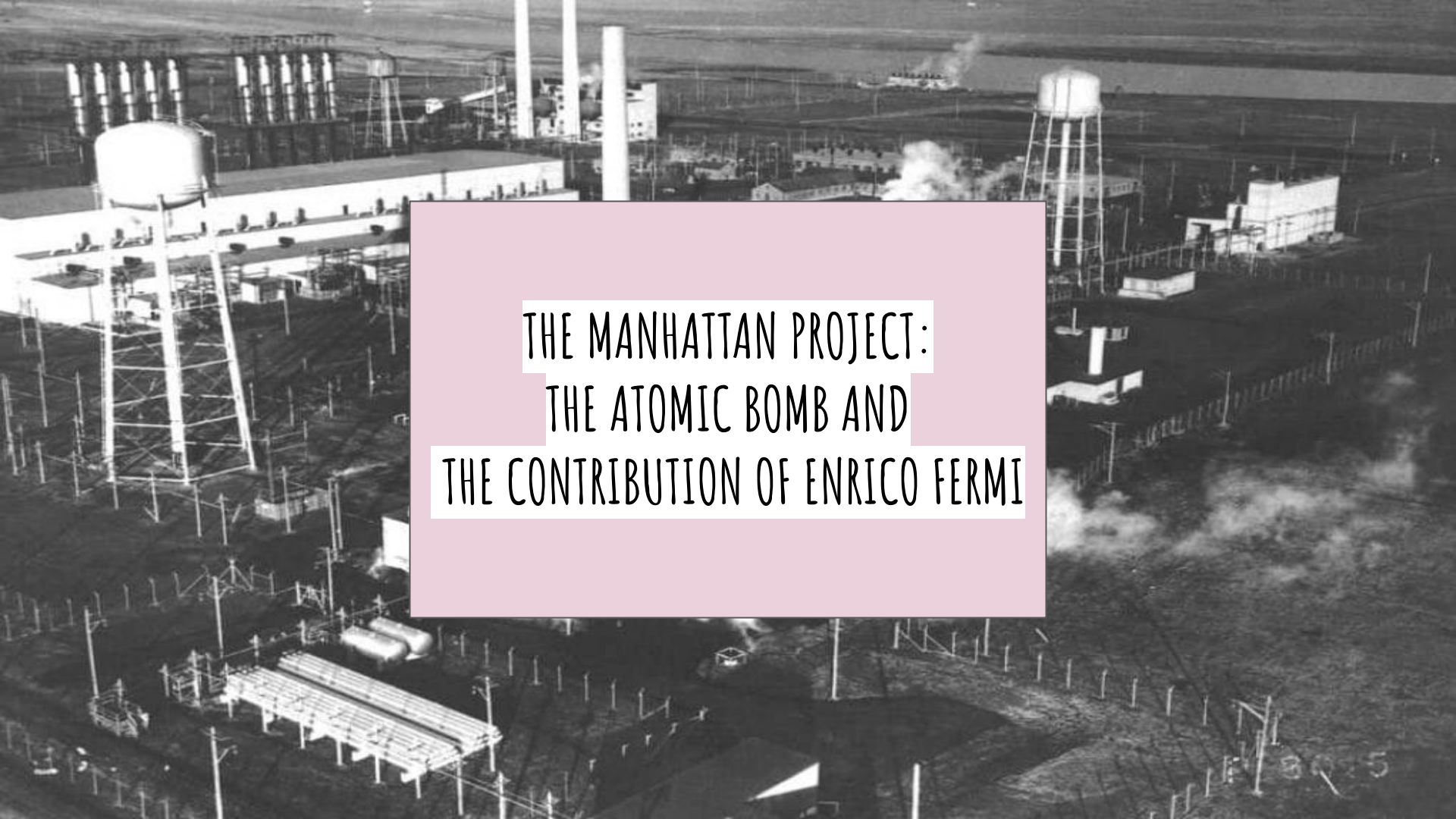


THE MANHATTAN PROJECT: THE ATOMIC BOMB AND THE CONTRIBUTION OF ENRICO FERMI

MANHATTAN PROJECT

- With the term **Manhattan Project**, (*Development of Substitute Materials* was the codename), we refer to a military research and development program, which led to the production of the first atomic bomb during World War II. It was conducted by the USA, supported by UK and Canada. From **1942 to 1946**, the program was directed by General Leslie Groves of the United States Military Engineers Corps. The project, led by the american physicist **J. Oppenheimer**, was attended by the world's top scientists.

- In **1942**, the U.S. government started the Manhattan project to quickly create laboratories capable of producing an atomic weapon before the Nazis, who had been engaged for years in a nuclear program, built their own. The project was led by the American Corps district of Manhattan in New York and began in total secrecy.

NUCLEAR SUBURBS

. They had to be isolated suburbs, far from cities.

3 sites were chosen :

- **Oak Ridge**, Tennessee
- **Los Alamos**, New Mexico
- **Hanford**, Washington

these 3 conurbations hosted more than **120,000** families and scientists

The Manhattan Project did also intelligence activities on the *German Military Nuclear Program*. Many men were sent to Europe, sometimes across enemy lines, to collect material and documents from the German program and *enlist scientists*.

A SECRET PROJECT

Centers were kept so secret that they did not even *appear* on the maps. Everyone was forbidden to *pronounce* the name of the city they lived in. Those were isolated but easily accessible by researchers and technicians.

FUNDAMENTAL CONDITIONS

The Manhattan project had to assure **4** basic conditions:

1- the material had to be *sufficient* and arranged according to a certain geometry

2- the neutrons used had to be *slow*

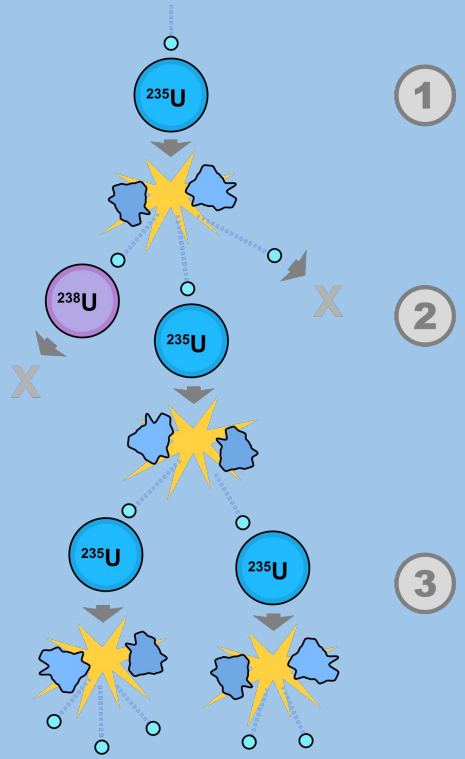
3- the neutron *flux* had to be adjusted to control the fission

4- the resulting energy had to be *usable*

Uranium 235 was used to meet these conditions, as its core is easily disbanded by slow neutrons.

NUCLEAR FISSION: URANIUM 235

- In physics, nuclear fission is a physico-nuclear process in which the atomic nucleus of a heavy chemical element ***decays*** into smaller fragments, with the emission of a large amount of energy and radioactivity.
- It can occur spontaneously in nature or be artificially induced by appropriate neutron bombardment. It's the nuclear reaction commonly used in nuclear reactors and simpler types of nuclear weapons, such as uranium bombs (such as ***Little Boy*** hitting *Hiroshima*) or plutonium (such as ***Fat Man*** on *Nagasaki*). All nuclear fission bombs are militarily labeled **A-bombs**.



LISE MEITNER: THE WOMAN OF THE NUCLEAR FISSION

On February 11, 1939, a Letter to the Editor titled "Disintegration of Uranium by Neutrons: a New Type of Nuclear Reaction" appeared in the science journal *Nature*. The letter provided the first theoretical explanation for the splitting of the atom, and coined a new term in physics: fission. The woman who co-authored the letter, and co-discovered the power of nuclear energy, is perhaps not quite as well-known as some of her contemporaries: she was Elise Meitner (1878-

She researched for over 30 years with her research partner Otto Hahn. Hahn published his chemical evidence for fission without listing Meitner as a co-author-understandable, as he was in Hitler's version of Germany and she was of Jewish heritage. He won the Nobel Prize in 1944.

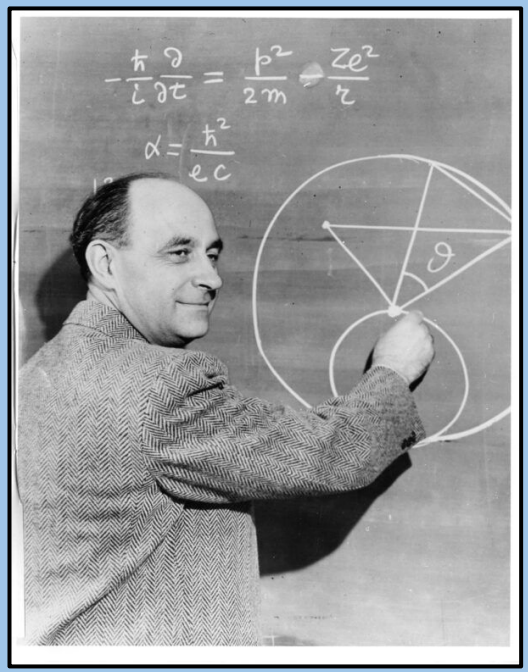
TEAM OF INTELLECTUALS

During the second World War a lot of scientists were refugees in the United States. In the USA, a community of experts physicists, including Enrico ***Fermi*** and Leo ***Szilard***. These, who had to flee their homeland due to German oppression, convinced the American authorities to use science in the war against Germany. Szilard, an unknown Hungarian theoretical physicist at the time, convinced *Einstein* to sign a letter to *Roosevelt* asking the government to prevent the sale of **uranium** to Germany.

Segre, ***Fuchs***, ***Groves***, ***Oppenheimer*** and ***Szilard*** participated in the project. The search was conducted in Los Alamos, New Mexico, and in just *three* years, **the bomb was built**.

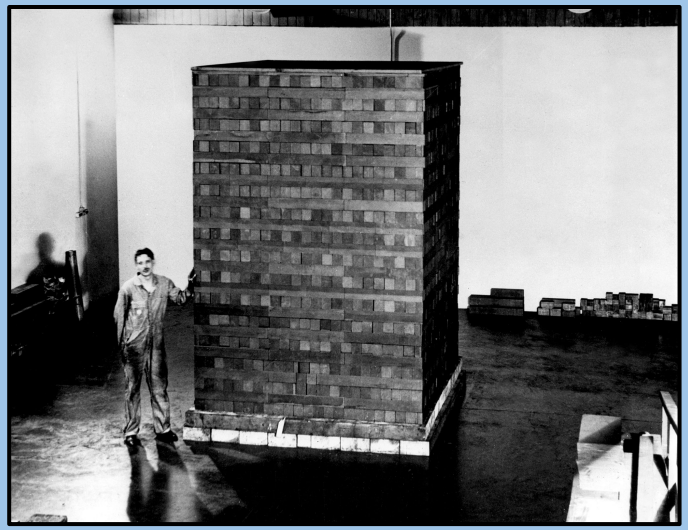
ENRICO FERMI

Enrico Fermi played a central role in the Manhattan Project. On December 2nd 1942, his group succeeded for the first time in operating a self-powered nuclear chain reaction: ***CHICAGO-PILE 1***, the world's first artificial nuclear fission reactor, comes into operation. Its operation is based on the extraction of energy through the bombardment of heavy atoms with ***projectiles*** of various kinds: they can be sub-atomic particles, such as neutrons, protons or high-energy electrons, or another atomic nucleus.



CHICAGO-PILE 1

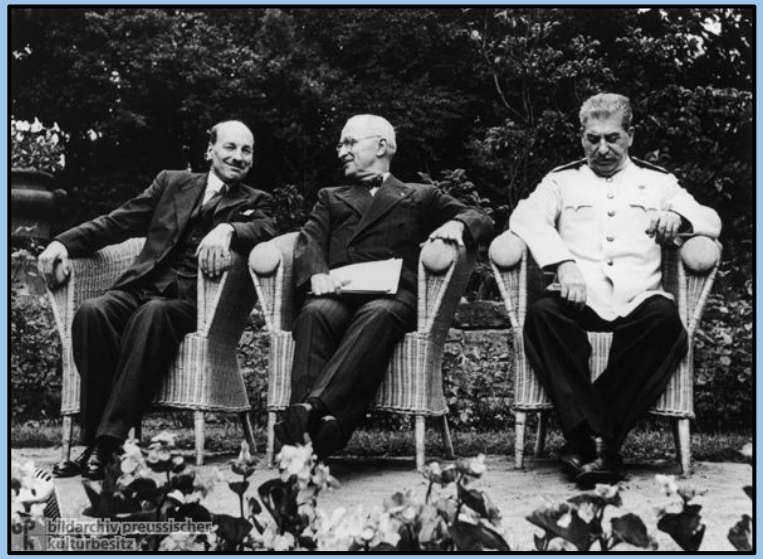
The reactor developed by Fermi and Leo Szilard was thus constructed: **45,000** blocks of **graphite** were used as moderators, materials capable of slowing down fast neutrons, in order to *increase* the probability of success in the collision; 5.4 tonnes of **metallic uranium** and 45 tonnes of **uranium oxide** needed as fuel. The spontaneous decay process of some uranium atoms, which resulted in the release of three neutrons, triggered the chain reaction. Neutrons bombarded other uranium atoms causing ***nuclear fission***, resulting in the release of energy.



POTSDAM CONFERENCE

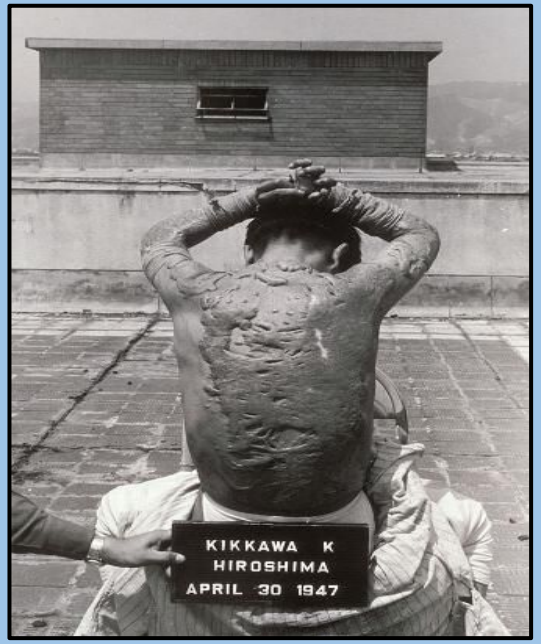
American President **Truman**, together with **Churchill** and **Stalin**, took part in the Potsdam Conference, which opened on 17 July 1945 and ended on the 2 August. During the meetings, Truman **cautiously** informed both the Soviet dictator and the British Prime Minister that he wanted to use a new ***destructive bomb*** against ***Japan***, which was much stronger than all those used up to that point.

On August 6th and 9th **1945** the cities of ***Hiroshima*** and ***Nagasaki*** were bombed.



THE CONSEQUENCES

In addition to the immediate deaths of ***thousands*** of people, the atomic bombs of Hiroshima and Nagasaki led to a series of terrible consequences that marked the entire area for a long time. Many people died within a *year* of the launch of the atomic bomb due to radiation and burns caused, and many Japanese died in the following years from ***cancer*** or ***birth defects*** due precisely to radiation released by the atomic bomb.



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