# The Fun of Physics

**ALVAREZ**
**Adventures of a Physicist**
By Luis W. Alvarez
Basic Books. 292 pp. $19.95

**RABI**
**Scientist and Citizen**
By John S. Rigden
Basic Books. 302 pp. $21.95

**By Alan Lightman**

*Isidor Isaac Rabi and Luis W. Alvarez*

ONE SENSES Luis Alvarez' deep regret that he has been praised only by the greatest physicists alive, that Rutherford and Faraday and Newton cannot find their way to Berkeley to celebrate his work. Resigned to present and future admirers, Alvarez tells us in his autobiography, *Alvarez*, that he had the longest Nobel Prize citation ever, was the first physicist to win the National Medal of Science, the first to use cosmic rays for a practical purpose, the first civilian to land an airplane under radar control (using the first ground-controlled approach system, which he invented). Once our eyes have adjusted to this incandescent egotism, we indeed see a genius, who eventually endears himself with his astonishing honesty. *Alvarez* joins the happy company of Freeman Dyson's *Disturbing the Universe* and Richard Feynman's *Surely You're Joking, Mr. Feynman!*, all splendid autobiographies by great physicists and each bearing the stamp of its author—Dyson's aloof and cultured intellectualism, Feynman's love of mischief, and Alvarez' can-do approach to any problem he can put a soldering iron to. Beyond its self-portrait, Alvarez provides an exceptionally clear view of the world of science.

Still active in his mid-seventies, Alvarez is already a legend. His career has been unconventional. If Alvarez had only perfected the hydrogen bubble chamber to track subatomic particles, transformed the cyclotron into a working tool, discovered the capture of electrons by atomic nuclei, and helped develop radar, he would be remembered. But, like a grand chess master, he has stunned the crowd with some totally unexpected moves. He developed a method for "X-raying" Egyptian pyramids (using cosmic rays from space instead of x-rays from the lab), so that hidden chambers could be located from the outside. He disproved the hypothesis that the motion of John Kennedy's head in the Zapruder film indicated bullets from two directions, by carefully applying the laws of physics and then testing his conclusions on watermelons at a firing range. With his geologist son, Walter, he discovered an anomalous layer of iridium deposited in rocks at the Cretacious-Tertiary boundary, when the dinosaurs died out. Then he helped propose that the iridium had come from a giant asteroid, which threw dust in the air and blocked out the sun for several years.

Alvarez is among a handful of physicists who have, by their personal force, created schools, surrounding themselves with talented young apprentices who later sally forth with the know-how and style of their master. John Wheeler was also one of these gurus. Robert Oppenheimer was another. Alvarez pays warm tribute to his own mentors, Arthur Compton and Ernest Lawrence, both Nobel Prize-winners themselves. For Alvarez, heroes and glory are part of the sport. "Any kind of science can be compelling if the people one most admires are interested in one's work."

LIKE MANY physicists of his generation, Alvarez was recruited for technical assistance in World War II, first to develop radar at the M.I.T. Radiation Laboratory and later to work on the Manhattan Project at Los Alamos. He gives a vivid and detailed account of these experiences. Alvarez sincerely believes that it was necessary to build the atomic bomb, necessary to drop the bomb on cities rather than in the ocean, necessary to drop the bomb twice. "Resolution, an important quality in war, is nor-

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mally defined as willingness to accept casualties in pursuit of victory, but it is also willingness to inflict casualties on the enemy." Alvarez also supported construction of the hydrogen bomb, called the Super, and describes his agonizing decision to testify against Oppenheimer, whom he enormously respected.

In the war, German submarines were causing great damage to Allied shipping. Although a patrol plane could find a surfaced submarine miles away by emitting a radio signal and then receiving its echo, the submarine could mount its own receiving antenna to pick up the direct radar beam from the plane. If this direct signal grew stronger, the submarine captain knew a patrol plane was approaching and could submerge his boat until the plane passed. In this way, the German subs were evading the British Royal Air Force patrol planes. Then Alvarez utilized a key difference between the echo and direct signals. As a plane approaches a sub, the echo signal received by the plane increases in strength enormously faster than the direct signal received by the submarine. By gradually turning down the transmitted signal, the approaching patrol plane can continue to receive a strengthening echo, letting it know it is closing on the sub, but the sub detects a decreasing direct signal, fooling it into thinking the plane is flying away. This system was called VIXEN. It worked.

While VIXEN was a brilliant idea, and there were many more like it, Alvarez is most renowned for his extraordinary laboratory technique and ability with his hands. While a senior in college, in 1932, he built the first Geiger counter at the University of Chicago, with only a few published articles to go on. While using a zoom-camera on an African holiday, Alvarez became annoyed with the jitter of the lens and invented on the spot a stabilized optics system to remedy the problem. From Nairobi, he mailed a disclosure statement to his patent attorney and later formed a company to produce the system. For ordinary people, the world is filled with mysteries. For Alvarez, the world is filled with possibilities.

Luis Alvarez' apparent lack of interest in anything not physics is matched by the multiple passions of I. I. Rabi, who might leave the lab to go to the opera and who is the subject of John Rigden's well-researched biography, *Rabi*. Rabi won his Nobel Prize in physics in 1944, for developing new methods for measuring the magnetic properties of atomic nuclei. Born in 1898 in Eastern Europe and brought up as an Orthodox Jew in Brooklyn, Rabi resolved in college never to read in the subjects he was taking courses. If he was taking a course in chemistry, he might be reading Freud. Although religion was eventually transcended by physics, God remained a symbol for truth. Whenever one of Rabi's students came to him with a scientific project, Rabi asked only one question: "Will it bring you nearer to God?" The students always understood what he meant.

Some of Rabi's greatest discoveries were made because of his laziness and distaste for details. He invented the technique of reversing the magnetic fields along the path of particles in molecular beams because this new procedure allowed a quick determination of nuclear spins, without any calculations. Rabi complains that the old way of making this measurement required that you "sit down and just calculate it from the data points . . . That didn't please me, it seemed to me a tedious sort of thing."

One is struck by other contrasts between Rabi and Alvarez. Rabi opposed the atomic bomb. Rabi used the prestige of his Nobel to back causes. Alvarez refused to sign petitions for fear of being used. Rabi left active research after World War II to become a statement of science. Alvarez could never stop doing physics. ■