A Timeline of the Hydrogen Bomb Debate

Fall 1941 Enrico Fermi suggests to **Edward Teller** (*right*) that an atomic bomb could be used to ignite a fusion reaction

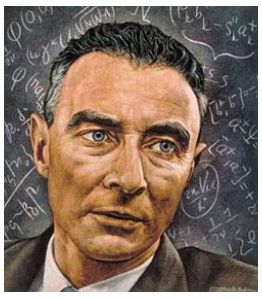
June 1942 At a meeting of theoretical physicists at UC Berkeley coordinated by **Robert Oppenheimer**, Edward Teller suggests that a fusion bomb would be more interesting to shoot for than just a fission bomb. Other participants, notably **Hans Bethe**, point out the difficulty in making a fusion bomb. Considerable time is devoted to discussing the "**Super**," as it is called, but it seems to be a much more difficult theoretical problem than the fission bomb.

1943-1945 Teller continues thinking about the "Super" bomb. Oppenheimer refuses to devote significant Los Alamos resources to the topic, but allows Teller to do some theoretical investigations into the matter as part of his work at Los Alamos. Some very small-scale experiments are developed at Los Alamos for testing for constants relevant to fusion work.

1945-1946 The atomic bomb is used on Japan. World War II ends. In attempting to figure out what information about the Manhattan Project should be released in the postwar period, the idea of the "Super" is explicitly put on a list of things to keep extremely secret, with no dissent. As of yet, they still have no idea how to make a workable bomb.

1946-1949 Work on the "Super" is lackluster and sluggish. It is one problem among many. There are no viable designs. Teller is frustrated and desires a more vigorous program. Priority at Los Alamos is on making more reliable and efficient fission bombs. The **Atomic Energy Commission** (AEC) takes over responsibility for the American atomic program.

Aug. 1949 The Soviet Union detonates its first atomic bomb (*right*), dubbed **Joe-1** by the United States. The United States detects it and announces it. Physicists Teller, Ernest Lawrence, and Luis Alvarez lobby for a "crash" program in developing the "Super." AEC Commissioner **Lewis Strauss** picks up their cause. AEC Chairman **David Lilienthal** resists. President Truman is not informed of the possibility of a "Super" bomb until October 1949.



October 1949 The **General Advisory Committee of the AEC** (GAC), chaired by Robert Oppenheimer (*right*) , meets to discuss whether a "crash" program to develop the "Super" is advisable. They conclude unanimously that it is not. The majority opinion rejects the "Super" program on both policy and technical grounds. A minority opinion authored by Enrico Fermi and I.I. Rabi rejects the "Super" on moral grounds: "By its very nature it cannot be confined to a military objective but becomes a weapon which in practical effect is almost one of genocide." Teller, Lawrence, Alvarez, and Strauss immediately attempt to lobby against the GAC's conclusion. The entire "Super" debate so far has been behind the scenes, only amongst those cleared for "Top Secret" information.

Nov. 1949 Senator Edwin C. Johnson, a member of the powerful Joint Committee on Atomic Energy (JCAE), appears on a television program on the theme of "Is There Too Much Secrecy in Our Atomic Program?" While defending the need for secrecy, and especially in regards to keeping scientists from leaking information, Johnson accuses the scientists of wanting to leak the idea of the hydrogen bomb, "a thousand times" the effect of the World War II weapons. In doing so, Johnson leaks the existence of the "Super" debate, and the leak is soon picked up by major newspapers, starting with the Washington Post. President Truman is extremely angry and orders Lilienthal, and Senator Brien McMahon (chairman of the JCAE) to plug any leaks, and to keep all further debate secret.

Dec. 1949-Jan. 1950 More leaks about the behind-the-scenes "Super" debate make their way into the press. The "Super" has become headline news, although nobody connected with the government has made any further attributed statements regarding it. Truman feels that his hand is being forced.

January 1950 The JCAE meets to discuss the October 1949 GAC report. Senator McMahon leads a passionate appeal for building the "Super."

Jan. 31, 1950 The National Security Council recommends to Truman that he order the AEC to develop a "Super" bomb. Lilienthal attempts to persuade Truman against acting hastily; Truman rebuffs him, telling him that the leaks have forced his hand. Truman issues a public statement saying only that he had "directed the Atomic Energy Commission to continue its work on all forms of atomic weapons, including the so-called hydrogen or superbomb." It is widely interpreted as an order for a "crash" program.

Feb. 2, 1950 The arrest of **Klaus Fuchs** (*right*) is made public by Scotland Yard. Neither the AEC nor the President are given more than 24 hours of advance notice. The news that the Soviets had "stolen" the bomb is front-page news. Within days it also emerges that Fuchs had been involved with a conference on the "Super" bomb at Los Alamos in 1946.

1950-1951 Work on the "Super" bomb proceeds at Los Alamos at great speed. Computer simulations prove without a doubt that all of Teller's ideas on "Super" design since 1942 are completely unworkable. Frustration mounts.

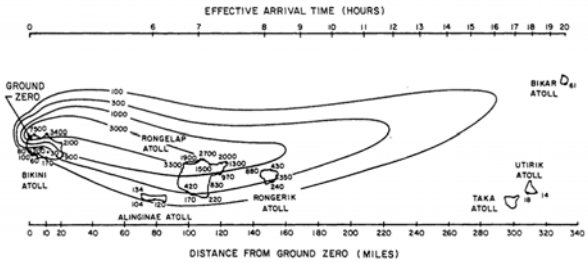
Spring 1951 Teller works on the idea of "radiation implosion" with regards to a nuclear experiment planned for the 1951 test series "Operation Greenhouse." Separately, the mathematician **Stanislaw Ulam** (*right*) considers the idea of using one fission bomb to achieve high compressions of another fission bomb, thus making an extremely efficient atomic bomb. Teller realizes that combining these two ideas could result in a working "Super" bomb: a fission bomb would, by means of radiation implosion, compress a container of fusionable material to extremely high densities before the heat of the fission bomb would ignite it. Teller and Ulam jointly author a paper on this new idea. All who hear about this new **Teller-Ulam design**, including Oppenheimer, agree it is almost sure to work.

May 1951 The United States detonates the nuclear test shot “George,” of “Operation Greenhouse.” “George” confirms that radiation implosion can achieve the densities required for thermonuclear ignition. Plans are begun to develop a prototype “Super” bomb.

Nov. 1952 The United States detonates the nuclear test shot “**Mike**,” (*right*) of “Operation Ivy,” in the Marshall Islands. It is a successful hydrogen bomb based on the Teller-Ulam design, and has an explosive yield equivalent to 10.4 million tons of TNT (megatons). It is not a deliverable weapon, however — it requires 70 tons of cryogenic equipment to operate. Work begins on a more portable hydrogen bomb.

Aug. 1953 The Soviet Union detonates a weapon which involves some thermonuclear reactions (“Joe 4”), with a yield of 400 thousand tons of TNT (kilotons). It is announced by the Soviet Union as a hydrogen bomb, however technical analysis of the debris reveals that it is not a “true,” multi-megaton weapon like the Teller-Ulam design. Nevertheless, unlike the “Ivy Mike” device, it is a deliverable weapon.

March 1954 The United States detonates the nuclear test shot “**Bravo**” of “Operation Castle,” at the Marshall Islands. It is a version of the Teller-Ulam design that is deliverable (it does not use material that requires cryogenic equipment), and has a yield of 15 megatons. The test blast is some two and a half times more powerful than had been expected. The radioactive fallout is considerable, and the weather changed directions from predictions, distributing the fallout over inhabited islands and a Japanese fishing boat which had entered into the “danger zone” without realizing it (*right*). The United States evacuates the contaminated Marshallese, many of whom will later suffer genetic damage (e.g. birth defects). The Japanese fishermen return to port and unload their catch. One of the fisherman soon dies. The ensuing panic over radioactive fish in Japan leads to a temporary boycott of all tuna. Concerns over fallout, nuclear testing, and environmental damage reach new heights in Japan and the United States.



Nov. 1955 The USSR detonates its first Teller-Ulam design weapon, with a yield of 1.6 megatons.

Further reading on H-bomb history:

- Richard Hewlett and Francis Duncan, *Atomic Shield, 1947-1952* (University Park, Penn.: Pennsylvania State University Press, 1969).
- Gregg Herken, *Brotherhood of the Bomb: The Tangled Lives and Loyalties of Robert Oppenheimer, Ernest Lawrence, and Edward Teller* (New York : Henry Holt and Co., 2002).
- Richard Rhodes, *Dark Sun: The Making of the Hydrogen Bomb* (New York: Simon and Schuster, 1995).
- Herbert F. York, *The Advisors: Oppenheimer, Teller, and the Superbomb* (Stanford, Calif.: Stanford University Press, 1989 [1976]).