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George Weil - from activator to activist

Thirty years ago this weekend, Enrico Fermi and his team were celebrating their successful operation of the world's first nuclear reactor. Today, the man who initiated that first controlled chain reaction is a vociferous critic of American nuclear technology

Dr George L. Weil is short, dapper, articulate, and outspoken. About current American nuclear technology he says "today's nuclear power-plant projects are too many, too large, too soon, too inefficient; in short, they offer too little in exchange for too many risks." He is by no means alone in this opinion; yet, coming from him, it carries a curious pungency. For George Weil this week celebrates - if that is the word - a unique 30th anniversary. Thirty years ago, on 2 December, 1942, George Weil started up the world's first nuclear reactor.

It was a snowy, sub-zero day in Chicago, but by 8.30 am an improbable group was beginning to gather in a disused squash court under the West Stands of Stagg Field, the University of Chicago football stadium. Those present, 43 in all, included Americans, Canadians, Hungarians, one woman and a supremely confident immigrant Italian Nobel prizewinner: Enrico Fermi. The scene had a surrealistic aura. The floor of the squash court measured some 60 ft by 30 ft. At one end of the floor was a balcony some 10 feet above the level of the floor. Facing this balcony, and all but filling the remaining volume of the squash court, was a structure which had provoked a standing joke among those working on it: "If people could see what we're doing with a million and a half of their dollars, they'd think we're crazy. If they knew why we are doing it, they'd be sure we were."

The structure began from floor upwards as a cube, sheathed in wooden planking. About 10 feet from the floor the planking ended; above this level could be seen a terraced pile of dull black bricks, ending in a level surface another six feet or so higher. From floor to top there were in all 57 layers of bricks, made of machined graphite. Inside the bricks, concealed from view but not from the battery of neutron detectors, were thousands of slugs of uranium and uranium dioxide. The entire structure was sitting inside an open rubber bag, which framed it rather like the wings of a stage set. On the side of the cube facing the balcony the planking was interrupted midway along the cube, exposing more black brickwork. Into this brick wall ran a series of woodwork channels, bridging the gap between balcony and cube just below the level of the balcony floor.

On the balcony were clustered panels with dials, and around them two groups of onlookers. One of the younger scientists later said "The control cabinet was surrounded by the big wheels; the little wheels had to stand back." Four of those present were not on the balcony. Three of these were huddled on a platform atop the centre of the pile, armed with five-gallon jugs of neutron-absorbing cadmium solution to be poured onto the pile if matters got out of control. The fourth was George Weil, standing on the floor between pile and balcony. His job was to follow Enrico Fermi's instructions and gradually pull out of the pile the final "control rod"; a 14 ft plank with thin cadmium strips tacked onto it from end to end. Its position in the pile was ascertained from a cheap metal roll-up tape measure.

There were two other sets of control rods, one electrically operated and one, called "Zip", which would be pulled into the pile by a weighted rope if the rope holding it out of the pile were cut from the balcony rail. One of Fermi's colleagues stood by "Zip's" fastening with a hatchet, poised to sever the rope.

Compared to the awesome dawn of 16 July, 1945, at Alamogordo, New Mexico, when the Trinity test first revealed the power of an uncontrolled chain reaction, the events of 2 December, 1942 would have been, to virtually all but that particular handful of onlookers, undramatic in the extreme. Neutron counters clicked; a pen recorder traced its placid track along a paper chart. Fermi, swift with slide rule, incisive in his instructions, ordered George Weil to pull the final rod out, foot by foot, then inch by inch, each time waiting see the effect on the neutron flux inside the pile. The only moment of drama came shortly after 11.30, when, with the counters ticking faster and faster, and the recorder pen climbing, there was abruptly a loud thump - which proved to be the automatic control rod reinserting itself, its trip-level having been set too low. At this point Fermi announced that it was now time for lunch.

After lunch, the run-up was unhurried but direct. At 3.25 pm, inside the latticework of graphite and uranium and uranium oxide, spontaneous neutrons were initiating further fissions fast enough to keep the supply of neutrons inside the pile steadily rising. Recalling the moment later, George Weil said "I couldn't see the instruments. I had to watch Fermi every second, waiting for orders. His face was motionless. His eyes darted from one dial to another. His expression was so calm it was hard. But suddenly his whole face broke into a smile." "The reaction is self-sustaining", Fermi announced. "The curve is exponential."

The world's first nuclear reactor operated for 28 minutes, before Fermi ordered "Zip-in", and stopped the chain reaction. At that point Hungarian colleague Eugene Wigner produced from behind his back what he had kept hidden there throughout the experiment: a bottle of Chianti wine, which he presented to Fermi. Fermi poured the assembled group a solemn libation in paper cups. The Chianti bottle in its wicker basket was autographed by the participants; this unlikely source later proved to be the only written record of those who had been present.

Twenty-five years later, speaking at the University of Western Ontario, Dr Weil reflected "How did we feel? I am often asked whether I was afraid. I don't believe anyone was afraid for his own life, For one thing we were too busy. For another, we accepted the fact that we were involved in a war of survival - we believed that we were in a race and had to win that race. Finally, I believe that each of us was affected by Fermi's calm confidence that he was master of the experiment. His performance was superb." The realisation that they had witnessed an earthshaking event was vivid in the minds of the participants; the ironclad wall of secrecy that had to surround their experience was uncannily frustrating.

Six months later, on the anniversary date of 2 June, 1943, Dr Arthur Compton, director of the Metallurgical Laboratory (as the reactor project was known), held a small party. After dinner Dr Compton asked each of his guests what would be the most promising utilisation of the chain reaction, for human welfare. Dr Weil recalls: "All of the leading citizens at this round table, with the exception of Fermi, flatly stated abundant, cheap energy". Fermi alone opted for radioisotopes, to use as tools for further scientific study, especially in fields related to the human species. Dr Weil continues: "Fermi, as usual, penetrated the obvious. Atomic energy had always been the popular catchwords. However, of what use is abundant, cheap energy to human welfare if there are no humans?"

When that party was held, the Hiroshima bomb was still more than two years in the future. George Weil was one of the observers of the Trinity test. After - as Dr Weil puts it - the Second World War was ended by an uncontrolled fission chain reaction, he carried on his work on reactors. When the US Atomic Energy Commission was set up in 1947, Dr Weil was appointed chief of the reactor branch, Division of Research, and rose swiftly to become assistant director of the Reactor Development Division. In 1952, Dr Weil resigned from the AEC, to become a consultant. But he grew more and more alarmed at the rush to turn nuclear technology over to private industry before

the technology was fully understood, and he found himself increasingly lined up in opposition to his old organisation.

Meanwhile Chicago Pile No 1, or CP-1, had been dismantled and moved from the squash court to what would become the Argonne National Laboratory. In 1956 the uranium and graphite were removed and the shell of the first reactor was buried beneath a rough stone marker near the Argonne Lab. The anniversaries of the first chain reaction came and went. On 1 December, 1962, the event of the 20th anniversary, almost all the participants whose signatures had been appended to Dr Wigner's Chianti bottle convened at the University of Chicago after a meeting held under the auspices of the American Nuclear Society and the Atomic Industrial Forum. It seems reasonable to suppose that the rapid ascendance of these two bodies was one of the consequences less vividly foreseen by the group in the squash court 20 years earlier. Dr Weil was there. But he does not expect to attend any festivities for the 30th anniversary, if indeed any are held. By this time he might well be considered *persona non grata*.

His concise, hardhitting book, *Nuclear Energy: Promises, Promises*, which he has published privately, is now in its second edition and third printing, and demand for copies is increasing steadily. (It can be obtained from him, at 1107 17th St NW, Washington DC 20036, price \$1 - 00.) It is a brisk, business-like survey of the growth of the American nuclear power programme, its military origins, its massive public subsidies, its government insurance, its inefficiency both technological and economic, its hazards whether accidental or intentional, its problems (as in the case of high activity waste management), its distorted perspectives and one-sided planning - a scathing indictment that carries more impact than all the industry's promotional ads put together.

Dr Weil is a supporter of the Consolidated National Intervenors, whose long-running confrontation with the nuclear industry has just entered a new phase, with the reopening of hearings on 14 November (see "US Probes possible runaway reactors", *New Scientist*, vol 55, p 476). Dr Weil also wages some battles of his own. He is presently engaged in challenging the plans of the Potomac Electric Power Company to build a large twin reactor power plant within 30 miles of Washington, DC. In a letter published in the *Washington Post* (23 October) Dr Weil took biting issue with a Post caption announcing the PEPCO plans, picturing the PEPCO chairman with the words "... hails nuclear safety". He drew attention to the on-going hearings in nearby Bethesda on this very subject, commenting acidly that "PEPCO's chairman appears to have already resolved the controversy".

In Dr Weil, PEPCO, Westinghouse, General Electric and the AEC itself have a formidable adversary. It is profoundly ironic that, like David Lilienthal, first AEC chairman, and like Dr John Gofman, co-discoverer of uranium 232 and uranium 233, Dr George Weil should now be in vigorous opposition to the American nuclear establishment. Thirty years after he started up the first reactor, Dr Weil is doing his damndest to push a much more cumbersome control rod back in.