PHYSICS

Strange Light of Service In Work of Peace and War

Polarized Light Leaves Laboratory To Work for Man; Has Many New Uses as Result of Scientist's Ingenuity

By WATSON DAVIS

A STRANGE sort of light, a scientific curiosity for 250 years, is being put to work in peace and war. It is a kind of light that to the ordinary eye seems no different from any other, yet it dances in a very restricted and circumspect way to make possible a hundred personal, industrial and military applications.

This light is called "polarized." Scientists will tell you it vibrates in one plane only. Famous Christian Huygens, in 1690, first recognized and began the explanation of this phenomenon. Professors have demonstrated it to their classes.

For years rare natural crystals like Iceland spar and tourmaline have been used as polarizing agents, in testing and in research. The basic test for ordinary sugar depends upon polarized light. But only very small areas of polarizing materials were available.

In 1852 a British scientist, Dr. William Bird Herapath, discovered, with the aid of his microscope, that tiny crystals formed by combining iodine with quinine salt had remarkable polarizing ability. But neither he nor anyone else was able to make sizable and practically useful areas of the synthetic crystals, called Herapathite. No one, that is, until the young American physicist, Edwin H. Land, tackled the task and solved it. He made a polarizing sheeting composed of the tiny quinine-iodine crystals, millions upon millions of them, suspended in a synthetic resin and all lined up the same way. This synthetic light-control material, trade named "Polaroid," produces or screens polarized light as desired, making possible extensive applications for the first time.

Will Aid Search for Planes

As America rushes its defenses, the old phenomenon of light polarization will find many more new applications, many of them kept secret for the sake of national security. When the eyes of soldiers attempt to penetrate the glare of the sky in search of enemy dive bombers, when the sea is scanned for submarines, the sheeting that screens polarized light will prove useful. In gun sights, periscopes, rangefinders, telescopes and in dozens of other ways, polarized light will be made to serve the military machine we are building.

In industry and in our everyday living, polarized light makes for lower costs, safety and comfort in scores of applications, ranging from fish inspection to motion pictures.

Consider the benefits conferred on the fish inspector, or fish candler as he is known. Polarized filters have banished for him the eye strain and fatigue that arise from looking at fresh fish silhouetted in ordinary bright light. The inspector of fish views fish after fish, just as an egg candler holds up eggs to a bright light for inspection. By use of polarizing screens, he sees only light that comes through the fish. The result is that fish-packing organizations have increased efficiency of inspections and have fewer rejections by Government inspectors who protect the public from inferior fish.

Inspects Bottles and Soap

Bottles by the thousands undergo a polarized light inspection to pick up defects in annealing. Cakes of soap, too, have their surface imperfections revealed when illuminated with polarized light—an inspection technique used by soap manufacturers.

To prove that beauty is only skin deep, polarized light is used in inspecting the skin of beautiful women. Bathed by polarized light and viewed through a polarizing filter surface highlights and reflections on the feminine skin are wiped out and sub-surface imperfections stand out in sharp detail.

The eye specialist can look his patient in the eye without fear of glare—the kind that is reflected from the eye of the patient without any emotional connection. The polarizing ophthalmoscope plays polarized light into the eye; the ophthalmologist views the eye through an analyzer which screens the reflection from the outside surface of the eye, and allows him to look deep inside without hindrance.

Trapped False Claimant

Polarized light, applied to eye examinations, has trapped persons who falsely claimed damaged eye sight in order to collect insurance. One young woman claimed that one of her eyes was damaged in an accident. The examiner gave her a pair of polarizing glasses with the planes of polarization of the two lenses at right angles to each other. She was asked to read from one of those scrambled alphabetical charts that eye doctors use. The trick in the examination was to first project the charts on a screen with vertically polarized light and then quickly switch from vertically to horizontally polarized. This means that the image can be seen by only one eye at a time. When the woman kept reciting as the illumination changed from vertically to horizontally polarized light, it proved conclusively that she was seeing equally well through both lenses and, therefore, with both eyes. Her $50,000 claim for damages was thrown out of court.

Crack railroad trains speeding over western plains are light-conditioned as well as air-conditioned. Light conditioning is made possible by windows of two polarizing discs with flat surfaces against each other. They are mounted in such a way that the outer disc is set stationary to block all reflected glare while the inner disc can be moved by turning a knob, whenever the passenger wants to reduce or increase the amount of light that enters the car. Exactly the same principle is used in new variable sun glasses which enable the wearer to reduce the brilliance of a scene simply by touching a button on the glasses.

Three-Dimensional Movies

Three-dimensional pictures, either still or in motion, black and white, or in color, are made possible and practical by using polarized light. The trick is similar in principle to that of the old stereoscope that was a familiar entertainment in the parlors of our grandfathers. The new three-dimensional photographs allow one eye to look at a picture that the other eye can't see because it is wearing a polarizing screen opaque to that kind of polarized light. The same thing applies to the other eye. Thus, the two eyes see slightly different pictures just as they do in real life scenes. This gives the illusion of depth.

The new vectograph process, as it is called, produces three-dimensional prints without distortion and the same process

makes possible the projection of three-dimensional pictures in natural color, either motion or still, with the use of standard motion picture projectors. Thousands of amateur photographers will soon be producing snapshots with real depth, and millions of moviegoers in the future will have the screen of their theaters disappear and become a stage before their eyes.

Solves Engineering Problems

To the engineer, polarized light brings the possibility of solving difficult engineering problems. Little models of bridges, buildings, airplanes, gears and other mechanical structures are built, and the stress within them can be determined by still another application of polarized light.

Solving the problem of glaring automobile headlights seemed imminent when the invention of Polaroid light-controls was first announced about four years ago. This invention which might very well save thousands of lives a year is not yet ready for application to America's millions of automobiles. There are a good many problems involved, not the least of which is the fact that every windshield and every headlight on all cars must be equipped with polarizing screens if all motorists are to receive protection all the time. Polaroid is finding other uses, meanwhile.

Colorful for Advertising

It does a colorful advertising job—literally. By placing colorless sheeting, like cellophane, between two polarizing screens colors are produced like those of the wings of a butterfly, or oil slicks on water. This phenomenon is being used practically in advertising displays, murals and stage sets.

Polarizing filters do for the camera what polarizing glasses do for vision. They reduce unwanted surface reflections and eliminate the "hot" spots of reflected light. Scattering of molecules in the atmosphere produces at least partial polarization of blue skylight. Since this is the case, polarizing filters can be made to darken a blue sky in a snapshot when attached to a camera, and photographing in a direction at right angles to the sun.

The scattering of particles under water produces partial polarization of the subsurface light. Hence, under-water photographers are able to create a dark background against which foreground objects stand out in sharp clarity and contrast.

Polaroid light-control material has an ever growing list of practical applications. Marksmen use it in gun sights to ease the eyestrain of target shooting. Amateur motion picture cameramen use it to get smooth professional "fades." Draftsmen use it to take the glare from drafting boards. Engineers use it to build giant telescopes. Textile experts to foretell the wearability of cotton fibers. It is used to study the corona of the sun. Sound engineers use it to determine the grain of crystals in phonograph pickups. In thin film research it is used to determine the presence of layers only one molecule thick. It is used as an aid in research for the cure of cancer. It makes three-dimensional X-ray pictures which can be viewed simultaneously by many doctors.

These and many other applications are made possible by Edwin H. Land's invention of the first polarizing screen made synthetically in almost limitless areas. With polarized light as a raw material, the scientist fashions new tools and the manufacturer makes new machines and products.

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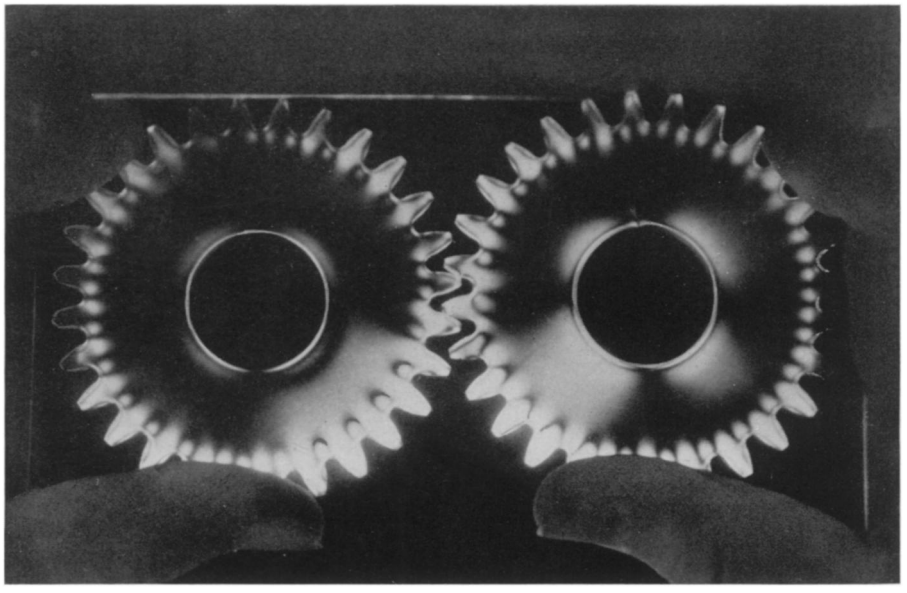

PRACTICAL APPLICATION

Models of gears are made with transparent bakelite and examined between polaroid screens. Dark lines indicate areas of strain in the model gears which would also occur in actual steel gears. Strain points are observed where the gears mesh.

ASTRONOMY

Theories of Spiral Galaxies Questioned by Astronomer

CURRENT theories of the evolution of the huge spiral galaxies, star systems that look like pinwheels and are really similar to our own Milky Way but outside its limit, are questioned by Dr. Gunnar Randers. He is a Norwegian astronomer now at the Yerkes Observatory of the University of Chicago.

In a paper in the *Astrophysical Journal* (October), he says that there is no observational evidence for the idea now held that the "old" spirals are formed from "young" elliptical nebulae.

"Many spirals," he says, "suggest that the greater part of their material may be in the arms. If the arms were ejected from a system originally densely packed, the almost complete dissolution of that system would have been accomplished against the pull of the system's gravitational force."

He suggests that "the nebular patterns are formed by the redistribution of the matter inside the originally 'smooth' nebula. This redistribution would take place early in the evolution of the nebula while it is still young and stars have not yet been formed from the gas of which it is composed."

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