Franck Report Issued in June 1945 by Nuclear Physicists Against Using the Atomic Bomb Against Japan

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*You can be forgiven for never hearing about **The Franck Report** that was issued on 11th June 1945, it was kept highly secret at the time and is one of those many WWII documents whose un-censored versions have only become public several decades later. The Franck Report was a document signed by several prominent nuclear physicists who had been working on the development of an atomic bomb recommending that the United States not use the atomic bomb as a weapon to prompt the surrender of Japan in World War II.*

This entry in our 1945 timeline provides the reader with an easy explanation of the nuclear fission process that underlies the so-called "atom" bomb and a short summary of the history of the secret Manhattan Project which produced the two bombs that were dropped on Hiroshima and Nagasaki in August 1945 (which events will be described on those dates in this timeline).

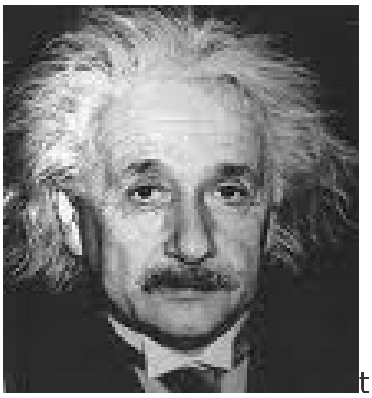
It was German physicists who first discovered, in December 1938, that one could force a uranium atom to split into two much smaller atoms by bombarding it with a moving neutron. The smaller atoms have kinetic energy and the other products of this fission process are 2 or 3 free neutrons and a lot of energetic photons, these fragments heat up the bulk material. If there are more uranium atoms close by the free neutrons will cause them to split if they hit them, and if enough uranium is assembled in one place, or if the escaping neutrons are sufficiently contained, then these freshly emitted neutrons outnumber the neutrons that escape from the assembly, and a sustained nuclear chain reaction will take place. A critical mass is the smallest amount of fissile material needed for a sustained nuclear chain reaction. This chain reaction of so-called fissile material produces lots of energy and it became obvious to the European physics community, both those physicists who stayed in Germany, and those European physicists who fled to the USA and the UK to avoid being persecuted or killed by the Nazis, that it would be relatively straight forward to make an "atomic" bomb based on the fission of uranium.

An atomic bomb design was relatively simple. When you bring together a sufficient amount of fissile material, it forms a critical mass, and if you continue to bring that material together as a critical mass, it will then begin the nuclear chain reaction. That chain reaction will occur very, very rapidly. Once the reaction starts you have a competing race. What's happening is, you've slammed the two pieces of nuclear material together so they have a certain inertial momentum that is holding the assembly together. And at the same time, the nuclear reaction begins and that starts to generate energy. And what happens when you heat something up? It expands. And it starts to disassemble and blow itself apart. So a nuclear weapon is a race between the energy of holding it together and the energy generating in the system blowing it apart. And the faster you can make the energy during the actual implosion or chain reaction process, the more powerful the output of the bomb. Taking the fact that these fission reactions occur so rapidly–it turns out you can just slam together two pieces of uranium using a gun or a gun barrel and get a pretty decent explosive yield.

This photograph is one of the most famous photographs made by Ed Westcott and is the Calutron Control Room in Beta 2 (Building 9204-2) at Oak Ridge Manhattan Facility, Tennessee in 1944. Photo credit: National Museum of Nuclear Science & History

In April 1939 the military applications of nuclear fission were recognized by the Ministry of War in Germany, and it started a high-priority program to develop them. The Nobel-prize winning German physicist, **Werner Heisenberg**, was amongst the leaders of the German physics community who were investigating the whole process needed to produce enough uranium of the correct type to create a critical mass and engineer the device where it would become an explosive bomb. For reasons that no-one is completely sure of, in the autumn of 1941 , he wrote a report for the German government in which he said that an atomic bomb could not be ready before 1945, and that it would require immense applications of German manpower and German money. And within weeks after that late 1941 report was received by the War Ministry, they reduced the priority on the atomic bomb program (which was not a very large program at the time) and shifted resources to programs related to the immediate war effort.

But this 1942 reduction in the level of German work on developing an atomic bomb was not known about in the USA where research into nuclear fission had begun in the summer of 1939 and was making good progress towards producing a controlled nuclear chain reaction by late 1942. Why had physicists in the USA received money from the US Government to work on understanding the nuclear fission process and its possible uses since late 1939?

Mostly because  the very famous physicist, **Albert Einstein**, had written a letter to President Roosevelt on 2nd August 1939 (but not delivered until 11th October 1939, by which time Britain had declared war against Germany) and the letter warned that Germany might develop atomic bombs and suggested that the United States should start its own nuclear program.

At the time of this Einstein letter, the estimated material necessary for a fission chain reaction was everal tons. Seven months later a theoretical calculation breakthrough in Britain, who had their own nuclear research program, would estimate the necessary critical mass to be less than 10 kilograms, making delivery of an atomic bomb by air a possibility. This critical mass discovery by German refugee physicists working in Britain was shared in August 1941 with the physicists working in the USA, many of whom were also European refugees who had seen the need to escape from Nazi Germany. Prompted by Einstein's letter, Roosevelt had authorized, in late October 1939, a small amount of funding for research into understanding nuclear fission and its possible use to produce electrical power, which was being carried out mostly in universities.

One outcome of this research was the understanding that the element uranium comes in 14 different types, called isotopes, which differ in how many neutrons their nuclei have, the most prevalent isotopes have 235 or 238 neutrons. Uranium which is mined from the earth is composed of 99.3% of U238 and 12 other minor isotopes and 0.7% of U235, and it was only the U235 that could make a nuclear chain reaction.

Various government committees had been in charge of disbursing funds for this research through late 1941, and on October 9th 1941 Roosevelt was told about the new estimate of the quite small critical mass needed to make an atomic bomb- from mostly U235. More money was swiftly assigned to confirming the British calculations; the engineer and inventor Vannevar Bush, who had been in charge of disbursing the above-mentioned funds was told, on December 6th 1941, to start an accelerated project for discovering how to extract U235 from mined uranium.

The Japanese bombed Pearl Harbor in Hawaii on December 7th 1941 and by December 11th the USA had declared war on Germany, Italy and Japan. On December 18th a new US governmental agency dedicated to developing nuclear weapons had its first meeting. On 19th January 1942 Roosevelt formally authorized an atomic bomb project that later became known as the highly secret Manhattan Project.

By mid 1943 three different brand new and top-secret facilities had been built/were being built in Hanford, Washington State, Oak Ridge, Tennessee and Los Alamos, New Mexico. By the end of 1944 over 100,000 people were working in the Manhattan Project at these 3 army-run, military sites.

The vast amounts of money spent on the Manhattan Project were not spent on designing the atomic bomb, that was relatively straight forward as described above, the money and huge personnel effort were spent on extracting or enriching U235 from the raw uranium, mined from the earth in the Belgian Congo and Canada, or on creating plutonium which was to be used in the bomb dropped on Nagasaki. For an ideal atomic bomb, you want to enrich the raw uranium to at least 80% to 90% of the U235. But because it's an isotope, you can't use chemical means to separate it, so it takes other long and arduous processes, the two main methods developed and used were gas centrifuges, and magnetic separators called Calutrons.

Which brings us to the photo at the top of this section. There were 1152 Calutrons built and operated, 24/7 as we would say now, at the Oak Ridge facility, called Y-12, in 9 large buildings. Young women were hired to keep the electric current running through the electromagnets at just the right value, they sat at control panels such as the ones in the above photo and remained constantly focused on the meter reading and the necessary adjustments they made to keep the beam current maximized in the Calutrons. They had no idea that was what they were doing, during their training they were told "We can train you how to do what is needed, but cannot tell you what you are doing. I can only tell you that if our enemies beat us to it, God have mercy on us!" Such repetitive tasks done without any understanding of why were common in the Manhattan Project, which considering its ~100,000 workers, was kept remarkably secret throughout the war.

So uranium separation plants were built in Oak Ridge, Tennessee, and they used the electric power from the Tennessee Valley Authority. It has been rumored that, during the Manhattan Project, as much as 5% of the electrical output of the United States was used to power the uranium enrichment processes that were occurring at Oak Ridge, Tennessee. The outcome was that enough U235 was enriched from raw uranium to make the bomb that was dropped on Hiroshima and there were just a few more bombs that had been made and could have been used on other Japanese cities.

Ironically, the development of the American bomb was motivated by the fear that the Germans would get one first, but in fact, the Germans did not seriously pursue their program because Hitler was so sure they would win the war before the bomb was ready, and by the time it was ready in the United States, Germany had already surrendered.

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