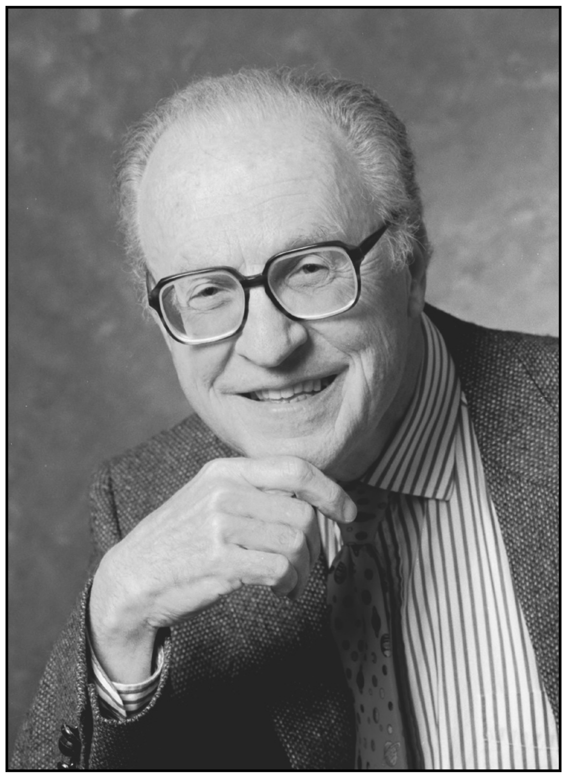
DONALD ARTHUR GLASER



UC BERKELEY DEPARTMENT OF PHYSICS

21 SEPTEMBER 1926 · 28 FEBRUARY 2013

DON GLASER passed away on 28 February 2013, at his home in the Berkeley Hills. Don received the Nobel Prize in Physics in 1960 for the discovery of the ingenious bubble chamber, which he made when he was 26. He was 86 when he died, and he lived his life as a great physicist, biotech entrepreneur, husband, father, and grandfather. Don was born in 1926 in Cleveland, Ohio, to William J. Glaser, a businessman, and his wife, Lena. He received a bachelor's degree in physics and mathematics in 1946 from Cleveland's Case School of Applied Science (now Case Western Reserve University). Even as a child, he loved the arts—especially music—and while at Case, he played viola in the Cleveland Philharmonic Orchestra. This love for music and the arts later shaped his personal life.

After getting that degree, Don started a Ph.D. in physics at the California Institute of Technology (Caltech). His interest in particle physics led him to work with Nobel laureate Carl Anderson; he studied cosmic rays using a cloud chamber, a device similar to the bubble chamber. During these years, Don learned to design and build the equipment needed for his experiments.

After Caltech, while teaching at the University of Michigan, Don used these skills and built the bubble chamber to trace the paths of subatomic particles. It was at Michigan that Don built the first bubble chamber, which is essentially a vessel filled with heated liquid. A sudden decrease in pressure produced by a piston forces the liquid into a superheated state. Charged particles create an ionization track around which the liquid vaporizes, forming microscopic bubbles, with the density of bubbles proportional to the particle's energy loss. The bubble chamber could show a particle's trajectory in greater detail than a cloud chamber, which used gas.

The impact of the bubble chamber on particle physics was deep. Its use generated data that enabled physicists to figure out that most particles of matter, such as protons and neutrons, comprised even smaller particles known as *quarks*. The first bubble chamber was 1 inch wide; over time, larger ones were developed. Then more advanced technologies led scientists in particle physics to develop the large accelerators that dominated physics until very recently.

Don's path to the discovery of the bubble chamber is as curious as his mind. For a physicist thinking about a device such as the bubble chamber, it would have been natural to consult the relevant chapter in Fermi's book *Thermodynamics*. This book included a small mistake in an equation that implied that the bubble chamber was not possible. However, Don had not read the book, which was unusual for a physicist of that time because Fermi's book was considered a keystone in the

discipline. As a result, Don did the calculations that supported the concept for the bubble chamber from scratch. This led him to design and build a prototype of the bubble chamber. Don's unfamiliarity with the miscalculation in Fermi's book led to a great discovery. What was one great physicist's mistake became another great physicist's breakthrough.

Don received the Nobel Prize for his work on the bubble chamber in 1960 at the age of 34. Don was a student of Anderson, who in turn was the student of Robert Millikan, another physics Nobel Prize recipient, also from Caltech. After Don received the prize, his students used to eye each other and wonder who was going to be the fourth in this distinguished line. In 1993, the Nobel Prize in Physiology or Medicine did indeed go to someone Don had worked with: biochemist Kary Mullis. Mullis received it for inventing the *polymerase chain reaction* (PCR), a technology used to amplify pieces of DNA into thousands or millions of copies. At the time, Mullis was working at Cetus, a company that Don founded years earlier.

In 1959, Don moved from the University of Michigan to teach at the University of California, Berkeley. In 1964, tired of the large size of the physics groups involved in designing particle accelerators, he shifted from particle physics to become a professor of molecular biology. His passion and skill at building equipment was put to work in the new fields of microbial genetics and molecular biology, where he invented several new methods for automating large-scale hunts for valuable mutants. He enjoyed working quietly in a laboratory on projects with a small team; this was his favorite way of doing things.

His entrepreneurial spirit emerged when he cofounded Cetus in 1971 (with Ron Cape and Peter Farley); he was chairman of the Science Advisory Board of Cetus until it merged with Chiron. Cetus was the very first biotech company before biotechnology existed as an industry. The group at Cetus made great discoveries, including interferon and PCR. After the merge with Chiron, the company was bought by Novartis.

As molecular biology became more dependent on biochemistry, Don again considered a career change. In part because of his artistic inclinations, he had developed an interest in human vision and how the brain processes what is seen.

He started to speak about vision at the end of the 1970s with Suzanne McKee and Gerald Westheimer, both at Berkeley. He had become aware of the problem of vision years before when he had to train human workers to recognize bubble chamber tracks for different high-energy particle reactions. He encountered the problem again in

genetics when he needed human vision to decide on the growth of cultures. He taught a popular introductory course on vision in the early '80s that inspired a few young people, now tenured faculty, to do research on vision. During that time, he was teaching from David Marr's book on vision. His approach differed from Marr's in that he was convinced that vision problems could not be generally defined but rather could only be specified by the hardware available. Don's attempt to understand the neural hardware or, better, wetware of the brain is what led him into psychophysics. Thus, from the early 1980s, Don began to work on experiments with a small group of young researchers, including T. Kumar, in the field of visual psychophysics.

During the last 25 years or so, his main goal in his small psychophysics and modeling group was to develop computational models of the human visual system based on its measured abilities (psychophysics) and known architecture (neurophysiology and anatomy). These models used mainly neural network methods, which can be simulated with conventional computers. The models were trying to mimic as closely as possible the real anatomy and physiology of the human visual system. They were expected to give insight into the workings of the human brain when it is engaged in visual tasks and make predictions about the response of the human visual system to both real world images and artificial laboratory stimuli. The architecture was explored with psychophysical experiments that usually involved presenting carefully designed patterns on computer monitors to observers who are asked to report their judgments of such things as depth, color, velocity, flow, identity of an object, texture boundaries, or simply the presence or absence of a signal.

Don's career change from molecular biology to computational modeling of the visual system and visual psychophysics led to a change in his position at Berkeley: in 1989, he became professor of physics and neurobiology.

I (T. P.) first met Don in 1981 and then several times in Cambridge, Massachusetts, in 1982 when he was on a mini-sabbatical at the Rowland Institute, a private laboratory, now part of Harvard, where Edwin Land, the founder of Polaroid, was studying human perception of color. He came to a vision conference I organized in 1984 in Erice, Italy. In 1992, Don and I organized a conference in Berlin, "Exploring Brain Functions: Models in Neuroscience."

As a family, we became close friends with Don and stayed in touch since the 1980s. We loved our discussions and the observations he made—always simple, crisp, and deep. Don was a charming mix of curiosity and innocence. His openness to possibility and discovery was key to his path in life. Don was the least arrogant and most delightfully

funny person you could hope to meet. His view of the world and the way he communicated his observations were unencumbered by noise. They were always clear, to the point, and fantastic. He carried his success in science and the high-tech industry in the most graceful way.

He retained the happy curiosity of a kid through his whole life. The world for him was a garden of wonders. He was always able, in an apparently effortless way, to come up with new, refreshingly counterintuitive observations of things and people. He was never bored. His life supports a clear lesson that he taught his children at a young age: "Boredom is the enemy."

Elected 1997

Tomaso Poggio
Eugene McDermott Professor
McGovern Institute for Brain Research
Computer Science and Artificial Intelligence Laboratory
Brain Sciences Department
Massachusetts Institute of Technology

Allegra Poggio
Senior Production Director
Visceral LLC