problematic plutonium weapon, which required a higher velocity due to its higher risk of predetonation. Two plutonium guns arrived in March and were field-tested successfully. In the same month, two uranium guns were ordered.

Early Implosion Work

Parsons assigned implosion studies a low priority and placed the emphasis on the more familiar artillery method. Consequently, Seth H. Neddermeyer performed his early implosion tests in relative obscurity. Neddemeyer found it difficult to achieve symmetrical implosions at the low velocities he had achieved. When the Princeton mathematician John von Neumann, a Hungarian refugee, visited Los Alamos late in 1943, he suggested that high-speed assembly and high velocities would prevent predetonation and achieve more symmetrical explosions. A relatively small, subcritical mass could be placed under so much pressure by a symmetrical implosion that an efficient detonation would occur. Less critical material would be required, bombs could be ready earlier, and extreme purification of plutonium would be unnecessary. Von Neumann's theories excited Oppenheimer, who assigned Parsons's deputy, George B. Kistiakowsky, the task of perfecting implosion techniques. Because Parsons and Neddemeyer did not get along, it was Kistiakowsky who worked with the scientists on the implosion project. While experiments on implosion and explosion continued, Parsons directed much of his effort toward developing bomb hardware, including arming and wiring mechanisms and fuzing devices. Working with the Army Air Force, Parsons's group developed two bomb models by March 1944 and began testing them with B-29s. Thin Man, named for President Roosevelt, utilized the plutonium gun design, while Fat Man, named after Winston Churchill, was an implosion prototype. (Segre's lighter, smaller uranium gadget became Little Boy, Thin Man's brother).

Elimination of Thin Man

Thin Man was eliminated four months later because of the plutonium-240 contamination problem. Seaborg had warned that when plutonium-239 was irradiated for a length of time it was likely to pick up an additional neutron, transforming it into plutonium-240 and increasing the danger of predetonation (the bullet and target in the plutonium weapon would melt before coming together). Measurements taken at Clinton confirmed the presence of plutonium-240 in the plutonium produced in the experimental pile. On July 17 the difficult decision was made to cease work on the plutonium gun method. Plutonium could be used only in an implosion device, but in summer 1944 an implosion weapon looked like a long shot.

Abandonment of the plutonium gun project eliminated a shortcut to the bomb. This necessitated a revision of the estimates of weapon delivery Bush had given the President in 1943. The new timetable, presented to General Marshall by Groves on August 7, 1944—two months after the Allied invasion of France began at Normandy on June 6—promised small implosion weapons of uranium or plutonium in the second quarter of 1945 if experiments proved satisfactory. More certain was the delivery of a uranium gun bomb by August 1, 1945, and the delivery of one or two more by the end of that year. Marshall and Groves acknowledged that German surrender might take place by summer 1945, thus making it probable that Japan would be the target of any atomic bombs ready at that time.

Question Marks: Summer 1944

It was still unclear if even the August 1 deadline could be met. While expenditures reached $100 million per month by mid-1944, the Manhattan Project's goal of producing weapons for the current war was not assured. Operational problems plagued the Y-12 electromagnetic facility just coming on line. The K-25 gaseous diffusion plant threatened to become an expensive white elephant if suitable barrier could not be fabricated. And the Hanford piles and separation facilities faced an equally serious threat as not enough of the uranium-containing slugs to feed the pile were available. Even assuming that enough uranium or plutonium could be delivered by the production facilities built in such great haste, there was no guarantee that the Los Alamos laboratory would be able to design and fabricate weapons in time. Only the most optimistic in the Manhattan Project would have predicted, as Groves did when he met with Marshall, that a bomb or bombs powerful enough to make a difference in the current war would be ready by August 1, 1945.