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PROFILE

Edwin H. Land

by David P. Robson

The other students drifted out of the laboratory as soon as they finished the assigned experiment, but one young man remained. He fiddled with a pair of *tourmaline* crystals, buttonsized pieces of mineral that looked like dirty glass. Holding them up to the light, he rotated one against the other and watched the illumination turn from bright to dark. At age 17, Edwin Land was beginning a lifelong involvement with crystals and light.

Land knew that the light was extinguished because it was *polarized*. Much of the light around us is polarized, but our eyes are not sensitive to this quality and can detect it only with the aid of a special filter, such as tourmaline. Thus made visible, polarized light has many uses. Tourmaline, however, is an uncooperative mineral. It is found in nature, but only in small pieces. Edwin Land dreamed of large polarizing sheets, the size of a window, which would open up dozens of new uses. But how could he make such a giant filter? Inspiration came from an old book about the kaleidoscope, that charming toy which looks like a telescope and produces changing colored patterns.

In early kaleidoscopes, the patterns were generated by chips of colored glass. Later, Sir David Brewster suggested making the colors by "optical interference" using polarized light. As Edwin Land described it:

> The kaleidoscope was the television of the 1850s and no respectable home would be without a kaleidoscope in the middle of the library. Brewster, who invented the kaleidoscope, wrote a book about it, and in that book he mentioned that he would like to use the herapathite crystals for the eyepiece. When I was reading this book, back in 1926 and 1927, I came

> across his reference to these remarkable crystals, and that started my interest in herapathite.

Just what is *herapathite*? It is a crystalline form of *iodoquinine sulfate*, which, Land explains, was discovered by

> William Bird Herapath, a physician in Bristol, England, whose pupil, a Mr. Phelps, had found that when he dropped iodine into the urine of a dog that had been fed quinine, little scintillating green crystals formed in the reaction liquid. Phelps went to his teacher, and Herapath then did something which I think was curious under the circumstances; he looked at the crystals under a microscope and noticed that in some places they were light where they overlapped and in some places they were dark. He was shrewd enough to recognize that here was a remarkable phenomenon, a new polarizing material.
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> Doctor Herapath spent about ten years trying to grow these green crystals large enough to be useful in covering the eye-piece of a microscope. He did get a few, but they were extremely thin and fragile—for it is very hard to grow them.

What good were these crystals if they could not be grown large enough to use? Because the crystals could lie in every direction, they would produce light rays polarized in all directions—a useless jumble of illumination. Land believed he could solve this problem and, in what might be considered a foolish move, took a leave of absence from Harvard so he could devote full attention to his experiments.

Land attacked the problem in a new—seemingly illogical—way. Instead of trying to make the herapathite crystals large, he made them far smaller. He knew that, theoretically, thousands of crystals would function as one if they were extremely small and were lined up with each other. He invented a process for precipitating needlelike crystals about 1 µm (millionth of a meter) long and a fraction of a micrometer wide. The minute needles, almost too small to be seen under a microscope, were made into a thick colloidal dispersion. This substance, of syrup consistency, was then squeezed through long narrow slits. The narrow openings forced the needles to orient parallel to one another, and the substance dried to form a solid, plastic sheet. This became the first large polarizing filter.

Edwin Land returned to Harvard and presented a lecture on this new optical device. The university provided him with a laboratory where he could continue his research.

Land’s strongest motivation in developing the sheet polarizer was his desire to equip automobiles with glareless headlights. When cars approach each other on a dark, narrow road, the drivers are momentarily blinded by each other’s headlights. Land believed that this hazardous situation could be prevented. He developed a system in which the headlights are covered with polarizing filters turned at a 45° angle. The driver views the road through a filter oriented at the same angle. With both filters at the same angle, the driver can easily see objects illuminated by his own headlights. However, when a car approaches from the other direction, its filters are tilted the opposite way, and the illumination from its headlights is blocked by the now-crossed filters. This system was thoroughly and successfully tested, but was not adopted by the auto manufacturers.

World War II brought new uses and challenges for sheet polarizers. In the North Atlantic, the search for German submarines became a matter of life and death. Aboard ships and aircraft, lookouts scanned the sea for periscopes and shadows moving under the waves. But observation was difficult, complicated by a moving craft, a bright sun, and reflections dancing on the water. Sheet polarizers were fitted into glasses, and the reflections disappeared—polarized sunglasses have been with us ever since.

However, although the war brought polarizers into wide use, it also threatened their manufacture, due to the shortage of raw material. In Africa and the South Pacific, Allied soldiers were fighting a battle with the tropical disease *malaria*. When stricken, the soldiers were hospitalized and treated with *quinine*. The same chemical was needed to make iodoquinine sulfate, the tiny crystals in polarizing filters. With increasing amounts of quinine being used as a drug, the production of polarizers was threatened.

Land personally responded to the wartime shortage by inventing a totally new type of polarizer that did not require quinine and was not based on microcrystals. Large sheets of clear plastic (polyvinyl alcohol) were stretched to pull the molecules into alignment and then dyed with iodine. The resulting filters were better than the type based on quinine and are the type used in sunglasses today.

After World War II, Edwin Land turned his attention to photography. Though chairman and president of Polaroid Corporation, he gave high priority to research and spent much of his time in the laboratory. He conducted the basic research and invented the film for instant photography. In 1948 he introduced the Polaroid Land camera, the first camera to produce a developed photograph in a minute.

Now retired from Polaroid Corporation, Edwin Land continues his research in the area of color vision. He has received 15 honorary doctorate degrees and many awards, including the National Medal of Science.

CAPTIONS

Dr. Land examines one of his inventions. This material makes possible 35-mm instant color slides.

An early Polaroid Land camera

Derived from the bank of a South American tree, quinine is an antimalarial drug and was used to make early polarizing sheet filters.

REFERENCES

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