PHYSICS

Three-D Home TV Foreseen

The revived photographic technique of holography could make life-sized, three-dimensional television sets a reality in U. S. living rooms before 1984—By Ann Ewing

➤ THE PACE of new developments in the recently revived method of photography known as holography is so fast that three-dimensional television sets portraying life-size scenes could be a reality before 1984, as was predicted in George Orwell's novel.

Holograms contain all the information a photograph does, plus more. They show the original scene so realistically that a person viewing them can peer around objects by moving his head, just as he could if he were actually present.

A hologram is a recording of an interference pattern reflected from an object. From this recording, the object's image can be reconstructed visually in a three-dimensional form.

Although holography is a form of photography, no lenses are required and the exposed film bears no resemblance to an ordinary negative. The film actually consists of a random granular pattern. The lines, specks, blobs and whorls sometimes seen are caused by dust particles on the equipment.

When light is beamed on the hologram, an exact reproduction of the original scene is formed. Until recently, only the highly intense and ordered light from a laser could be used either to reproduce or to reconstruct a sharply defined hologram.

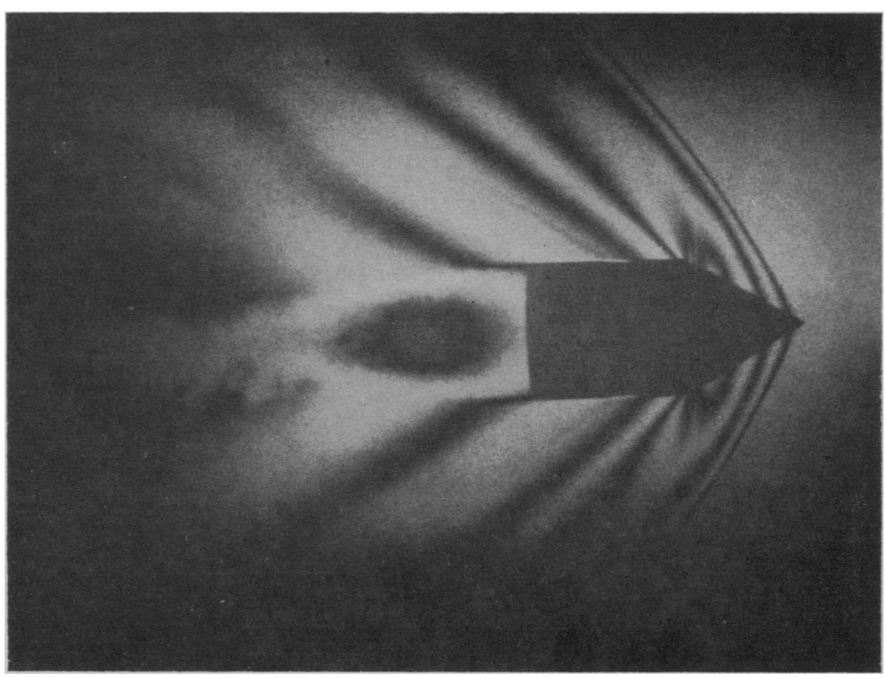
Now, however, holograms have both been made and reconstructed using ordinary white light. Furthermore, three-dimensional color holograms have been produced using only black and white film.

Eliminate Laser Light

Eliminating the requirement of laser light is seen as a tremendous advance by experts in the field, even though results can now be achieved only by using elaborate opto-electronic equipment and processing methods.

Storage of hologram images in such three-dimensional media as thick film emulsions or crystals has resulted in several new uses for this technique of lensless photography. An animated hologram, or 3-D movie, has been produced in full color in ordinary light by scientists at the University of Michigan, Ann Arbor.

The animated hologram is produced from several images, or interference patterns, each of which is diffused over the entire surface of a single photographic emulsion by rotating the emulsion plate slightly for each successive recording.



TRW Systems

SPEEDING BULLET—This photograph was taken from a holographic interferogram of a conically tipped .22 caliber bullet moving through argon gas at two and a half times the speed of sound. Scientists at TRW Systems, Redondo Beach, Calif., are among those who have developed a method of mating interferometry and laser holography.

Each image must be recorded—and viewed—at a particular angle. By changing slightly the angle of each exposure, several holograms can be recorded on one plate, provided it is of sufficient thickness. These can then be viewed in succession merely by rotating the plate in a beam of light.

This advance resulted from the exploration of the high storage capabilities of various three-dimensional media. The University of Michigan scientists involved in the studies included Drs. Emmet Leith, Juris Upatnieks, and George Stroke.

They are extending a theory developed independently by a Russian scientist, Prof. Yu N. Denisyuk, and an American at the Polaroid Corporation, Dr. Peter van Heerden. This theory describes how thick film emulsions or crystals can be used to store many images.

The full-color hologram follows Prof. Denisyuk's work of combining holography with the time-honored Lippmann photographic process. In 1908, Prof. Gabriel Lippmann was awarded the Nobel Prize in Phyiscs for his method of reproducing color by the interference process now bearing his name.

His process involved producing color pictures using black and white film of high resolution. This was accomplished by recording the emulsion interference fringes that selectively reflect different colors under a beam of white light.

The Lippmann effect can be likened to the way an oil film floating on water produces a rainbow-like display of color when viewed by reflected light from the right angle. The same process is applied in holography, using a wavefront or interference recording instead of the photographic negative to produce the 3-D color representation.

The process for reconstructing wavefronts was discovered in 1947 by Dr. Dennis Gabor of the Imperial College of science and Technology in London. During the following few years, Dr. Gabor developed the method systematically, with particular emphasis on its application to electron microscopy.

However, it was the invention of the laser that spurred the recent ad-

vances in the intriguing photographic process known as holography. This was because previous efforts to develop wavefront reconstruction were hampered by the lack of an adequate source of coherent light—that is, light whose waves are all in step, instead of the usual jumble of frequencies.

The widespread resurgence of interest in and research on holography has, in a paradoxical full turn, now enabled scientists to use white light to produce 3-D color reproductions.

Holography permits a complete recording and reconstruction of the light waves scattered by, or reflected from, the object or person illuminated. Because of this, the most striking feature of a hologram is its absolute realism.

Resolution, Detail High

Likely more important, however, is the fact that the resolution and detail of a hologram is virtually as high as the original objects, thus permitting microscopic examination of the image with powerful optical instruments. Also, because lenses or other focusing elements are not necessary to make a hologram, the depth of field recorded is virtually unlimited. This permits microscopic examination of a sample volume millions of times greater than a conventional microphotograph.

Furthermore, a very wide range of brightness values can be recorded with great fidelity.

Because a hologram, in effect, "freezes" a scene as it actually was and because it can be made in 20-billionths of a second or less under pulsed laser light, holography is becoming a valuable tool for studying effects that take place too fast for other known observational techniques.

Whenever desired, the "frozen holographic" image, containing all of the information of the original, can be reconstructed for leisurely and detailed examination.

Holographic Microscopy

Applications of holographic microscopy are reported to be important in studies of air pollution, biology, oceanography, electrification of fluid streams, combustion processes, colloid rocket engines and many other fields.

Another important application of holography is interferometry—an optical method of measuring extremely small changes in the dimensions, density or other properties of solids, liquids and gases by actually comparing light waves. Because the wavelengths of light are extremely short, interferometry is one of the most sensitive methods of measurement known. It is commonly used to test large telescopic lenses for the required smoothness.

Holography permits interferometric measurements to be made of very complex subjects and situations that could not be explored using other methods. This has application in such areas as

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Science Club News

El Paso Summer Institute

➤ THE NATIONAL Science Foundation reduced its support of summer science training programs for high school students from 194 in 1965 to 129 in 1966, with participation being reduced from about 8,000 to some 5,000 students.

The NSF brochure states that ". . . the Foundation expects to stimulate . . . and to encourage the further development of similar programs with other sources of support." It appears that the NSF hopes that school districts will sponsor such programs without Federal assistance.

One example of what the National Science Foundation is hoping for is the El Paso Summer Institute for academically able and ambitious students sponsored by the El Paso Public Schools and the El Paso Rotary Club in cooperation with Texas Western College and New Mexico State University and numerous scientists working at area industrial and military establishments.

The Institute is now under way, running from June 7 through July 16 with approximately 230 student participants.

Eighteen to 29 students enrolled in the senior division will take a 12-day field trip to scientific facilities as far as Chicago at the conclusion of the Institute.

There is a charge of $20 for one course, or $35 for two courses, plus $175 for those students taking the 12-day field trip.

The El Paso Rotary Club and several PTA groups have made some scholarships available to defray the cost for qualified students on the basis of financial need.

Each course will be taught by a qualified college-level instructor. Students who are enrolled in the senior division should be better prepared to take advanced standing or college placement tests and find adjustment to college work easier. Each course is comparable to a semester's work in college.

El Paso hopes other school districts also will organize such local programs.

Observation Week

The Astronomy Club of Goshen, N.Y., plans an August trip to a member's cabin in Vermont, where they will view and chart various star clusters and constellations, and view a scheduled meteor shower and satellite appearances.

Does your club have special plans for summer? Are you planning outstanding projects for the coming school year? Share you plans and experiences by writing to Science Clubs of America, 1719 N St., N.W., Washington, D.C. 20036.

Remember, those who will win next year's science competitions are at work on their science projects now. Last minute attempts are not likely to be successful.

• *Science News, 89:471 June 11, 1966*

Three-D TV

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aerodynamics, fluid dynamics, plasma and explosion research, material strain and vibration, erosion, optical testing and quality control.

Holographic interferograms have been used to trap successive instants in the lifetimes of such lightning-fast events as the flight of a rifle bullet and the warming of a light bulb.

The successful mating of interferometry with laser holography was recently achieved independently by scientists at several laboratories. The double-exposure technique has been dubbed "good physics but bad photography."

The method was developed by scientists at TRW Systems, Redondo Beach, Calif., the National Physical Laboratory, Teddington, England, the University of Michigan, and Bell Telephone Laboratories, among others.

Such wide and active interest in holographic techniques points to an even wider range of applications in the future.

Although some scientists charge that predictions of 3-D television pictures in color on a home screen several years from now are visionary if not downright unrealistic, the advances made recently in developing holography could easily prove the skeptics wrong.

• *Science News, 89:468 June 11, 1966*

GENERAL SCIENCE

Knowing Weather Can Save Industry Fortune

➤ THE CONSTRUCTION industry in the United States could save up to one billion dollars each year by using weather information now available to avoid losses caused by the elements.

This conclusion, resulting from a continuing study to determine how weather affects differing segments of the economy, was reported to the Weather Bureau in Washington, D.C., by the Travelers Research Center, Inc., Hartford, Conn.

The construction industry accounts for more than 10% of the gross national product.

Weather affects nearly all construction operations, from planning and surveying through paving, landscaping and painting. Nearly half the annual construction cost is especially sensitive to weather factors since it involves outdoor work or perishable materials.

• *Science News, 89:471 June 11, 1966*

TECHNOLOGY

Gyro-Stabilized Sight Operates From Air

➤ A GYRO-STABILIZED gunsight designed to aim the U.S. Army's supersonic TOW antitank missile from helicopters, will keep a fixed bead on a target despite the 'copter's vibrating and maneuvering.

Hughes Aircraft Company, Culver City, Calif., developer of both missile and sight, explained it will enable gunners to hold the aiming crosshairs on moving or stationary targets such as tanks, armored vehicles or ground emplacements even while the helicopter pilot is taking evasive action to avoid ground fire.

TOW, which stands for Tube-launched, Optically-tracked, Wire-guided missile, will follow the gunner's line of sight to the target, steered by electronic signals that are jam-proof because they are sent over hair-thin wires that unreel during flight.

• *Science News, 89:471 June 11, 1966*