



From Fission to Fusion and Beyond

Teller's Contributions to Applied Physics and Defense

January 15, 2008, marks the 100th anniversary of Edward Teller's birth. This highlight is the sixth in a series of 10 honoring his life and contributions to science.

THE discovery of nuclear fission in Germany in 1939 was a turning point for scientists. Nuclear physicists quickly recognized the potential for a fission weapon of previously unimagined power.

In 1939, Edward Teller was teaching quantum mechanics at George Washington University in Washington, DC. In the four years since completing his Ph.D. in theoretical mechanics, he had made groundbreaking contributions to chemical, nuclear, and solid-state physics. In the summer of 1939, Teller participated in Leo Szilard's famous visit with Albert Einstein, during which they encouraged Einstein to write to President Franklin D. Roosevelt about fission's possibilities as a weapon. Because Szilard did not drive, he asked his good friend Teller to chauffeur him to Einstein's home. Teller was happy to do so, but not for any political reasons. At that time, Teller was thoroughly apolitical.

A Nation at War

His attitude changed, however, with the terrifying Nazi Blitzkrieg into Holland, Belgium, and Luxembourg. Teller listened intently when Roosevelt issued a call for scientists to "act together to protect and defend, by every means at our command, our science, our culture, our American freedom and our

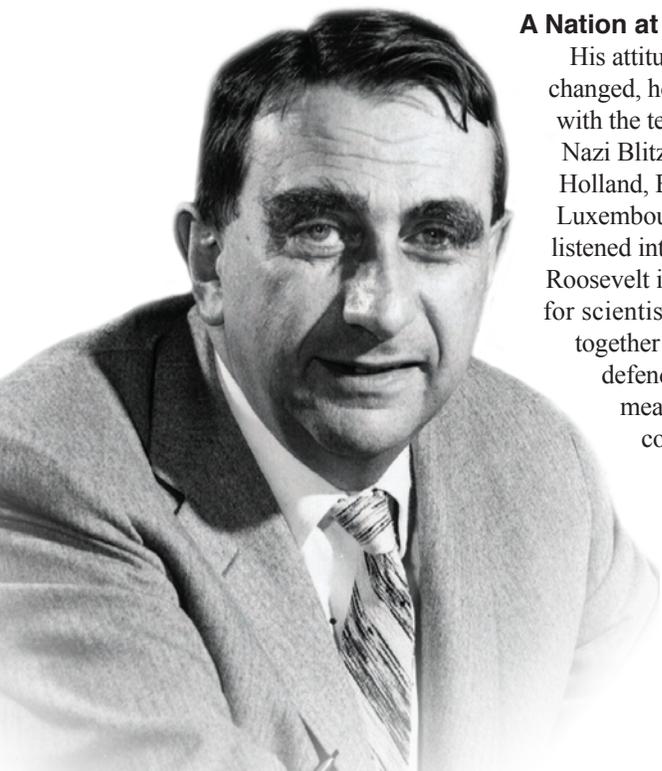
civilization." Teller commented in *Memoirs*, "I had the strange impression that he was talking to me." He was quickly drawn into the center of scientific events that led to the Manhattan Project at Los Alamos.

A question from Enrico Fermi in 1941 about using a fission device as a trigger for a fusion weapon set Teller to thinking about what would become the hydrogen bomb. Although Teller made significant contributions to the development of the atomic bomb, he considered that weapon largely "an engineering problem." Most of his weapons work during the 1940s focused on the thermonuclear superbomb known as the Super.

Teller spent years trying to design a practical hydrogen bomb. After the Russians tested their first atomic bomb in 1949, President Harry S. Truman decided to proceed with development of the hydrogen bomb although the U.S. did not yet have a design. Finally, in 1950, Teller had the crucial idea of radiation implosion, which, when combined with Stanislaw Ulam and Teller's idea of "staging," produced a workable design for a thermonuclear device. Teller was at the University of California at Berkeley during the first major test at Bikini Atoll on November 1, 1952. A seismograph registering the detonation thousands of kilometers away spoke to the success of the Teller-Ulam design.

A New Laboratory

Just months before, a second weapons laboratory had been cofounded at Livermore by Ernest O. Lawrence and Teller, who helped



Edward Teller received the Presidential Citizens Medal from President Ronald Reagan in 1989.

convince the government to accelerate the development of thermonuclear explosives. Teller served as the Laboratory's director for two years, from 1958 to 1960, and acted as a spark plug for new ideas for more than four decades. In 1955, it was Teller who assured the Navy that the Laboratory could develop a nuclear warhead small enough to be carried on a missile fired from a submarine. The scientists back at Livermore stepped up to the challenge. They quickly came through with the small, strategic Polaris warhead for submarines, thus providing a secure second-strike force.

Livermore scientists also responded imaginatively to another concern of Teller's—defense against incoming weapons. In the 1960s and 1970s, Livermore worked with the Army on a ballistic missile defense system. However, the new multiple independently targeted reentry vehicles, first developed at Livermore, soon outstripped available defense systems.

Strategic Defense

President Ronald Reagan's introduction of the Strategic Defense Initiative (SDI) in 1983 gave a boost to Teller's vision of security through defense: "Better a shield than a sword." Working with the Strategic Defense Initiative Organization and scientists from several laboratories, Livermore explored many possible concepts for SDI, including a nuclear-pumped x-

Teller was the impetus behind the miniaturization of nuclear weapons for launch from submarines.



ray laser and a constellation of tiny nonnuclear satellites dubbed Brilliant Pebbles. When activated, a Brilliant Pebble would intercept and destroy an attacking missile before the weapon could deploy its warheads. Less than two years after the Brilliant Pebbles concept was proposed, the Berlin Wall fell, and soon after, the Cold War was over. However, the legacy of SDI lives on in the dozens of new materials and devices that have since been commercialized and continue to find use in Laboratory research.

So, too, does Edward Teller's legacy live on at Lawrence Livermore in innovative ideas, fertile minds, and superb science.

—Katie Walter

Key Words: Edward Teller, hydrogen bomb, multiple independently targeted reentry vehicles, Strategic Defense Initiative (SDI).

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