obituary

Vannevar Bush

Dr Vannevar Bush died on June 28 at his home in Belmont, Massachusetts. He was 84. He had been Professor, Vice-President and Dean of Engineering at the Massachusetts Institute of Technology in the 1920s and 1930s, and President of the Carnegie Institution in Washington, DC, from 1939 to 1955. While there, he served as science adviser to President Roosevelt. He was Chairman of the Corporation of MIT from 1957 to 1959 and Honorary Chairman from 1959 to 1966.

Bush received BSc and MSc degrees from Tufts College in 1913. With money for only one year's study, he entered MIT and earned a doctorate in electrical engineering in that single year. In 1916, the DEng was awarded to him jointly by MIT and Harvard.

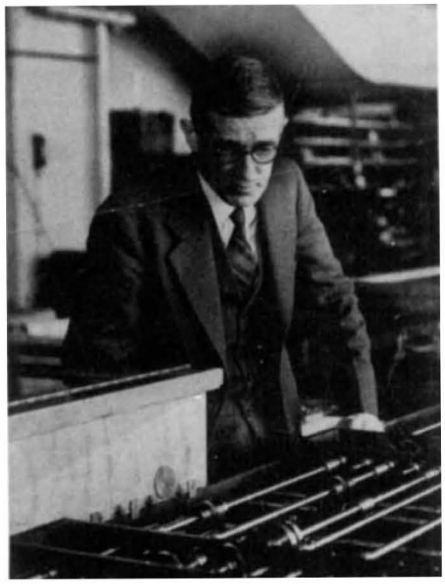
After the entry of the United States into the First World War he did anti-submarine research, developing a magnetic device for detecting submarines. In 1919 he returned to MIT as associate professor of power transmission.

In studies of power lines, he found that traditional mathematical methods were inadequate for the analysis of increasingly complex systems. In 1925 he set several graduate students to work designing an analogue machine called the Product Integraph to grapple with such problems. It was the first in a series of machines which were precursors to modern computers.

His Differential Analyser was completed in 1931 and was so successful that it served as a prototype for machines built elsewhere in Europe and the United States. This led to the construction of a 100-ton giant known as the Rockefeller Differential Analyser, which had 2,000 tubes, 200 miles of wire and 150 motors.

In 1939 he began meeting with a small group to discuss what might be done to prepare for a massive technological programme which was thought to be essential if the United States entered the war. They concluded that the nation was "... pathetically unprepared from the standpoint of new weapons".

In early 1940, Dr Bush went to President Roosevelt with the group's plan for the establishment of the National Defense Research Committee. The President approved, and appointed Dr Bush as its chairman. Compton took charge of radar research, Conant chemistry and explosives, Jewett com-



Dr Bush with the differential analyser *(Courtesy: MIT).*

munications and Tolman armour and ordnance. Research activity became so extensive that by 1941 the Office of Scientific Research and Development was established, with Dr Bush as director.

In 1941, after preliminary studies indicated the feasibility of developing an atomic bomb, Dr Bush secured the President's approval to proceed and gave Dr Conant the responsibility for the programme. When the project was ready for large-scale construction, it was turned over to the Corps of Engineers, which established the Manhattan Engineering District to carry the enterprise to completion. A Military Policy Committee, to function as a kind of board of directors, was formed, with Bush as chairman and Conant as his deputy. Following the death of President Roosevelt, it was Dr Bush who gave the first detailed information about the bomb to President Truman. Bush, Conant and Compton were members of the Interim Committee which, after careful deliberation, recommended to the President that the bomb be used.

Of that recommendation, Dr Bush wrote in *Pieces of the Action*: "I knew that Japan would succumb within a matter of months even if the bomb were not used. But I also knew that an invasion of Japan was already being mounted, that it involved several hundred thousands of estimated casualties, and that once rolling, it could not be stopped in its tracks. I also felt that use of the bomb, far less terrible in my mind than the fire raids on Tokyo, if it brought a quick end to the war, would save more Japanese lives than it snuffed out.

"But there was another aspect of this heavy subject. By that time I knew that civilisation faced an utterly new era and I felt that it might as well face it squarely. I knew that nerve gases delivered in a dozen different ways, could be as terrible as an A-bomb. And I had no illusions about the potential power of biological warfare. When science became really applied to warfare, which occurred only during the Second World War, it presented humanity with two alternatives. Either it could refrain, formally or informally, from use of weapons of mass deestruction—no only the bomb but also gases and bacteria and viruses—or it could thrust itself back into the dark ages. Over twenty years have passed, and the world has understood and has thus far refrained. If for no other reason I would justify the use of the bomb at Hiroshima and Nagasaki because it was the only way in which the dilemma could be presented with adequate impact on world consciousness."

At the same time he was responding to Roosevelt's request for a comprehensive report on postwar scientific research policy. Published in 1945 under the title *Science the Endless Frontier*, it contained the recommendations of committees (which Dr Bush had organised) to make studies, with respect to health, education, unemployment and other areas in which science would play a part. Dr Bush wrote: "... without scientific progress no amount of achievement in other directions can insure our health, prosperity and security as a nation in the modern world ... Basic scientific research is scientific capital. Moreover, we cannot any longer depend upon Europe as a major source of this scientific capital."

The report was a stimulus for growth in science and technology with an impact on virtually every aspect of American life. The National Science Foundation was established as a major source of Federal support for research. The Office of Naval Research was formed to move far beyond the limits of traditional military research. When the Department of Defense was organised Dr Bush became chairman of its Research and Development Board.

A justifying typewriter was one among a number of Dr Bush's inventions. While still at MIT he invented a high speed library research machine called the rapid selector which was taken over by the Navy for crypto analysis. He obtained his first patent in 1912 while he was still in college, for a machine mounted on two bicycle wheels which could be used in surveying land. He was granted dozens of patents and built many unpatented devices, ranging from a birdfeeder which discriminated against pigeons and bluejays to hydrofoil boats.

Endless Horizons and *Modern Arms and Free Men* were two of Dr Bush's popular books.