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Aug 2nd, 11:30 AM - 1:30 PM

## The Manhattan Project and the Globalization of Nuclear Weapons

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### Recommended Citation

Schreiber, Cole and Shand, Paul, "The Manhattan Project and the Globalization of Nuclear Weapons" (2019). *Summer Undergraduate Research Program (SURP)*. 34.

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## Discovery of Fission

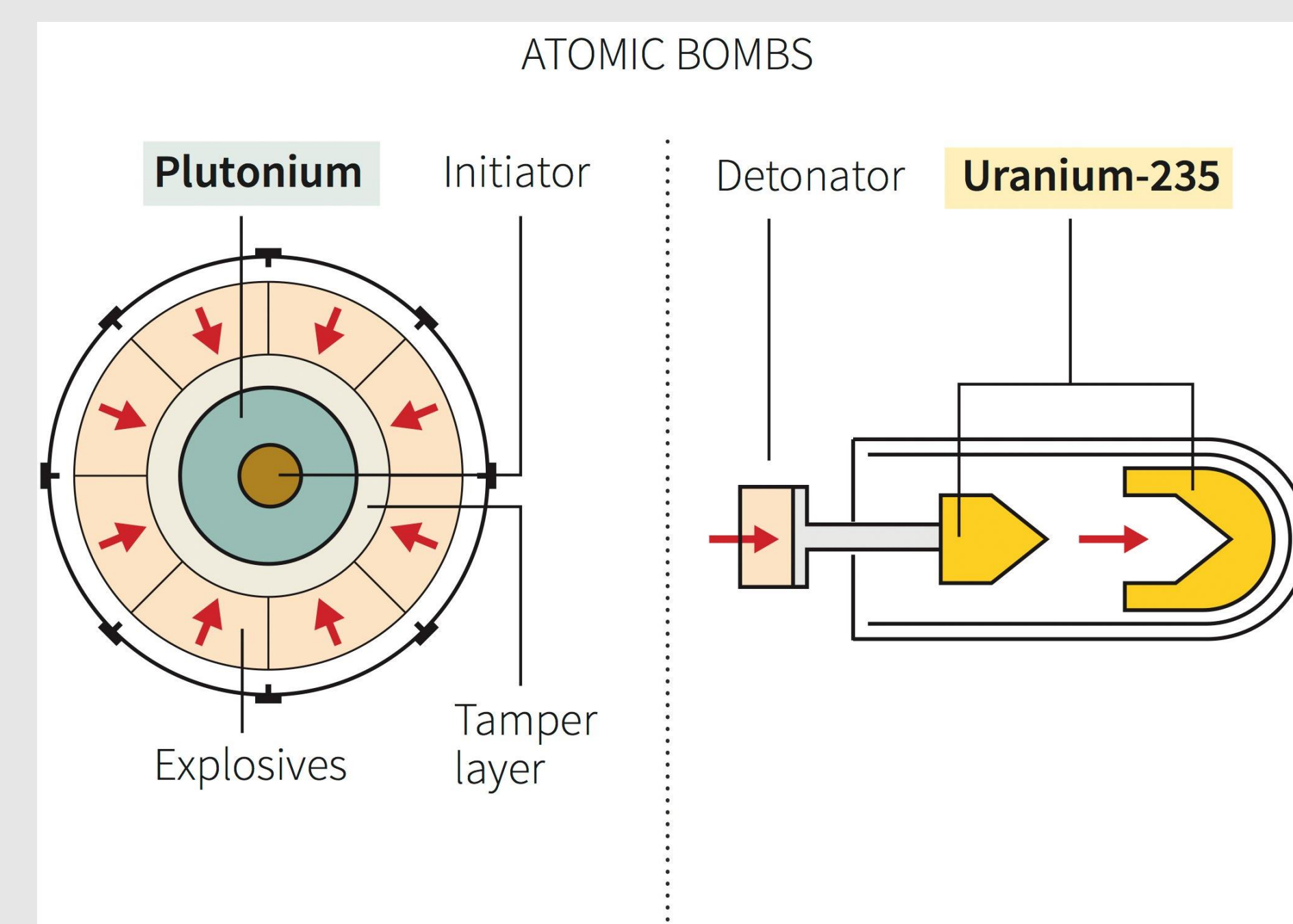
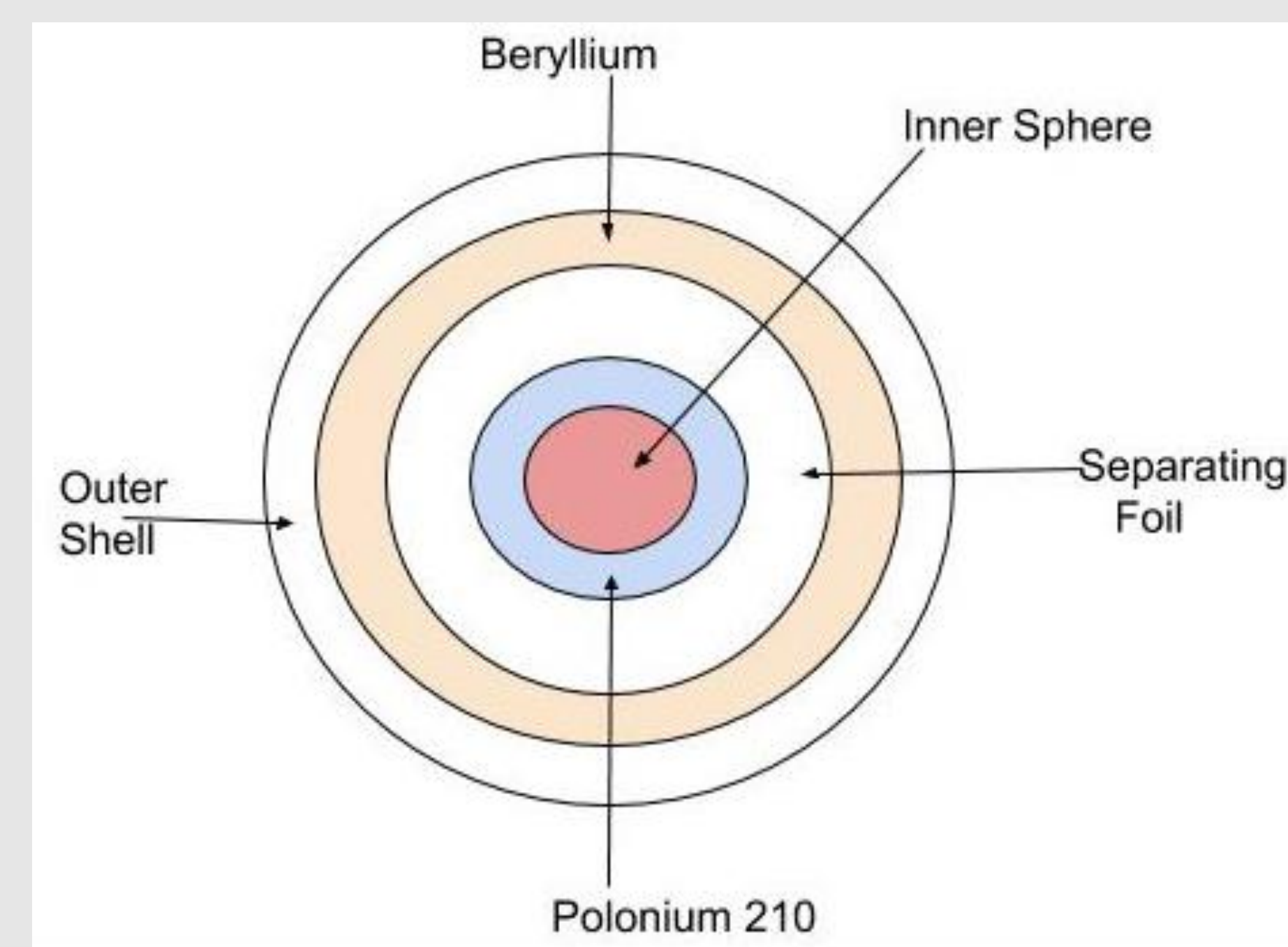
- James Chadwick discovered the neutron in 1932 by bombarding beryllium with alpha particles.
- In 1934, Enrico Fermi bombarded uranium with neutrons and he thought he discovered Transuranic elements.
- Otto Hahn and Fritz Strassman also bombarded uranium with neutrons in 1938 and discovered barium in the decay products.
- Lise Meitner and Otto Frisch correctly explained Hahn's experiment in terms of splitting of the nucleus.

## Manhattan Project

- Albert Einstein and Leo Szilard sent a letter to President Roosevelt stating that Germany could weaponize fission.
- President Roosevelt signed off on the project and started to mobilize and coordinate efforts with various companies, renowned scientists, and the military to build a nuclear weapon.
- Project sites were stationed across the country working on various aspects of the bomb.
- Many processes were involved, from enriching uranium to determining the detonation time of the bomb.
- The first nuclear test, called the Trinity Test, took place in the deserts of New Mexico.

## Physics of the Fission Bombs

- Initiators used for "Little Boy" and "Fat Man" bombs.
- Plutonium 239 has high spontaneous fission rate.
- Initiator comprised of beryllium and polonium separated by a foil.
- When crushed, alpha particles are emitted and thus neutrons are released.



<https://www.sciencealert.com/what-are-the-actual-differences-between-a-hydrogen-and-an-atomic-bomb>

## Fat Man and Little Boy

- The Fat Man bomb core weighed in at about 6.3 kg and the Little Boy at about 60 kg.
- The Fat Man used an implosion method and the Little Boy used a gun type method to achieve supercriticality.
- The Fat Man bomb was dropped on Nagasaki and the Little Boy bomb was dropped on Hiroshima.
- President Truman had a difficult time weighing the option to use the bombs against Japan.
- President Truman decided to use the bomb to save American lives and avoid another D-Day.



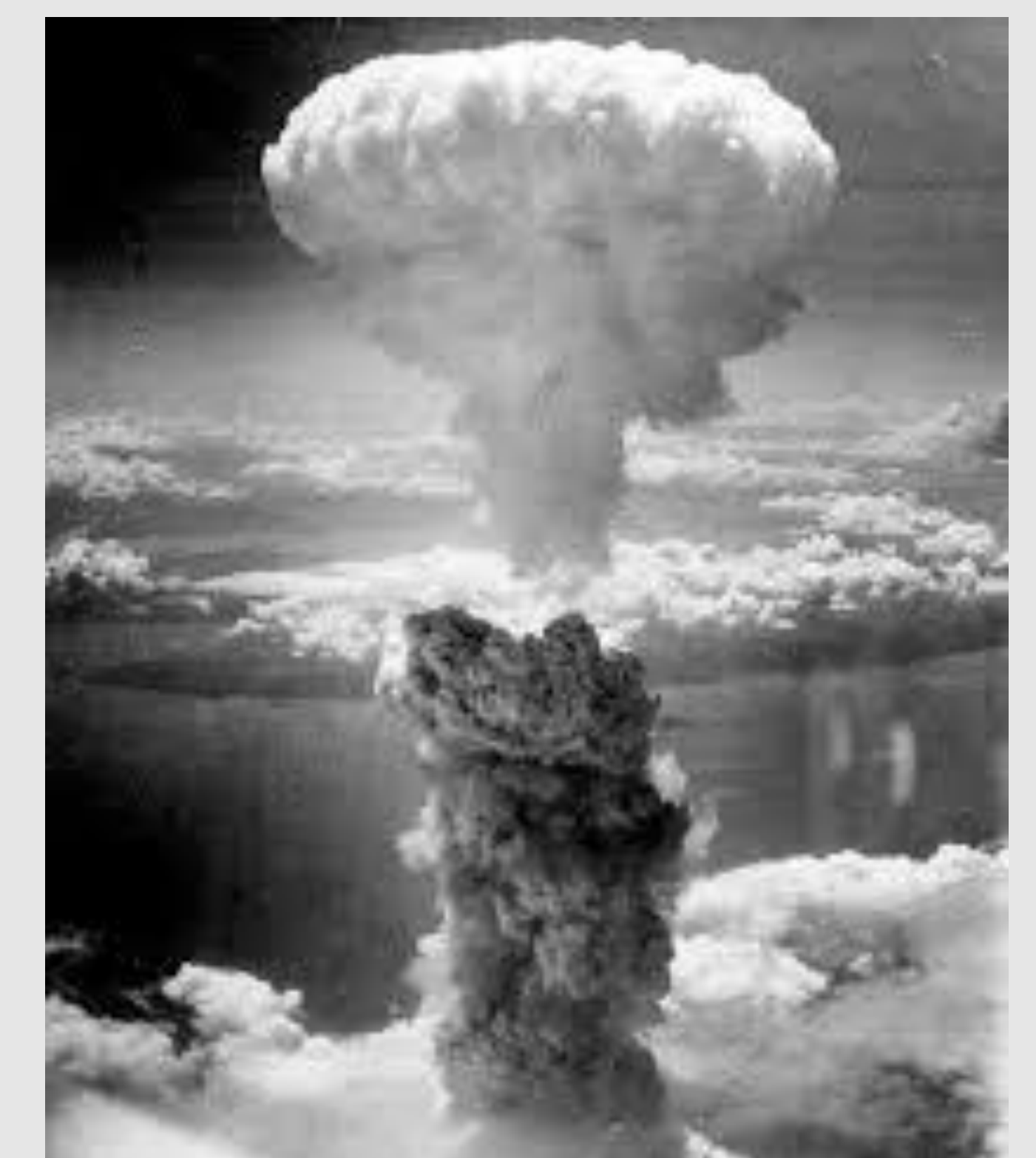
<https://www.cbsnews.com/pictures/anniversary-hiroshima-nagasaki-atomic-bomb-world-war-ii/19/>



<https://allthatsinteresting.com/little-boy>

## Nuclear Proliferation

- After WWII other nations started to develop nuclear weapons.
- Nuclear weapons became more destructive with the invention of the hydrogen bomb that utilizes nuclear fusion.
- Great Britain developed its first atomic weapon in 1952, Russia in 1949, and other countries followed suit in the following years.
- The limited test ban in 1963 restricted areas where tests could be conducted.
- The Non Proliferation Treaty (NPT) that was signed in 1968 states that nuclear weapons will not be spread to other countries who do not have them.
- If there is noncompliance with the NPT, not much is being done save for sanctions.
- North Korea has developed nuclear weapons even with punishing sanctions.



<https://www.atomicheritage.org/history/debate-over-bomb-annotated-bibliography>