

THE CHAIN REACTION: DECEMBER 2, 1942 AND AFTER

The University of Chicago is not only the site of the world's first self-sustaining nuclear reaction, but also one of the earliest and most influential centers of the atomic scientists' movement.

On December 2, 1942, scientists at The University of Chicago produced the world's first self-sustaining nuclear chain reaction in a nuclear pile constructed in a squash court beneath the west stands of Stagg Field. The experiment, crucial to the control of nuclear fission, was one of several research projects at sites around the country, each concentrating on some task critical to production of an atomic bomb. All were administered by the Army under the code name of Manhattan Engineer District, or Manhattan Project.

After the discovery of nuclear fission in 1938 by German chemists Otto Hahn and Fritz Strassman, theorizing and experimentation in this country had proceeded rapidly at Columbia, Princeton, Berkeley, Chicago, and elsewhere. Enrico Fermi, who had defected from Italy while accepting the Nobel Prize in physics, arrived at Columbia in 1939 where he theorized that the neutrons emitted in fission might induce fission reactions. Fermi further concluded that it should be possible to sustain a chain reaction in uranium which, under the right conditions, might multiply fast enough to cause a nuclear explosion. Fermi and Columbia physicist Leo Szilard proposed placing uranium in a matrix of graphite, forming a cubical lattice of uranium with potential for inducing a self-sustaining controlled reaction.

Amid fears that German scientists might already be well on their way to constructing an atomic weapon, President Roosevelt in the fall of 1931 approved a full-scale effort to translate these theories into the construction of the bomb. Arthur H. Compton, professor of physics at Chicago and Nobel laureate, was placed in charge of the program with work on a reactor to be concentrated in Chicago under the code name Metallurgical Laboratory. Consequently, early in 1942 groups of scientists from Princeton and Columbia arrived at Chicago to combine their efforts.

In November 1942 construction began on the reactor in the west stands. Layers of graphite blocks containing slugs of uranium metal and uranium oxide alternated with layers of solid graphite blocks, in a pseudo-spherical shape supported by a wood framework. A square of balloon-cloth bag encased the reactor to reduce absorption of neutrons by nitrogen in the air. Higher grades of uranium became available as work progressed, and the pile was redesigned in a reduced size with a flattened top.

Construction halted with the fifty-seventh layer on December 1, when measurements indicated the pile would become self-sustaining should the control rods be withdrawn. On December 2, Fermi and his colleagues gathered on the balcony of the squash court to test the reactor, slowly withdrawing the last control rod until the "critical," or self-sustaining, level was reached, then watching the reactor operate for twenty-eight minutes before reinserting the rod and stopping the reaction. Compton telephoned the news to Harvard president James B. Conant, member of the Manhattan Project Military Policy with the coded message: "The Italian navigator has just landed in the New World."

While research continued at Chicago, primary attention shifted to weapon development at Oak Ridge, Los Alamos, and elsewhere, and some Chicago scientists were transferred to these projects. Samuel K. Allison, one of the scientists who moved to Los Alamos, was present at the detonation of the first atomic bomb in the desert at Alamogordo, New Mexico on July 16, 1945. Three weeks later, the

first atomic bomb was dropped over Hiroshima, Japan.

Chicago was one of the earliest centers where apprehension about the dangers of nuclear research found expression. By the summer of 1943 Chicago staff members were voicing their concerns in private conversation, as well as at several meetings held with project permission, but with guard present. At one of these gatherings James Franck, a German Jewish refugee who had become professor of chemistry at the University in 1938, spoke movingly of his own experience of the danger of governmental control over science.

Throughout 1944 the scientists expressed their opinions with increasing frequency and clarity. Compton and the Metallurgical Project council authorized a committee headed by Zay Jeffries to appraise the future of nuclear research. The Jeffries Report, submitted to Compton on November 18, 1944, included a lengthy section concerning the grave dangers posed by nuclear weapons, and the need for education of the general public, and the critical importance of international controls. Meanwhile, a group of twenty-two Chicago scientists headed by Samuel Allison, recommended to Washington that the United States forewarn its allies of the bomb.

In June of 1945, when the War Department formed an Interim Committee to recommend executive and legislative policies for nuclear energy in the postwar period, Met Lab scientists organized committees to transmit their views to Washington. Franck chaired the Committee on Social and Political Implications which drafted a report underlining the need for internal controls and anticipating the nuclear arms race. The committee urged that the atomic bomb be demonstrated to Japanese leaders in an uninhabited place rather than dropped without prior warning, arguing that "if the United States were to be the first to release this new means of indiscriminate destruction upon mankind, she would sacrifice public support throughout the world, precipitate the race for armaments, and prejudice the possibility of reaching an international agreement on the future of such weapons."

The bombing of Hiroshima heightened the urgency of earlier discussions, and the Franck Committee called an open meeting of the Chicago staff on the evening of August 7, the day following the bombing. Those gathered designated Eugene Rabinowitch chair of a group to draft a statement arguing for civilian administration of atomic research, international controls to head off an arms race (including the possibility of world government as a means to this end), and the need to educate scientists, governmental leaders, and the public about atomic weapons as well as about potential energy applications.

Chicago scientists were particularly concerned about federal legislation, especially in regard to secrecy and military control in atomic research. Leo Szilard, who had come to Chicago from Columbia in 1942, and who was active member of the Franck Committee, outlined in early September a "platform for conversations" with members of Congress, signaling the key role which Chicago scientists were to play in Congressional lobbying. By September 14, a Planning Committee was circulating a "Statement of Intent" for what was to organize officially a few days later as The Atomic Scientists of Chicago.

The May-Johnson Bill, introduced in Congress in early October, called for stringent security restrictions, failed to provide for the sharing of information with foreign countries, and granted a dominant role to the military, which galvanized scientists throughout the country. Fledgling organizations at several research sites began issuing press releases, writing to the War Department, and wiring members of Congress to point out the bill's shortcomings. John A. Simpson, chair of the executive committee of the Atomic Scientists of Chicago, joined William Higinbotham of the Los Alamos group in

coordinating the Washington effort, notifying local organizations of critical turns of events and attempting to channel the energies of eager scientists who appeared in the capital to volunteer.

With the tabling of May-Johnson in December, due in part to lobbying by scientists' groups, the Atomic Scientists of Chicago turned their attention to popular education, particularly in the Midwest. The ASC editorial group prepared a pamphlet, *The Atomic Bomb*, which was ready for distribution in mid-February 1946. During the winter of 1945-1946, the ASC speakers bureau filled an average of one request per day from schools, churches and synagogues, clubs, and business associations. Over forty members used these opportunities to explain the essential facts of atomic energy, and impress on the public the need for international control of arms and civilian control of research.

Perhaps the most concrete demonstration of the commitment of the Chicago scientists to educate themselves and others and the most enduring symbol of the scientists' movement as a whole was the *Bulletin of the Atomic Scientists*. This publication was reputedly conceived in the unlikely setting of Hyde Park's Stineway Drug Store where Eugene Rabinowitch, Hy Goldsmith, and social scientist Edward Shils met to drink coffee and discuss means of weighing issues and share opinions in the atomic policy debate. On the basis of a proposal from Rabinowitch and Goldsmith, the ASC executive committee on November 24, 1945, authorized a newsletter with weekly committee reports, items from other site newsletters, and responsible statements as well as "terrible stuff" from the public press.

Goldsmith and Rabinowitch guided the enterprise which had an almost immediate impact far beyond the Chicago area. Goldsmith, a physicist, had wide contacts outside the scientific community which set the *Bulletin* apart from other site newsletters, and Rabinowitch, a Russian-born biophysicist who had collaborated with James Franck at Göttingen in the early 1930s, was a talented writer with a deep and longstanding concern about the bomb's practical and social implications. He had played a key role in formulating the Franck Committee report and in the organization of the ASC.

The first issue of the *Bulletin of the Atomic Scientists of Chicago* appeared on December 10. Its six pages featured an ASC press release on the anniversary of Pearl Harbor, pointing out the futility of nuclear preparedness and urging efforts to achieve international control. From the beginning, the editors were interested in distributing the *Bulletin* not only locally and at other research sites, but to interested or influential "nonscientific" groups and individuals.

Reflecting its broad appeal, the *Bulletin* dropped *of Chicago* from its name in the seventh issue (March 15, 1946) and published an increasingly wide range of articles, from the technical ("Can Air or Water Be Exploded?" by physicist H. A. Bethe) to the general ("The Moral Responsibilities of Scientists" by British physiologist A. V. Hill). The editors continued to publish important primary documents such as the report of the State Department Committee on Atomic Energy which was hailed as the first step toward international control. Commentary by scientists frequently accompanied such documents, in this instance by Harold Urey, professor in the University of Chicago Department of Chemistry and wartime director of a Manhattan Project laboratory at Columbia.

It was not until 1947 that the *Bulletin* cover began to display the Doomsday Clock, which, originally intended to mark halting progress towards arms control, has since become symbolic of the *Bulletin's* cause. Designed by Martyl Langsdorf, the wife of a Manhattan Project physicist, the clock evoked both the imagery of the Apocalypse, and the contemporary idiom of military attack—the countdown to zero hour. The precise location of the minute hand took on greater significance when the editors decided to move it to reflect changes in international security. Having begun at eight minutes

before midnight, the clock has been as close as two minutes, where it stood from 1953 to 1960 following nearly simultaneous detonations of hydrogen bombs by the United States and the Soviet Union. The clock has moved forward and back fourteen times, and since 1988 has been pushed backward from six to seventeen minutes to midnight.

Soon after atomic scientists began their lobbying campaign in Washington in the fall of 1945, the advantages of a joint organization for scientists across the country became apparent, not only for maximum efficiency as a lobby, but for exchange of opinions and information and for mutual support. This culminated in a meeting of seventeen delegates representing twelve scientists' associations at George Washington University where a constitution for the Federation of American Scientists was drafted in early December 1945. The constitution set forth the group's aims as working toward international control and scientific cooperation, examining the social responsibilities of scientists, dissemination of facts germane to the social implications of atomic research, and safeguarding freedom of inquiry and of information in science.

Senator Brien McMahon's introduction on December 20 of S-1717, a bill to guide the development and control of atomic energy, demanded the organization's immediate attention. After studying the bill, the FAS pronounced it "the best practical solution to a number of complicated and difficult problems," and provisionally recommended that its constituent associations work enthusiastically for the bill's passage. Providing for civilian control of atomic energy and pointing in the direction of international arms control, the bill approximated what the scientists had been advocating.

The FAS directed its efforts on behalf of the McMahon Bill toward Congress and toward the general public. When President Truman endorsed the principle of civilian control, FAS secretary Melba Phillips sent a telegram to each association urging a flood of telegrams and letters supporting Truman and McMahon. The Atomic Scientists of Chicago immediately wired back the text of their letter to McMahon and the FAS reissued this strong statement of support as its own in a press release the following day.

The greatest strength of the FAS campaign was the decree to which it stimulated and worked in cooperation with lay organizations at the grassroots level. In February, the Washington office prepared a petition to Congress which incorporated the language of the Chicago letter and the FAS press release and distributed it to research sites, organizations, and individuals for circulation. In the first ten days, four thousand persons around the country signed the petition. A prime example of cooperation at the local level was the close association of the Chicago scientists with the Chicago Committee for Civilian Control of Atomic Energy, an umbrella organization of forty-one civic groups coordinated by Mrs. Harriet Welling, a prominent Chicagoan. Sharing a cramped basement office in the Social Science Research Building with the ASC and the *Bulletin*, Mrs. Welling and her corps of volunteers marshalled public support by distributing fifty thousand copies of an "Atomic Power Quiz" and contacted Illinois members of Congress at crucial junctures to assure their endorsement of S-1717.

When the House of Representatives on July 20 passed a watered-down version of the bill which the Senate had approved in June, the FAS expressed dismay over the amendments providing for military influence, extreme security regulations, dropping of grants-in-aid research, and other changes. Within twelve hours of the House action, wires went out to the associations, calling for "an avalanche of telegrams" to the House-Senate conference committee and visits to Washington by scientists "with American names." (During earlier lobbying one legislator wondered whether there were any atomic

scientists with American names, prompting the FAS's response.) Senate conferees finally gave ground on points deemed important by the scientists, thereby gaining House approval for restoration of key features of the original version.

Expressing satisfaction with the passage of the McMahon Act and establishment of the civilian Atomic Energy Commission, Goldsmith and Rabinowitch of the *Bulletin* conveyed scientists' gratitude to Senators McMahon and Arthur Vandenberg and to the lay organizations which had helped to rally public opinion. But they warned that "The only way to prevent the threat to peace stemming from the accumulation of atomic explosives is by placing the control of all fissionable materials in an international agency . . . or else to outlaw the fabrication of such materials together with that of bombs."

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1. Naval seaman's guard at Stagg field, 1942.

Radio and Signal School students marching on 57th Street, summer 1942. In the background is the south tower of the west stands, where physicists were beginning work on construction of the nuclear pile.

2. Herbert L. Anderson, "Measurements in Chain Reaction Pile," notes from laboratory notebook, December 1, 1942.

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3. Artist's drawing of CP-1, 1946

4. Graphite from CP-1

5. "Neutron Intensity in the Pile as Recorded by a Galvanometer," December 2, 1942.

6. Arthur H. Compton, ca. 1940.

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7. Fragment of Stagg Field Wall.

8. Metallurgical Project, "Report for Month Ending December 15, 1942." Enrico Fermi's report for his work group said simply, "The chain reacting structure has been completed on December 2 and has been in operation since then in a satisfactory way."

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9. CP-1 under construction, November 1942. Photo shows the 19th layer of graphite blocks, partially covering the 18th layer with inlaid slugs of uranium.

10. Enrico Fermi, U.S. certificate of naturalization, 1944.

11. Graphite from CP-1.

12. Model of CP-1.

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1. James Franck, undated.

Franck Committee Report, June 1945.

2. Fused sand from atomic test site, Alamogordo, New Mexico.

Samuel K. Allison, Alamogordo notebook, July 1945.

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3. Eugene Rabinowitch, notes from Metallurgical Laboratory staff meeting, August 7, 1945.

4. Leo Szilard, undated.

Leo Szilard, "An Attempt to Define the Platform for Our Conversations with Members of the Senate and House of Representatives," September 7, 1945.

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5. John A. Simpson to Atomic Scientists of Chicago, telegram, December 5, 1945.

6. Atomic Scientists of Chicago, Editorial and Records Committee, memo to "All Scientific Personnel," September 14, 1945.

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7. H.D. Smyth, *A General Account of the Development of Methods of Using Atomic Energy for Military Purposes under the Auspices of the United States Government 1940-1945*, August 1945. The Smyth Report was the first public account to give details of nuclear research conducted during the war.

8. Atomic Scientists of Chicago, *The Atomic Bomb* (Chicago, 1946).

9. The Reverend G. Carlton Story to A.S. Langsdorf, April 10, 1946.

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1. Atomic Scientists of Chicago, Executive Committee minutes, November 24, 1945.

2. "Bulletin Clock" from the office of the bulletin of the Atomic Scientists, ca. 1980.

3. Eugene Rabinowitch, undated.

4. *Bulletin of the Atomic Scientists of Chicago*, Volume 1, Number 1, December 10, 1945.

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5. Hyman Goldsmith to John A. Simpson, December 14, 1945.

6. *Bulletin of the Atomic Scientists*, Volume 1, Number 7, March 15, 1946.

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7. Harold C. Urey, undated.

Bulletin of the Atomic Scientists, Volume 1, Number 8, April 1, 1946.

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8. *Bulletin of the Atomic Scientists*, Volume 3, Number 6, June 1947.

9. Office of the Bulletin of the Atomic Scientists, in former Lorado Taft home, ca. 1970.

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1. First pile scientists at the University of Chicago for fourth anniversary observance, December 2, 1946. Back row, left to right: Norman Hilberry, Samuel K. Allison, Thomas Brill, Robert G. Nobles, Warren Nyer, and Marvin Wilkening. Middle row: Harold Agnew, William Sturm, Harold Lichtenberger, Leona W. Marshall, and Leo Slizard. Front row: Enrico Fermi, Walter H. Zinn, Albert Wattenberg, and Herbert L. Anderson.

Herbert L. Anderson at the "Council Tree," 1976. Manhattan Project scientists often met under this elm in front of Eckhart Hall for informal conversations, where they were free to talk without fear of being overheard.

2. Paperweight from the 170-inch synchrocyclotron, inscribed to William B. Harrell, 1951.

3. Federation of American Scientists, organizational meeting minutes, December 7-8, 1945.

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4. Federation of Atomic Scientists, "S.1717," evaluation of McMahon bill, December 1945.

McMahon Bill, 1946.

5. Atomic Scientists of Chicago, Executive Committee minutes, December 1, 1945.

6. B. T. Feld to Federation of Atomic Scientists, telegram, February 4, 1946.

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7. Federation of American Scientists, press release, February 8, 1946.

8. Chicago Committee for Civilian Control of Atomic Energy, Atomic Power Quiz, 1946.

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9. W. Higinbotham to Aaron Novick, telegram, July 21, 1946.

10. Federation of Atomic Scientists, "Petition for Civilian Control of Atomic Energy," February 20, 1946.