

Inventions and Innovations of Edwin Land

Jeff Hecht

Edwin Land was the Thomas Edison of twentieth-century optics, a prolific inventor and entrepreneur. His milestone introduction of instant photography, at an Optical Society spring meeting in New York on 21 February 1947, often overshadowed his other contributions, ranging from 3D movies to surveillance satellites.

Land's first transformative invention was the plastic sheet polarizer in 1928, when he was not yet 20. Fascinated by polarization, he tried growing large sheets of iodoquinine sulfate, a polarizing material invented in the nineteenth century. That did not work, but he found he could make polarizing sheets by applying an electric or magnetic field to align tiny crystals of the material, then embedding them in a celluloid film. Later he invented a process for making polarizing sheets by stretching the plastic to align the polarizing crystals. Those plastic sheet polarizers became the foundation of the Polaroid Corporation.

Land also invented a polarizing filter system that he hoped could solve a major highway safety problem—headlights blinding other drivers at night. He proposed applying polarizers aligned one way to headlights and orthogonal polarizers to windshields. Light scattered from the environment would lose its polarization, so the windshield polarizer would transmit it. But the polarized windshield would block light directly from the headlights, so only a few percent would reach the driver's eyes. It sounded great, but the auto industry never embraced it.

Instead, the polarized film found other applications. In 1934, Eastman Kodak contracted to buy it for photographic filters. Kodak was also interested in polarizing sunglasses, but Land got a better deal from American Optical and in 1935 signed a contract to supply them with polarizing film bonded to glass for sunglasses.

Meanwhile, Land invented polarization-based stereoscopy for 3D movies. The first generation of 3D movies projected overlapping images in two colors, which viewers watched through glasses with red and green or red and blue filters. Land realized that glasses with a pair of polarizers, one horizontal and the other vertical, could give the same effect for overlapping images projected in horizontal and vertical polarization. A short polarized 3D film at the Chrysler Pavilion was a hit at the 1939 New York World's Fair. World War II interrupted 3D movie development but created a need for stereoscopic surveillance imaging that was met by the vectograph, a transparency-based process invented by Joseph Mahler and Land at Polaroid. Polarized 3D movies returned after the war to produce a brief boom in the early 1950s, including the first color 3D film, *Bwana Devil*.

A prescient question asked by Land's young daughter during a 1943 vacation launched his quest for instant photography. Why couldn't she see the photo he had taken right away? Land's logical mind realized it was a matter of chemistry, so he invented a self-developing film that combined exposure and processing of the negative and transfer to a positive. In early versions, the photographer pulled a paper tab or leader after exposure, starting a series of events. Inside the camera, a pair of rollers pressed the positive and negative sheets together and spread a processing fluid between them. This then emerged from the camera and, after a brief specified waiting time, the photographer pulled the two sheets apart to display the image. Afterward, brushing a final coating across the image could preserve it.

The first Polaroid cameras had input rolls of negative and positive monochromatic film. Color film followed in the late 1950s. Polaroid introduced film packs combining both types in the early 1960s, simplifying handling. Instant photography delighted amateurs, and also found many other applications—notably, recording oscilloscope traces in research labs. Theodore Maiman’s notebook recording the first laser includes Polaroid prints of laser pulse traces.

Land’s success lay in hiding the messy chemistry inside the film package. The most refined version was the SX-70 color film introduced in 1972, in which each photo was a separate dry plastic package ejected by the camera after exposure. The image area was pale green when ejected, then took on its final color over several minutes. It marked the pinnacle of Polaroid’s instant-photography success; a 1977 effort to introduce Polavision instant movies was a commercial failure.

Behind the scenes, Land was a pioneer in optical surveillance from aircraft and satellites. In 1952 he served on a panel that recommended flying a spy plane at 70,000 feet over the Soviet Union to photograph military facilities. He drew on that experience in 1954, when he was named to the steering committee that proposed the U-2 spy plane, which performed exactly that mission, collecting the first reliable data on Soviet nuclear and missile activity. Land was among the scientists that President Eisenhower assembled days after the 1957 Sputnik launch to discuss its implications. That led to Land’s involvement in the Corona series of photographic surveillance satellites, described elsewhere in this book, which provided hard evidence that debunked the myth of a missile gap, a key step in stabilizing Cold War tensions.