NEW SPACES

THE HOLOGRAPHER'S VISION

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The Franklin Institute

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Karen Spitulnik Peiffer, Visiting Curator

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PHOTO CREDITS

Rudie Berkhout
"Sketching Away"*
"Spatial Frequencies II"*
"12 mW Boogie"*

Anaït Arutunoff Stephens
"Space Daisies"

Rudolph Burkhardt
"Hologram"

Nancy Safford
"Digital"

David A. Klein
"Dancing Bars"*

Jeanne Leong
"Self-Portrait"

Stephanie Beroes
"The Wave"

Paul Foley
"A Woman"

Nishan Bichajian
"Equivocal Forks I"

Donald K. Thornton
"Untitled (Rose Prism)"*

Steven Borns
"Thoughts"

*reproduced from original color photograph.

COVER DESCRIPTION

FRONT COVER: "Sketching Away," Rudie Berkhout, 1979, White light transmission 8″ x 10″ 20.32 cm x 24.5 cm, collection of the artist

BACK COVER: detail from "12 mw Boogie," Rudie Berkhout, 1978, White light transmission, 8″ x 30″ 20.32 cm x 76.2 cm, collection of The Franklin Institute

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INTRODUCTION

Ancient Babylonian, Hebrew, and Egyptian myths unite scientific thought and artistic expression. In more recent times, Newton's influence on Blake, Keats, Turner, and other 18th and 19th century creative artists; the breakdown of "common sense" Newtonian physics and representational art late in the 19th century and the subsequent emergence of modern physics and cubism; and the obvious debt more recent movements such as op and kinetic art owe to contemporary technology, all strongly assert the unity of all of man's creative achievement.

In presenting "New Spaces: The Holographer's Vision," an exhibition uniting science, technology, and art, The Franklin Institute seeks to give truth to T.S. Eliot's profound comment:

> It is ultimately the function of art, in imposing a credible order upon ordinary reality, and thereby eliciting some perception of an order in reality, to bring us to a condition of serenity, stillness, and reconciliation.

JOEL N. BLOOM
Director
Science Museum and Planetarium

NEW SPACES: THE HOLOGRAPHER'S VISION

"New Spaces," quite simply, is both an international group exhibition of the finest works of holographic art extant and an explication of the scientific and technological underpinnings of the medium. Discovered in 1947 by Dr. Dennis Gabor, holography—a three-dimensional imaging process using laser light—did not become possible as an art medium until the sixties.

As the science and technology of holography became better known, artists of varying backgrounds as well as scientists rushed to make holograms and to perfect technique. Unfortunately, many of these earlier works, though reflecting scientific and technical knowledge and skill, often lacked expressive, aesthetic dimensions. In the public gallery melee that ensued, art and science became confused, and technological bravura masqueraded as fine art.

That holography might one day become a valid vehicle for aesthetic expression was not the major question. The basic criticism centered around its then fledgling status—the harsh uncontrollable colors, the limited, uninspired and often meaningless selection of subject matter, and the unyielding, unpredictable technological base.

The aesthetic challenge to the new medium became clear: Could the color and forms of this three-dimensional image-making process be made into an aesthetically valid form of communication, not an inferior form of sculpture or a popular celebration of technology? Could the time element involved in the phenomenology of the holographic vision be made an expressive element of visual discovery, not the revelation of trivial details offered by the presentation of the "illusion" of three dimensions?

"New Spaces" presages broad public and critical acceptance of holography today as a legitimate fine art medium, based upon the acid-test of aesthetic quality alone. Although holography is still comparatively young, holograms of a wide variety of types are currently being produced that are worthy of serious attention and of critical recognition. Holographic artists have begun to develop a "holographic vernacular"—an aesthetic vocabulary of expressive, "sensuous forms, soaked in significance."

That holography still has enormous potential for aesthetic and communicative growth is not an issue. In a loose analogy, the same could be said of easel painting and most other vital art media. That its difficult technological infrastructure will be simplified and ultimately tamed, I have no doubt.* At this very moment, however, we can enjoy holographic works of art of first-rate quality.

For example, Rudie Berkhout, in "12 mW Boogie," "Sketching Away," and "Photon Study #10," has made brilliant use of the often intractable rainbow color, produced by the diffraction of light in the holographic imaging process, to create color harmonies melding fluidly in luminous compositions of abstract or geometric forms. Al Razutis ambitiously has integrated holograms and literal sculptural elements in his surrealist, mixed media conceptions. Anaït sensitively weaves holographic visual elements within traditional collage. Using her lithe, dancer's body as part of her aesthetic statements, Amy Greenfield in "The Wave" has successfully translated a film of her rolling in the pounding surf into a 360° integram. Peter Nicholson has produced a startlingly detailed holographic self-portrait, using a pulsed ruby laser and reverse lens. In "Pumpkin Seeds," Scott Nemtzow has transformed the ordinary into a precisely defined yet seemingly random composition, which, paradoxically, evidences sensitivity to texture, visual rhythm, and great control. William Larson has effectively used the temporal element of the holographer's vision to explore the serpentine coruscations of light as it travels along slender metal pins suspended from a vine. And Sam Moree, in "Sidewalk Dreams," has produced a beautiful work, which sings with color as clear and crisp as nature herself.

* * *

It is perhaps interesting to note that over a century and a half ago, The Franklin Institute was composed of scientists and inventors, of artists and artisans. It was the national forum for the discussion, public instruction, and dissemination of scientific and technological achievements. True to this tradition, the Institute was historically

*In holography, one speaks developmentally in terms of weeks and days, for what was impossible yesterday, and has occurred today, will be a usable tool tomorrow. Therefore, we have included a very small number of works in the exhibition that represent the most recent, diacritic, technological breakthroughs of special importance to holographers. These new imaging techniques are so closely married to the ultimate look of the holograms produced that even in themselves they have an aesthetic significance; they profoundly affect the state of the art by expanding the means available. The closest analogy is the "material-process interaction" concept often found in exegesis of the historical development of art and architecture.

important in introducing and recognizing new developments in photography, photochemistry, and optics—from the first American translation of Daguerre's account published in its *Journal* and the general investigation of the visual properties of light, to the many articles published, meetings held, and competitive exhibitions initiated to advance the aesthetic as well as technical innovations of photography.

Though not alone, the Institute finds itself today once more standing in "the shoes of the fisherman," by recognizing and presenting to the public important works of art of a young medium with an optical and technological basis. Similarly, the rather arduous, complex, and lengthy holographic image-making process echoes the earlier method of producing daguerreotypes and calotypes. It should be pointed out that there is general agreement that many early photographers produced images of lasting beauty and influence while they sought to bend the cumbersome technology of photography to express aesthetic ideas as well as to record visions of a new world.

As the years pass, we anticipate that the quality of the work in "New Spaces" will underscore the propitious beginning of high, artistic achievement in holography; and, that holography will be generally regarded as a significant, serious, and accessible means of aesthetic expression.

HARVEY S. SHIPLEY MILLER
Curator of Museum Collections

THE HOLOGRAM

In the broadest sense, a hologram is a record of information that describes a space. If an object is irradiated by a beam of light or sound or radio waves, much of the incoming beam bounces off the object (or passes through the object in a special way) to create a scattering of rays traveling in many different directions. Each ray of sound or light or radio wave carries with it special information about the spatial and surface characteristics of the point on the object from which it bounced. We perceive the existence and characteristics of the object by intercepting some of these rays with an eye or ear or antenna and interpreting the information carried by them. Since our visual experience is mediated by rays, it is enough to record the information carried by all these rays to record the complete visible nature of an object. This is exactly what a hologram does: a "hologram" is a "complete record" of optical, acoustic, or radio information.

Ordinary photographic paper records the brightness or intensity of all the light rays that fall on it. Since an illuminated object usually scatters light in many directions (an exception would be a mirror), simply placing an unexposed piece of film near an object and turning on the light for a while would give a confused jumble of light and dark points in the film: each point in the film could have received a light ray from many points on the object. In order to have a recognizable image, an encoding or mapping system is needed to provide a one-to-one correspondence between points on the film and points on the object: a camera uses a pinhole or a lens to do this. Thus film exposed in a camera and developed yields an image or imitation of an object, though the image is not a complete one for two reasons: first, no matter how big the piece of film is, all the rays from some parts of the object will miss it; second, the photographic image is flat, even when the object is not.

Like a photograph, an optical hologram is a record of light information. A hologram, however, is made with an entirely different mapping system, which makes it possible to encode both the brightness or darkness and the exact location of each point of the object. Thus full information on all three dimensions of an object is present in the hologram; when the image is reconstructed from the hologram, it is visually indistinguishable from the original object.

In order to examine the properties of a hologram it is useful to use a window as a metaphor. Suppose it is morning, and you are looking out a window. Everything you visually perceive about the objects outside the window comes through the window. If there is a telephone pole in the foreground, you sense it is in the foreground because your eyes converge more and your lenses swell to focus the light from the

telephone pole on your retina; you can also move your head so that the pole appears to move across the background of the horizon or opposite building as you adopt a new viewpoint. In fact, you can look through any part of the window and still see almost the whole scene outdoors, although, of course, you limit your perspective to that from the area you allow yourself to look through. If in an instant you could freeze all the light that comes through the window, when you freed it at a later time the entire scene would appear for an instant exactly as it had appeared earlier. This is exactly what a hologram does: it encodes all the light that passes through the window of the film at the instant of exposure. The rays can be reconstructed so that the entire scene is out there—in all its dimensionality and volume, from every perspective allowed by the size of the hologram, and exactly the same size and distance from you as it was before.

JAY SHIPLEY NEWLIN
Assistant Director of Exhibits

BECOMING A HOLOGRAPHER

ANAÏT ARUTUNOFF STEPHENS

As a traditional artist-sculptor, little did I realize that in 1965 I was on my way to holography! Looking back I see that my interest in and use of light and space as art media was the exciting journey to this mysterious and mystical new form of nature.

In 1972, after learning the basics of holography, I sent away for a small but complete holography kit. In a corner of my studio I built a concrete block table and there practiced and mastered, to a degree, the awesome and difficult technology.

In 1973, upon completion of the Multiplex system by Lloyd Cross, I used it for a series of seven "performance" pieces. The best known of these "Holodeons," as I named them, is the first one, "Space Grafitti—Whipped Cream." Prints of it belong to the Dali Museum (Spain), Seibu (Tokyo), Reynolds Morse Museum (Cleveland) and the Museum of Holography (New York), to name a few. In 1975, "Space Grafitti" and "Daughter of Icarus" were exhibited for one year at the holography show at the Knoedler Gallery (New York), in the Dali apartment, which was a perfect setting.

Another avenue of my exploration at this time consisted of laser light environments, of which I did two. All during this time I was learning more about and improving my holographic technique. Reflection holography was my medium. It was a natural choice for me due to the facility with which reflection holograms could be installed and lit in galleries (as opposed to the transmission types, most of which must have monochromatic back-lighting). Therefore reflection holography could be more accessible to the public. Some of my early holograms were composed—framed, with mixed media. I wished to introduce some familiar art concerns into the multi-dimensional magic—to aid in communication and, above all, to show holography's versatility.

In 1976, I had a solo exhibition of 18 reflection holograms and two "Holodeons," called "Theme and Variation." For two years it toured museums in the U.S. and Canada. I consider that these original works pertain to the infancy of holography as art, and that I, as an artist working alone, am a "primitive" holographer.

ON ART, TECHNOLOGY, AND HOLOGRAPHY

HARRIET CASDIN-SILVER

The pencil is technological—as are paints, chisels, pens, and ink. Rejection of technological art by a portion of the "art establishment" is misconceived. Lawrence Alloway in his introduction to "5 Artists/5 Technologies," a recent exhibition by five Center for Advanced Visual Studies artists, including myself, at the Grand Rapids Art Museum, Michigan, stated: "Technology is part of the condition of all work, not simply the alliance of art and engineering. . . . The artists in 5/5 do not believe that new systems are expressive in themselves apart from the intention of the artist. . . . Art originates in the artists, not in the hardware."

Equally misconceived by many holographers and others is the idea that the medium or science or technology of itself generates art. Otto Piene writes for the same exhibition/catalog: "the research in the arts which makes eminent sense—and must have priority over scientific understanding of research—is the search for new imagery, i.e. new images, new languages, new vocabulary. . . . Techniques can become important determinants in the 'total picture' of a work of art. . . . Without conceiving, perceiving, and guiding artists, however, they are useless."

Holography does not make one an artist. For myself, it is a means of expression and communication. If I were not concentrating on holography—if Dennis Gabor had never invented holography—I would be working with other aesthetic media. Actually, by virtue of my own intensity as well as by museums and art/academia, at times I feel caged into holography. This was never my intention. I am opposed to bars and boxes. Does it matter if it is holography? The holographic artist employs the technique of holography for its special inherent qualities, but the value of the finished work is determined by its strength of concept and content.

The installation or environment is as important to my expression as each piece. I am wary, therefore, of group holography exhibitions. My preference, indeed an essential element of my work, is the composition of "environments occupied or energized by the works that they contain. . . . [T]he works include factors of physical entrance, occupation and participation. . . . The public shares the space of the work." (Alloway)

I am wary for other reasons: the conglomeration of forces in holography apart from the few committed artists—the arena is much like early movie-making—the commercial activisits, the entrepreneurs, even some scientists, all of whom see the art world as a means of

display, as they call it, and promotion, motivated by a drive for immortality (unconscious) or money (very conscious) or both; the general intrigue with the technology and lack of discrimination—too often at group exhibitions spectators are awed by holographic technique, or they stand in the entrance and decide there is no art at all. Of course, holography cannot be viewed that way. A few allow their eyes to grasp the image as it reveals itself in space, to discover and experience the spatial distribution of light, the kinetic play, the philosophical or psychological content. In some holograms, or better, in some holographic environments, these elements do exist.

Regarding research in the arts and sciences: surely a cure for cancer is more important than an art project. But it seems to me that too low a priority is afforded development and experimentation in art relative to science. I speak of technological art, particularly holography. Artists can and do expand the technology, at the same time contributing their perception and insight. For artists to create fine art holograms of scale and impact, they require sophisticated facilities and equipment. Add an ironic note: science can fail and publish the reason for the failure; art must produce. It might be argued that this expensive art medium is unnecessary. But the ever-increasing interest in the art of holography indicates otherwise. And its potential for communication is undeniable.

Throughout my exploration of the medium, from 1969 through my abstractions formed by laser light alone—no objects within the system—I worked toward a time when I would communicate more directly. Of the two works in this exhibition, "Equivocal Forks I" is an extension of "Phalli" 1975. But "Forks" is fe/male. The forks emerge from a circular form, prongs heading away from the spectator—pseudoscopic equivocal. Phallic prongs thrusting toward the viewer would project only hostility. There is more subtlety, grace, and ambivalence—conceptually important—in the recedence. Positive and negative spaces fuse and separate, causing kinetic visual interplay with the movement of the spectator. "Forks" is also an example of my frontally projected imagery. Ideally the environmental ambience should cause the plate to disappear, leaving the forks to float in space unattached and unhampered except by spectator/participants who reach out to the image.

"A Woman," my most recent work and a self-portrait, is a result of experimental endeavor, which I believe successful, to extend the boundaries of integral holography. The mass of hair is reminiscent of "Cobweb Space." But emerging in a tangle through the film, it is a jungle.

Currently, my interest lies in investigation of holographic movies by holographing the subject directly. The combination of theatre arts background and ten years of holography makes this a natural direction for me to follow. My personal choice of content derives from a humanistic—as an extension of "feministic"—sociological orientation.

Whatever form it takes, holography is sculpture of light . . . enlightenment . . . immaterial energy. It is shaping imaginary spaces. It is fantasy, reality, politics, change.

UNIFYING SCIENCE AND ART

RUDIE BERKHOUT

One of the beauties of this age is our discovery of the obsolescence of thinking in terms of opposites. Perhaps out of need for their specific developments, the arts, sciences, and philosophies have been previously perceived as separate cultural components. As the limitations in isolating the three units become increasingly apparent, however, so too does the boundless potential of their confluence. Holography, therefore, is the perfect medium to give this new union a chance to express itself.

For me, working in holography is not merely shifting back and forth between empirical knowledge and aesthetic judgments, but is also comprehending them as a part of a unified whole. I see myself as the medium through which the technology can express itself. I see technology as an integral part of nature; my function is to articulate the beauty of technology. To do this requires an understanding of the behavior of light and its interaction with matter. Although studying the available texts about the properties of light has been helpful, most of my technical information has come from trial and error experimentation. Yet light's nature is subtle enough to easily elude mere facts and figures, and I find most often the best means of comprehending it is through my own intuition. Becoming one with the light, following in thought its path through space and time gives me a framework of understanding from which the technical and aesthetic values seem to flow.

Beyond the requirements in approach to its creation, the visual impact of the hologram itself is perhaps a more succinct expression of this unification of art, science, and philosophy. As we adjust to what we are seeing, we are redefining and expanding our knowledge of visual possibilities. My hope is that the expansion of our perception's frontiers in one area may lead to questioning of all of its boundaries in general.

SOME NOTES ON THE ART OF HOLOGRAPHY

AL RAZUTIS

From Mimesis to Surrealism

Mimesis, the imitation of reality, is a well-known beginning, and the first stage of accomplishment, for the holographic artist. Having contended with hours of toil and experimentation, many will see their first results, the mimetic image, as an end in itself. A simple example of mimetic holography can be seen in holograms that render a virtual image of a toy train, King Tut's mask, geometric solids, jewelry or curios. To the artist truly interested in exploring the aesthetics of the medium, these exercises are merely akin to sharpening the pencil and acquiring basic craft-like skills. Mimetic holography, left to itself, merely restates what a 20th century public already knows, namely, dimension, perspective, proportion, proximity, size, and form. Of course, an undiscerning public may be initially fascinated by this contemporary "magic," but this fascination will soon evaporate and leave the artist's sense of accomplishment quite vacant. The mimetic mandate will demand a larger, brighter, better resolved, full color, motion picture rendition, with quadraphonic sound added—all at the expense of more sophisticated conceptual and perceptual investigation. Compounding this will be the cultural demand for spectacle (motion picture holographic billboards on Sunset Strip!) and maximal experience through novelty. As an artist, and one not particularly prone to mimetic expression, I am dismayed. The largest transmission holograms that I created (24″ x 30″, with a depth of field of 6 feet) are no more satisfying, except in terms of the above cultural prerequisite, than those measuring 4″ x 5″. In most cases, the aesthetic concepts and experience are the same. After all, what is the aesthetic of scale and size, unless it is somehow intrinsically related to the architecture of the surrounding space? But the disenchantment with reproducing reality can best be illustrated with the following two considerations. First, is not the reproduction of reality inherently redundant? Why not simply install a large sheet of glass, place objects behind it, and illuminate both with laser? After all, imitative considerations only treat the transparency of the holographic image as a temporary flaw! Secondly, if spectacle is what we're after, Disneyland has outdone everyone. For in their Haunted House ballroom display, they feature non-holographic renditions of ghosts flying about the setting. This technique of using mechanized mannequins, reflected in a partially transparent angled mirror, allows the viewer to engage in experience of illusory spectacle (60 feet of it) and is optically analogous to the holographic virtual image experience.

Mimetic holography reaches a curious apex in what I will loosely term pure holography. Rather than presenting a framed plate, conspicuously present as a formal gesture of rendering, the holographic plate or film is rendered almost invisible—for example, suspended in a room, with little or no ambient light—and the image is rendered in space behind or in front of the plate in orthoscopic configuration. The creation of image-objects floating in space, with whatever contained field of view, and free from contextual confines, is, to say the least, unnatural. In that it does not readily conform with our everyday experiences, it is extraordinary. (On a technical note, this process also can be accomplished by projecting a pseudoscopic image into a spherical mirror and reconstructing the final result as orthoscopic image in space.) Hence, the pursuit of realism in holography reaches its apex of expression in the creation of *surrealism*.

The nature of surrealism is to create a sense of anomaly either by the use of optical paradox or thematic ambiguity and paradox. The pseudoscopic image in holography is one such paradox. Though mimetic in nature (the laws of light are the laws of nature—it is only our habituated sense of reality that would have difficulty in accepting this), it presents a paradoxical experience of space to the viewer accustomed to normal orthoscopic perspective.

Perceiving New Spaces:
The Didactic Nature of Hybrid Holography

One of the basic struggles of an emerging medium is to convince the public of its importance. Aside from the familiar technique of engaging in hyperbolic argument, the act of educating the viewer is carried out in two ways: by a declaration of perceptual/conceptual principles and by an accompanying reeducation of the viewer's ability to perceive space. Considering the omnipresence of two-dimensional graphic media (painting, photography, and their kinetic successors, film and television), the task of reeducation would seem to be all the more difficult.

Holography, as is true in all visual media, presents a system of signs, codes—a language—that, in effect, must be read. To engage in the reading of these visual texts is a necessary prerequisite to understanding holography's aesthetic propositions. The artist enters into this kind of discourse by the creation and exhibition of the artifact; the viewer's participation in the discourse is determined by his/her interest in, and familiarity with, the subject matter. In the case of the mimetic technical hologram, the visual text is usually quite simple, and its presentation usually evokes questions relating to process of creation or presentation: "How was it done?" In this case, the public is usually referred to explanatory material. This circumstance is basically

didactic in nature and not directly related to aesthetic investigation. An aesthetic based on "how was it done?" or "what materials were used?" would be the same as equating instructional processes with beauty—a ludicrous, but not uncommon, proposition.

A more fruitful area of investigation occurs when we consider two hybrid forms of holography: the *graphic-hybrid* hologram and the *sculptural-hybrid* hologram. The first category is representative of works that are usually presented in the familiar graphic format (i.e., framed, and hung on a wall), and feature a play on the flatness of graphic image(s) and context of presentation, as contrasted by the depth and dimensionality of the holographic image. Here we have two aesthetic attitudes presented as a visual discourse, with a resultant synthesis as aesthetic gesture. Rainbow holograms are an evident example of this, though their lack of vertical parallax weakens their ability to articulate the relationship between image and flat plane. In reflection holography, the plane of glass, under normal installation circumstances, will always be evident and part of the composition. It is in this regard that I am reminded of some of the work of Anaït Stephens who, taking this consideration in mind, articulates the relationship between implied perspective (of a graphic wedge collaged to the glass) and the spatial characteristics of the holographic image. In my work, I have been prone to articulate this relationship by the use of a mirror-plane ("Prima Materia," or "Point Source"), which acts as conceptual plane reference (the mirror, in effect, is physically there, but it bisects not only the holographic plane of imagery but also the viewer's physical plane). A further extension of the graphic-hybrid is found in work that features serial holograms. Whether image-serialization uses juxtaposition of orthoscopic and pseudoscopic images, as in the works of Anaït or my "Newtonian Galactic Assembly Line," or complex patterns of mosaic composition, the results are initially derivative of graphic-serialization (Warhol) processes. However, the spatial texture that these works exhibit (a texture that must be experienced by a viewer moving about and seeing the compositional dynamics from multiple vantage points) can only be rendered in the domain of holography. Further examples of graphic-hybrids include work that features surface texture, shadow-etchings of the holographic image (as in my "Rainforest"), multiple-plate (in-depth) installations, and the inclusion of mathematical formulae (as in "Point Source") or written information (as in "Newtonian Anagraph"). The final result of this type of hybrid expression is two-fold: first, it establishes an aesthetic transition from graphic to holographic; secondly, it reveals the obsolescence of Renaissance-graphic rules of perspective and articulates the basic nature of the holographic departure.

The second category, that of the sculptural-hybrid, is intrinsically more complex. Works of this nature feature a combination of sculptural (spatial) artifact and holographic image—each of which contributes

to a resultant synthesis. The Multiplex stereogram can be considered in this light, but once again it fails to articulate clearly the synthetic relationship between its evident shape (the cylinder) and the holographic image contained within. (The magic of the artifact in the bottle will not suffice as aesthetic gesture). I have only seen a few Multiplex stereograms that have even approached a successful synthesis, and one ("Three Objects in Space" by Anaït) is largely successful because it makes explicit use of the limitations of this process (namely, spectral rendering in place of vertical parallax). In other words, it is specific to the material and process of expression, and clearly articulates this relationship. (Not to work within the nature of the material and process would be akin to a sculptor in marble attempting to articulate the qualities of mass-cast resin!) Examples of other work in this category include my reflection holograms, "Surrogate" and "Aether Vane," and 180-degree transmission pieces, such as "Inclined/Stressed/Plane," and "Chain Link." The subject matter for this synthesis can be extended beyond mere consideration of materials and form. In "Surrogate," the mythical connection between images (the holographic face in the vanity mirror) approaches the classical concern for vanity and death (*Vanitas*); in "Aether Vane," the visual context of cobwebs (obsolescence) and an antiquated device for measuring, as it were, the nonexistent aether alludes to both the preoccupations of the scientific community (Michelson-Morley) and the dimensional (hence material) properties of light. It is didactic in nature, but humorous in intent. The sculptural-hybrid, moreso than the graphic-hybrid, is fundamental to holography because both aspects of the hybrid—the sculptural and holographic—are naturally related, and to divorce them completely would amount to a cessation of aesthetic dialogue between matter and light.

Holographic Expressionism

Works that are expressionist in nature prominently feature the artist's intercession or gesture. This aspect of holography is in direct opposition to the precepts of mimesis. The primary focus of expressionism is the synthesis of experience and language via the personal touch of the artist's imagination. Rather than reproduce a given reality, the artist engages in a romantic quest to discover or create other realities. Examples of this kind include the use of painterly-like "brush strokes" (painting on emulsion) found in the works of Anaït, patterns of ripples in sand (object expressionism) found in the work of Dunkley, or even the use of interferometric techniques to create controlled contour lines in space (a "stress topography" in which a black ribbon-like waterfall effect is created) as in my "Perspective Wedge (Stress Topography) #1,2,3." Ultimately, such expressionistic investigations can lead an artist to the central concerns of conceptual and environmental art.

INTEGRAL HOLOGRAPHY: THE MOTION OF CIRCULAR SPACE

AMY GREENFIELD

The 360° integral hologram is an apparition moving in mid-space inside a cylinder. The image moves, not realistically three-dimensional, but something more marvelous—an illusionistic volume of a new kind based on complex interrelationships of space, time, and motion. One of the most fascinating and important of these manipulations, which creates this new kind of image, is the conversion of motion picture film time into the circular space of the integral hologram, or through the fourth dimension of motion.

This new form is created because, in the process of converting film into integram, time is literally converted into space, and motion into volume.

In motion picture film, each rectangular film frame represents an increment of time. If we shine a light bulb through a piece of this film, we see many separate still images, each slightly different. When the laser rerecords each of these frames, turning specific photographic information into specific light wave information, this information is squeezed into a line approximately eight inches high and a tiny fraction of an inch wide. Each of these lines is focused and locked onto a piece of holographic film, and all of the lines are stacked side-by-side in the exact sequence corresponding to the film frames. This recording means of laser light can so accurately refine the image information into the rarer medium of light, that when we shine a light bulb through the developed holographic film at the correct angle, an amazing phenomenon happens: we are able to see what was formerly (approximately) 100 film frames as one single image. In other words, what in motion picture film was 100 separate moments in time, can now be integrated by a complex process of the eye and mind into the perception of one single image in space. In effect, motion has been concentrated in order to create a new space. But motion is only converted into the illusion of volumetric space by this process when the motion picture film contains a specific kind of motion information on it. This information is principally about revolution—the subject must turn around a tiny bit in each film frame. This information could be a dancer's pirouette filmed in very, very slow motion. In my 360° integram, The Wave, this information is in part the woman rolling into the ocean. You can simulate the information with your hand. Hold it, palm toward you, and turn it in tiny little movements until the back is toward you. Each tiny angle of the turn would be a film frame. One hundred of these angles would describe the movement around a volume of your hand. Since in the process of making an integral hologram, 100 film frames are converted into the perception of one space, this space will describe a

volume. The mind has converted motion into volume. Further, since a 360° integral hologram is made up of 1,080 film frames converted into hologram "light lines," the total progression around the cylinder is perceived as the perfectly smooth motion continuum of a curved volumetric space, and the illusion of an omni-directional volume—an image describing depth—is created. The viewer's mind continually sees around a volume created by means of the manipulation of motion. Since the viewer's mind is always moving around the illusionistic volume, he/she posits that there is a simultaneous volume on the other side of the circle. Actually the "other side" represents a different set of moments in time *converted* into spatial illusion. If there were a real volumetric "other side" to The Wave, the ocean would in reality be a circle, which we know of course it isn't. Yet this is the illusion in the mind. The viewer is seeing motion while perceiving volume. Motion has not been recorded, but this most intangible of properties has become palpably solid—captured like a spirit inside a capsule of space.

If it seems that I am going from logical explanation to irrational poetry, it is because the process is not a simple one-to-one equation, but a perceptual tongue-twister, a twisting of laws of optics and physics that creates paradoxical image concepts that give the artist a new space for the manipulation of visual and kinetic thought.

Paradox Number One: Because in converting motion picture film into an integral hologram, motion has been stretched out then concentrated, broken up then made continuous, made flat then round, and finally re-made by the viewer's own motions or by a motor in the integram, motion has been made relative to many factors, and so the cause or exact sources of motion in an integral hologram become a densely mysterious riddle. Everything seems to move, yet nothing seems to move. In The Wave, the motion is complex, yet there seems a changeless constancy. The woman and wave move inevitably to meet, yet never arrive. The space of the integram moves in stillness around an invisible source . . . "at the still point of the turning world. Neither flesh nor fleshless; Neither from nor towards, at the still point, there the dance is; But neither arrest nor movement." (T.S. Eliot, "Burnt Norton")

Paradox Number Two: This mysterious volume not only turns, but also hangs in mid-space, so that our sense of gravity is unearthed. In the physical world, volume is associated with gravity. The sense of the mass of our bodies comes from our sensation of gravity. In the integram, the perception of volume is dissociated from the property of gravity, and metaphysical ideas can result from this dissociation. In my next integram, a man and a woman will seem to intertwine in mid-space, creating an external, deathless space-travel, and the materialization of the metaphysical idea of the eternal union of opposite.

Paradox Number Three: Perhaps the most elusive quality of all in the integram is its transparency, its translucency, "neither flesh nor fleshless." The integram space, as in all holograms, is seen behind a transparent medium—the cylinder around which is wrapped the transparent holographic film. Unlike film, where we look at a shadow on an opaque surface, in a hologram we look *into* a translucent volume in mid-space behind a transparent surface. The cylinder is not the space of the image, but is a medium which acts both as a barrier between the viewer and the space of image, and as the purveyor of the information about the image to the viewer. This dual aspect of the cylindrical holographic film creates an untouchable, invulnerable, timeless world which is simultaneously intense, imminent and direct. This timeless and remote yet clear and immediate world is a space for sacred dance made not in obsolete stone temples but through the materials of contemporary technology. We look *into* this space as magicians and clairvoyants of the past looked *into* the crystal ball and *into* the future, but the magic is the mind's ability to know, and the future is what is set clearly before us.

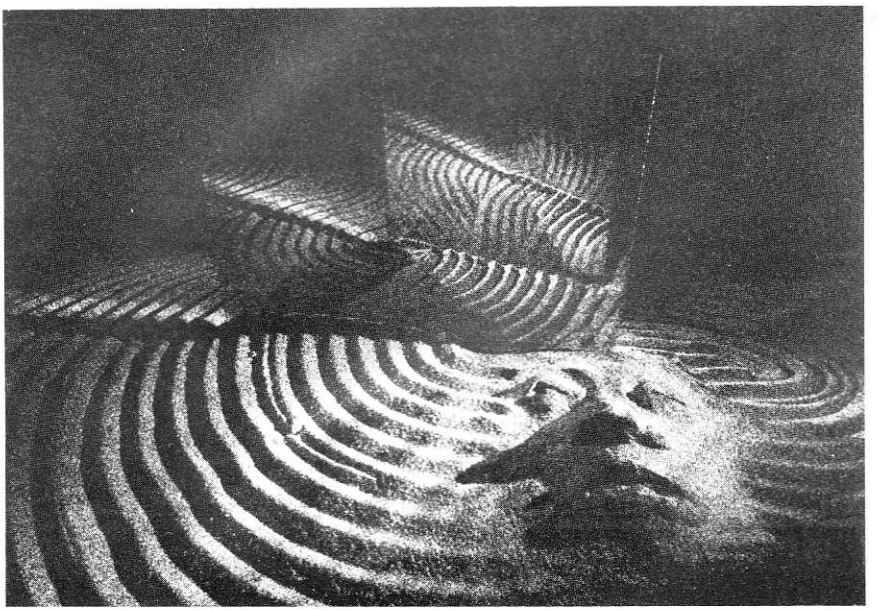
The sacred space of the integral hologram is not a *place,* but is the movement of *connection* between the cavity of the circle and the cavity of the mind's perception. The connection between the light thrown back from the holographic film into the circular space and the light shooting out from the holographic film through the eye to the mind. Above all, this connection of moving light in space creates for me, as a dancer approaching the 1980s, a new possibility for the essence of ecstatic dance of the soul. Isadora Duncan could have prophesied the holographic dance when she wrote: ". . . the body, by force of the soul, can in fact be converted to a luminous fluid. The flesh becomes light and transparent as shown through the X-ray—but with the difference that the human soul is lighter than these rays. When in its divine power it completely possesses the body, it converts the body into a luminous manifestation of the soul . . . speaking out of himself and out of something greater than himself."

(Isadora Duncan, "The Philosophers Stone of Dance")

HOLOGRAMS EXHIBITED IN "NEW SPACES"

THOUGHTS

Kenneth Dunkley
1973
Transmission/orthoscopic
8" x 10" 20.32 cm x 25.4 cm
Facility: New York University
Collection of the artist
Photograph © 1979 Steven Borns

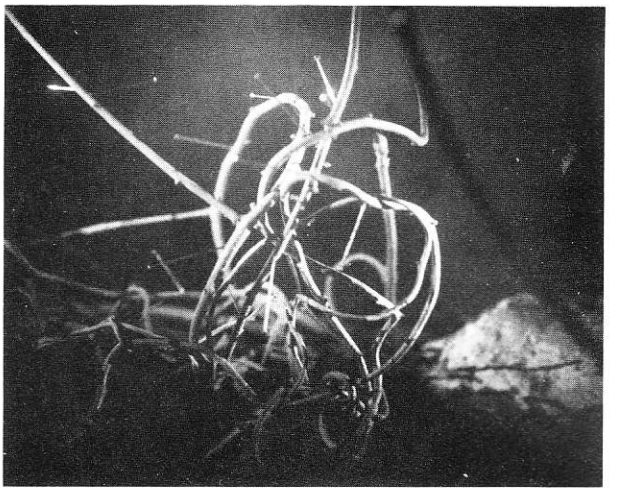


THE CRYSTAL WHITE

Setsuko Ishii
1979
White light transmission
11¾″ x 15¾″ 30 cm x 40 cm
Collection of the artist

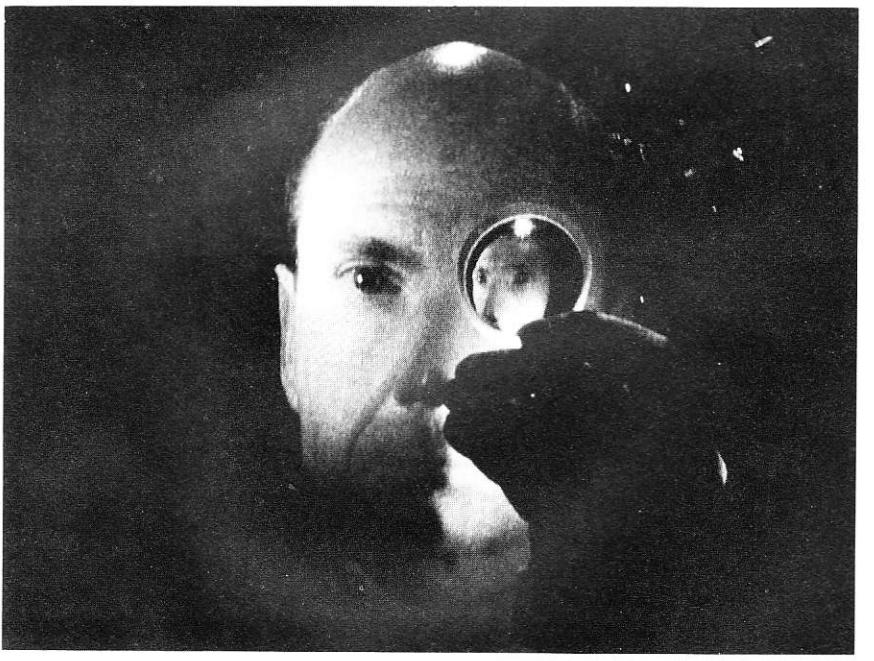
UNTITLED

William Larson
1977
Transmission
8″ x 10″ 20.32 cm x 25.4 cm
Facility: Tyler School of Art, Temple University
Collection of the artist



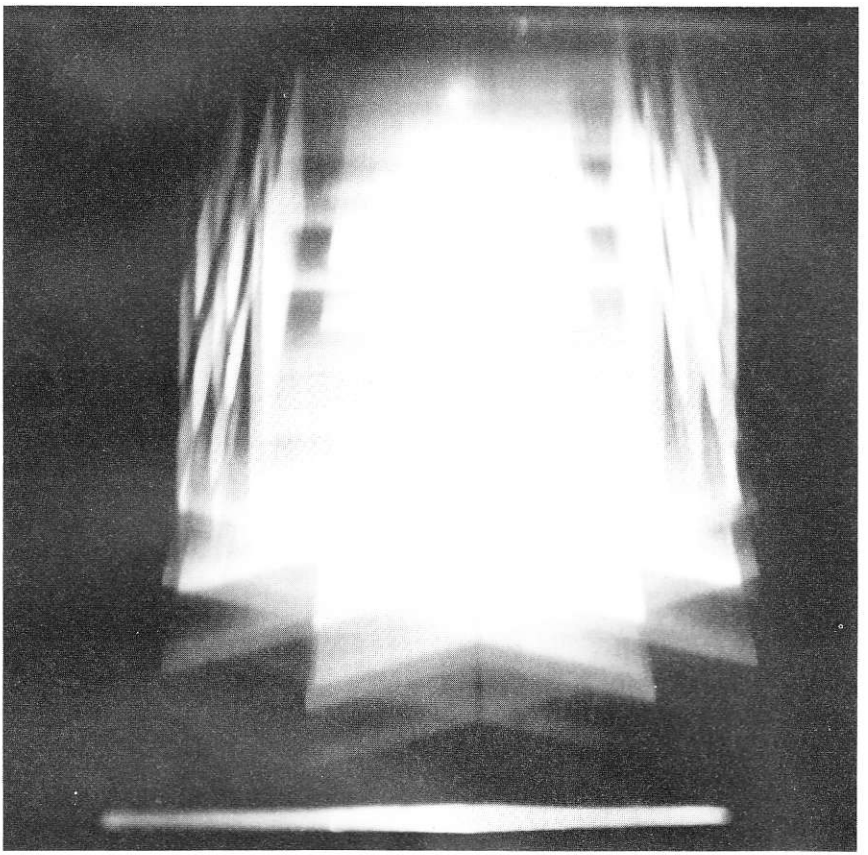
SELF-PORTRAIT

Peter Nicholson
1979
Pulsed transmission
11″ x 14″ 27.94 cm x 35.56 cm
Facility: Haran Corporation
Work supported through the generosity of the J. M. Kaplan Fund
Collection of the artist



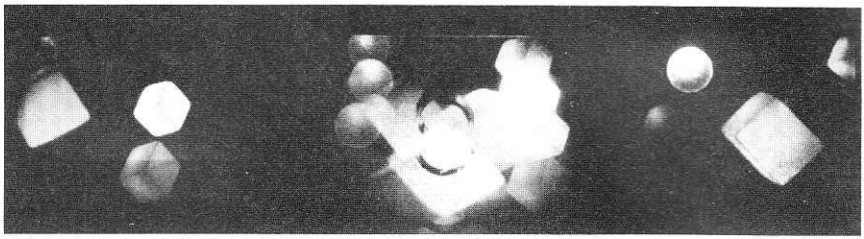
CATHEDRAL

William J. Molteni Jr.
1978
White light transmission/orthoscopic
8″ x 10″ 20.32 cm x 25.4 cm
Facility: Brown University, with the help of Rick Silberman
Collection of the artist



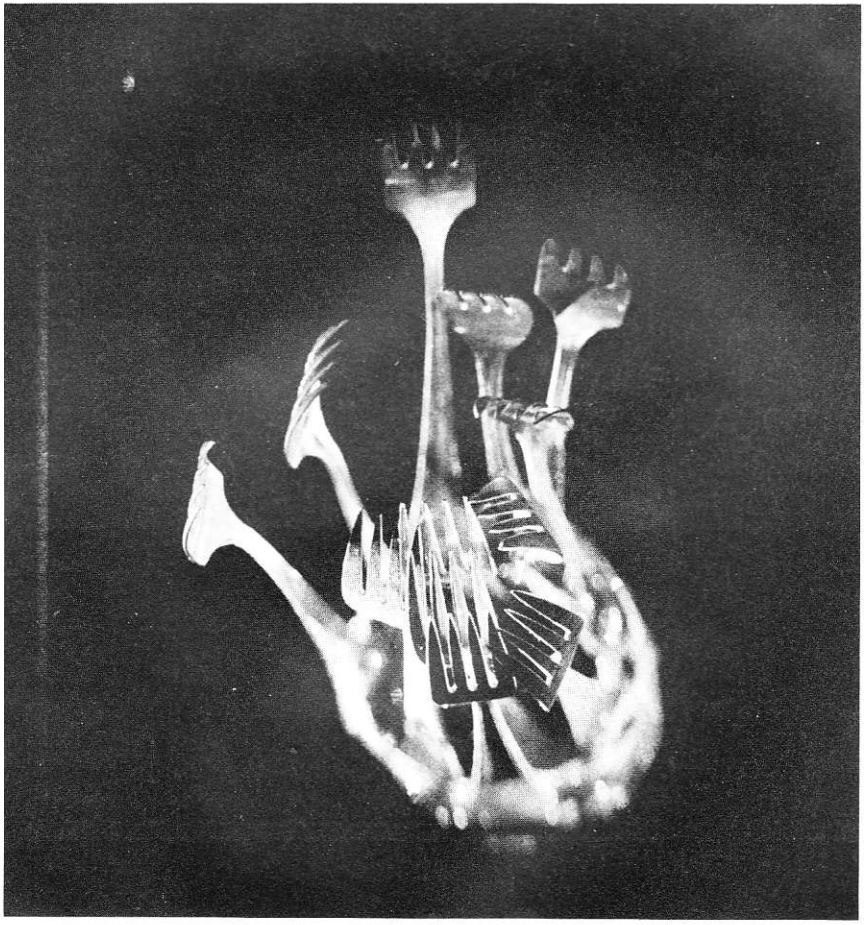
12 mW BOOGIE

Rudie Berkhout
1978
White light transmission
8″ x 30″ 20.32 cm x 76.2 cm
Facility: New York Holographic Laboratory
Collection of The Franklin Institute
Purchased for The Franklin Institute exhibition, "Mathematics, the Arts, and the Humanities"



EQUIVOCAL FORKS I

Harriet Casdin-Silver; Laboratory assistants **Donald Thornton, Gordon Cates**
1977
Transmission
11″ x 14″ 27.94 cm x 35.56 cm
Collection of the artist



PUMPKIN SEEDS

Scott Nemtzow
1977
White light dichromate/orthoscopic
8" x 10" 20.32 cm x 25.4 cm
Facility: Holex Corporation
Collection of the artist

DANCING BARS

David Klein
1978
White light transmission, mirror-backed to view in reflection mode
4" x 5" 10.16 cm x 12.7 cm
Collection of the Museum of Holography
On loan from the Museum of Holography