

9531

Smithsonian Videohistory Program

Manhattan Project

Session Four

Collection Division 2: Oak Ridge

Stanley Goldberg, Interviewer

March 3, 1987

Babcock, Dale F.

SMITHSONIAN VIDEOHISTORY PROGRAM

Release of Interview Material

HOCKESSIN

In interest and consideration of the increase and diffusion of knowledge to which the Smithsonian Institution is committed I, Dale F. Babcock, of ~~Rockessing~~, Del., hereby donate to the Smithsonian Institution any and all copyright and any other rights, title, and interest that might exist or I may have in the interview(s) granted by me to the Smithsonian Institution on the following date(s):

March 3, 1987

At the same time, I also hereby transfer and donate to the Smithsonian Institution any and all rights, title, and interest in and to any and all physical properties, including but not limited to videotapes, audiotapes, and transcripts, that fix the above-referenced interview in tangible form.

The information disclosed by me will be made available without restriction for research in accordance with the general procedures of the Smithsonian Institution Archives.

Dec 16-1987
Date

Dale F. Babcock
Signature

Manhattan Project: S-4

Borst, Lyle

SMITHSONIAN VIDEOHISTORY PROGRAM

Release of Interview Material

In interest and consideration of the increase and diffusion of knowledge to which the Smithsonian Institution is committed I, Lyle Borst, of Williamsville, N.Y., hereby donate to the Smithsonian Institution any and all copyright and any other rights, title, and interest that might exist or I may have in the interview(s) granted by me to the Smithsonian Institution on the following date(s):

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December 16, 1987
Date

Lyle B. Borst
Signature

Manhattan Project: S-4

SMITHSONIAN VIDEOHISTORY PROGRAM

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In interest and consideration of the increase and diffusion of knowledge to which the Smithsonian Institution is committed I, Edward Creutz, of Rancho Santa Fe, Cal., hereby donate to the Smithsonian Institution any and all copyright and any other rights, title, and interest that might exist or I may have in the interview(s) granted by me to the Smithsonian Institution on the following date(s):

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The information disclosed by me will be made available without restriction for research in accordance with the general procedures of the Smithsonian Institution Archives.

12/17/84

Date

Edward Creutz

Signature

Wattenberg, Albert

SMITHSONIAN VIDEOHISTORY PROGRAM

Release of Interview Material

In interest and consideration of the increase and diffusion of knowledge to which the Smithsonian Institution is committed I, Albert Wattenberg, of Urbana, Ill., hereby donate to the Smithsonian Institution any and all copyright and any other rights, title, and interest that might exist or I may have in the interview(s) granted by me to the Smithsonian Institution on the following date(s):

March 3, 1987

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The information disclosed by me will be made available without restriction for research in accordance with the general procedures of the Smithsonian Institution Archives.

January 7, 1988
Date

Albert Wattenberg
Signature

Manhattan Project: S-4

Wigner, Eugene P.

SMITHSONIAN VIDEOHISTORY PROGRAM

Release of Interview Material

In interest and consideration of the increase and diffusion of knowledge to which the Smithsonian Institution is committed I, Eugene P. Wigner, of Princeton, N.J., hereby donate to the Smithsonian Institution any and all copyright and any other rights, title, and interest that might exist or I may have in the interview(s) granted by me to the Smithsonian Institution on the following date(s):

March 3, 1987

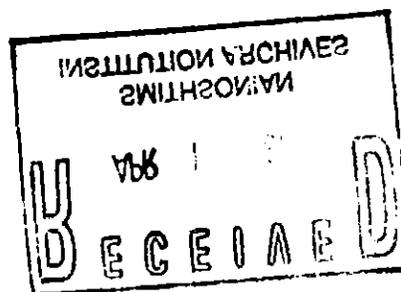
At the same time, I also hereby transfer and donate to the Smithsonian Institution any and all rights, title, and interest in and to any and all physical properties, including but not limited to videotapes, audiotapes, and transcripts, that fix the above-referenced interview in tangible form.

The information disclosed by me will be made available without restriction for research in accordance with the general procedures of the Smithsonian Institution Archives.

March 25, 1988
Date

Eugene P. Wigner
Signature

Manhattan Project: S-4



9531

Smithsonian Videohistory Program

Manhattan Project

FINDING AID

Sessions 1 - 18

Collection Divisions: 1 - 5

1987 - 1990

The Manhattan Project

The United States government began underwriting investigations of the feasibility of atomic weapons in October 1941. Within a year, promising research at several universities, particularly at the Metallurgical Laboratory of the University of Chicago, showed that it was possible to produce atomic bombs based on the chain-reacting fission of uranium 235 isotope or of plutonium. This led to the reorganization of the Manhattan District, or "Project," of the U.S. Army Corps of Engineers to make these bombs a reality. Brigadier General Leslie R. Groves directed and coordinated the Project from 1942 to 1945, spending 2.3 billion dollars on nuclear reactors and chemical separation plants at Hanford, Washington, and Oak Ridge, Tennessee, and on the weapon research and design laboratory at Los Alamos, New Mexico. The first plutonium bomb was successfully detonated at Alamogordo, New Mexico, on July 16, 1945. The B-29 bomber "Enola Gay" exploded the first uranium bomb, "Little Boy," over Hiroshima, Japan, on August 6, 1945; the B-29 "Bock's Car" exploded the second plutonium bomb, "Fat Man," over Nagasaki, Japan, two days later.

Stanley Goldberg, consulting historian for the National Museum of American History, recorded eighteen video sessions with fifty-five participants involved in the engineering, physics, and culmination of the Manhattan Project. Goldberg examined the research and technologies necessary to realize the uranium and plutonium bombs. He supplemented interviews with visual documentation of the industrial plants that refined and separated the isotopes, and of the machinery that delivered and dropped the bombs. Interviewees explained the other steps of designing, building, testing and detonating an atomic bomb. Discussions with participants also elicited a social history of the Project as recalled by men and women with different duties in different locales. Between January 1987 and June 1990 the sessions were recorded on-site or in-studio in Hanford, Washington; Boston, Massachusetts; Oak Ridge and Louisville, Tennessee; Alamogordo and Los Alamos, New Mexico; Washington, D.C.; and Suitland, Maryland. They are divided into five collection divisions described further below: Hanford, Oak Ridge, Cambridge, Los Alamos, and Alberta.

Collection Division 1 contains Sessions One through Three. Goldberg interviewed selected employees, engineers, and administrators responsible for the construction and operation of the nuclear reactors and chemical separation plants at the Hanford Engineering Works in the state of Washington, commonly referred to as the Hanford Reservation. Participants discussed the mechanics of the reactors, separation plants, and cooling systems; the living and working conditions; and the administrative tasks involved in producing plutonium. Session One took place at a reactor face and control room at the Hanford Reservation and featured extensive visual documentation of the instrumentation. Sessions

Two and Three were shot at a Columbia Cable Television studio in Kennewick, Washington.

Collection Division 2 contains Sessions Four through Eight. Goldberg continued to focus on nuclear engineering as it developed from Enrico Fermi's experimental reactor to the pilot reactor and the Clinton Engineer Works at Oak Ridge, Tennessee. Participants included physicists, engineers and plant operators. Their discussions covered the development of fission theory; the application of theory to reactor construction; living and working conditions; and the technologies used at the Y-12 Electromagnetic Separation Plant and the K-25 Gaseous Diffusion Plant for the separation of uranium isotopes. Sessions Four through Six took place at the Kennedy Maxwell Productions studio in Louisville, Tennessee. Visual documentation included diagrams of calutron components and photographs of Oak Ridge and Clinton under construction. Interviewees in Sessions Seven illustrated their explanations at the instrument faces of the K-25 Plant. Session Eight documented visually the interiors of the K-25 and Y-12 Plants.

Collection Division 3 contains Sessions Nine through Twelve. Goldberg interviewed physicists and their spouses who helped design the bombs at the Los Alamos Scientific Laboratory in New Mexico. Participants recalled the formation, organization, and research activities of the Laboratory, as well as the social and cultural life of the community. The plutonium implosion program; preparation for and execution of the Trinity test; the explosion over Hiroshima; and reactions of the Project physicists in the aftermath of the bomb are also discussed. The interviews were taped at the studios of the Audvid Film and Tape Production Company in Boston, Massachusetts, but are labeled the "Cambridge" sessions.

Collection Division 4 contains Sessions Thirteen through Sixteen. The participants covered the topics of the Cambridge sessions from different personal perspectives. Goldberg interviewed eight physicists in New Mexico who contributed to the design and testing of the atomic bomb. Participants in Session Thirteen visited various locations at the Trinity test site near Alamogordo. Sessions Fourteen and Fifteen took place at the Fuller Lodge in Los Alamos. Session Sixteen documented the landscape of Los Alamos in 1945 and 1988.

Collection Division 5 contains Sessions Seventeen and Eighteen. Four participants reviewed their roles in Project Alberta, the conversion of the atomic bomb from a test device to a deliverable weapon system. The two scientists and two military officers recalled design restrictions, flight training, and the missions themselves. Session Seventeen took place by a Fat Man plutonium bomb casing and in a conference room at the National Museum of American History; Session Eighteen was recorded in and around the Enola Gay at the Paul E. Garber Facility in Suitland, Maryland, where the plane was undergoing restoration.

These sessions were recorded on three different videotape formats, and the original tapes are reserved for the archives. VHS copies and full time-

coded transcripts with abstracts of important visual information are available for research use. Dubbing masters may be duplicated for presentation and exhibition. Fees are charged for copies.

Collection Division 1: Hanford

Interviewees in this collection contributed in various roles to the refinement of plutonium 239 isotope at the Hanford Engineer Works in the state of Washington. In January of 1943, General Groves chose the site for construction of three full-scale plutonium piles for the mass production of plutonium 239--an isotope for the chain reaction in an atomic bomb--as well as water-treatment plants for cooling the reactors. The E.I. Du Pont de Nemours Company also built four remote-controlled "canyons" for the chemical separation of plutonium from uranium 238. Sessions were shot at the Columbia Cable Television studio and on-site at the Hanford Reservation.

Participants for Session One assisted in operations at the "B" site nuclear reactor as operators or support personnel. **Lawrence Denton** began work at the Hanford construction camp in September 1942 as a receiving and shipping Clerk. **Wilson A. Cease** came to Hanford as a Du Pont employee in March 1944, and worked as a security patrolman in the area where uranium slugs were canned and sealed. **Jess R. Brinkerhoff** and **Ralph K. Wahlen** were both employed by the Remington Arms plant in Salt Lake City, Utah, and transferred to Hanford. Brinkerhoff arrived in November 1943, and worked in the fire department before becoming a power operator in a water treatment plant. Wahlen was employed in the fuel piece canning area. **R.M. Buslach** arrived in Hanford after the war and worked in plant maintenance for the General Electric Company.

Session Two participants worked for the Du Pont Company as chemical engineers at Hanford. **Wakefield A. Wright** and **Vivian Russell Chapman** were first transferred from Alabama Ordnance Works by Du Pont to the Manhattan Project facilities at Oak Ridge, Tennessee, for training before arriving in Hanford in 1944. **William P. McCue** was employed at the Oklahoma Ordnance Works before training at the Argonne National Laboratory in Chicago, Illinois, and relocating to Hanford. The responsibilities of the three men at Hanford included training the crews and supervising the operators in the nuclear reactors and chemical separation plants.

Session Three brought together a group of Hanford administrators. **Oswald H. Greager** had been a chemist for Du Pont after receiving his Ph.D. in that field from the University of Michigan in 1929. He came to Hanford in October 1944, from the Separations Development Division at the Clinton Engineer Works in Oak Ridge, Tennessee. Greager, on military duty at Hanford, served as Technical Officer and supervised the work of the contractor in the chemical separations area. **Richard T. Foster** joined the project in September 1943, on a contract with the Office of Scientific Research and Development at the University of Washington College of

Fisheries. He studied the effects of radiation on the Columbia River and eventually became concerned with evaluating radiological doses received by people from all environs at Hanford. **Leonard F. Perkins, Sr.**, came to Hanford in the spring of 1944 as an employee of the United States General Accounting Office to audit the contract of the Du Pont Company. In 1946, he transferred to the Atomic Energy Commission and returned to Hanford in 1951 to direct government-contracted construction there until 1973. During World War II **Frederic W. Albaugh** worked in the Metallurgical Laboratory at the University of Chicago as a group leader in the plutonium chemistry section. He arrived in Hanford to head its plutonium chemistry section in 1947 and continued to work there in various administrative capacities until 1971. Colonel **Franklin T. Matthias**, who had worked under General Groves in construction contracting for the Pentagon, was largely responsible for the site selection of Hanford. Groves appointed Matthias in February of 1943 to be commanding officer of the Hanford facilities.

The discussions detailed the nature of the workload at Hanford, the living conditions, and the administration of the Project. The sessions were shot on three-quarter-inch U-Matic tape and provided visual documentation of the "B" site nuclear reactor, tools used for the charge/discharge process, and period photographs of the interiors of the chemical separation "canyons."

Box 1 Transcripts of Sessions

Session One (January 13, 1987), at the Hanford Reservation "B" site nuclear reactor face and in the reactor control room, featured Brinkerhoff, Buslach, Cease, Denton, and Wahlen on the operation of the first large-scale reactor, c. 1942-1945, including:

- discussion and demonstration of procedures for making the reactor operational;
- canning of uranium slugs and the charge\discharge process of the reactor;
- cooling system operations and general reactor maintenance;
- methods for controlling the reactor's power levels and operating the various safety systems.

Visual documentation included:

- period photographs of Hanford Reservation under construction;
- "B" reactor face;
- reactor control room and instrument boards;
- specialized tools developed for canning uranium slugs.

Session Two (January 13, 1987) at the Columbia Cable Television station, Kennewick, Washington, featured Chapman, McCue, and Wright on their roles in producing plutonium at Hanford, c. 1942-1945, including:

- how they came to Hanford;
- conditions and operating procedures in the chemical separation "canyons";
- charge/discharge procedures for the reactor;
- development of specialized equipment;
- accidents and problems involving radioactive material;
- living conditions during and after construction.

Visual documentation included:

- period photographs of Hanford reactors and canyons under construction.

Pages 1 - 56

Session Three (January 14, 1987), at the Columbia Cable Television station featured Albaugh, Foster, Greagher, Matthias, and Perkins on administration at Hanford, c. 1942-1945, including:

- selection of site;
- staffing and conditions during the construction period;
- Manhattan District accounting and purchasing procedures;
- measures to abate or control potential radioactive hazards;
- efforts to ascertain impact of Hanford operations on the Columbia River and local fisheries.

Pages 1 - 39

Videotapes of Sessions

Session One - Tape One - January 14, 1987 - 120 minutes

Session Two - Tape One - January 14, 1987 - 120 minutes

Session Three - Tape One - January 14, 1987 - 105 minutes

Collection Division 2: Oak Ridge

Interviewees in this collection contributed in various roles to the refinement of uranium 235 isotope at the Clinton Engineer Works in Oak Ridge, Tennessee. Built concurrently with the Hanford Reservation, the Clinton complex was designed for continued research and the refinement of the fissionable isotope uranium 235 from uranium 238. The sessions were

shot at a studio of Kennedy Maxwell Productions, and on-site at the Y-12 Electromagnetic Separation Plant and the K-25 Gaseous Diffusion Plant.

Participants for Session Four were instrumental in designing and running the nuclear reactors at Oak Ridge and Hanford. **Dale F. Babcock** received his Ph.D. in physical chemistry at the age of twenty-three from the University of Illinois in 1929. Du Pont employed his services as a research chemist until 1942, when he became a technical specialist on the explosive potential of plutonium. Before the war, **Lyle F. Borst** stayed at the University of Chicago as a Research Associate after his doctoral studies in physics. In 1943 he was appointed chief physicist of the Clinton Laboratories near Oak Ridge, where he remained until 1946. **Edward C. Creutz** received his Ph.D. from the University of Wisconsin in 1939, taught physics at Princeton University, and joined the Manhattan Project as a group leader between 1942 and 1946. After he received his M.A. from Columbia University in 1939 **Albert Wattenberg** was a spectroscopist for Schenley Products, Incorporated. He spent a year with the Office of Scientific Research and Development at Columbia University before moving to the Metallurgical Laboratory in Chicago as a group leader under Enrico Fermi in January 1942. **Alvin M. Weinberg**, born in 1915, earned his three degrees in physics at Chicago by 1939. He stayed there during the war at the Metallurgical Laboratory and moved to Oak Ridge in 1945. **Eugene P. Wigner** was born in Hungary in 1902. He earned his doctorate in physics at the Technical University of Berlin in 1925 and came to the United States at the behest of Princeton five years later. Together with Leo Szilard he played a key role in sparking President Franklin D. Roosevelt's interest in atomic power and during the war he designed the Hanford reactors. Wigner won the Nobel Prize for physics in 1963.

The four participants of Session Five helped operate the isotope separation machinery designed by the physicists and engineers. **Colleen Black** was nineteen years old when she arrived in July 1944 and was assigned to find pipe leaks at the K-25 Plant. The other three worked in the Y-12 Plant. **Connie Bolling** was teaching at Coburn High School, Virginia, in 1943 when he gave six weeks' notice to join a government project that he understood would end the war. He trained cubicle and vacuum pump operators and remained after 1945 in the effort to maximize calutron output. **Jane W. Larson** arrived in September 1943, as a historian before switching to technical editor, reporting on the effort to maintain vacuum consistency. She also worked part-time for the Oak Ridge Journal. **Audrey B. Livingston**, born in 1926, started in 1944 as a cubicle operator.

Participants for Session Six helped design, build and operate the calutrons in the Y-12 Plant. **George M. Banic, Jr.**, worked on high voltage power supplies for the General Electric Company in Schenectady, New York, and came to Oak Ridge in March 1944, to help with the stable isotope program. He stayed after the war to continue isolating isotopes at the pilot plant until it closed in 1975. **Clarence E. Larson** and **Robert S. Livingston** received their Ph.D.'s from the University of California at Berkeley and continued their research at the Radiation Laboratory there until 1943. Larson then took charge of the technical staff at the Y-12 plant at Oak Ridge through

1950 when he became director of the Oak Ridge National Laboratories. Livingston oversaw Stone and Webster Engineering Corporation's design of the Y-12 Plant and continued working at Oak Ridge until his retirement in 1981. **John M. Googin** sought out a position in nuclear chemistry while finishing his B.S. at Bates College in Maine. He started work at Oak Ridge as a process chemist in the summer of 1944, assisting in the recycling of uranium waste. **Chris P. Keim** received his Ph.D. in chemistry from the University of Nebraska in 1940. In 1944 he left his fellowship at the Mellon Institute to become a research physicist for the stable isotope program at the pilot plant. Keim continued working at Oak Ridge until his retirement in 1971.

Session Seven's participants helped design and operate the K-25 Plant for the gaseous diffusion of uranium 235. **Paul R. Vanstrum** and **James A. Parsons** majored in chemical engineering at Columbia University where they participated in the manufacture of part of the diffusion barrier. Vanstrum began working for Union Carbide Corporation, the K-25 operating contractor, after graduating and transferred to Oak Ridge in August 1944. He stayed at the K-25 Plant until it closed in 1964. Parsons continued to work on the manufacture of diffusion barriers in New York until September 1944, when he went to Oak Ridge as a foreman. **Paul Huber** also had a degree in chemical engineering and began work at Oak Ridge in 1944.

Goldberg focused discussions on the theory and practice of reactor construction; nature of the workload; living conditions; and security measures at Oak Ridge. The sessions were shot on one-inch tape and provided visual documentation of the Y-12 and K-25 plants, calutron components, and period photographs of Oak Ridge.

Box 2 Transcripts of Sessions

Session Four (March 3, 1987), at the Kennedy Maxwell Productions studio, Louisville, Tennessee, featured Babcock, Borst, Creutz, Wattenberg, Weinberg, and Wigner on the conversion of fission theory to the construction of nuclear reactors, c. 1939-1944, including:

- pre-war fission research;
- Albert Einstein's letter to President Franklin D. Roosevelt;
- the Chicago pile or reactor (CP-1);
- problems with canning uranium slugs for reactors at Oak Ridge and Hanford;
- conflicts between university-based physicists and engineers employed by Du Pont;
- xenon poisoning of early reactors;
- impact of security measures on research;
- acquisition of raw materials;
- motivation of physicists by German progress in fission research.

Visual documentation included:

- painting of first successful testing of Chicago pile;
- period photographs of X-10 reactor at Oak Ridge.

Pages 1 - 138

Session Five (March 3, 1987), at the Kennedy Maxwell Productions studio featured Black, Bolling, Larson, and Livingston on the plant operators' lives and work at Oak Ridge, c. 1943-1949, including:

- living conditions during and after construction;
- layout of Oak Ridge and Clinton Engineer Works;
- job training at Y-12 and K-25 Plants;
- racial segregation;
- knowledge of goal of the Manhattan Project;
- security measures;
- reactions to news of Hiroshima bombing.

Visual documentation included:

- period photographs of Oak Ridge and Clinton Engineer Works.

Pages 1 - 74

Session Six (March 4, 1987), at the Kennedy Maxwell Productions studio featured Banic, Larson, Googin, Keim, and Livingston on the development of calutrons for uranium separation, c. 1943-1945, including:

- early designs at the University of California at Berkeley;
- improvement of calutron equipment;
- obtaining and returning silver from the U.S. Treasury Department;
- training of operators;
- the magnet short-circuit crisis;
- chemistry of recycling uranium waste;
- security measures and their effect on research;
- shipping uranium 235 to Los Alamos;
- safety precautions;
- reactions to Hiroshima bombing and the Smyth Report.

Visual documentation included:

- schematic drawings and period photographs of the Y-12 Plant;
- models of calutron components.

Pages 1 - 111

Session Seven (March 5, 1987), at the K-25 Gaseous Diffusion Plant, Oak Ridge, Tennessee, featured Huber, Parsons, and Vanstrum on the design and operation of the first gaseous diffusion plant, the K-25, c. 1943-1945, including:

- principles of the diffusion process;
- manufacture of pumps, diffusers, and seals;
- design and construction of K-25 building;
- working conditions;
- training of operators;
- operation of K-25 from control room;
- operation of a diffusion cell;
- safety precautions.

Visual documentation included:

- schematic drawing of diffusion process;
- period photographs of K-25 equipment and controls.

Pages 1 - 50

Session Eight (March 6, 1987), at the K-25 Gaseous Diffusion Plant and the Y-12 Electromagnetic Separation Plant, Oak Ridge, Tennessee, consisted of approximately thirty minutes of visual documentation of interiors, including:

- half-mile length of one wing of the K-25 Plant;
- explanation by Goldberg of construction of K-25;
- K-25 pipe gallery and catwalk;
- exterior and interior views of Y-12 calutron units;
- exterior and interior views of Y-12 control boards during operation.

There is no time code for the VHS tape of this session.

Page 1

Videotapes of Sessions

Session Four - Tape One - March 3, 1987 - 120 minutes

Session Four - Tape Two - March 3, 1987 - 120 minutes

Session Five - Tape One - March 3, 1987 - 120 minutes

Session Six - Tape One - March 4, 1987 - 120 minutes

Session Six - Tape Two - March 4, 1987 - 120 minutes

Session Seven - Tape One - March 5, 1987 - 105 minutes

Session Eight - Tape One - March 6, 1987 - 30 minutes

Collection Division 3: Cambridge

Interviewees in this collection worked on the physics of atomic bomb design at the Los Alamos Scientific Laboratory in New Mexico. The sessions were taped at the studios of Audvid Film and Tape Production, in Boston, Massachusetts.

Four physicists who played important roles in the "Trinity" atomic bomb test at Alamogordo, New Mexico, were reunited for Session Nine. **Kenneth Bainbridge**, a physicist at Harvard University, designed and built the Harvard cyclotron which was used at Los Alamos. In 1940 he joined researchers on radar at the Massachusetts Institute of Technology, and soon after went to Cambridge University in England to work on radar and uranium experiments. He was recruited for the Manhattan Project and moved to Los Alamos in the summer of 1943. In March 1944, he took charge of the Trinity test and administered it from site selection to detonation. **Donald Hornig**, also a physicist at Harvard before he joined the Los Alamos staff, designed the high-voltage capacitors that fired the Fat Man's multiple detonators. **Philip Morrison** received his Ph.D. in theoretical physics from the University of California at Berkeley in 1940, and worked on the Project at the Metallurgical Laboratory of the University of Chicago before arriving at Los Alamos in 1944 to serve as Physicist and Group Leader. **Robert Wilson** had recently completed his Ph.D. at the University of California at Berkeley and taught at Princeton University before he arrived in Los Alamos in April 1943. He headed various subgroups engaged in cyclotron research for the Trinity test.

Session Ten participants worked at Los Alamos with different levels of responsibility. **Robert Wilson** and **Robert Serber** were Division Leaders. Serber received his Ph.D. from the University of Wisconsin in 1934, and worked with J. Robert Oppenheimer as a Research Associate at the University of Chicago's "Met Lab" before arriving at Los Alamos. Serber's introductory lectures on the physics and chemistry of the Project in April 1943, became the Los Alamos Primer. **Anthony French** received his A.B. in physics at Cambridge University. He worked at the Cavendish Laboratory there before coming to the Los Alamos in 1944. **David Frisch** was still a graduate student when he arrived at Los Alamos as a Junior Physicist in 1943. He received his Ph.D. from MIT in 1947.

Four women from Los Alamos convened to discuss their professional and domestic lives in Session Eleven. **Lillian Hornig** received her M.A. in chemistry from Harvard in 1943 and her Ph.D. in 1950. From 1944 to 1946 at Los Alamos she served as Staff Scientist in the plutonium chemistry division and as Section Leader for high explosives development. **Rose Frisch** received her Ph.D. in physiological genetics from the University of Wisconsin in 1943. At Los Alamos, she monitored the effects of radiation in the medical laboratory. **Alice Kimball Smith** received her Ph.D. in history from Yale University and taught social studies at Los Alamos High School. After the war she served as historian for the Association of Los Alamos Scientists. Her book, A Peril and a Hope: The Scientists' Movement in

America 1945-1947, was published in 1965. **Jane S. Wilson** also taught at the Los Alamos High School.

Physicists who worked on the implosion program gathered for Session Twelve. **Bernard T. Feld** worked at the Met Lab at the University of Chicago before coming to Los Alamos in 1944. He received his Ph.D. in physics from Columbia University in 1945. **Cyril Smith** received his D.Sc. in metallurgy from MIT in 1926. He served as associate division leader in metallurgy at Los Alamos from 1943 to 1946. **Robert Serber** and **Philip Morrison** appeared again in this interview.

Goldberg encouraged discussion of the culture and the workload at Los Alamos, and the attitudes towards that work and its consequences. Sessions Nine through Twelve were shot on one-inch tape; sessions Thirteen through Sixteen were shot on three-quarter-inch U-Matic tape.

Box 3 Transcripts of Sessions

Session Nine (December 1, 1987), at the Audvid Film and Tape studio, Boston, Massachusetts, featured Bainbridge, Hornig, Morrison, and Wilson on preparations for and execution of the Trinity test at Alamogordo, c. 1944-1945, including:

- working groups at Los Alamos;
- instrumentation devised for the Trinity test, the hundred-ton test, the "Jumbo" blast containment canister, and the spontaneous fission of plutonium;
- Los Alamos reorganization and formation of the G division during the summer of 1944;
- measurements of the effects of the bombing of Hiroshima.

Visual documentation included:

- copies of Manhattan Project documents;
- Los Alamos personnel graph;
- photographs from Bainbridge's Trinity test report.

Pages 1 - 95

Session Ten (December 1, 1987), at the Audvid Film and Tape studio featured French, Frisch, Serber, and Wilson on the organization of and the scientific activities at Los Alamos, c. 1943-1945, including:

- rationale for forming the Laboratory and the considerations for site selection;
- whether to make Los Alamos a military or civilian camp;
- background to the Serber lectures of April 1943;
- performance of Oppenheimer as administrator and colleague;

- living conditions;
- changing perceptions of the nature of making an atomic bomb;
- the spontaneous fission of plutonium and its effect on the organization of the laboratory;
- the British contingent and comparisons between the Los Alamos and the Cavendish Laboratories;
- controversies over the use of the bomb;
- objections to pursuing research for the hydrogen bomb;
- formation of the Association of Los Alamos Scientists.

There is no visual documentation in this session.

Pages 1 - 79

Session Eleven (December 2, 1987), at the Audvid Studios featured Hornig, Frisch, Smith, and Wilson on the roles of women in both the domestic and scientific life of Los Alamos, c. 1943-1946, including:

- homemaking facilities and child care arrangements;
- social and recreational activities in the area;
- school and library system;
- Hornig's role as a scientist in the implosion program and high explosives development;
- Frisch on radiation research at the medical laboratory;
- agreement on constraints on women's participation in scientific activities;
- perceptions of the Trinity test and post-Trinity conflicts between the scientific community and the military.

Visual documentation included:

- period photographs of Los Alamos.

Pages 1 - 93

Session Twelve (December 2, 1987), at the Audvid Studios featured Feld, Smith, Serber, and Morrison on the design and fabrication of a viable implosion system for the plutonium bomb, c. 1944-1945, including:

- metallurgical experiments to determine characteristics of plutonium;
- technologies for creating plutonium hemispheres;
- strategies to prevent plutonium oxidation;
- design and use of the initiator;
- preparations at Tinian Island for Nagasaki bombing;
- division of responsibilities for various bomb components;
- early surveys at Hiroshima to determine effects of the bomb.

Visual documentation included:

- copies of Manhattan Project documents;
- gold foil ring for the initiator in the Trinity device;
- uranium 238 sample.

Pages 1 - 67

Videotapes of Sessions

Session Nine - Tape One - December 1, 1987 - 120 minutes
Session Nine - Tape Two - December 1, 1987 - 45 minutes

Session Ten - Tape One - December 1, 1987 - 120 minutes
Session Ten - Tape Two - December 1, 1987 - 35 minutes

Session Eleven - Tape One - December 2, 1987 - 120 minutes
Session Eleven - Tape Two - December 2, 1987 - 35 minutes

Session Twelve - Tape One - December 2, 1987 - 110 minutes

Collection Division 4: Los Alamos

Interviewees in this collection also contributed to the atomic bomb design and testing program in New Mexico. J. Robert Oppenheimer, the physicist from the University of California at Berkeley charged with supervising this part of the Manhattan Project, picked the Los Alamos location because of its isolation and its beauty. The sessions were shot at the Trinity test site and in a Los Alamos conference room.

The participants in Session Thirteen worked on the Trinity test at different levels of responsibility. **Kenneth T. Bainbridge** administered the test from site selection to the write-up of the official report. He came to Los Alamos in the summer of 1943, having previously worked on radar at Massachusetts Institute of Technology and in England; he had also designed and built Harvard University's first cyclotron. **Robert Wilson** was not yet thirty when he arrived at Los Alamos in April 1943, where he headed various subgroups using cyclotron research. Wilson had come directly from a Ph.D. at Berkeley and a teaching and cyclotron research post at Princeton. During the Trinity test he helped install the bomb and measured implosion and fission behavior during the explosion.

Session Fourteen's participants worked at various levels on the theoretical underpinnings of an atomic weapon. **Hans Bethe**, head of the Theoretical Division at Los Alamos, left Germany in 1933 for Cornell University before applying his research to the war effort in 1940. He gave up his work on explosives and radar in July 1942 when he became convinced of the feasibility of an atomic bomb. Bethe returned to Cornell after the war and won the Nobel Prize in Physics in 1967. **Frederick Reines** made his reputation as a doctoral student at New York University when he developed

a new equation in applied mathematics. Reines joined the Theoretical staff in late 1943 and remained at Los Alamos as a Group Leader until 1959. Canadian **J. Carson Mark** came to Los Alamos via research at the Metallurgical Laboratory in Chicago and a doctorate under Oppenheimer at Berkeley. Fellow Canadian **Robert Christy** arrived by way of George Placzek's Montreal study group and summer seminars in applied mathematics at Brown University in 1941 and 1942.

In addition to **Bainbridge**, Session Fifteen included experimentalists **Robert Bacher** and **Norris E. Bradbury** and administrator **David Hawkins**. Bacher led fission studies at Cornell and worked at MIT's Radiation Laboratory before heading the Experimental and Gadget Divisions at Los Alamos. His opposition to militarized working conditions manifested itself further in his post-war efforts for civilian control of nuclear research. Bradbury put his Berkeley Ph.D. to work at the U.S. Navy's Dahlgren Proving Ground for four years before his assignment to the Ordnance Division at Los Alamos. He replaced Oppenheimer as director of the Los Alamos Laboratory in September 1945. Hawkins grew up in New Mexico and went to Berkeley to earn his Ph.D. in philosophy. He returned as administrative assistant to Oppenheimer in the summer of 1943, becoming the primary liaison between the scientists and the military administration of the Project.

Goldberg elicited comparisons of the work experience from the theoretical and experimental physicists as well as discussions of social life at Los Alamos. The series was shot on half-inch Betacam tape and provides visual documentation of the Trinity test site, Los Alamos in 1989, and period photographs of Los Alamos and preparations for the Trinity test.

Box 4 Transcripts of Sessions

Session Thirteen (August 15, 1989), at the Trinity test site, Alamogordo, New Mexico, featured Bainbridge and Wilson. Their commentary on the preparations for and detonation of the Trinity bomb, c. 1944-1945, was sparked almost solely by the surviving structures at the site and included:

- post-blast sample collection;
- test site selection;
- Jumbo blast containment cannister;
- Julian Mack's camera system;
- quality of life at and uses of base camp;
- U.S. Air Force overflights and bombing practices;
- effect of the blast on base camp.

Visual documentation included:

- Ground Zero;
- Jumbo;
- West 800 camera bunker;
- Base Camp;
- McDonald Ranch house;
- West 10,000 observation bunker.

Pages 1 - 60

Session Fourteen (August 18, 1989), at Fuller Lodge, Los Alamos Scientific Laboratory, featured Bethe, Christy, Reines, and Mark on the theoretical physicist's view of the Laboratory's operation, c. 1943-1945, including:

- reasons for participation;
- division of labor between and relationship of theoretical and experimental physicists;
- insulation from other Project researchers;
- uranium hydride program;
- theoretical and experimental emphasis on physical power of atomic blast;
- implosion research;
- reactions to the Trinity test;
- post-blast measurements of yield.

Pages 1 - 51

Session Fifteen (August 18, 1989), at Fuller Lodge, Los Alamos Scientific Laboratory, featured Bacher, Bainbridge, Bradbury, and Hawkins on the experimental physicist's experience at the Laboratory, c. 1943-1945, including:

- methods of recruitment and reasons for participation;
- debate on civilian or military nature of Lab;
- differences between internal and external exchanges of information;
- organization of Laboratory;
- gun experiments;
- relationship of Groves and Oppenheimer;
- weekend recreation;
- understanding Klaus Fuchs;
- predicting the Soviet bomb;
- post-blast depression and efforts to regulate nuclear power.

Pages 1 - 62

Session Sixteen (August 19, 1989), consisted of visual documentation of the landscape of Los Alamos in 1945 and 1989, including:

- Nine still photographs of the preparations for Trinity;
- views of Los Alamos Scientific Laboratory and environs;

Pages 1 - 3

Videotapes of Sessions

In Sessions Fourteen and Fifteen, Camera A focussed mainly on the speaker. Camera B focussed mainly on the listeners or the group as a whole.

Session Thirteen - Tape One - August 15, 1989 - 120 minutes
 Session Thirteen - Tape Two - August 15, 1989 - 10 minutes

Session Fourteen - Tape One - Camera A - August 18, 1989 - 120 minutes
 Session Fourteen - Tape One - Camera B - August 18, 1989 - 120 minutes

Session Fifteen - Tape One - Camera A - August 18, 1989 - 120 minutes
 Session Fifteen - Tape One - Camera B - August 18, 1989 - 120 minutes
 Session Fifteen - Tape Two - Camera A - August 18, 1989 - 15 minutes
 Session Fifteen - Tape Two - Camera B - August 18, 1989 - 15 minutes

Session Sixteen - Tape One - August 19, 1989 - 25 minutes

Collection Division 5: Alberta

Four participants from "Project Alberta" convened for Sessions Seventeen and Eighteen. This phase of the Manhattan Project dealt with the conversion of the Trinity test device into the practical weapons systems that were used twice on Japan. The interviewees were among those who designed the bombs to fit the B-29, wired them with redundant electronics, rehearsed the mission, established a base on Tinian Island, and released the bombs over Hiroshima and Nagasaki. The sessions were shot at the National Museum of American History in Washington, D.C., and at the Paul E. Garber Facility in Suitland, Maryland.

Norman F. Ramsey, Jr., received his Ph.D. in physics from Columbia University in 1940. During World War II, Ramsey consulted with various government groups concerned with military technology. In 1943 he moved from the offices of the Secretary of War to Los Alamos, where he became a

group leader for bomb delivery. After the war, he returned to Columbia and won the Nobel Prize for Physics in 1938. **Harold M. Agnew** received his A.B. in chemistry from the University of Denver in 1942. His advisor referred him to Enrico Fermi, under whom he was responsible for some of the measurements of the atomic explosions over Japan. After the war Agnew earned his Ph.D. in particle physics at the University of Chicago before returning to Los Alamos Scientific Laboratory. He directed the Laboratory there from 1970 to 1979.

Frederick L. Ashworth graduated from the United States Naval Academy and completed the Naval Postgraduate School course in ordnance engineering shortly before the Japanese attack on Pearl Harbor in 1941. After service in the Pacific Theater of Operations, he worked for William S. Parsons and Ramsey on the detonation components of the atomic bombs. Ashworth acted as weaponeer on the Nagasaki mission and as General Groves's representative on Tinian Island. His book, The Atomic Bombings of Hiroshima and Nagasaki, was published in 1947. **Charles W. Sweeney** was born in 1920 and grew up in eastern Massachusetts. He enlisted as an air cadet in April 1941, and rose to commander of a bomber squadron in the European Theater of Operations. With nearly three thousand hours of accident-free flight time to recommend him, Sweeney joined Colonel Paul Tibbetts's 509th Composite Group of B-29's in September 1944. He piloted an observation plane at the Hiroshima bombing and dropped the Fat Man over Nagasaki from Bock's Car. After he completed his enlistment, he returned to Massachusetts to begin a wholesale leather business and served in the Air National Guard until 1976.

Goldberg used the Enola Gay site to draw from the participants details of their involvement with the technologies of Project Alberta. Other questions stimulated recollections of experiences on Tinian Island and on the two missions to Japan. The sessions were shot with half-inch Betacam tape and provide visual documentation of the Little Boy and Fat Man bomb models and the B-29 Enola Gay.

Box 5 Transcripts of Sessions

Session Seventeen (June 5, 1990), at the National Museum of American History, Washington, D.C., featured Agnew, Ashworth, Ramsey, and Sweeney on their assignments in Project Alberta, c. 1944-1945, including:

- designing the Fat Man plutonium bomb: contents and aerodynamics;
- definition of weaponeer's role and mechanics of bomb;
- William S. Parsons' contributions to Manhattan Project;
- reasons for interviewees' participation in Manhattan Project;
- flight training for the 509th Composite Group;
- preparation of Tinian Island as flight base ("Project Silverplate");

- life on Tinian with conventional B-29 bomber crews;
- comparison of Hiroshima and Nagasaki missions;
- photography of atomic explosions;
- disposal of facilities at Tinian after Nagasaki explosion;
- reaction to use of the bombs.

Visual documentation included:

- the Fat Man bomb casing on display at the Museum.

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Session Eighteen (June 6, 1990), at the Enola Gay restoration project, Paul E. Garber Facility, Suitland, Maryland, featured Agnew, Ashworth, Ramsey, and Sweeney on the specific technologies required for Project Alberta, c. 1944-1945, including:

- designing the Little Boy uranium bomb: contents and aerodynamics;
- development of bomb release mechanism;
- Bernard O'Keefe's claim to last-minute rewiring of Little Boy;
- flight qualities of B-29;
- pilot-bombardier communication;
- the Nagasaki mission;
- operation of Norden bombsight;
- comparison of the two bombs' electronic characteristics;
- mechanics of monitoring devices at Hiroshima.

Visual documentation included:

- the Little Boy bomb casing on display next to the Enola Gay;
- the bomb bay, cockpit, and weaponeer's cabin of the Enola Gay.

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Videotapes of Sessions

Session Seventeen - Tape One - June 5, 1990 - 120 minutes

Session Seventeen - Tape Two - June 5, 1990 - 70 minutes

Session Eighteen - Tape One - June 6, 1990 - 80 minutes