. Therefore, he proposed on March 13, 1950, that the United States deal directly with South Africa instead of negotiating through the Combined Development Agency in which the British and Canadians were also members.

Wilson promptly took Johnson's proposal to Joseph A. Volpe, Jr., the Commission's general counsel, and Jesse Johnson, director of raw materials. The three men believed that the proposal would disrupt the negotiations with the South Africans and threaten American ties with the British and Canadians. The Commissioners agreed and recommended continuing the conversations with the South Africans while the American members of the Combined Policy Committee assessed Secretary Johnson's proposal. From Arneson, Wilson learned that Secretary Dean G. Acheson disliked the Johnson idea. When Pike met with Johnson and Acheson on April 25, Johnson accepted the softer position that negotiations through the development agency should continue during a review of relations with Britain and Canada. It was a bureaucratic solution to a troublesome suggestion. Negotiations with the South Africans were difficult enough in their own right, and not until

November, 1950, could the Combined Development Agency conclude an agreement.[33]

THE RETURN OF DU PONT

The Johnson proposal was merely an awkward interruption to the consideration of production reactors. Williams was pressing for decisions. As he pointed out to the Commissioners on April 28, if heavy-water reactors were the choice, construction of heavy-water plants should begin soon so that their product would be available on time. All in all Williams believed that the Commission would require a new production site, a new operations office, and another major contractor. Smyth saw the matter in a larger context. The Commission would soon have to reply to the President on the rate and scale of the thermonuclear effort. Once the magnitude of the program was fixed, the Commission could make implementing decisions. To Smyth, the best way to get Presidential approval was for the Commission to draw up a proposal in which the Department of Defense would concur. Robert F. Bacher, now a Commission consultant, stressed with Smyth the need for a flexible program. If the thermonuclear gamble failed, the new installations should be useful in producing fissionable material. From this perspective, Bacher found the heavy-water reactors attractive. They promised good neutron economy for thermonuclear or fissionable material, and the safety aspects seemed sound. Back in his office, Shugg planned with Volpe the course to follow. Hafstad, McCormack, Volpe, and Weil should draft a paper for the Department of Defense and the President. During the next few days others were called in to help, and Wilson himself dictated a few paragraphs. On May 5, the Commission sent its proposal to the Military Liaison Committee.[34]

Shugg had been keeping du Pont aware of the general course of events through R. Monte Evans, a company engineer whose experience in reactor work went back to early Hanford days. Now that the Commission's plans were taking final shape, Wilson and Shugg on May 12 caught the noon train from Union Station for the du Pont headquarters in Wilmington, Delaware. In Crawford H. Greenewalt, the company president, Wilson and Shugg faced a shrewd negotiator. Du Pont would consider the project if the company were given full responsibility for the new reactor facilities, including design, construction, and at least initial operation. The company would make no commitment until its engineers had reviewed the Commission plans, evaluated the several approaches to heavy-water production, and estimated the chances of completing the project on schedule. Moreover, du Pont would need to know the details of heavy-water production, since difficulties in this area might affect the reactor operating data. Following the policy that du Pont had established in the Manhattan days, Greenewalt insisted upon a letter from

President Truman confirming the importance of the project for national security. Having stated these terms, Greenewalt accepted some basic studies for his engineers to analyze.

Wilson reported to the Commissioners that du Pont would accept the assignment if its conditions were met. Since Greenewalt was about to leave for Europe, Wilson urged quick action. The Commission discussion revealed an uncomfortable feeling of wariness. Smyth understood the du Pont concern over the selection of the heavy-water production process, but on the other hand he did not want to see the Commission abdicate its responsibility to du Pont. Dean wondered what other companies the staff had considered. Union Carbide, Monsanto, Dow Chemical, and American Cyanamid, replied Wilson, but they could not match the du Pont experience in design and construction of production reactors and chemical processing facilities.[35]

HEAVY WATER: PROCESSES AND REACTOR

The Commission had already come to some conclusion on heavy-water production processes. During the Manhattan project, Groves had chosen the water-distillation and the catalytic exchange processes for the small amount of heavy water needed. The drawback to these processes was the high unit cost of the product. Two other processes—dual-temperature and hydrogen-distillation—had been considered briefly, but scaling them up from the laboratory bench to the production plant revealed severe engineering difficulties. These obstacles seemed less formidable as industrial techniques improved after the war, and the Commission had asked Hydrocarbon Research, Inc., to design a plant based on the hydrogen-distillation process. On March 1, 1950, the Commission approved the construction of a pilot plant. In this process, hydrogen gas would be cooled to liquid temperatures and the deuterium separated from the gas by fractional distillation. There were disadvantages: hydrogen gas could be hazardous and the low temperature required by the process could make plant operation difficult.

As promising as the hydrogen-distillation method appeared, Williams's production division was anxious to get Commission approval for another heavy-water plant based on the dual-temperature approach. Edward J. Bloch, deputy director of production, told the Commissioners on May 11, 1950, that estimated requirements for heavy water were increasing. Furthermore, the wisdom of relying on a single method was doubtful. Bloch favored constructing another pilot plant for the dual-temperature process. Early work on the method had been done under Harold C. Urey at Columbia and by Jerome S. Spevack. In the dual-temperature process, deuterium was concentrated first in water and then in hydrogen sulfide gas as water was passed through the gas in alternately hot and cold mixing towers. The process

required several towers and was dangerous. Because the hydrogen sulfide gas was toxic, men assigned to the plant would have to wear gas masks and work in pairs.

At first the Commission had rejected the dual-temperature approach because of the long construction time required and high costs. Using some of the existing facilities at the Wabash River Ordnance Works near Dana, Indiana, would reduce the cost of the pilot plant. If all went well with the pilot plant, more equipment could be installed at the Wabash site so that production could be increased to tonnage amounts. Commission approval of the Wabash project eased but did not meet the supply situation for the future. Wilson was worried. As he studied the production plans with the staff, he concluded that the availability of heavy water might be the pacing item. He reported to the Commissioners on May 18 that constructing and operating heavy-water facilities for the tritium production effort might well be part of the du Pont assignment.[36]

While the Commission in Washington deliberated over heavy-water processes, Zinn at Argonne had his reactor men working intensively on a heavy-water-moderated and -cooled production reactor. Zinn and his staff believed their design had certain advantages over the North American proposal, which they thought overestimated production rates and overlooked some difficulties in heat transfer. The only obvious drawback they saw in the Argonne design was that the quantity of enriched uranium required was greater than the hurried estimate Zinn had given Shugg on March 31. The positive factors Zinn saw were impressive: The Argonne design should compare favorably to the Hanford reactors on fuel economy, and conversion of heat by cooling towers rather than by large bodies of water promised greater latitude in choosing a site.[37]

Shugg strongly inclined toward the Argonne plan, but Weil was less certain. Confronted by drawings, data, and analyses from Argonne and North American Aviation, he called a meeting of reactor leaders for May 24. After Weil's introductory remarks, Wigner warned that other reactor types should not be overlooked. Although the point was sound, others at the meeting resisted broadening the scope of the session beyond a comparison of the two designs. Tex Fahrner presented the North American design and Zinn described the Argonne approach. For three days the group argued over reactor physics and the definition of terms and constants.

The main differences between the two designs lay in the use of heavy water. The North American group planned to use heavy water only as a moderator, while the Argonne team proposed it as both a moderator and coolant. Zinn challenged the North American idea of forming the reactor core by placing four aluminum tanks side by side to hold the heavy water and the fuel elements. In his view the design called for too much welding, often the source of corrosion problems. Wigner doubted whether the tanks could be made leakproof. He was not satisfied with Fahrner's assurances that aircraft

manufacturers in the Los Angeles area were confident of their ability to meet the specifications, because they had had no experience with welds which would be subjected to irradiation. Others at the meeting questioned whether the North American design contained sufficient flexibility to make uranium 233 from thorium or plutonium from depleted uranium.

Zinn fared reasonably well; the main criticism came over the means for heat removal in case of emergency shutdown. After three days, there was agreement that North American and Argonne should begin experimental investigation of pumps and heat exchanger equipment, and undertake further studies of corrosion.[38] By the end of May, the Commission had made its decisions on the technical aspects of reactors for the expansion program.

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How large the expansion program would be was the subject of the report which Truman requested on March 10, 1950. McCormack and General Alvin R. Luedecke, executive secretary of the Military Liaison Committee, coordinated the Commission and Defense parts of the report and on May 25, 1950, Pike and Secretary Johnson submitted it to Truman. Cast in the form of a letter, the report dealt mainly with tritium production. Hanford should be able to provide the amount needed by Los Alamos and a test of thermonuclear principles in the spring of 1951. Although this goal was acceptable for the interim, long-range production required more reactors which, to make most efficient use of fissionable material, should take advantage of improved technology. Therefore, the President was requested to approve two heavy-water reactors, along with a recommendation that du Pont design, construct, and operate the new facility. After advising Truman of the effect of the thermonuclear effort on fissionable material production and weapon stockpile, the two leaders assured the President that the Joint Chiefs of Staff had measured and accepted the cost.[39]

Without waiting to study the proposals, Truman authorized negotiations with du Pont. By the time he approved the program on June 8, the Commission and the company had agreed on the broad terms of a contract. On June 12, Pike formally requested du Pont to take the assignment. He asked the company to accept responsibility for the site survey, design, construction, and operation of a new reactor installation and to review the technical analyses of the reactors and the processes for making heavy water. Aware of the pitfalls of community management, the Commission hoped that du Pont could find a location which would not require a Government town. Truman met the du Pont stipulation by writing Greenewalt on July 25 that the project was of the highest urgency and vital to national security. The

Commission and du Pont were to reach agreement on a letter contract on October 17, 1950, but contract negotiations were to drag on for years.

The only remaining loose end in June was the Commission's own organization. Wilson had no question of the ability of Williams and his production division, but further coordination was needed among the Washington staff. On June 23, 1950, Wilson gave Shugg authority to act as general manager on matters involving the new program.[40]

From his office on Capitol Hill, McMahon impatiently watched the Commission's steps. He had asked Secretary Johnson and the Joint Chiefs of Staff to assure him that the atomic energy program offered the nation adequate security. On May 5, 1950, Johnson had replied that he and the Joint Chiefs could make no categorical answer; in developing the thermonuclear weapon there were too many imponderables to know whether the United States would be successful, and there was no way of finding out what the Russians were doing. The response galvanized McMahon to action. He declared that he could not, in clear conscience, accept so vague an answer on an issue of such magnitude.

Gravely concerned for the nation's security, McMahon turned to Pike for a detailed explanation of the methods the Commission and the Department of Defense used in setting military requirements for atomic energy projects. McMahon's restlessness and anxiety were clearly evident during hearings on June 22, 1950, with General Electric officials. McMahon began reading a highly classified report written by Borden. Citing the President's recent approval of two heavy-water reactors, Borden saw no reason why the Commission could not also build additional reactors at Hanford. He had studied intelligence estimates and found that 1952 and 1953 were most often cited as years of greatest danger to the United States. Yet the President's program would add nothing to the nation's strength during this crucial period. Hanford-type reactors would be able to produce material more quickly. Failure to build them as well as heavy-water reactors was subjecting the United States to grave peril. It was obvious to those listening that McMahon was deeply impressed by Borden's reasoning and they must have expected his announcement that he was going to seek the views of the nation's military leaders.[41]

Truman's approval of the scale and rate of effort to produce thermonuclear material had, at least for a time, defined the program. Implementation required engineering judgment, for there was no doubt that heavy-water reactors could be built. Zinn had a small heavy-water research reactor at Argonne and the Canadians had a larger one at Chalk River. There was also no doubt that heavy water could be produced. Instead, the question was which process or combination of processes would provide the quantities needed on a tight schedule. The unknown was whether a thermonuclear weapon was possible. Neither Truman at the White House, McMahon in his Senate office, Johnson at the Pentagon, nor the Commissioners and Wilson

around their huge triangular conference table could answer that question. All they could do was wait for results from Los Alamos.

NATIONAL SECURITY: THE LONG VIEW

Through the winter and spring of 1950, the Commission properly focused its attention on the immediate challenge of military requirements. On the verge of a national emergency, if not on the doorstep of war, first priorities had to go to producing fissionable materials and weapons and to speeding research on a thermonuclear weapon. But short of war, the Commission could not neglect the continuing vitality of long-range research and development. The achievements of the Commission's laboratories today would provide the technology for tomorrow.

Whatever the Commission accomplished in research and development, either for military applications or basic science, success would depend in large part on the performance of the national laboratories. During the first three years the function and nature of the laboratories had been anything but clear. In a sense they were not "national" at all, but regional, and even that term did not apply to all of them. Argonne, under Zinn's strong leadership, was largely a reactor development center with little time or inclination for the basic research interests of scientists in the participating universities. After the Commission's reorganization in the summer of 1948, no one understood exactly how the laboratories were related to Washington. Each laboratory encompassed a broad spectrum of scientific disciplines, yet each was responsible to only one of the Washington divisions. This new tie to Washington also confused the relationship of each laboratory to its neighboring operations office.

By the fall of 1949 Carroll Wilson had sensed enough concern about the role of the laboratories to take some direct action. He asked David B. Langmuir, executive secretary of the program council and himself a scientist, to organize a research committee consisting of Wilson, Hafstad, Kenneth S. Pitzer, and Shields Warren. The committee's first concern was the function of the laboratories. At Argonne the heavy stress on reactor development had sapped the strength of the research divisions, and the board of governors representing the participating universities had never become an effective link in the chain of authority from Hafstad to Zinn. The research committee suggested that the laboratory, like Brookhaven, have a small nucleus of permanent staff in the basic sciences to maintain the fundamental structure of a research laboratory. Applied work, mainly in reactor development, would be organized in projects outside the permanent structure.

At Oak Ridge the research committee saw the principal problems as the diffusion of effort and unrestricted growth, largely reflecting Weinberg's

exuberant personality. Oak Ridge needed a long-range central mission. Perhaps, the committee thought, aircraft nuclear propulsion, the homogeneous reactor experiment, or a chemical separation process more advanced than Redox would serve that purpose. At Brookhaven there was an uneasiness about the tenuous ties to the Commission's activities. Just the opposite of Argonne, Brookhaven seemed heavily oriented toward basic research. The research committee was troubled by delays in completing the reactor and other facilities and the very high level of overhead and indirect expenses.[42]

Commissioner Henry D. Smyth summed up much of his discussions with the research committee in a speech at Oak Ridge in October, 1949. Smyth told his audience that a mixture of "pure" and "bread and butter" research was one of the strengths of the national laboratories. The increasing costs of research required Government laboratories to supplement the effort previously carried alone by universities and private institutions. The national laboratories also made it possible to maintain secrecy when needed and to provide expensive equipment like reactors and accelerators. The varied background of the Commission's laboratories precluded the possibility of any single pattern of organization. Nor could there be any single pattern for controlling them. The arguments over control in 1949 were to Smyth the sign of a healthy organization. Smyth defended some of the features of decentralization, but he admitted that Washington was tightening its controls over the laboratories. What had to be clarified was the interlocking authority of the laboratory directors, the managers of the operations offices, and the Washington division directors.[43]

Many of the difficulties the Commission was experiencing in directing the work of the laboratories stemmed not from deficiencies in organization but from snarled administrative practice. The laboratories, Smyth had acknowledged in his speech, had to "be alert to fight red tape, even red tape imposed on them by the Commission in Washington." A meeting with the laboratory directors in December, 1949, concentrated on administration and management, and the research committee undertook to prepare a survey of "the mechanisms of administering the laboratories." [44]

The management report was the work of Howard C. Brown, Jr., on the staff of Fletcher C. Waller, now the director of organization and personnel. Brown concluded that the "laboratory problem," the term commonly used in Washington, was not so intractable as many had assumed. Most of the early difficulties he attributed to growing pains in the new administrative structure created by the 1948 reorganization and by the transition from an obligation to a cost-type budget. The staff had worked out most of the kinks in budget procedure. Management troubles, Brown thought, would be resolved by better use of cost controls, better schedules for preparing budgets, and more communication with administrators in both the laboratories and the operations offices. The new policy statements which the Commission adopted in June, 1950, to define the roles of Argonne, Oak Ridge, and Brookhaven reflected

many of the ideas which Brown had collected in his management report. After years of uncertainty the character of the national laboratories was beginning to emerge.[45]

INDEPENDENT RESEARCH: A STEPCHILD?

The growing preoccupation with military security in late 1949 and early 1950 had implications beyond the national laboratories in the broader reaches of the scientific community. On the one hand, as Oppenheimer and the General Advisory Committee had recognized, the growing demands of national defense threatened the free spirit of inquiry on which scientific progress depended. On the other hand, scientific discoveries were themselves directly responsible for some of the conditions which made a greater defense effort necessary. Oppenheimer told a Washington banquet audience in March, 1950, that science had profoundly altered the conditions of man's life, both materially and spiritually. Science had for the first time given man "the means for abating hunger for everyone on earth," but he admitted that its greatest impact had been on warfare.[46]

Samuel K. Allison, who had spent World War II at the Metallurgical and Los Alamos laboratories, was more emphatic while addressing the American Physical Society. War itself, he said, was responsible for the emergence of modern physics as a decisive force in American life. The physicists' new importance, in Allison's opinion, was a peril to science. Because physics was now relevant to military security, secrecy was necessary, and secrecy was a grave threat to scientific inquiry. As a good example of the peril to science, Allison cited the legal requirement for security clearances for Commission fellowships. Another danger was that military demands might lure too many scientists from basic research to work "on a kind of applied gadgetry unworthy of the inheritors of Newton and Planck." He urged his colleagues to speak out for more support of the basic sciences by the Federal Government, either through the joint Commission-Navy accelerator program or a national science foundation.[47]

Allison could not hope to stem the rising tide of concern about military security, but he could suggest that basic research was still possible in any situation short of a full emergency. Zinn had assured the Congressmen at Argonne that greater effort on military reactors would not require the end of all basic research. In fact, the year 1950 brought several reasons for encouragement among independent scientists. In May, the Congress at long last approved the establishment of the National Science Foundation. As Lee A. DuBridge told the readers of the *Bulletin of the Atomic Scientists*, the Act was an excellent piece of legislation. The security provisions were unobjectionable and the powers granted the foundation would forward the cause of science

without undue restrictions. "At last," he concluded, "we have an agency which will free basic science from the danger of becoming a step-child of military technology." [48]

The Commission itself was continuing to support basic science in several ways. By 1950, the divisions of research and biology and medicine had negotiated more than 125 contracts totaling $5.6 million for basic research in the universities and private institutions. The Commission's part in the joint effort with the Office of Naval Research was almost $6 million, covering about a hundred contracts in fiscal year 1950. In the spring of that year, Pitzer had also responded favorably to a request from North Carolina State College for authorization to build a research reactor and for a loan of the fissionable material needed for fuel. By summer the university group, led by Clifford K. Beck, had completed a feasibility study of the reactor. The Commission's attorneys concluded that the reactor would qualify as a research facility under Section 4 of the Atomic Energy Act and would not therefore be subject to the legal requirement that all facilities producing significant amounts of fissionable material be owned by the Commission. In October, 1950, the Commission approved allocation of the fissionable material. Barring unforeseen difficulties, North Carolina State would earn the distinction of being the first university in the United States to have its own research reactor.[49]

PARTNERSHIP WITH INDUSTRY

The increasing attention to defense requirements in the Commission posed as great an obstacle for engineers and technology as it did for scientists and basic research. Lilienthal in his Detroit speech in October, 1947, had spoken in glowing terms of a partnership with industry in developing the peaceful uses of atomic energy, but the results had been disappointing. The industrial advisory group under James W. Parker consisted of too many executives too busy ever to dig deeply into nuclear technology. More than a year later, in December, 1948, the committee had little more to recommend than declassifying and publishing technical information and bringing more American companies into atomic energy work as contractors.[50]

The Parker report and some persistent pleas from Philip Sporn to release technical information useful to the electric power industry momentarily rekindled Lilienthal's concern about industrial participation. In the winter of 1949 Wilson and the staff looked for ways of accomplishing the Parker and Sporn proposals. Following up the Parker idea of releasing more technical data, Morse Salisbury, director of the Commission's public and technical information service, concluded that it would be possible to organize technical information according to specific technologies, such as metallurgy and chem-

istry, and then to permit small teams of technical experts in each field to select reports that would be useful to industry. If the Commission could declassify these reports, they could be published in trade journals or press releases. Sporn's proposal was more difficult to handle. If the Commission granted representatives of the power industry access to classified information, what would prevent other industries from asking for the same privilege?

By August, 1949, the Commission had resolved enough of the administrative difficulties to permit a trial of both ideas. A temporary advisory committee representing professional societies and the trade press would explore declassification of technical information, and a temporary three-man committee under Sporn's direction, but not formally representing the power industry, would examine classified information on reactors.[51]

The Sporn group, like the Parker committee, had difficulty finding time to digest the vast amount of technical information available behind the security barriers. But the technical information group, under the leadership of Ernest E. Thum of the American Society for Metals, soon produced results. Thum reported early in 1950 that in eight hundred patent abstract files the group had not found any large amount of declassifiable information that would have been of interest to American industry. Stemming from facts rather than superficial generalities, this and subsequent reports established the Thum committee as an effective channel of communication between the Commission and the engineers.[52]

Education was another way of encouraging industrial participation in Commission work. In June, 1949, the American Society of Mechanical Engineers proposed a series of one-week seminars covering classified information for executive engineers, a plan for on-the-job training for working engineers in the Commission's laboratories, and development of a guide which the Commission staff could use in declassifying technical information. The Commission never adopted the first proposal in its original form, and the second encountered the resistance of the Commission's contractors, who were wary of having employees of other companies in their organizations on a temporary basis. But study of these suggestions did lead to more practical ideas, such as the Oak Ridge School for Reactor Technology, which began offering a twelve-month course for scientists and engineers in the spring of 1950. In July, 1950, the Commission announced a new procedure for issuing technical reports, which were indexed in a biweekly summary called *Nuclear Science Abstracts*.[53]

These tentative efforts to educate scientists and engineers helped to break through some of the barriers which security had erected around the Commission's activities. It seemed likely that universities would soon have research reactors and that the use of radioisotopes would become standard practice in American science and industry. But none of these secondary applications of nuclear technology would in themselves create an atomic energy industry. That, in Hafstad's opinion, would come only when there was

concrete evidence that the generation of electric power from nuclear energy was economically feasible. Even successful operation of the Commission's several power reactor experiments would not be enough. Hafstad told his friend John G. Grebe, in Washington temporarily as an Army consultant, that it would take commercial operation of nuclear power plants to bring industry into the main stream of nuclear technology. Impressed by Hafstad's remarks, Grebe visited Argonne and Oak Ridge in the spring of 1949. Soon after returning to his regular job at the Dow Chemical Company in August, he began exploring the possibility of building nuclear power plants.

Other industrial leaders were also interested in nuclear power. Charles A. Thomas of the Monsanto Chemical Company had sparked his company's efforts to develop the Daniels reactor as a power demonstration plant at the Clinton Laboratories in 1947. A friend of Lilienthal's since 1946, Thomas knew of the Commission's efforts in 1948 and 1949 to establish ties with industry. He welcomed the formation of the Sporn and Thum committees in the summer of 1949, but he too had set his sights on nothing less than a nuclear power plant. Among the several informal proposals Hafstad received in the fall of 1949 was one from the Kellex Corporation suggesting that the Commission finance a survey of industrial interest in power reactors. Hafstad and George G. Brown, the Commission's director of engineering, considered writing specifications for a power reactor and inviting industry to bid. The idea, however, of bringing industry behind the security barrier still seemed like a daring idea in early 1950, especially in the worsening international situation.[54]

If outside initiative were necessary to bring about public discussion of nuclear power, the opportunity was in the making in the spring of 1950. Within a few weeks after leaving the Commission, Lilienthal began to reflect on the way defense needs had delayed the constructive development of atomic energy. Probably increasing his concern was the news in March that the Commission had canceled the power-breeder project at Schenectady and redirected research at Knolls to submarine propulsion. By May, Lilienthal had completed an article entitled "Free the Atom" for *Collier's* magazine. The article proposed an end to Government monopoly of nonmilitary and commercial aspects of atomic energy. So enthusiastic was the publisher that Lilienthal thought it wise to warn President Truman of the impending "blast."

Lilienthal did not record in his journal any correspondence with Thomas about the article, but he had seldom delved into such subjects during his chairmanship without consulting his former colleague. It may therefore have been more than a coincidence that two days after the *Collier's* article appeared on June 9 with full-page advertisements in some major newspapers, Thomas proposed an industrial study of nuclear power.[55]

Thomas suggested that industry be allowed to design, construct, and operate atomic power plants at its own expense, to produce both useful power and plutonium. Thomas had no doubt drafted his proposal to appeal to

Commission needs more pressing than industrial development. A dual-purpose reactor would give the Commission an additional source of plutonium at the very time it was endeavoring to increase plutonium production for weapon requirements. If Thomas could entice the Commission to accept such an agreement, private industry would have a compelling reason for access to classified technical information. Furthermore, revenues from the sale of plutonium to the Government could be used to offset power costs and thereby make the dual-purpose reactor more attractive to electric power companies. Thomas thought this incentive, plus the promise of long-term amortization, would induce private industry to undertake the huge capital investment required.

Thomas's proposal was sufficiently attractive to command extensive study by the Commission's staff in the summer of 1950. Because Thomas had no precise data on plutonium production costs, the staff first examined the economics of the proposal and determined in a rough way that plutonium revenues might be high enough to provide electric power at a reasonably low cost. More difficult to accept was Thomas's assumption that the necessary design data for the dual-purpose reactor already existed in the Commission's files. The best approach seemed to be to let Monsanto first study the Commission's reactor development projects and then determine whether development and construction of a reactor should proceed.[56]

THE SUPER: A RECEDING GOAL

In the shadow of an international crisis the Commission had done well to maintain its equilibrium. Whatever the demands for nuclear materials and weapons, it was still possible to move ahead on other fronts—on basic research in the universities, on reactor development in the national laboratories, and on industrial studies of nuclear power plants. But the shadow of crisis remained, and as it lengthened in May, 1950, the prospects of devising a thermonuclear weapon took on new importance. Only Los Alamos could gauge the chances for success.

At Los Alamos in early 1950 Edward Teller looked to the future with eagerness and enthusiasm. In two staff lectures he had outlined his ideas of a thermonuclear weapon. The most likely way to attain energy from thermonuclear reactions was to fuse the tritium and deuterium isotopes of hydrogen. Fusion, however, would require exceedingly high temperatures which perhaps could be reached by using the energy released from a fission bomb to ignite the thermonuclear reaction. This approach posed for Teller and his group a very different set of problems from those which Los Alamos had faced nearly a decade earlier in designing the fission bomb. Then it had been a matter of bringing together a supercritical mass of fissionable material—either by

implosion for a plutonium weapon, or by firing a uranium projectile into a uranium target for a gun-type weapon. Teller did not consider these techniques practical for a thermonuclear weapon.

It was also uncertain whether a fusion reaction once begun could be maintained. The possibility existed that natural phenomena, as inexorable as the force of gravity, stood in the way as insurmountable barriers. By careful design, the theoretical physicists at Los Alamos hoped in some way to overcome them. The obstacles were but challenges to Teller, who wrote to Luis W. Alvarez that the physicists at Los Alamos were "busy like monkeys." [57]

Los Alamos desperately needed data to predict and describe the behavior of materials at incredibly high temperatures, the method in which energy moved from particle to particle, and the means by which energy was dissipated and lost. The greatest handicap of the physicists in Carson Mark's T, or theoretical, division, was the lack of computers. The most advanced machine available was the electronic numerical integrator and calculator, a title inevitably shortened to ENIAC. The ENIAC was completed in 1946 at the Aberdeen Proving Ground in Maryland, and with its 19,000 or more vacuum tubes and hundreds of thousands of other electrical parts, was useful for rapid and repetitious calculations needed for ordnance tables. But the machine had no ability to store information. The problems coded by Los Alamos were already pressing against the boundaries of computer technology. John von Neumann, mathematician and consultant to the Army and Los Alamos, was in a perfect position to bring computers to bear upon the fusion calculations. He had in mind the MANIAC, a more sophisticated computer to be built in Princeton.

Los Alamos could not wait. With slide rules, desk calculators, and tabular data, Stanislaw M. Ulam and Cornelius J. Everett of the T division explored the mechanism of thermonuclear reactions. By reducing problems to stark simplicity, by pruning them vigorously, by making intuitive assumptions, the two hoped to establish orders of magnitude for some of the answers while the laboratory waited for more complete and precise results from the computer. The work was laborious, but as February, 1950, began, Ulam saw a fifty-fifty chance that the fusion reaction, once begun, would continue.[58]

Idea after idea tumbled from Teller's mind and, with exhilarating zest, he scattered them throughout the division and the laboratory. Bradbury had to devise some sort of administrative framework in which Teller could work without disrupting the rest of the laboratory. The Los Alamos director proposed a committee, consisting of the main division leaders and with Teller as chairman, which would be responsible for the thermonuclear effort at Los Alamos. Through this arrangement Bradbury could keep the laboratory organization intact, and yet bring to bear upon thermonuclear problems the strength of each division.

To Teller, administration was a dreary business which he did not

understand. If Los Alamos were to succeed, it would be by heroic measures, not by organizational palliatives. Teller held it imperative that Los Alamos become once again, as it had been under Oppenheimer, a center around which the scientific leaders of the nation would gather to concentrate their talents. For assistance in recruiting these leaders he turned to Borden and the Joint Committee. Teller wrote to Borden that the position of the General Advisory Committee was crucial. "I feel that the attitude of the members of the GAC has been a serious difficulty in our recruiting efforts. . . . A man like Conant or Oppenheimer can do a great deal in an informal manner which will hurt or further our efforts." Borden had no difficulty in enlisting McMahon's assistance, but he was pessimistic over getting Conant or Oppenheimer to take a more positive stand.[59]

By March optimism was fading fast. In the early part of the month Ulam completed his first report on the possibility of igniting a thermonuclear
440 reaction under given circumstances. He acknowledged that the entire calculation surpassed the capacity of any existing computer, a situation which only the MANIAC at Princeton could rectify. Nonetheless, Ulam had estimated the values of multidimensional integrals which expressed that fraction of energy originating in the form of fast particles with sizeable mean free paths and ranges in one zone and transmitting thermal energy to another zone. From these and other assumptions he and Everett performed their hand calculations. The procedures, Ulam had admitted freely, were unorthodox. Gloomily he reported, "The result of the calculations seems to be that the model considered is a fizzle." [60]

The obvious step was to change the model. As Foster and Cerda Evans and John W. Calkin formulated the long and complex problems for the ENIAC, Ulam traveled to Princeton to see von Neumann. He arrived on April 17, the day on which Teller ended his visit with the Princeton mathematician. Late on the afternoon of April 21 the telephone rang in the von Neumann house. It was Enrico Fermi. That evening and the next day the three talked over the implications of Ulam's results. Von Neumann concluded that there was no choice but to increase the amount of tritium in the theoretical design. The direction of the change made the Super less attractive, but von Neumann could see no alternative. Ulam returned to Los Alamos, bringing to Teller the parameters for the new problem.

Teller reacted intensely. Ulam reported to von Neumann, "He was pale with fury yesterday literally—but I think is calmed down to-day." Teller admitted his anxiety to von Neumann, who offered reassurances that the motives behind the changes were constructive. Nor was the shift in the parameters intended to be the basis for a final calculation, but only a way of revealing the magnitude of some of the factors to be considered. On May 18, 1950, von Neumann received disappointing news from Ulam: "The thing gives me the impression of being miles away from going." Von Neumann admitted that prospects for success were not bright, but he wondered if Ulam

was not premature in his pessimism. In any event, von Neumann expected to spend part of the summer at Los Alamos.[61]

That summer Hans A. Bethe visited Los Alamos, not to work upon the Super, but to do what he could on fission weapons and to investigate certain phenomena which had received inadequate treatment earlier. He looked over the Ulam-Everett calculations and agreed that prospects for the Super were poor. He had little doubt but that the ENIAC would confirm the hand calculations. Nonetheless, Bethe thought that the test of thermonuclear principles, one of a series of tests planned for the spring of 1951, should go forward.[62] By the end of June, the proposed tests had been given the name *Greenhouse.*

Throughout much of Los Alamos work continued along the accustomed grooves of practiced efficiency. In the T division there was tension. Some felt that the Super would not work, that insurmountable natural barriers blocked the way to success. Perhaps the quest for the Super was squandering talent and material which could be better spent on improving fission weapons. Teller's response to bleak obstacles was an ever more determined and fiery assault, involving a further marshalling of the nation's scientific leadership. Beyond this he could think of no other ways to reach his goal.

The fading hopes for a thermonuclear weapon in the last days of spring in 1950 seemed to blend with the somber outlook in international affairs. For the United States the twilight between peace and war ended abruptly on June 25, 1950, when communist troops in North Korea launched an attack across the 38th parallel. President Truman immediately ordered naval and air units to Korea, and the first American troops met the enemy on Korean soil on July 5. For the moment there was a feeling of unity and a recognition that the President could make no other responses. In the Commission there would no doubt be new demands for nuclear materials and weapons, but would these military requirements further delay the pursuit of peaceful uses of atomic energy? Only firm decisions and a judicious appraisal of resources could answer that question.