



Edwin Land

EDWIN HERBERT LAND

1909–1991

WRITTEN BY STANLEY H. MERVIS SUBMITTED BY THE NAE HOME
SECRETARY

EDWIN HERBERT LAND—inventor, scientist, entrepreneur, teacher, visionary, and public servant—was born in Bridgeport, Connecticut, on May 7, 1909, and died in Cambridge, Massachusetts, on March 1, 1991, at the age of eighty-one. He was educated at the Norwich Academy and Harvard University.

While still a freshman at Harvard, Land was intrigued with the natural phenomena of polarized light and was challenged simultaneously by the difficulty of using it in science and the impossibility of using it in applied science for industry because the then-available light polarizers were Nicol prisms, large single crystals, heavy, expensive, and necessarily limited in size. There were no "sheet" polarizers. Land conceived the idea of making in sheet form the optical equivalent of a large, single crystal by suspending submicroscopic polarizing particles in plastic or glass and orienting these polarizing particles in a transparent sheet. Following a leave of absence to pursue his ideas, he returned to Harvard bringing with him his new light polarizer. In 1932 at a Harvard physics colloquium he announced a "new polarizer for light in the form of an extensive synthetic sheet," a polarizer known as "J-sheet." He later took another leave of absence to devote himself entirely to research in polarized light. Although he never graduated, Land returned to Harvard on many occasions as a lecturer, and to receive an honorary doctor of science degree in 1957.

During World War II Land invented the "H-sheet" light polarizer made by staining oriented polyvinyl alcohol with iodine. H-sheet is still the most widely-used light polarizer.

The light polarizers Land invented made it economically possible to make use of the phenomenon of light polarization in products as diverse as camera filters, scientific instruments, train and airplane windows, three-dimensional movies, and polarizing sunglasses. His dream of an automobile headlight system using polarizers to prevent blinding glare from on-coming vehicles while increasing visibility for the driver never became a reality, although all the scientific and technological problems involved were fully solved.

During World War II, Land turned Polaroid to military research and production. A number of inventions contributed to the war effort, including infrared light polarizers; dark adaptation goggles; variable density goggles; polarizing ring sights, which had no optics and no restriction on aperture or exit pupil; and Vectograph three-dimensional light-polarizing images uniquely suited for aerial reconnaissance.

"Din" Land is a unique example of the success of the American Patent System in carrying out its constitutional charter "to promote the Progress of Science and Useful Arts." The limited exclusive rights given for Land's inventions permitted him to organize Polaroid Corporation to exploit his light polarizer, and permitted Polaroid to grow and to support the research and development necessary to bring succeeding inventions to the marketplace. He filed his first patent application in 1929 and received 537 U.S. patents during his life, a total exceeded by only a few others. Land actively participated in the preparation of his patent applications and often suggested unconventional ways to define his inventions.

Land is perhaps most widely known for the Land instant photographic process, invented in the mid-1940s, stimulated by his three-year old daughter's question, "Why can't I see the picture now?" This photographic process was first publicly demonstrated on February 21, 1947, at a meeting of the Optical Society of America. In that talk he outlined the theoretical considerations involved in designing one-step systems and

broadly described the entire field of instant "one-step" photography. His concept of developing the film immediately after exposure in a hand-held camera, employing only a single "dry" step, was made practical by making the processing reagent viscous and enclosing the viscous reagent in a single-use, rupturable container called a "pod." That invention was protected by U.S. Patent Number 2,543,181, issued February 27, 1951, the patent cited when Land was inducted into the National Inventors Hall of Fame in 1977. The entire photographic industry found the pod to be a uniquely valuable instrument, which remains fundamental to all instant films.

Full-color instant prints were introduced by Polaroid in 1963. In 1972 Land described his system of "absolute one-step photography" in which full-color images develop outside the camera, a system embodied in the Polaroid SX-70 camera and film. A "chemical darkroom" provided by pH-sensitive opacifying dyes replaced the mechanical darkroom embodied in the earlier one-step cameras.

Land subsequently developed the Polavision instant movie system, a major technological achievement, which was unsuccessful in the marketplace. The technology, however, became the basis for Polachrome instant 35-mm slides.

Land's work in optics and color led him to experiments that showed inconsistencies in classical concepts of color vision. These experiments led him to construct his Retinex theory of color vision, in which it is not the relative amount of red, green, and blue light coming to the eye that determines color, but rather the formation in the retina and the cortex of an image in apparent lightnesses on three or more wavebands and a comparison at each point in this image of the three or more independent lightnesses that determines the color.

Land was elected a member of the National Academy of Engineering in 1965 and was awarded its Founders Award in 1972.

Land advocated continuing education for everyone in industry and in the professions. He established generous tuition refund programs to encourage employees to gain new capabilities. He instituted in-house educational and training programs, which became so extensive that Polaroid was called the

third largest educational institution in Cambridge, surpassed only by Harvard and the Massachusetts Institute of Technology (MIT). Believing that college students should gain first-hand research experience, he regularly brought them into Polaroid for summer jobs. Land was a visiting Institute professor of physics at MIT and served as a member of the Harvard University Board of Overseers Visiting Committee for physics, astronomy, and chemistry.

Land served the federal government in a number of capacities, including membership in the President's Science Advisory Committee and in the President's Foreign Intelligence Advisory Board for many years. He has been given major credit for the development of the U-2 high-altitude reconnaissance airplane. He received the Presidential Medal of Freedom in 1963, the National Medal of Science in 1967, and the National Medal of Technology in 1988. Land was a past president of the American Academy of Arts and Sciences and a former trustee of the Ford Foundation. He was a member of the National Academy of Sciences and the National Academy of Engineering.

As a member of the Carnegie Commission on Educational TV in 1966–1967, Land's testimony before Congress has been cited as having played a pivotal role in the creation of the present American system of public broadcasting.

He received fifteen honorary doctorate degrees and was a fellow, honorary fellow, or honorary member in numerous scientific and engineering societies. He received medals from numerous scientific organizations, including the Franklin Institute, the Royal Photographic Society, the American Society of Mechanical Engineers, the Optical Society of America, and the Society of Photographic Scientists and Engineers.

Polaroid Corporation was organized in 1937 as a successor to Land-Wheelwright Laboratories, with Land as president, director of research, and chairman of the board. He continued as president until 1975, as director of research until 1980, and as chairman until 1982. He took pride in having established a company that provided wonderful products for its customers and also had as a corporate aim an environment that provided a satisfying and rewarding work life for its employees.

A video tribute to Land, presented at the 1991 annual meeting of Polaroid stockholders, included the following Land quotations, which give an insight into his philosophy:

Any problem can be solved with the materials available in the room at the time.

Science is a technique to keep yourself from kidding yourself.

Keep your options open, baby. Don't say *yes*; don't say *no*; if you can, say *maybe*.

Anything worth doing is worth doing to excess.

Every creative act is a sudden cessation of stupidity.

While cognizant of the importance of the stock market, Land's disdain for Wall Street's growing obsession with profits per se in the 1970s was evidenced by his answer to a reporter's question about Polaroid's "bottom line": "The bottom line is in heaven."

Land founded the Rowland Institute for Science, a nonprofit basic research laboratory, in 1980 and served as its president and director of research until his death.

Land was survived by his wife of sixty-one years, Helen Maislen Land, and two daughters, Jennifer and Valerie.