



THE BLUE SKIES OF HOLOGRAPHY

By Louis M. Brill



Holograms, a magic word that conjures up 3-D pictures, images floating in space, multi-dimensional environments, is all these concepts and more. Basically holography is a process of creating special lenses that present either three dimensional reproductions of a scene occupying the same form and space as the original object, or prismatic lenses which generate multitudes of various rainbow effects. The potential design aspects of the medium present new lighting concepts for entertainment that incorporate techniques of illumination with the magical possibilities of optical illusion. Applications of this process provide a host of visual possibilities in theatrical and dance set designs, interior design, fashion design, lobby displays, window displays and kinetic light sculptures.

The process of holography was discovered in 1948 by Dennis Gabor, but was not "launched" until a suitable form of illumination (laser light) was discovered in 1961. Laser light, unlike ordinary white light, has special qualities (coherence, monochromatic, directional and concentrated intensity) which enable it to create the unusual imaging effects which are the trademarks of holography. The end result, a hologram (a word meaning "complete message") radiates a certain kind of magic with its images floating casually in space. Although it has yet to come full term in all of its potential (complete color, life size projection and cinemaholography), holography has established a basic foundation as an artistic visual medium, a viable commercial process and a new chapter in lighting design techniques.

Hologram Production

An explanation of the production of holography entails physics, optics, chemistry, and a certain amount of "cosmic consciousness." The unique features necessary to create a hologram are a positioning table (to set up the optics), various optical elements (lenses, mirrors, beam splitters, etc.), a source of coherent light (laser light) and sensitive films to take advantage of the laser illumination. Our concern in this discussion is more the application rather than the production of the holographic process. However, we will provide a basic understanding of how a three dimensional image is produced.

A hologram is a piece of film that records and plays back the patterns of light waves from their original points in space. In recording these patterns of light from an object, it documents the actual shape

of the object — information about its surface characteristics, its sides and top, and also its relationship in space to its surrounding environment. All of this information is recorded into a holographic film emulsion which (through laser light exposure) is now changed into a special "lens." Once properly developed and illuminated correctly the film will present an image of the original object to the viewer, floating in space with an accurate rendering of its shape.

What actually happens is that the holographic film converts its gelatine state into a diffraction grating (a way of manipulating light) which acts as a lens to reflect or transmit lightwaves back to their points of origin in space. Thus these recorded lightwaves project an image into space which is visually interpreted by our brain.

In the case of holography it is the holographic film that captures the optical information and holds it within the film, presenting a recorded version of the original three dimensionality of the object, its surface characteristics of depth of field, (length, width and height), and its visual characteristics (reflected light, and parallax), creating a projected duplicate shape of the original object.

An analogy is to think of a mirror with a frozen image — one that never changes. You can walk around the scene, see the sides of it and the surrounding area...hence the view is complete. A hologram is similar in some respects to a mirror in that it reflects a scene. Better yet, a hologram preserves it.

Properties of a Hologram

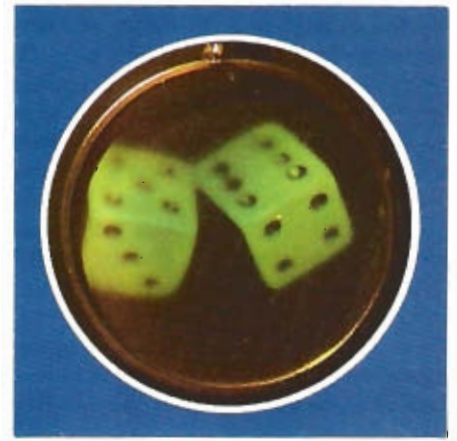
A holographic image can present a scene in unique ways. The characteristics of holography provide the basic tools for lighting design with the following techniques that intergrate both production concepts and image style.

Holograms have certain *properties* in presenting three dimensional images and several *processes* for forming these images. Taking the former characteristic first, some of the properties include:

1) Holograms can *project a scene* in space causing it to float either in front of, behind or coming through the film surface.

2) A hologram can *record two or more different scenes* on the same piece of film as a double exposure and can be viewed separately or as part of the same image.

3) It can project images backwards,



an inside-out visual effect known as the *pseudoscopic view*.

4) Holograms establish a *true depth of field* recording the shape of an object.

5) Holograms create *Parallax*, the three dimensionality of the image which provides several points of view of observation by changing your angle of view.

6) Holograms establish *chromatic signature*; depending on your selected process, they will exhibit specific ranges of colors.

Thus in the design aspects of holography, scenes are composed taking advantage of these various optical properties. For example, projecting images into space (as even a one inch projection has a startling effect) causes a personal involvement between the viewer and the hologram



Left: *NORTHERN LIGHTS...chromagram used as a backdrop for photo or cinematic visual effects. Photo and hologram by Vincent DiBiase. Above: DICHROMATE...formed as pendant jewelry. The dice are known to come up '7-11' under the right conditions of bright light and a good shake. Dichromate hologram by WesTech Development Labs. Photo by Margie McCoy. Below: UNTITLED...holographic chromatic collage assembled as juxtaposed color separations. Shifting view causes color changes within the hologram. Rainbow collage process. Photo and hologram by Randy James.*

because people not only stop to examine the image, but also feel compelled to reach out and touch it. To their surprise, people can see around the image. Double entendres can be created by hiding real objects within the image to create a deceptive view especially as the real objects or holograms fade out creating a different meaning to the scene.

The design aspects of a holographic concept are definitely a visual special effect and should take into consideration maximum viewing appeal, dramatic presence and general location within the context of its presentation.

Five Processes

Not only can you manipulate various optical possibilities in creating holograms, but you can choose between several "processes" each with a unique imaging situation and chromatic signature. There are many types of holograms. Some of the more popular production formats include:

Reflection Image Plane

Holograms which are illuminated from the front of the film surface and can form projected images... images that appear to float off of the film surface and provide the observer with several points of view (parallax). A second feature is the depth of field within the surface of the hologram can be several inches "through" the film area. These holograms tend to give off a reddish-orange color but can be 'fixed' to reflect in a particular color. They are produced in glass or film acetate.

Rainbow Holograms

Holograms which are viewed by light transmitting through them, they present a scene through the primary scheme of colors from blue to red. These holograms yield very bright images, demonstrate good horizontal parallax and have a projected depth up to a couple of feet. They are produced on glass or film mediums.

Dichromate Holograms

Brightest type of manufactured hologram. Images are sometimes brighter than the original object, and the hologram appears as if the scene was glued into the film. Dichromates are usually formed on glass disks (1-1/2 to 2 inches diameter) as pendant type jewelry. These holograms

yield excellent viewing in almost any lighting conditions (indoors & outdoors) and can be viewed from any angle. Holograms are created on glass only and film size varies up to 8 x 10 inches.

Multiplex Holograms

Holographic method of recording people or objects in motion. A two step process whereby the 'scene' is established on a circular stage, facing a fixed position camera at stage front. The stage is slowly moved past the camera and the people are filmed in varying degrees of parallax as they move about. The film is developed and edited and then placed in a special optical printer where the celluloid images are transferred into holograms and printed across the holographic film. With three frames of movie film to every degree of motion, a complete 120° multiplexed film contains 360 holographic images. The developed multiplexed hologram is placed in a semi-circular display where the images are eerily suspended in a three-dimensional form floating within the center of the film display case. The hologram scene moves back and forth with its own particular motion relative to the viewer as they walk around the image. The creative possibilities with multiplexing lie not only with its staging, but also cinemagraphically with the tricks of fades, dissolves, overlaps, and multiple exposures. The holographic film is placed in a display case approximately 12 x 19 inches with a built in light source, ready to be mounted on a shelf or wall.

Diffraction Grating

A holographic effect which acts as a prismatic lens and converts illuminating sources (incandescent lights, candles, sunlight, etc.) into bursts of colors. These chromatic effects come in varying shapes that either radiate in circular patterns or from a central point like the spokes of a wheel. The spectrums are very bright and seem to float outwards from the light sources. This holographic film technique lends itself very well to theatre staging, photographic and cinemagraphic effects and under certain circumstances will project various rainbow images across the floors and awals of walls of whatever rooms they occupy. This process is most suitable for wide viewing areas, visual special effects and light sculptures.

Thus holography becomes a particular part of the lighting design process, a phenomena that works not as a lighting source but as the "product" of a lighting source. While

there are many types of holograms, most of them are illuminated under similar conditions. Optimal viewing is created by clear incandescent bulbs and the exact placement of the hologram in relationship to both its lighting source and the viewer's eyes. Correctly set up, a hologram will offer very bright and visually clear three dimensional images.

Interior Spaces

Holograph (although in its infancy of technological development) offers not only creative processes, but it also redefines the possibilities of interior design spaces of buildings and lobbies with its potential as well as practical applications. Thus previously empty spaces such as walls, windows, and podium displays take on new meaning as one considers the decorative aspects of a well placed 3-D image. Holograms can be set-up as hallway hangings, or kinetic sculptures in lobbies of public or corporate buildings. Cleverly built displays can easily hide the source of illumination and still project a three dimensional image, change its color or move around within its display.

A well defined hologram is more than an interesting image, it defines the space around it. Overhead ambient lighting should be dimmed; the hologram should be placed at approximately eye level of the viewer. Since holograms have limited viewing angles, companion pieces can be included at various levels to accommodate the assorted heights of the viewers, and most important, the holographic space should consider pedestrian traffic movement. People will certainly take the time to look at the displays, so they should be placed to suit group viewing situations rather than impede the traffic flow of people.

The design criteria (controlled lighting, location...) defines some viewing spaces for commercial applications in window displays or point of purchase areas. For theatre environments, holograms lend themselves very well as light sculptures for lobby or window displays and in limited ways as a stage effect. The Diffraction Grating material with its prismatic color changes can certainly make the difference in a scene's set design or as part of the costume of an actor. Colorful and easily viewable they can add a certain life to a production's "atmosphere." Like other special effects, it is not to be used in every play, but can certainly provide the right 'look' for musicals, fantasies or avant garde productions.

(Continued from pg. 25.)

Holography has established itself as a technological process with not one but five or more processes. Most important, the production technology is always improving with new films, new developing processes as well as the ability to copy large volume quantities of images. The variable factors for viewing such as brightness color control, and depth of field, are constantly changing to provide crisp images, very large and easy to observe.

Future Applications

As for the future, we can also ask for the moon: life size projected holograms on rolls (like wallpaper), hang merely from the ceiling and with a well placed light source aimed at it. There you are in your living room right in the middle of the Amazon jungle or perhaps sitting atop the French Alps. For museums,

there is a chance to create life size walk through panoramas with no worrying about "please do not touch." The standard screens of television and film will be replaced with liquid crystal "light valve" projection screens to present their version of 3-D image projection. The cost for large scale holography will be astronomical, with technological gaps still to be filled with years of experimentation... but sooner or later...

But for the present, with a wealth of creative possibilities and a growing population of artists and art galleries investigating the process, the sky's the limit. Gary Zellerbach put in succinctly, "Holography isn't going to go away. It's not a trick or a fad. It's how we record the universe, and given time through public exposure, people will begin to appreciate it as a tool of visual perception and an artistic medium."

In the meantime lighting designers' ac-

cessibility to this process is limited only by their imagination. They can rest assured that now or two years from now when they need the process, it will be there shining bigger and better.

About the Author

Louis M. Brill is involved in the artistic and entertainment aspects of lasers and holography. He has formed Wavefronts (San Francisco) as a design center for visual special effects for theatre and dance performance situations. The center is currently assembling "The Theatre of Performing Lights" as a multi-media light show, and exploring the various aspects of holography as special effects for theatre set designs, interior design light sculptures and museum exhibitions. Mr. Brill is also a design consultant for Holos Gallery. □

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Other Applications

One should also consider the possibilities of holography and fashion design. The often mentioned color burst Diffraction Grating has great potential as a fabric source and potential in design of clothing. The grating material which changes color in regard to light can react to both sunlight and indoor light. The different illuminations create subtle color shifts within the fabric material or if carefully designed, could even project an image off the pocket or collar of a shirt or blouse.

Holography today is like the tip of an iceberg — you know there is more to it, but how much more...? Not only does holography provide us with three dimensional image projection and abstract pure color displays, but most of all, it is establishing a new visual literacy for artists, lighting designers and viewers.

Holographer Vince DiBiase describes the hologram process as a "frontier experience" for the viewers and creators of these three dimensional images. "Current graphic design media for the most part use flat art-images printed or painted onto a sheet of paper and only representative of depth. A holographic image, of course, is truly three dimensional and projects in space and away from the surface of the film plane. Most people who still have a linear "flat art" spatial orientation of visual art have had to literally learn how to comprehend projected 3-D images."

DiBiase has established several interesting holographic processes during his many years of flashing lasers into holographic environments: large plate projection holography including images ranging from Buddahs to UFOs; all floating serenely two feet in front of the film surface, hologramed photographs, a unique optical process that enables one to convert any standard 35mm slide into a hologram, and most exciting an abstract process known as "Chromagrams."

Chromagrams

Chromagrams are holograms of pure color that project in space literally dancing through the rainbow of colors they present. The chromagrams establish "color messages" evocative of flower petals, crystal shapes and swirling patterns that not only are three dimensional, but also change their shape and color in relationship to distance from the hologram. An added benefit is their chromatic interpretation differs in regard to their light source. Incandescent light presents a totally dif-

ferent spectrum than fluorescent lighting, sunlight or whatever else you choose. DiBiase explains that the chromagrams act as kinetic light sculptures that produce colors and placement of colors above and through each other in a multidimensional space not normally seen in everyday reality.

The success of holography can be measured in the interest expressed in the medium around the country. In New York City, the Museum of Holography (founded in 1975) has successfully produced one of the greatest collections of holograms by artists throughout the world coupled with a bookstore, information center, lecture-demonstrations and several touring hologram shows. Demonstrated in its most important way, the art has inspired a host of holographic galleries around the country that exhibit the various holographic art forms to the public.

Expectations Vs. Technology

As public exposure to holography expands, the expectations of people sometimes exceed the possibilities of current technology. While the basic technique of holography is demonstrated in its ability to present projected images in space, it also suffers from the promise of science fiction with no consideration to cost effectiveness. Holography is a business as much as an art form. The costs for original design manufacture of holographic images are expensive enough to limit the process to the mass production of commercial resale applications (jewelry, pendants, and wall plaques), to corporate promotional and advertising budgets and entertainment design applications (stage lighting, costume enhancement or visual effects).

Gallery director Gary Zellerbach of the Holos Gallery of San Francisco, having established a center for the artistic presentation of holography, underlines that point of holography as a misunderstood process. People conjure up holographic concepts with no idea of the production costs involved or technological feasibilities. One must understand that holography is a particular kind of experience; it involves a delicate relationship between the brain and the eye. Unlike a photograph — a person must learn 'how to see' the images rather merely looking at them. It requires participation. But gallery viewers do not always understand this and often walk around missing a lot of image presence.

"Customers come in and ask for the moon," Zellerbach claims. "While people don't go to gun stores and ask for

laser pistols or try to book flights on star ships at the local airport, they do take the science fiction expectations of holography very seriously and expect things that are not technologically available. Holos Gallery, has fielded requests for projected full size floating images of Greek gods flinging lightning bolts, ghosts shooting through space and an encounter of planets, moons, and asteroids hanging over the audience of an upcoming play."

This misconception shows that people understand the potential of the process but not its current technological limitations. In time, the various limitations will be solved and add to the repertoire of the artistic possibilities.

Another holographer, Randy James, also expressed concern for the public appreciation of the art form: "People have to take the time to look at holograms and when they do are often surprised by the results. Generally those most impressed with holography are people who've never seen holograms or scientists who are surprised by the technological expertise and artistic development outside the institutional laboratory setting."

The artistic development of holography becomes the proving ground for lighting possibilities with the various optical and chromatic techniques of diffraction grating, Dichromate and Rainbow effects. For the lighting designer, holography offers a challenge with its applications and a whole new set of rules for lighting in presenting holograms in large spaces, stages or window displays.

"People have to accept holography, like neon lighting with its own set of limitations," Randy points out. "It has limits in terms of size and ambient light levels, yet in suitable environments such as night clubs, or bars, these very limitations become selling points for visual displays or as potential advertising medium."

Through Randy's pursuits in holography, several interesting image concepts have emerged: a triptych of apple holograms with each succeeding image showing the apple eaten towards its core, an egg with a jewel floating across its surface, and a series of science fiction other world scenes. James's current interest in holography is concerned with its optical possibilities rather than three dimensional aspects. Accordingly, he is emphasizing the chromatic optical and distortion effects of holographic images juxtaposing color separations by collage techniques. This is a rainbow effect that alternates — each time you move, the rainbows swing back and forth — reds to blue, blues to green.

(Continued on pg. 40.)