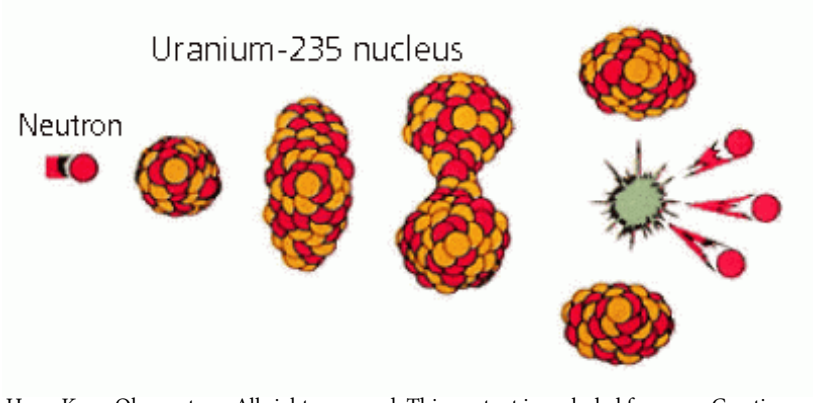
Applications: Nuclear Weapons

What is a nuclear bomb?

- *fission* (“atomic”) or *fission and fusion* (“hydrogen” / “thermonuclear”) device



- Massive amounts of energy release (we’ll visualize later)

The origins of nuclear weapons

- Leo Szilard and Albert Einstein write a letter to Franklin D. Roosevelt in 1939

Albert Einstein
Old Grove Rd.
Nassau Point
Peconic, Long Island

August 2nd, 1939

F.D. Roosevelt,
President of the United States,
White House
Washington, D.C.

Sir:

Some recent work by E.Fermi and L. Szilard, which has been communicated to me in manuscript, leads me to expect that the element uranium may be turned into a new and important source of energy in the immediate future. Certain aspects of the situation which has arisen seem to call for watchfulness and, if necessary, quick action on the part of the Administration. I believe therefore that it is my duty to bring to your attention the following facts and recommendations:

In the course of the last four months it has been made probable - through the work of Joliot in France as well as Fermi and Szilard in America - that it may become possible to set up a nuclear chain reaction in a large mass of uranium,by which vast amounts of power and large quantities of new radium-like elements would be generated. Now it appears almost certain that this could be achieved in the immediate future.

This new phenomenon would also lead to the construction of bombs, and it is conceivable - though much less certain - that extremely powerful bombs of a new type may thus be constructed. A single bomb of this type, carried by boat and exploded in a port, might very well destroy the whole port together with some of the surrounding territory. However, such bombs might very well prove to be too heavy for transportation by air.

The United States has only very poor ores of uranium in moderate quantities. There is some good ore in Canada and the former Czechoslovakia, while the most important source of uranium is Belgian Congo.

In view of this situation you may think it desirable to have some permanent contact maintained between the Administration and the group of physicists working on chain reactions in America. One possible way of achieving this might be for you to entrust with this task a person who has your confidence and who could perhaps serve in an inofficial capacity. His task might comprise the following:

a) to approach Government Departments, keep them informed of the further development, and put forward recommendations for Government action, giving particular attention to the problem of securing a supply of uranium ore for the United States;

b) to speed up the experimental work,which is at present being carried on within the limits of the budgets of University laboratories, by providing funds, if such funds be required, through his contacts with private persons who are willing to make contributions for this cause, and perhaps also by obtaining the co-operation of industrial laboratories which have the necessary equipment.

I understand that Germany has actually stopped the sale of uranium from the Czechoslovakian mines which she has taken over. That she should have taken such early action might perhaps be understood on the ground that the son of the German Under-Secretary of State, von Weizsäcker, is attached to the Kaiser-Wilhelm-Institut in Berlin where some of the American work on uranium is now being repeated.

Yours very truly,
A. Einstein
(Albert Einstein)

The origins of nuclear weapons

- Leo Szilard and Albert Einstein write a letter to Franklin D. Roosevelt in 1939
- 1941 - start of Manhattan Project
- First use:
  Aug 6, 1945, Hiroshima ("Little Boy", 13 kiloton yield).
  Aug 9, 1945, Nagasaki ("Fat Man," 20 kiloton yield).

“Little Boy” detonated over Hiroshima.

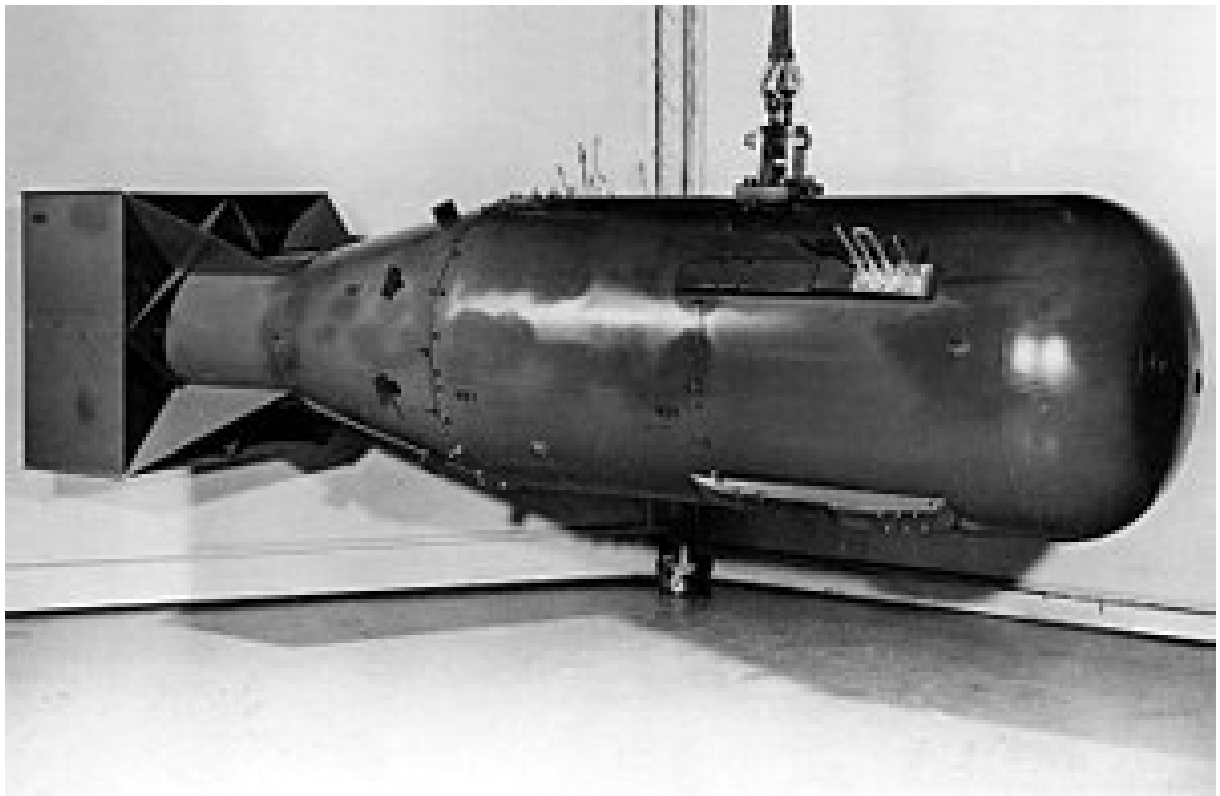


Image courtesy of the National Archives and Records Administration. Source: Wikimedia Commons. This image is in the public domain.

“Fat Man” detonated over Nagasaki.

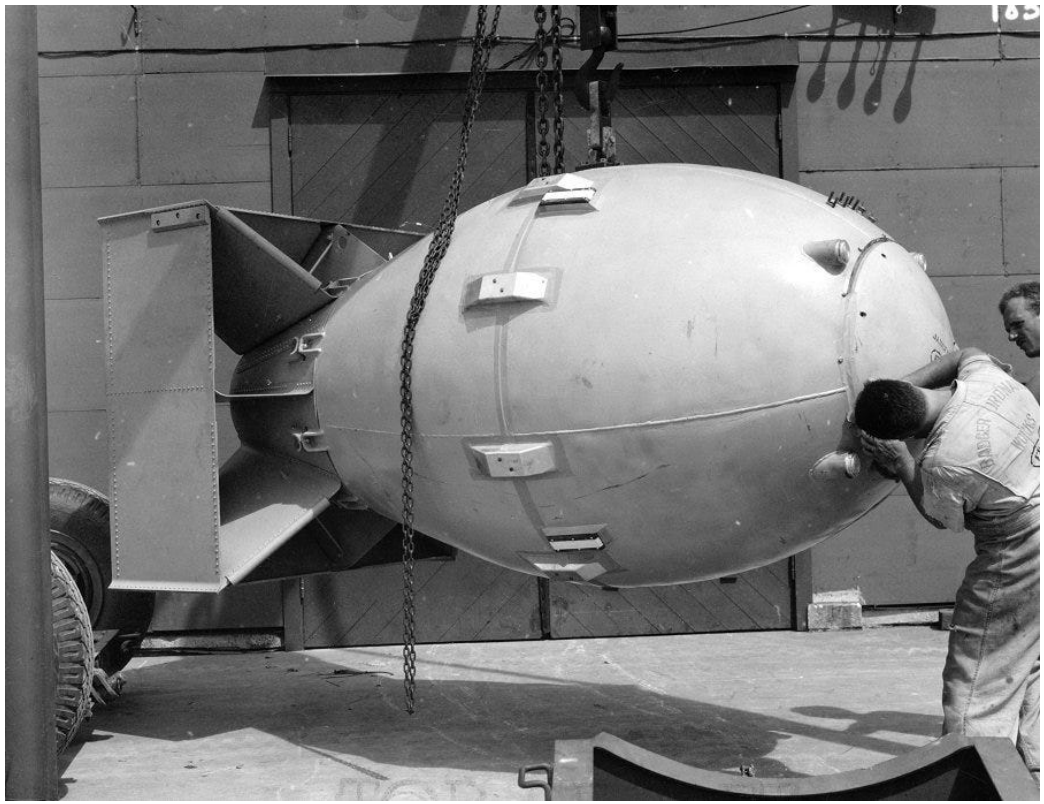


Image courtesy of the National Museum of the U.S. Navy. Source: Wikimedia Commons. This image is in the public domain.

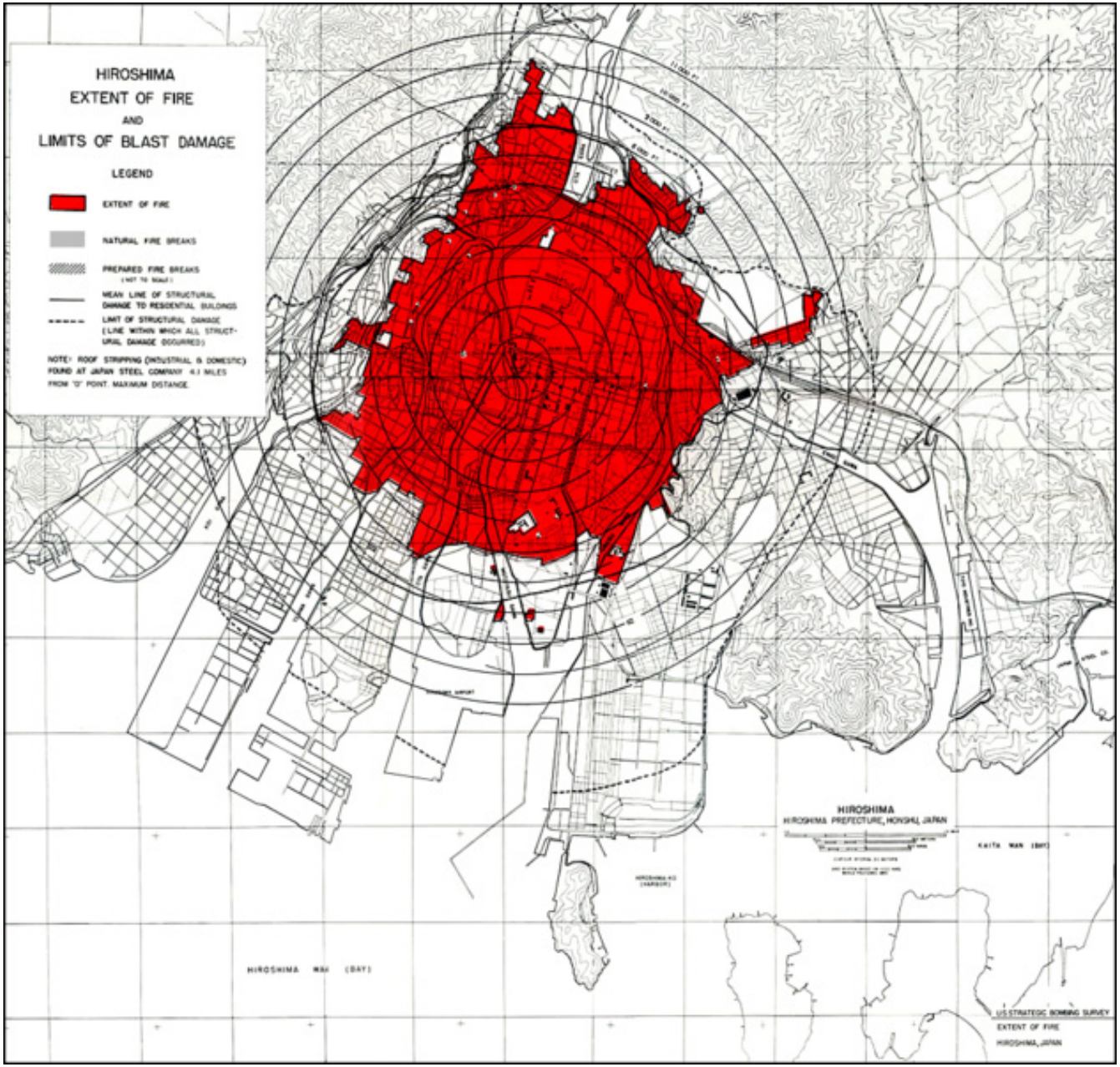
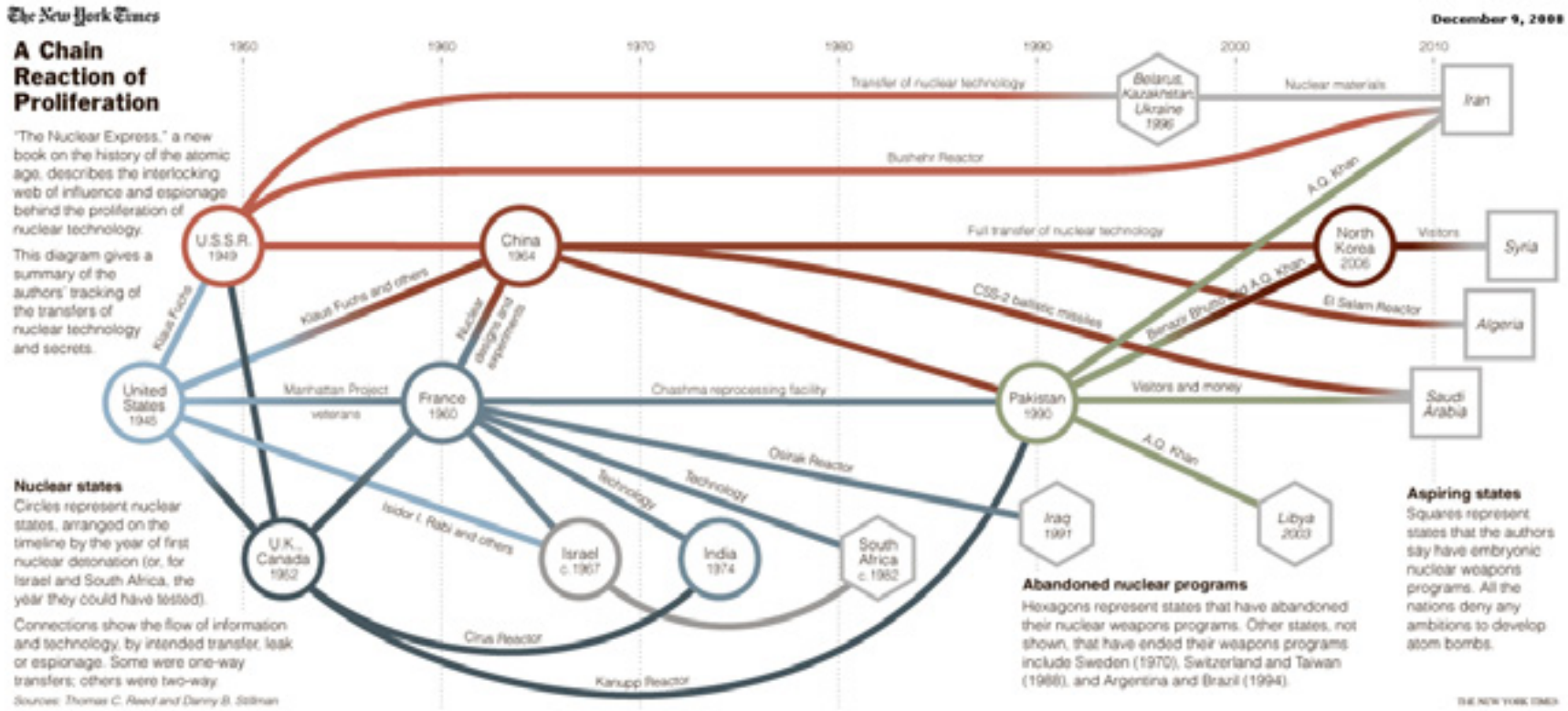


Image courtesy of the U.S. Strategic Bombing Survey. Source: Wikimedia Commons. This image is in the public domain.

Development and testing

- Desert Rock Tests, 1951-1957 (link)
- "downwinders"
- Castle Bravo Test, 1954 (link)
- End of (most) open air testing in 1963 (France 1974, China 1980)
  - 1963 Partial Test-Ban Treaty
  - Comprehensive Nuclear-Test-Ban Treaty (adopted by UN General Assembly in 1996, but not yet in force).

Proliferation



https://archive.nytimes.com/www.nytimes.com/imagepages/2008/12/09/science/20081209_BOMB_GRAPHIC.html?ref=science

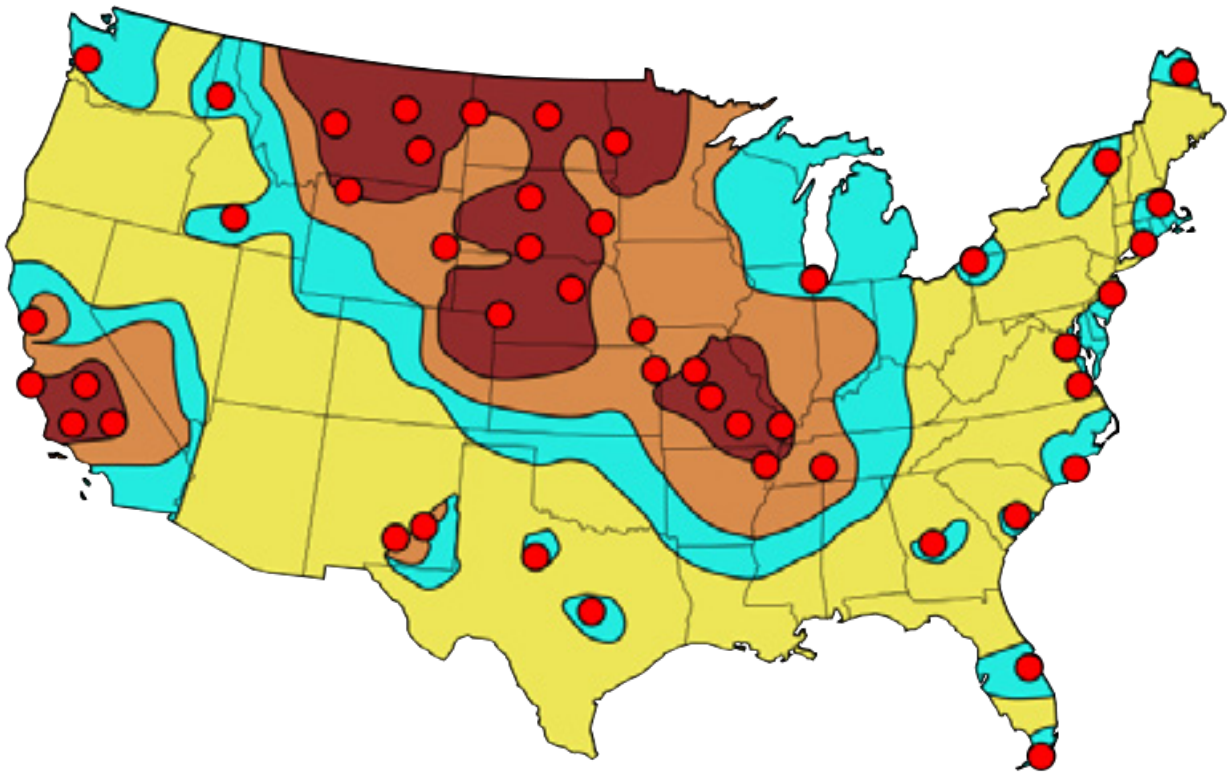
Development of nuclear doctrine and strategy

- 1945-1949: Discussions about UN control of nuclear weapons
- 1949: USSR tests its first weapon in Kazakhstan
- 1950s: Many believed that nuclear weapons use in war would be relatively common.
- 1957: First ICBMS
- 1962: Cuban missle crisis
- 1960s: Mutually Assured Destruction (MAD)
- 1980s: development of Submarine launched ballistic missiles (SLBMs)
- 1991: Collapse of Soviet Union ends the Cold War
- Present: Strategy of potential nuclear powers is unclear.

Consequences of Nuclear War

Nuke map (link)

Consequences of Nuclear War



1990: FEMA-estimated primary counterforce targets for Soviet ICBMs.

Controversy: Is proliferation good or bad?

17.41 Introduction to International Relations

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