LBL-29446

Lawrence Berkeley Laboratory

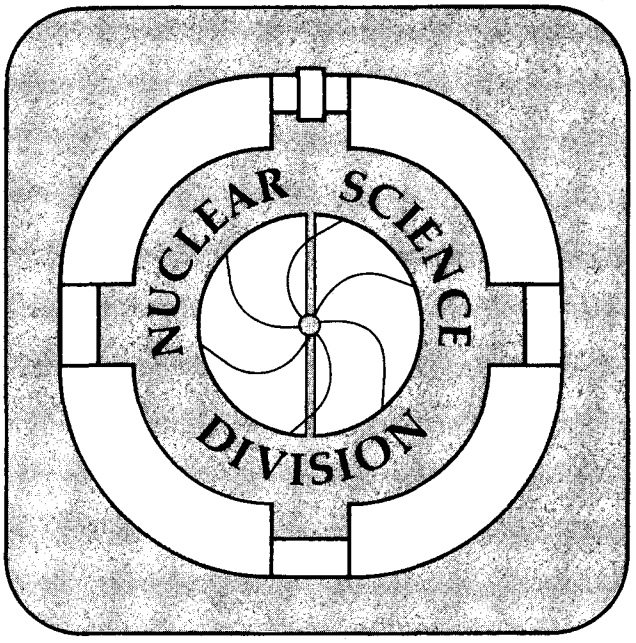
UNIVERSITY OF CALIFORNIA

To be presented at the Symposium on the Establishment of Research Support Agencies, Washington, D.C., August 30, 1990, and to be published in the Proceedings

Evolution of Federal Support of Science

G.T. Seaborg

August 1990



Prepared for the U.S. Department of Energy under Contract Number DE-AC03-76SF00098.

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Evolution of Federal Support of Science

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August 1990

Presented at the 200th ACS Meeting, Washington, D.C.

Symposium on the Establishment of Research Support Agencies
August 30, 1990

This work was supported by the Director, Office of Energy Research, Office of High Energy and Nuclear Physics, Nuclear Physics Division of the U.S. Department of Energy under Contract DE-AC03-76SF00098.

Evolution of Federal Support of Science

Remarks by Glenn T. Seaborg
at the ACS Symposium
Establishment of Research Support Agencies

Washington, D.C.
August 30, 1990

The federal support and organization of science in the United States started, in effect, with World War II. At the time of the outbreak of World War II the United States had little capacity for federal support or the organization of American science for war. The National Academy of Sciences, created by an Act of Congress in 1863, and the National Research Council, created by an Executive Order in 1918, were in the position to be helpful, but they were not government agencies supported by the Congress and reporting directly to the President and were, therefore, not designed to focus attention on such relatively narrow portions of the field of science as those concerned with the instrumentalities of war.

A more effective organization was the National Advisory Committee for Aeronautics (NACA), established by Congress in 1915 "to supervise and direct the scientific study of the problems of flight." President Roosevelt, in June 1939, directed the NACA to become a consulting and research agency for the Joint Army and Navy Aeronautical Board at the outbreak of a national emergency. For some years prior to the outbreak of the war, the members of the NACA had become acutely conscious that they were living in a pre-war period. Vannevar Bush, a professor of electrical engineering at the Massachusetts Institute of Technology and an inventor with business experience, became chairman of the NACA in 1939 and, not long after that, he resigned the vice presidency of the Massachusetts Institute of Technology to become President of the Carnegie Institution of Washington. After the outbreak of war in Europe, Bush's thoughts turned more and more to the need for overall organization of science for war. It was at his initiative more than anyone else's that an apparatus for science advice to the President and the gearing of science for aid to the war effort took place.

So far as I can recall, I first meet Vannevar Bush during his visit to Berkeley near the end of March 1940. Together with James B. Conant, Karl T. Compton, Arthur H. Compton and Alfred Loomis, he came to discuss with Ernest O. Lawrence his proposed 184-Inch Cyclotron. My future wife Helen Griggs, who at that time was serving as Ernest's secretary, also met him then and attended a dinner in his honor (Figures 1 and 2).

The discovery of fission by the two German chemists, Otto Hahn and Fritz Strassmann, in December 1938, soon led to the recognition that uranium might be developed as the explosive ingredient for a bomb of unprecedented explosive capacity. As is well known, the Americanized Hungarian physicist Leo Szilard, (Figure 3) became concerned about this possibility and believed that he should give some direct advice to President Franklin D. Roosevelt (Figure 4) in order to get the United

States started on such a project. Szilard and his Hungarian friend Eugene Wigner went to see the most eminent physicist Albert Einstein (Figure 5) in the summer of 1939, to persuade him, and help him, to write a letter to President Roosevelt, calling attention to the potential of a uranium bomb, the need to ensure the supplies of uranium ore, the German interest in such a project, and the need for action by the appointment of a person to maintain contact between the administration and the physicists working on this problem. They enlisted the services of Alexander Sachs, a layman corporation economist who was reputed to have ready access to the White House.

Sachs finally was able to get an appointment with the President on October 11, 1939, at which he presented the letter signed by Einstein with accompanying memoranda. This advice to the President resulted in the immediate appointment of an Advisory Committee on Uranium to investigate the problem. The chairman of the Committee was Lyman J. Briggs, Director of the National Bureau of Standards. The other two members were Navy Commander Gilbert C. Hoover and Army Colonel Keith F. Adamson. Briggs called a meeting of the Committee at the Bureau of Standards for October 21, 1939, which was attended by Szilard and Wigner, and also Edward Teller. As a result of this meeting, the Advisory Committee on Uranium reported to the President on November 1st, that the uranium chain reaction was a possibility, but that it was still unproved and that it might be a possible source of bombs with a destructiveness vastly greater than anything now known. Briggs heard from the President on November 17th that he had noted the report with deep interest and wished to keep it on file for reference. There was little action during the ensuing months. Harold Urey and Vannevar Bush proposed the establishment of an advisory committee of scientific experts to counsel the President's Committee on Uranium. Such a committee was established in June 1940, consisting of Harold Urey, George Pegram, Merle Tuve, Jesse Beams, Ross Gunn, and Gregory Breit.

A new force now appeared on the scene--the National Defense Research Committee (NDRC)--to give science advice to the President and organize American science for war. At the suggestion of Bush, President Roosevelt set up this committee by executive action in June 1940. At the suggestion of Bush it was to be similar in form to NACA, but empowered "to correlate governmental and civil research in fields of military importance outside of aeronautics. It should form a definite link between the military services themselves, and it should exist primarily to aid these services. . ."

Vannevar Bush served as the initial chairman of the NDRC and, during the next year or so, its membership included J. B. Conant (President of Harvard University, who became chairman in 1941), F. B. Jewett (President of the National Academy of Sciences), Rear Admiral J. A. Furer (Coordinator for Research and Development, Navy Department), R. C. Tolman (Dean of Graduate School, California Institute of Technology), K. T. Compton (President, Massachusetts Institute of Technology), Roger Adams (Head, Chemistry Department, University of Illinois), C. P. Coe (U.S. Commissioner of Patents), and Irvin Stewart (who served as Executive Secretary). Carroll L. Wilson also served in a key staff position (Figure 6).

Bush soon moved to strengthen the Committee on Uranium. By the early autumn of 1940, he reorganized the Committee, dropping Commander Hoover and

Colonel Adamson, and adding Tuve, Pegram, Beams, Gunn, and Urey. However, the ensuing rate of progress was too slow to suit people like Ernest Lawrence and Arthur Compton, who pushed Bush to move things faster.

In order to better coordinate the scientific activities for war, the Office of Scientific Research and Development (OSRD) was established by executive order by President Roosevelt in June 1941, with Bush as director. The OSRD was located within the Office for Emergency Management of the Executive Office of the President. It oversaw the NDRC, the NACA, the laboratories of the military services, and the newly-created Committee on Medical Research. The Committee on Medical Research consisted of Dr. A. N. Richards (who served as chairman), Dr. Lewis H. Weed (who served as vice chairman), Dr. R. E. Dyer (Public Health Service), Rear Admiral Harold W. Smith, Dr. A. Baird Hastings, Dr. Chester S. Keefer (Medical Administrative Officer), Brigadier General James S. Simmons, Dr. A. R. Dochez, and Dr. Irvin Stewart (who served as Executive Secretary) (Figure 7).

Conant replaced Bush as Chairman of the NDRC and the Committee on Uranium became the OSRD's Section on Uranium, soon designated cryptically as the S-1 Section. This then constituted the U.S. administrative body for advice to the President and organization of science for the war that the U.S. was to enter just a few months later. Thus, it oversaw work on:

radar (carried out under the leadership of Lee A. DuBridge in the Radiation Laboratory at the Massachusetts Institute of Technology),

rockets (carried out by people like Charles C. Lauritsen at the California Institute of Technology at what would become known later as the Jet Propulsion Laboratory),

chemical explosives (carried out under the leadership of such people as George B. Kistiakowsky, Roger Adams, and Warren K. Lewis,

gas warfare (carried out at such places as Edgewood Arsenal in Maryland),

proximity fuses (with leading contributions by Merle A. Tuve at the Department of Terrestrial Magnetism of the Carnegie Institution of Washington),

submarine warfare (two of which laboratories were at New London, Connecticut, operated by Columbia University, and at San Diego, run by the University of California),

military medicine (such as work on antimalarials and blood substitutes, penicillin, and so forth).

A comprehensive account of the role of NDRC and OSRD during the war by James Phinney Baxter, Scientists Against Time, was published in 1946.

By the summer of 1941, Bush, initially somewhat skeptical, was convinced that the possibility of producing an atomic bomb before the end of the war was so strong

that every effort must be made as fast as possible. On October 9, 1941, he met with President Roosevelt and Vice President Henry Wallace to seek authority to proceed at a greatly increased level of intensity with commitments to spend millions of dollars, an increase in orders of magnitude. The President, in an historic decision, agreed both immediately and completely. From this point on, the effort proceeded at an accelerated rate.

In November 1941, Eger V. Murphree (Vice President of Standard Oil Company) was appointed chief of a new Planning Board to advise the S-1 Committee on the engineering aspects. The advent of Pearl Harbor on December 7th resulted in a surge forward. Three program chiefs were appointed--Urey in charge of separation by both the gaseous diffusion and centrifuge method, Lawrence responsible for electromagnetic separation methods and work on Element 94, and Compton responsible for nuclear weapon theory and the chain reaction for producing Element 94. There would correspondingly be main laboratories at Columbia University, the University of California at Berkeley, and the University of Chicago. J. Robert Oppenheimer was brought in by Lawrence to help with the design of the bomb (Figures 8 and 9).

On May 23, 1942 the leaders of the S-1 Section met--Briggs, Murphree, Compton, Lawrence and Urey--and formulated plans for large-scale uranium-235 enrichment plants, plants for the production of Element 94, and a plant to produce heavy water on a large scale with the aim of producing a few atomic bombs by July 1, 1944. A report of June 13, 1942, incorporating these plans, was approved by President Roosevelt on June 17th. It was now necessary to construct an organization that would make all this possible. In June 1942 Bush authorized the appointment of a new S-1 Executive Committee--Conant as chairman, with Briggs, Compton, Lawrence, Murphree, and Urey as members.

An important meeting was held at the Bohemian Grove in California on September 13 and 14, 1942, attended by Major Thomas Crenshaw (area engineer, Berkeley), J. R. Oppenheimer, Harold C. Urey, E. O. Lawrence, James B. Conant, Lyman J. Briggs, E. V. Murphree, A. H. Compton , R. L. Thornton, and Colonel K. D. Nichols (Figures 10 and 11). A number of important decisions were made: authorization to acquire 1200 tons of high grade Belgian uranium ore stored on Staten Island, a decision to acquire the Tennessee site immediately, a recommendation to secure a chemical company to assist in developing the chemical process for separating plutonium.

It became apparent that more supervisory strength for the atomic bomb project was needed. After some attempts at arrangements that I will not attempt here to describe, the Army was placed in charge. On September 23, 1942, newly-promoted General Leslie R. Groves, chosen by General Brehon B. Somervell and General Wilhelm D. Styer, was given the assignment to run the project as part of the Manhattan Engineer District (established on August 13), which became known as the Manhattan Project. Lieutenant Colonel Kenneth D. Nichols became his chief aide. Bush and Conant and members of the S-1 Executive Committee continued in positions of responsibility. Groves and Nichols have both written interesting accounts of their experiences in directing the Manhattan Project: Groves' entitled Now It Can Be Told

and Nichols' entitled The Road to Trinity--A Personal Account of How America's Nuclear Policies Were Made. I first met Groves during a visit to the Metallurgical Laboratory at the University of Chicago. This was shortly after we had isolated the first weighable samples of plutonium. We showed him a sample of plutonium hydroxide under a microscope. Groves didn't seem very impressed; he disappointed us by saying, "I don't see anything," as he peered into the microscope.

It is beyond the scope of the present account to describe the successful production of uranium-235 and plutonium-239 during the war and their use as the explosive ingredients for the bombs for detonation over Hiroshima (uranium-235) and Nagasaki (plutonium-239), which led to termination of the war following the successful test of a plutonium bomb at Alamogordo, New Mexico, on July 16, 1945 (known as Trinity). Excellent accounts of the work on the atomic bomb have been written by Richard Hewlett and Oscar Anderson (The New World 1939/1946, Volume 1: A History of the United States Atomic Energy Commission) and, more recently, by Richard Rhodes (The Making of the Atomic Bomb).

The Atomic Energy Act, creating the Atomic Energy Commission, went into effect on August 1, 1946 (Figure 12). On October 28, 1946, President Harry Truman appointed, and on December 31, 1946, he transferred control to, the first members of the AEC--David E. Lilienthal (Chairman), Lewis L. Strauss, Robert F. Bacher, Sumner T. Pike, and William W. Waymack (Figure 13). Carroll Wilson served as first General Manager of the AEC, a very important role in its administrative structure.

Near the end of 1946 President Truman appointed me as a member of the nine-person General Advisory Committee (GAC) of the newly established and appointed Atomic Energy Commission. The initial members of the GAC were J. Robert Oppenheimer (who served as chairman), Enrico Fermi, James B. Conant, Isidor I. Rabi, Lee A. DuBridge, Cyril S. Smith, and industrialists Hood Worthington and Hartley Rowe. With such a membership the GAC exerted tremendous influence on the initial Commissioners of the AEC. The first meeting of the GAC was held in Washington on January 3, 1947, and I attended meetings on the average of every other month until the end of my term, August 1, 1950. We advised the AEC in a very influential manner on the rehabilitation of the Los Alamos Weapons Laboratory (which had become somewhat disorganized after the end of the war), the operations of the facilities for the production of fissionable material, the diminishing role of secrecy in its operations, the distribution of radioactive isotopes produced in its facilities, the instigation of its marvelous program for support of basic research in U.S. universities and colleges, the operation of its national laboratories, the direction of its emerging civilian nuclear power program, the organizational structure, and many other areas where we thought our advice, sought or unsought, would be helpful.

Bush was concerned with the governmental organization for supporting research after the disbanding of the OSRD at the end of the war. Pending the creation of a national science foundation, which he recommended in his famous report, Science--The Endless Frontier, he was searching for other coordination mechanisms. In order to coordinate the research and development activities of the military services he created a temporary instrument called the Joint Research and Development Board. Bush served as chairman, and day-to-day administration was the responsibility of the

Executive Secretary, Lloyd V. Berkner, who had worked for Bush at the Carnegie Institution in Washington. Under Berkner's direction the Joint Board in 1946 had organized six committees and each was responsible for one technical area of interest to the Armed Forces. One of these committees was the Atomic Energy Committee, which included three civilian members--Conant (Chairman), Oppenheimer and Crawford H. Greenewalt (a vice president of the duPont Co., who had played such an important role in the company's building of the plutonium production plant at Hanford). The six other members were representatives of the Army and Navy--all members of the Military Liaison Committee that had been created by the Atomic Energy Act to effect liaison between the civilian Atomic Energy Commission and the Armed Services. The Research and Development Board had control over our nation's major science efforts in the early post-war years, and it performed a useful function by providing a forum where the many diverse viewpoints of the three services could be heard and acceptable compromises reached. However, this did not take care of the non-military aspects of the government's interest in science. After five years of persistent lobbying by scientific interest groups, the Congress finally established the National Science Foundation in 1950. Dr. Alan Waterman was named Director of NSF (Figure 14) He had served as the Chief Scientist of the Office of Naval Research, which together with the AEC did so much to fill the gap for the support of basic research and applied research during the intervening years.

William T. Golden (Figure 15), who had served as the administrative assistant of Lewis Strauss and who later became the longtime treasurer and member of the Board of Directors of the American Association for the Advancement of Science, served in 1950 as a special consultant to the White House and designed the first scientific advisory apparatus for President Truman. Oliver E. Buckley, president of the Bell Telephone Laboratory, was appointed by President Truman in April 1951 to be the first Presidential Science Advisor.

However the presidential science advisory apparatus did not become effective until the creation of the Presidential Science Advisory Committee (PSAC). In 1959 President Eisenhower appointed me to his first Presidential Science Advisory Committee, whose membership in 1960 included George W. Beadle, Donald F. Hornig, Jerome B. Wiesner, Walter H.Zinn, Harvey Brooks, Alvin M. Weinberg, David W. Beckler, Emmanuel R. Piore, John W. Tukey, Wolfgang K. H. Panofsky, John Bardeen, Detlev Bronk, Robert F. Loeb, James B. Fisk, George B. Kistiakowsky, James R. Killian, Jr., Isidor I. Rabi, and me (Figure 16).

Although it might go beyond the scope of my intended discussion, I thought it might describe some of the role played by the Atomic Energy Commission during the period (1961-1971), when I served as chairman. As I have indicated, earlier the AEC played an important and needed role in supporting research in the years immediately following World War II. The AEC continued to be a contributor to such support during the years of my chairmanship--very broadly in the areas of high- and low-energy nuclear physics and other areas of physics, and broadly in chemistry, biology and medicine, and other fields, and in the production and furnishing of radioisotopes for use in medicine, agriculture, industry and research.

I had an early meeting (on February 16, 1961) with President John F. Kennedy

to brief him on these and other issues (Figures 17 and 18).

I had an especially fine relationship with President Lyndon B. Johnson (Figures 19 and 20) and a number of large accelerator building projects were completed or initiated during this time, including the Stanford Linear Accelerator (SLAC), the Los Alamos Meson Physics Facility (LAMPF) and the 200 BeV Accelerator at the National Accelerator (Fermi) Laboratory at Chicago (Figure 21). In retrospect, it might be said that the success in getting the latter, expensive project launched was due, in large part, to an early shift of the debate from the question of *whether* we should build such an accelerator to the question of *where* we should build it (by instigating a national competition to determine the site).

The accelerator was constructed on schedule, well within cost estimate, and the design parameters for beam energy and intensity were met and exceeded, due to the seminal contributions of the Lawrence Radiation Laboratory, the competent leadership of Fermilab Director Robert W. Wilson, and the excellent performance of the outstanding group of scientists that he had assembled. Operation began with the attainment of the first beam of 200-BeV protons on March 1, 1972. The success of this objective was also, in my opinion, following the initial contributions of the Piore and Ramsey Panel, a result of the skillful execution of the game plan, including the national competition in the site selection procedure, and the cooperation with President Johnson and White House staff, the National Academy of Sciences, and many members of Congress, by the AEC Commissioners and their competent and experienced staff.

I might add that the Atomic Energy Commission persuaded President Richard M. Nixon to present special unique Atomic Pioneer Awards to Bush, Conant, and Groves in a ceremony that took place at the White House on February 27, 1970 (Figure 22).

Our most valuable resources are our intelligence and ingenuity. As a nation, we pride ourselves on our history of pioneering new technologies; in the future much will depend not only on that capacity for innovation but also on our general preparedness to participate in the practice and production of those technological advances. The United States owes its current preeminent position in the world and its high standard of living in considerable part to science and technology. We have been leaders in development of new knowledge and ideas and in their application to human needs and desires. This leadership has brought us unprecedented prosperity , health and national strength. Recently, however, our lead has been challenged by other countries.

Basic research is research driven by intellectual curiosity, rather than by immediate practical problems. Its results are unpredictable, and can't be programmed. It is the engine that drives applied research and technology. Scientists are explorers. However, we do not stumble upon innovative new technologies in a barren wilderness. New ideas take root from knowledge already accumulated. Basic research is the fertile field where grows the understanding which is the stock of applied research. Incremental scientific advances, as well as major discoveries, result in new technologies of great commercial importance. They can give us entire new

industries, as in the case of advances in molecular biology. They can give us whole new ranges of products, as in the case of polymer chemistry. They can revolutionize other technologies and industries, as has been the case of the transistor and the laser.

Today we have a national debate in the U.S. scientific community between the advocates of "Big Science" and "little science." In the "Big Science" category are the expensive projects, totaling in the range of hundreds of billions of dollars, such as the Superconducting Supercollider (SSC), the Space Station, the Hubble Space Telescope, the Human Genome Project, the Moon-Mars Mission, the Mission to Planet Earth, the international Tokamak (controlled thermonuclear fusion project), and others.

Many scientists fear that support of such expensive projects will be at the expense of support of "little science," basic and applied research across the spectrum of scientific fields, especially in biological areas, and in areas needed to enhance our international economic competitiveness, such as superconductivity, high-definition television (HDTV), magnetically levitated trains (maglev), and others.

I believe that our country can afford to support a judicious approach to both areas of endeavor if we can be wise enough to reduce drastically the hundreds of billions of dollars that are going into the no-longer-needed military budget.

FIGURE CAPTIONS

Figure 1: Meeting in the Radiation Laboratory on the Berkeley campus in March 1940 to discuss the 184-inch cyclotron. (L to R): Ernest O. Lawrence, Arthur H. Compton, Vannevar Bush, James B. Conant, Karl T. Compton, and Alfred Loomis. (Morgue 1958-8 [P-40]- H-930)

Figure 2: Party at DiBiasi's Restaurant in Albany (near Berkeley) on March 26, 1940. (Clockwise around the table): Ernest Lawrence, Betty (Mrs. Charlton) Cooksey, Vannevar Bush, Molly (Mrs. Ernest) Lawrence, Alfred Loomis, Dorothy Axelrod, David Sloan, Charlton Cooksey, Helen Griggs and S. Mrozowski. (Cooksey 187-A - H-942)

Figure 3: Leo Szilard in England in 1936. (XBB 763-7228 - H-361)

Figure 4: Roosevelt, the Earl of Athlone (Governor-General of Canada), and Churchill (with Canadian Prime Minister Mackenzie King in background) meeting in Quebec on August 18, 1943. (ZBB 8812-11275 - H-974)

Figure 5: Portrait of Albert Einstein. (ZBB 891-63 - H-984)

Figure 6: National Defense Research Committee: (front row, L to R): F. B. Jewett (President of the National Academy of Sciences), Rear Admiral J. A. Furer, (USN, Coordinator of Research and Development, Navy Department), J. B. Conant (President of Harvard University), R. C. Tolman (Dean of Graduate School, California Institute of Technology); (rear row, L to R): K. T. Compton (President of Massachusetts Institute of Technology), Roger Adams (head of the Chemistry Department, University of Illinois), C. P. Coe (UI.S. Commissioner of Patents), Irvin Stewart (Executive Secretary of the Office of Scientific Research and Development). (ZBB 891-0061 - H985)

Figure 7: The Committee on Medical Research: (L to R): Dr. R. E. Dyer (Public Health Service), Rear Admiral Harold W. Smith; Dr. A. Baird Hastings; Dr. Chester S. Keefer (Medical Administrative Officer), Dr. A. N. Richards (Chairman), Dr. Lewis H.. Weed (Vice-Chairman), Brigadier General James S. Simmons, Dr. A. R. Dochez, and Dr. Irvin Stewart (Executive Secretary). (ZZB 8901-62 - H-986)

Figure 8: Vannevar Bush and Arthur Compton in 1940. (XBB 793-3586 - H-975)

Figure 9: Lawrence, Seaborg and Oppenheimer in early 1946 at the controls of the magnet of the 184-Inch Cyclotron, which was being converted from its wartime use to its original purpose as a cyclotron. (Morgue 1946-12 (P-1) - H-928)

Figure 10: Meeting at the Bohemian Grove on September 13, 1942: (L to R):

Major Thomas Crenshaw (area engineer at Berkeley), J. R. Oppenheimer, Harold C. Urey, E. O. Lawrence, James B. Conant, Lyman J. Briggs, E. V. Murphree, A. H. Compton, R. L. Thornton, and Colonel K. D. Nichols. (Morgue 1958-8 [P-71] - H-976)

Figure 11: Meeting of the S-1 Executive Committee at the Bohemian Grove on September 13, 1942: (L to R): Harold C. Urey, Ernest O. Lawrence, James B. Conant, Lyman J. Briggs, Eger V. Murphree, and Arthur H. Compton. Morgue (1958-8 [P-70] - H-977).

Figure 12: Members of the Special Senate Committee on August 1, 1946, gathered around President Truman as he signed the Atomic Energy Act of 1946.: (L to R): Senators Thomas Connally, Eugene D. Millikin, Edwin C. Johnson, Thomas C. Hart, Brien McMahon, Warren R. Auston, and Richard B. Russell. (XBB 8812-11336 - H978)

Figure 13: President Truman transferring control to the Atomic Energy Commission on December 31, 1946. (L to R, seated): Carroll Wilson, Truman, and David Lilienthal; (L to R, standing): Commissioner Sumner T. Pike, Colonel Kenneth D. Nichols, Secretary of War Robert P. Patterson, General Leslie R. Groves, Commissioner Lewis L. Strauss, Commissioner William W. Waymack. (The fifth commissioner, Robert F. Bacher, was at Los Alamos.) (ZBB 8812-11276 - H973)

Figure 14 Portrait of Alan Waterman (XBP 907-6061 - HS-127)

Figure 15: Portrait of William T. Golden (XBB 907-5957 - HS-124)

Figure 16: Members of the President's Science Advisory Committee with President Dwight David Eisenhower at the White House on December 16, 1960. (L to R standing): George W. Beadle, Donald F. Hornig, Jerome B. Wiesner, Walter H. Zinn, Harvey Brooks, Seaborg, Alvin M. Weinberg, David Z. Beckler, Emmanuel R. Piore, John W. Tukey, Wolfgang K. H. Panofsky, John Bardeen, Detlev Bronk, Robert F. Loeb; (L to R seated): James B. Fisk, George B. Kistiakowsky, President Eisenhower, James R. Killian, Jr., Isidor I. Rabi. (XBB 888-8758 - H-972)

Figure 17: Seaborg and John F. Kennedy on a visit to AEC Germantown headquarters, February 16, 1961 (XBB 732-893 - R-1)

Figure 18: Seaborg and John F. Kennedy, February 16, 1961. (XBB 732-892 - R-3)

Figure 19: Seaborg and Lyndon B. Johnson in 1966. (XBB 732-1240 - R-73)

Figure 20: Lyndon B. Johnson and Seaborg, June 17, 1965. (XBB 732-1147A - H-927)

Figure 21: The Fermilab 200 BeV Accelerator. (XBB 907-5886 - HS-122)

Figure 22: Atomic Pioneer Award ceremony at the White House on February 27, 1970: (L to R): Seaborg, President Richard M. Nixon, General Leslie Groves, Vannevar Bush, and James R. Conant. (XBB 884-3249 - H-929)

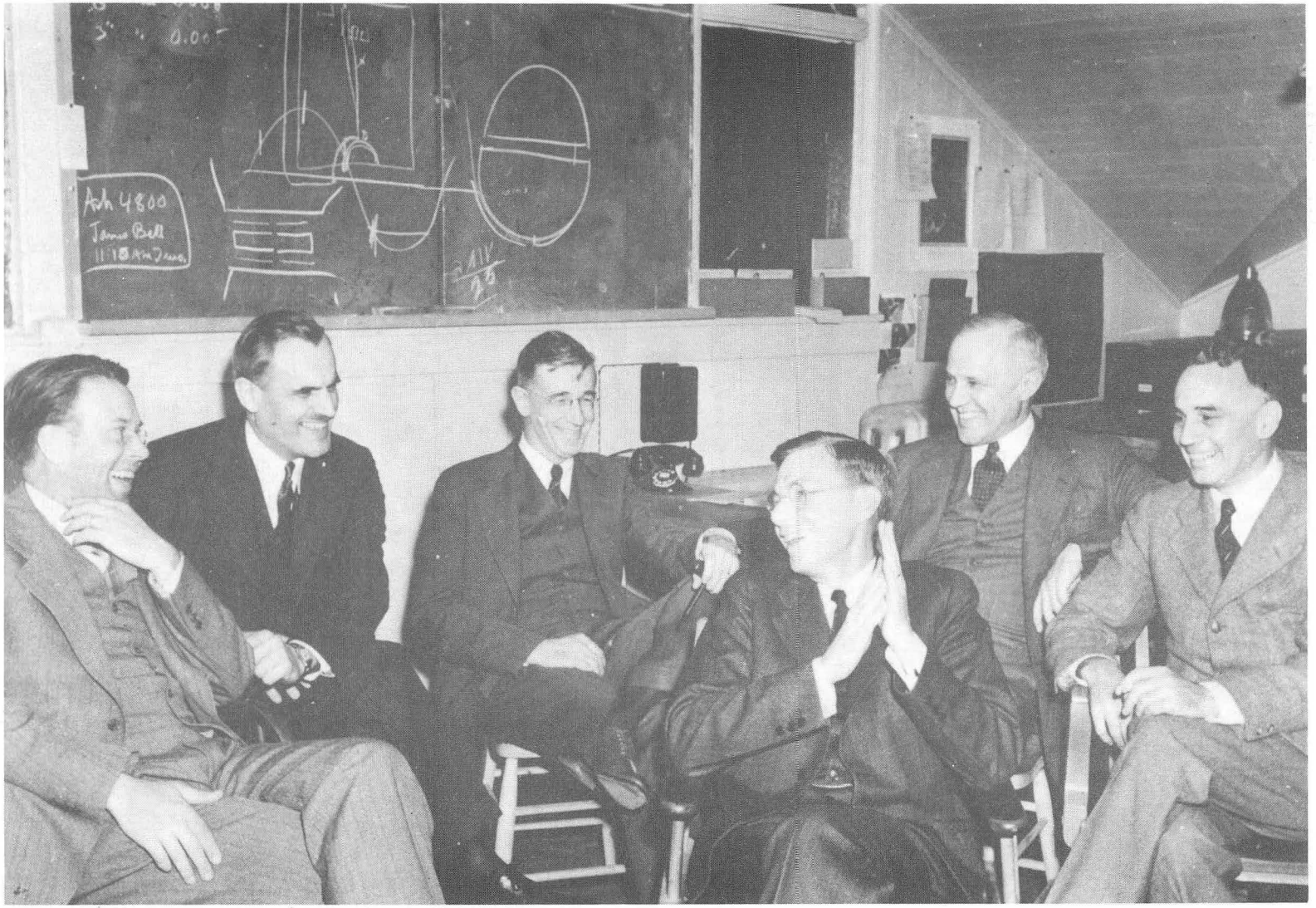
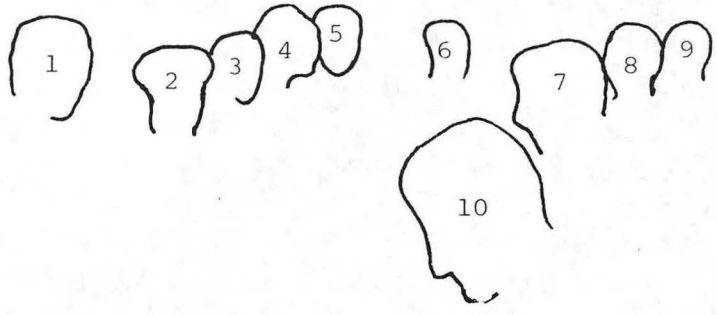


Figure 1: Meeting in the Radiation Laboratory on the Berkeley campus in March 1940 to discuss the 184-inch cyclotron. (L to R): Ernest O. Lawrence, Arthur H. Compton, Vannevar Bush, James B. Conant, Karl T. Compton, and Alfred Loomis. (Morgue 1958-8 [P-40]- H-930)



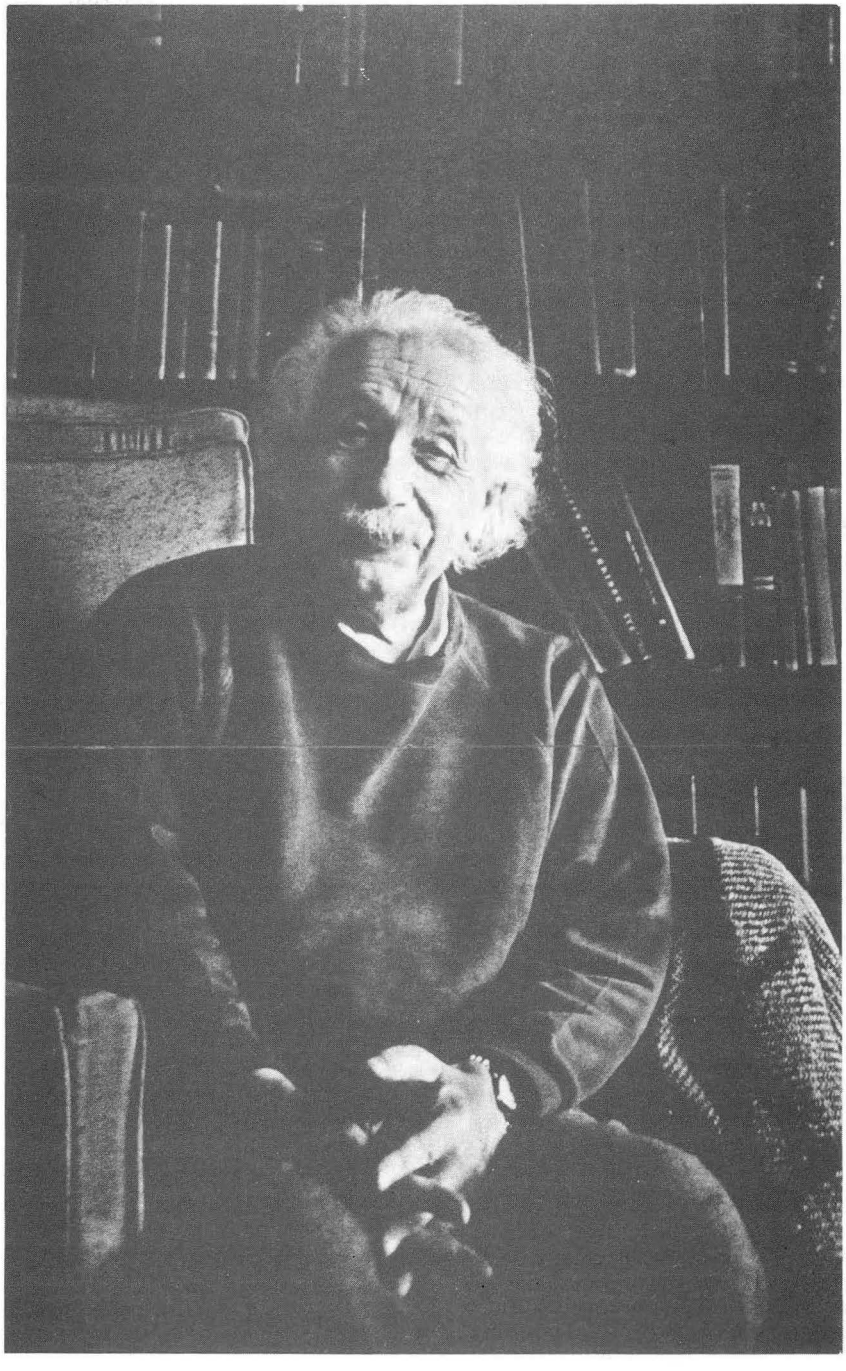
1. Ernest Lawrence, 2. Betty (Mrs. Charlton) Cooksey, 3. Vannevar Bush, 4. Molly Lawrence, 5. Alfred Loomis, 6. Dorothy Axelrod, 7. David Sloan, 8. Charlton Cooksey, 9. Helen Griggs, 10. S. Mrozowski

Figure 2

Figure 3: Leo Szilard in England in 1936. (XBB 763-7228 - H-361)

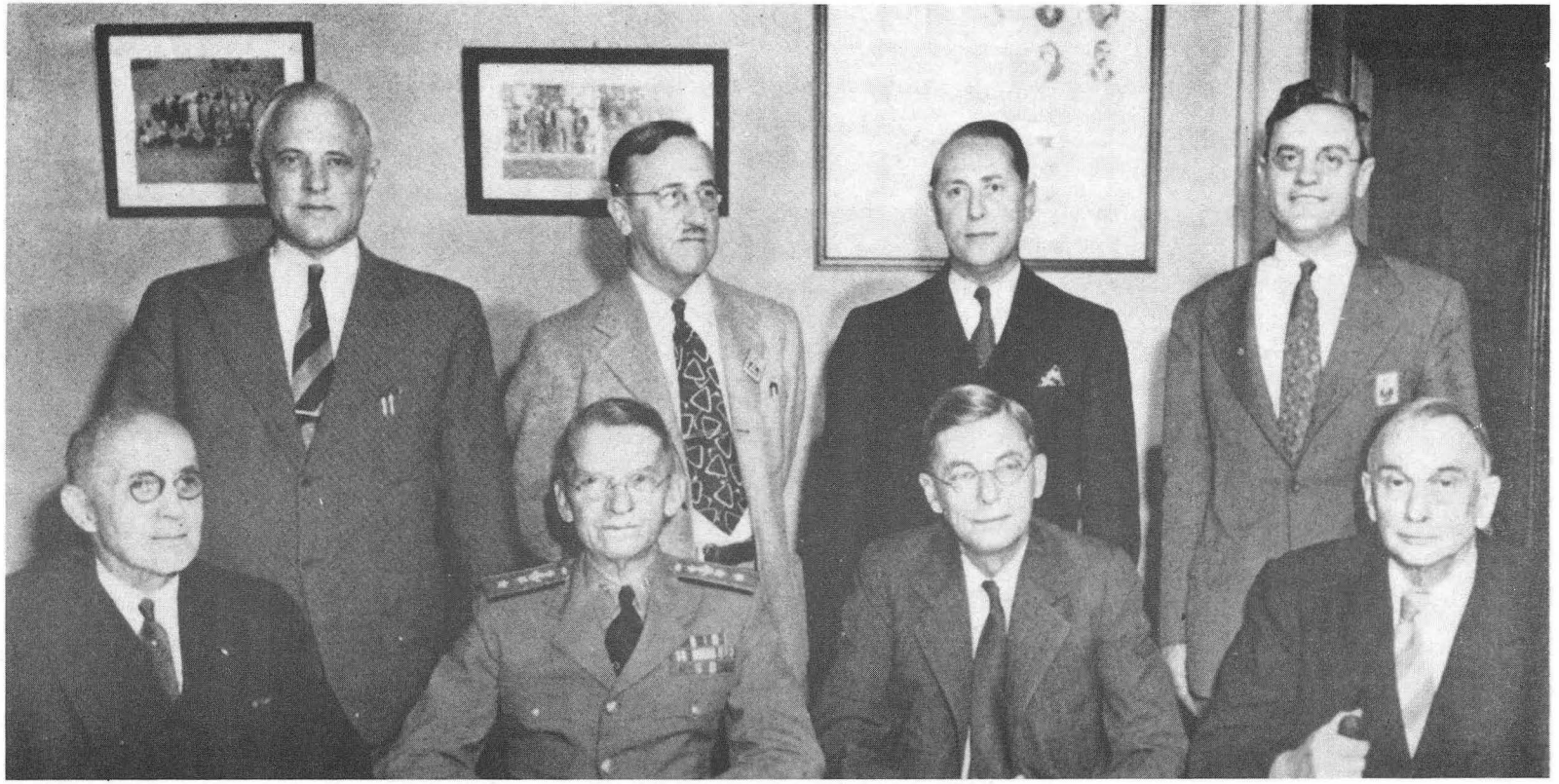
ROOSEVELT AND CHURCHILL AT QUEBEC, 1943 / Photograph taken August 18, the day before the President and the Prime Minister signed the Quebec Agreement. Canadian Prime Minister Mackenzie King is in the background, while in the foreground is the Earl of Athlone, Governor-General of Canada.

Figure 4



Albert Einstein · 1879-1955

Figure 5



National Defense Research Committee

FRONT ROW (*left to right*): *F. B. Jewett, President of the National Academy of Sciences; Rear Admiral J. A. Furer, USN, Co-ordinator of Research and Development, Navy Department; J. B. Conant, President of Harvard University; R. C. Tolman, Dean of Graduate School, California Institute of Technology*

REAR ROW: *K. T. Compton, President of Massachusetts Institute of Technology; Roger Adams, Head of Chemistry Department, University of Illinois; C. P. Coe, U. S. Commissioner of Patents; Irvin Stewart, Executive Secretary of the Office of Scientific Research and Development*

Figure 6

The Committee on Medical Research

Left to right: Dr. R. E. Dyer, Public Health Service; Rear Admiral Harold W. Smith, Navy; Dr. A. Baird Hastings; Dr. Chester S. Keefer, Medical Administrative Officer; Dr. A. N. Richards, Chairman; Dr. Lewis H. Weed, Vice-Chairman; Brigadier General James S. Simmons, Army; Dr. A. R. Dochez; Dr. Irvin Stewart, Executive Secretary

Figure 7

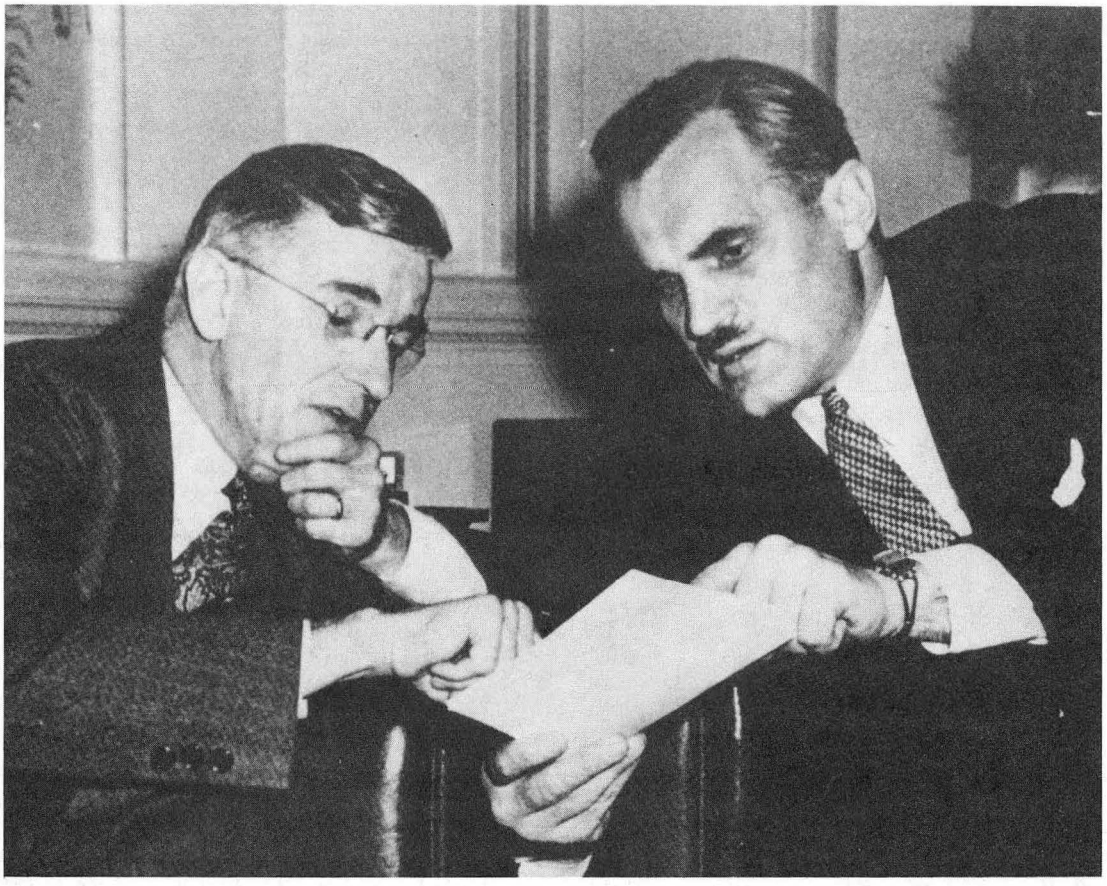


Figure 8: Vannevar Bush and Arthur Compton in 1940. (XBB 793-3586 - H-975)

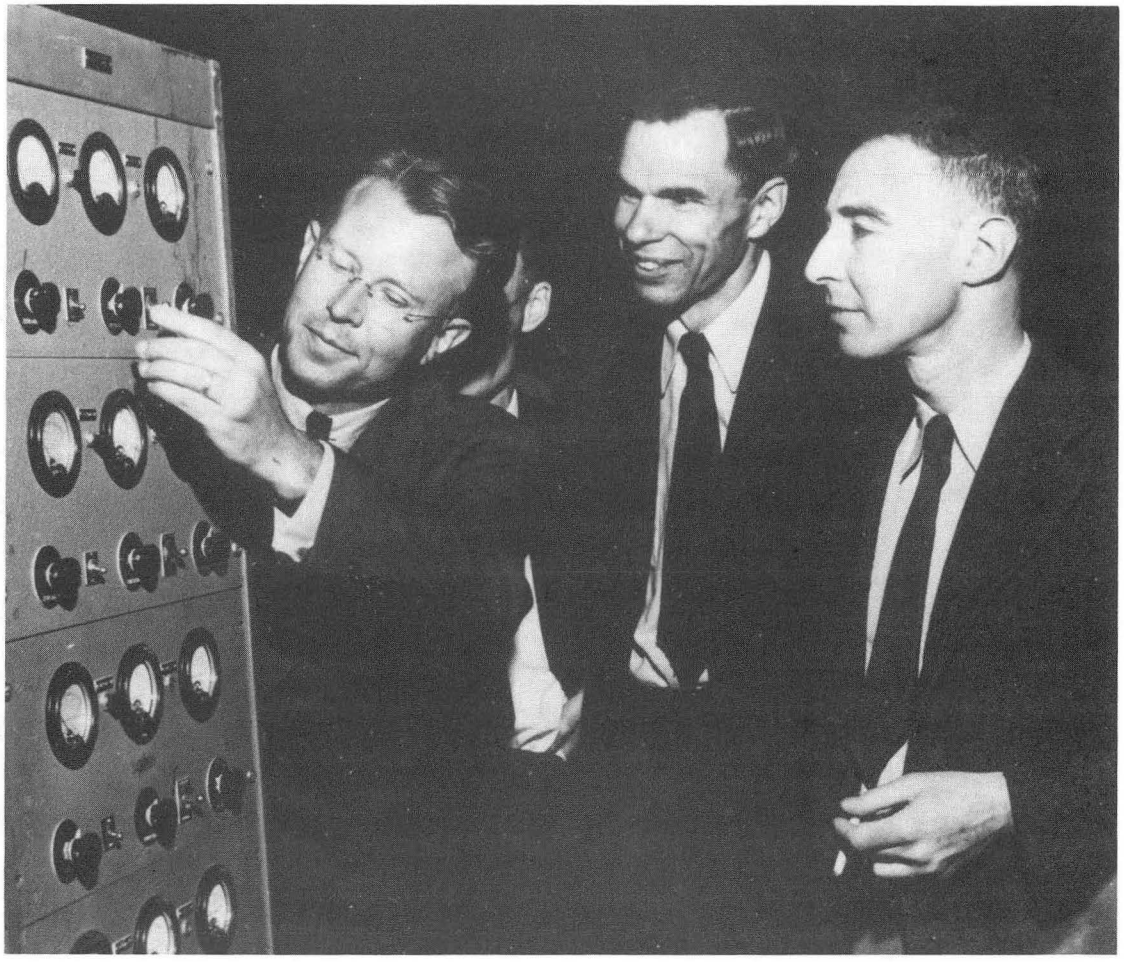
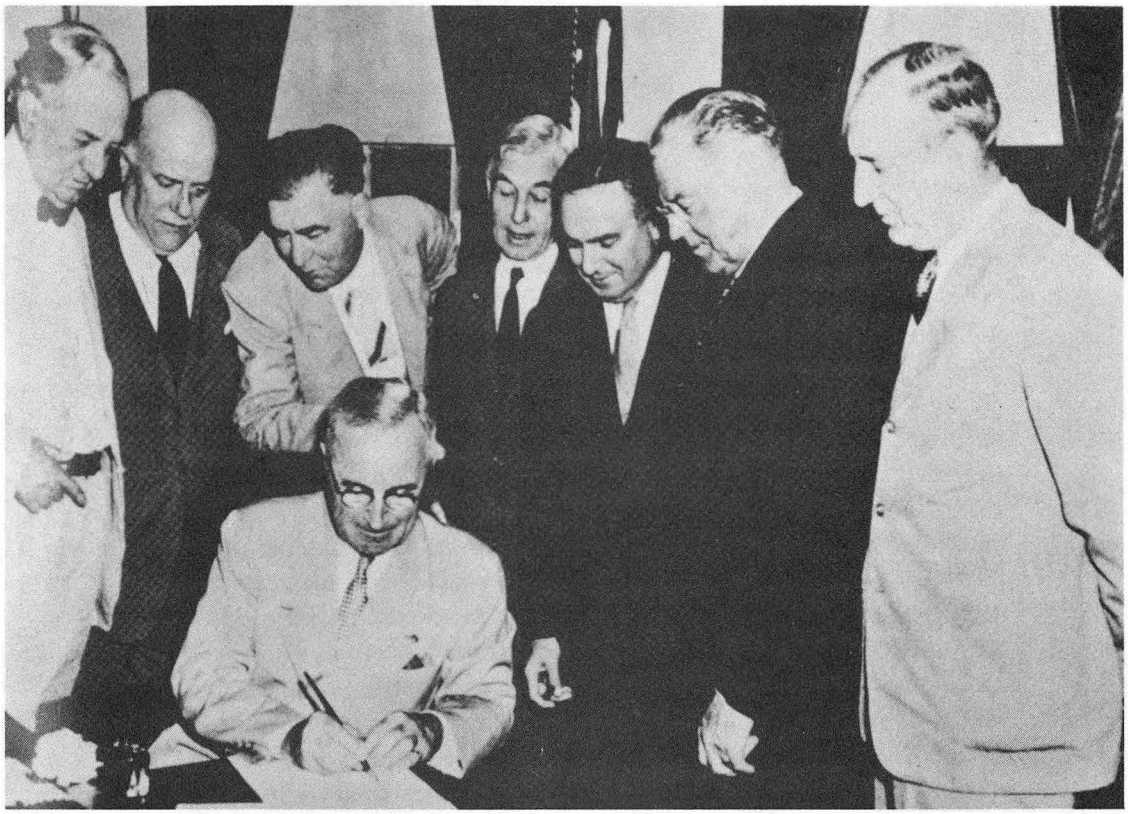


Figure 9: Lawrence, Seaborg and Oppenheimer in early 1946 at the controls of the magnet of the 184-Inch Cyclotron, which was being converted from its wartime use to its original purpose as a cyclotron. (Morgue 1946-12 (P-1) - H-928)

Figure 10: Meeting at the Bohemian Grove on September 13, 1942: (L to R): Major Thomas Crenshaw (area engineer at Berkeley), J. R. Oppenheimer, Harold C. Urey, E. O. Lawrence, James B. Conant, Lyman J. Briggs, E. V. Murphree, A. H. Compton, R. L. Thornton, and Colonel K. D. Nichols. (Morgue 1958-8 [P-71] - H-976)

Figure 11: Meeting of the S-1 Executive Committee at the Bohemian Grove on September 13, 1942: (L to R): Harold C. Urey, Ernest O. Lawrence, James B. Conant, Lyman J. Briggs, Eger V. Murphree, and Arthur H. Compton. Morgue (1958-8 [P-70] - H-977).



Members of the Special Senate Committee: (left to right) Senators Tom Connally, Eugene D. Millikin, Edwin C. Johnson, Thomas C. Hart, Brien McMahon, Warren R. Austin, and Richard B. Russell, on Aug. 1, 1946, gathered around President Truman as he signed the bill which thereby became the Atomic Energy Act of 1946 and, as part of it, established the AEC.

Figure 12

HARRIS AND EWING

PRESIDENT TRUMAN TRANSFERS CONTROL TO THE ATOMIC ENERGY COMMISSION, DECEMBER 31, 1946 / The President is signing the executive order formally transferring control from the Army, effective 12:01, January 1, 1947. General Manager Carroll L. Wilson is on the President's right; Chairman David E. Lilienthal on his left. Standing, left to right: Commissioner Sumner T. Pike, Colonel Kenneth D. Nichols, Secretary of War Robert P. Patterson, General Leslie R. Groves, Commissioner Lewis L. Strauss, Commissioner William W. Waymack. The fifth Commissioner, Robert F. Bacher, was at Los Alamos.

Figure 13

Figure 14 Portrait of Alan Waterman (XBP 907-6061 - HS-127)

Figure 15: Portrait of William T. Golden (XBB 907-5957 - HS-124)

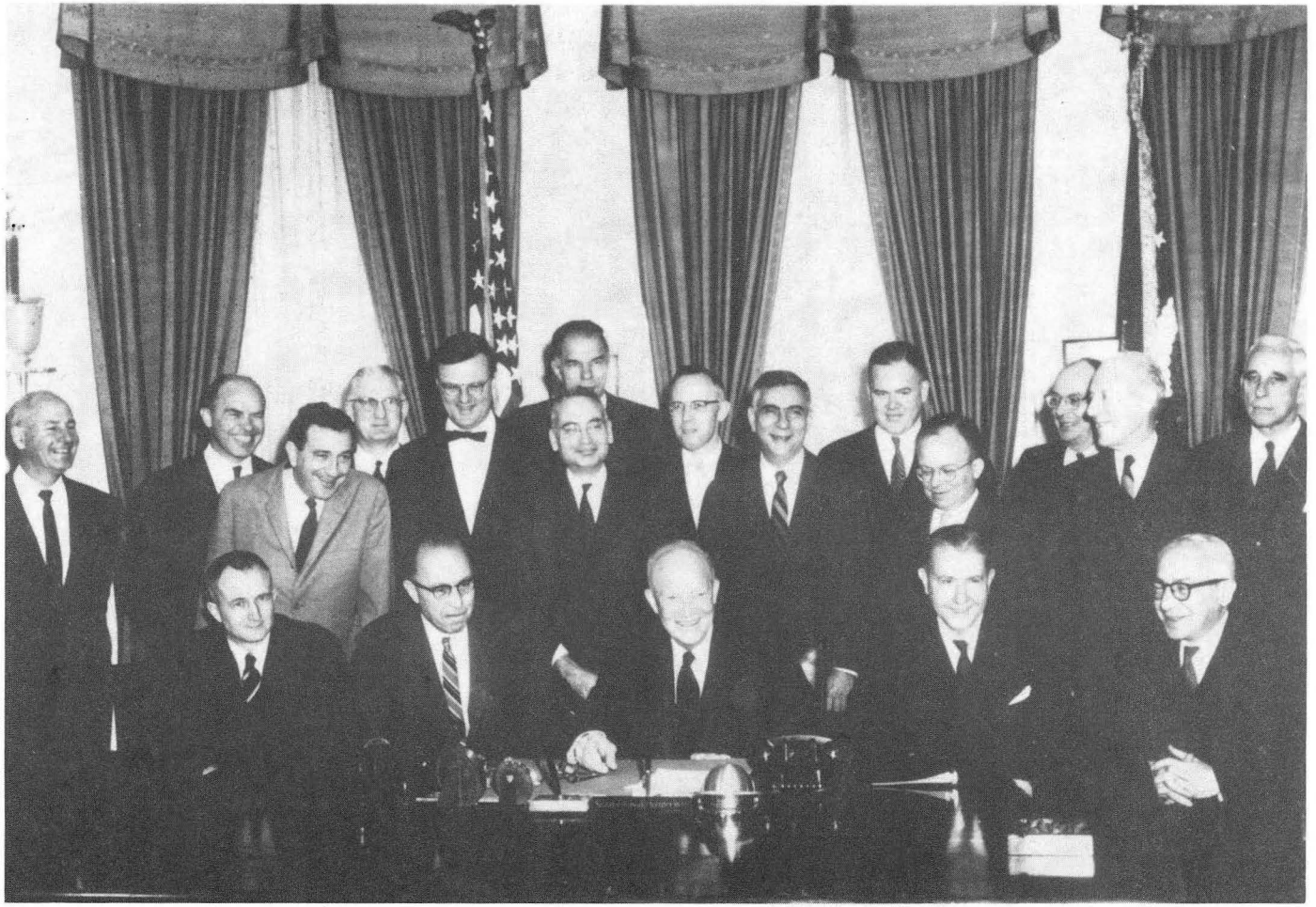


Figure 16: Members of the President's Science Advisory Committee with President Dwight David Eisenhower at the White House on December 16, 1960. (L to R standing): George W. Beadle, Donald F. Hornig, Jerome B. Wiesner, Walter H. Zinn, Harvey Brooks, Seaborg, Alvin M. Weinberg, David Z. Beckler, Emmanuel R. Piore, John W. Tukey, Wolfgang K. H. Panofsky, John Bardeen, Detlev Bronk, Robert F. Loeb; (L to R seated): James B. Fisk, George B. Kistiakowsky, President Eisenhower, James R. Killian, Jr., Isidor I. Rabi. (XBB 888-8758 - H-972)

Figure 17: Seaborg and John F. Kennedy on a visit to AEC Germantown headquarters, February 16, 1961 (XBB 732-893 - R-1)

Figure 18: Seaborg and John F. Kennedy, February 16, 1961. (XBB 732-892 - R-3)

Figure 19: Seaborg and Lyndon B. Johnson in 1966. (XBB 732-1240 - R-73)

Figure 20: Lyndon B. Johnson and Seaborg, June 17, 1965. (XBB 732-1147A - H-927)

To Glenn Seaborg
Another fruitful discussion - from his friend
Lyndon B. Johnson

Figure 21: The Fermilab 200 BeV Accelerator. (XBB 907-5886 - HS-122)

Figure 22: Atomic Pioneer Award ceremony at the White House on February 27, 1970: (L to R): Seaborg, President Richard M. Nixon, General Leslie Groves, Vannevar Bush, and James R. Conant. (XBB 884-3249 - H-929)

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