WALTER H. ZINN

1906–2000

Elected in 1974

"Contributions to nuclear physics and reactor development."

BY ALVIN M. WEINBERG AND ROBERT ZINN

WALTER HENRY ZINN was Enrico Fermi's close associate during the Manhattan Project and after World War II became the leading US figure in the earliest development of nuclear energy. So pervasive was his stamp on the field that a proper memorial to Walter Zinn must be nothing short of an account of the origins of nuclear energy and of his influence on its development. He died at age 93 on February 14, 2000, in Clearwater, Florida.

Walter was born December 10, 1906, in Kitchener, Ontario, Canada, the second son of Maria Anna (née Stoskopf) and John Zinn. He was the only one of his immediate family to attend college. His father worked for much of his life in a tire factory, and his brother Albert, 10 years his senior, was also a factory worker. As a boy, Walter too worked in one or more factories. He managed, though, to skip a few grades during elementary school, and when the time came entered Queen's University. He graduated in 1927 with a BA degree in mathematics and got his MA degree in 1930. In 1933 he married Jennie (Jean) A. Smith, whom he had met when they were students at Queen's. The next year he got his PhD in physics at Columbia University, and in 1938 he became a naturalized US citizen.

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Walter held teaching positions at Queen's (1927–28) and Columbia (1931–32), and was on the faculty at City College of New York (1932–41). By the time fission was discovered in 1938 he was collaborating, in a laboratory at Columbia, with Leo Szilard and Enrico Fermi to elucidate the nature of fission.

Walter had a tremendous admiration for Fermi, and was awed by his genius both as an experimental physicist and as a theorist. He appreciated that at one moment Fermi could invent a novel way to make a difficult measurement and in the next argue a subtle point in theory with the very best theorists (e.g., Eugene Wigner). Walter later enjoyed telling about having served twice as a real estate agent for Fermi by finding places for his family to live near New York City and then Chicago, traveling for work together, and what it was like to have Fermi as a friend and colleague.

He also had high regard for Leo Szilard, his collaborator on one of the first experiments on fission. While he acknowledged that Szilard was of little real help with the design or operation of the experimental apparatus, Walter characterized him as an "idea man" with few peers who motivated others to conduct the "right" experiments.

In those exciting days nuclear physicists were asking how many neutrons were emitted by a uranium nucleus undergoing fission induced by a neutron. If the answer were greater than one, a nuclear chain reaction was possible; if less than one, a divergent chain reaction was impossible. Zinn and Szilard found that about two neutrons were emitted by a fissioning uranium nucleus, confirming the results of Fermi, Herbert L. Anderson, and H.B. Hanstein. Thus was born experimental verification of the Manhattan Project's purpose: to make an atomic bomb.

After this important result was achieved, Fermi lost no time in demonstrating the chain reaction. Zinn joined Fermi's experimental team and soon became his "executive officer" as he organized the heavy experimental work necessary to carry out Fermi's plan to build a divergent chain reaction.

The aim was to demonstrate that a lattice of uranium and graphite would chain-react if it were large enough, a difficult feat given the small amount of uranium and graphite then available. Zinn participated in the first of these experiments, which was done at Columbia. This first attempt was unsuccessful, but Fermi was confident that purer uranium and graphite and improved experimental geometry would yield a positive result.

By late 1941 the plutonium branch of the uranium project was consolidated under Arthur Compton at the University of Chicago Metallurgical Laboratory, and Zinn accompanied Fermi to the Met Lab. Each experiment involved a pile of graphite and uranium about 11 feet high and 8 feet wide. Changing from one configuration to another required a team of strong university athletes bossed by Zinn, who was in daily contact with Fermi.

The first experiment that showed a divergent chain reaction was performed in May 1942. Wigner said he was so sure the pile would chain-react that he doubted he would attend the historic event (he did attend).

For the first criticality experiment, at about 3:20 p.m. on December 2, 1942, Fermi was in overall charge and Zinn saw to it that his directions were carried out. At the instant of criticality Walter was responsible for the so-called "zip" rod, a simple bar of cadmium held by a spring and tied outside the pile by a 100-pound counterweight. Holding an axe, he was ready to cut the rope holding the zip rod if the chain reaction got out of hand. Fortunately the "landing in the new world" (Compton's words in a phone call to James Conant) was uneventful and Zinn did not have to cut the rope that kept the zip rod from entering the pile.

His accounts of events at the beginning of the Manhattan Project and this first chain reaction corresponded with those published by historians, but captured much more of the excitement of the moment. He also recalled the great concern among the scientists about the possibility that the Germans were ahead of the United States in the race to produce the first bomb.

By 1946 the Atomic Energy Act had been passed by Congress and the Manhattan Project was transformed into the US Atomic Energy Commission (AEC). Most of the senior members of the project returned to their universities; their replacements included Zinn as director at Argonne: he had emerged as a natural leader—he was intelligent, very close to Fermi, and tough.

In 1948 the AEC designated Argonne as the national laboratory responsible for all work on reactors and Walter became the nominal scientific boss of several reactor projects. These included the High Flux, a water-moderated, highly enriched reactor being designed in Oak Ridge under Wigner's supervision; the NaK-cooled fast breeder prototype (EBR-1), being developed directly under Zinn's supervision at Argonne; and the newly established Submarine Thermal Reactor (STR) for naval propulsion, essentially a pressurized version of the High Flux reactor.

The EBR-1 project, Walter's baby from the start, smoothly merged with the rest of Argonne and became the first reactor to generate electricity. The High Flux, renamed the materials testing reactor (MTR), had already received extensive preliminary design at Oak Ridge, so the project was divided between the Oak Ridge group, which was responsible for the interior of the MTR, and the Argonne group, which was responsible for the external facilities required to manage the 30,000 kW generated in the MTR. Zinn chaired a five-member steering committee that oversaw the project. MTR was the first successful demonstration of a very-high-power-density, water-moderated, and water-cooled reactor.

STR was a different story. Although the AEC had assigned a naval reactor role to Argonne, Zinn's relations with Captain Hyman G. Rickover were never friendly, with the result that Argonne's role in developing STR became secondary to that of the Westinghouse Bettis Laboratory.

Relieved of prime responsibility for STR, Zinn experimented with boiling-water reactors (BWRs), which now account for about 20 percent of the world's fleet of approximately 440 nuclear power plants.

Although EBR-1, MTR, and the BWR were the main efforts at Argonne, the laboratory designed or built several other reactors: the first medium-power (300 kW) heavy-water reactor; the huge D_2O tritium producers built and operated at Savannah River, South Carolina, by the DuPont Company; and power reactors cooled by various coolants.

Walter's important role as leader of the postwar development of reactors was symbolized at the First Geneva Conference on Peaceful Uses of Atomic Energy in August 1955. This UN-sponsored gathering involved over a thousand nuclear energy experts from both sides of the Iron Curtain. The opening session was like a 13th century jousting tournament, with the Soviet Union and United States each putting forward its champion. D.I. Blokhintsev described the Obninsk 5000 kW graphite-moderated, water-cooled pilot plant; Zinn then gave the first public account of successful experiments with the boiling-water reactor. The Russian pilot plant was the forerunner of that country's plutonium-producing reactors; Argonne's BWR experiments led to the 90 large commercial BWRs now operating.

The McCarthy era occurred during Walter's tenure as director of Argonne National Laboratory, and he had a few stories to tell about the hysteria that enveloped that period, including imagined security breaches at Argonne. One particularly frustrating episode for him involved a small bottle of slightly enriched uranium that some media people and politicians were convinced had been taken by Russian spies. Walter was in some hot water until the missing bottle was discovered in Argonne's landfill. Experiences like that caused Walter to hold most politicians in low esteem, because they seemed less interested in the truth than in advancing their careers.

He left Argonne in 1956 after serving 10 years as its first director. The general campus-like layout of the laboratory reflects his sensitive practicality. He was a model of what a director of the then-emerging national laboratories should be: respectful of the aspirations of both contractor and sponsor, and confident enough to prevail when necessary.

Because at Argonne he was in no position to design and build large power reactors, he left to establish the General Nuclear Engineering Company (GNEC) with headquarters in Dunedin, Florida. The company flourished and was much involved in large-scale pressurized-water reactors. Eventually GNEC was acquired by Combustion Engineering Company, and Walter became head of its fast-growing Nuclear Division. He retired from Combustion in the early 1970s but remained on its board of directors until the early 1980s.

Walter Zinn greatly influenced the earliest postwar decision as to which of the myriad power reactor concepts to pursue. He suggested two basically different paths: variants of the naval STR, which led to the commercial PWRs and BWRs; and the fast breeder, which led to the EBR-1 and its successor, EBR-2, and breeders in Russia, Japan, the United Kingdom, France, and India. It was his persistent advocacy of the NaK-cooled EBR-1 that thrust the US reactor program on this dual path, which has been followed by most nuclear-developing countries.

His espousal of the fast breeder was based on the earliest estimates of how much uranium could be extracted. In those early days uranium was thought to be scarce, so the breeder would have to be developed if nuclear energy were to be a long-term source of energy. Thus a primary goal of the earliest reactor development plan was the fast breeder. In hindsight, the relative abundance of uranium made the quick development of the fast breeder unnecessary, although Zinn's EBR-2, a 20,000-kW sodium-cooled reactor, was a major technical success.

Walter was proud of his work on the development of nuclear energy for the production of electricity. He worked on many of the designs that later became standard for the nuclear power industry. He prioritized reactor safety, and recalled experiments at the Idaho test site where a reactor was purposely destroyed to better understand various safety issues. He held that properly designed and operated reactors were very safe and firmly believed in a bright future for nuclear energy.

Many of the most important decisions of the early American nuclear effort are attributable to Zinn. Among those were the establishment of the Reactor Test Station in Arco, Idaho, where the prototypes of the first naval reactor as well as

MTR, EBR-1, and EBR-2 were built and operated; and the founding of the American Nuclear Society (ANS), for which he was the first president. Today ANS has about 10,000 members and is the main technical society in the field of nuclear science and engineering.

As something of a gray eminence of nuclear development, Walter received the highest honors: the Ford Family's Atoms for Peace Award (1960), the Enrico Fermi Award (1969), and election to membership in both the National Academy of Sciences (1956) and National Academy of Engineering (1974). He also served on the President's Science Advisory Committee during the 1960s. In 1957 Queen's University awarded him an honorary DSc degree.

Jean died in 1964. In 1966 Walter married Mary Teresa Pratt; she died in 2008. His stepsons Warren and Robert Johnson died in 2020 and 1991, respectively. He is survived by his sons John Eric and Robert James Zinn and nine grandchildren.