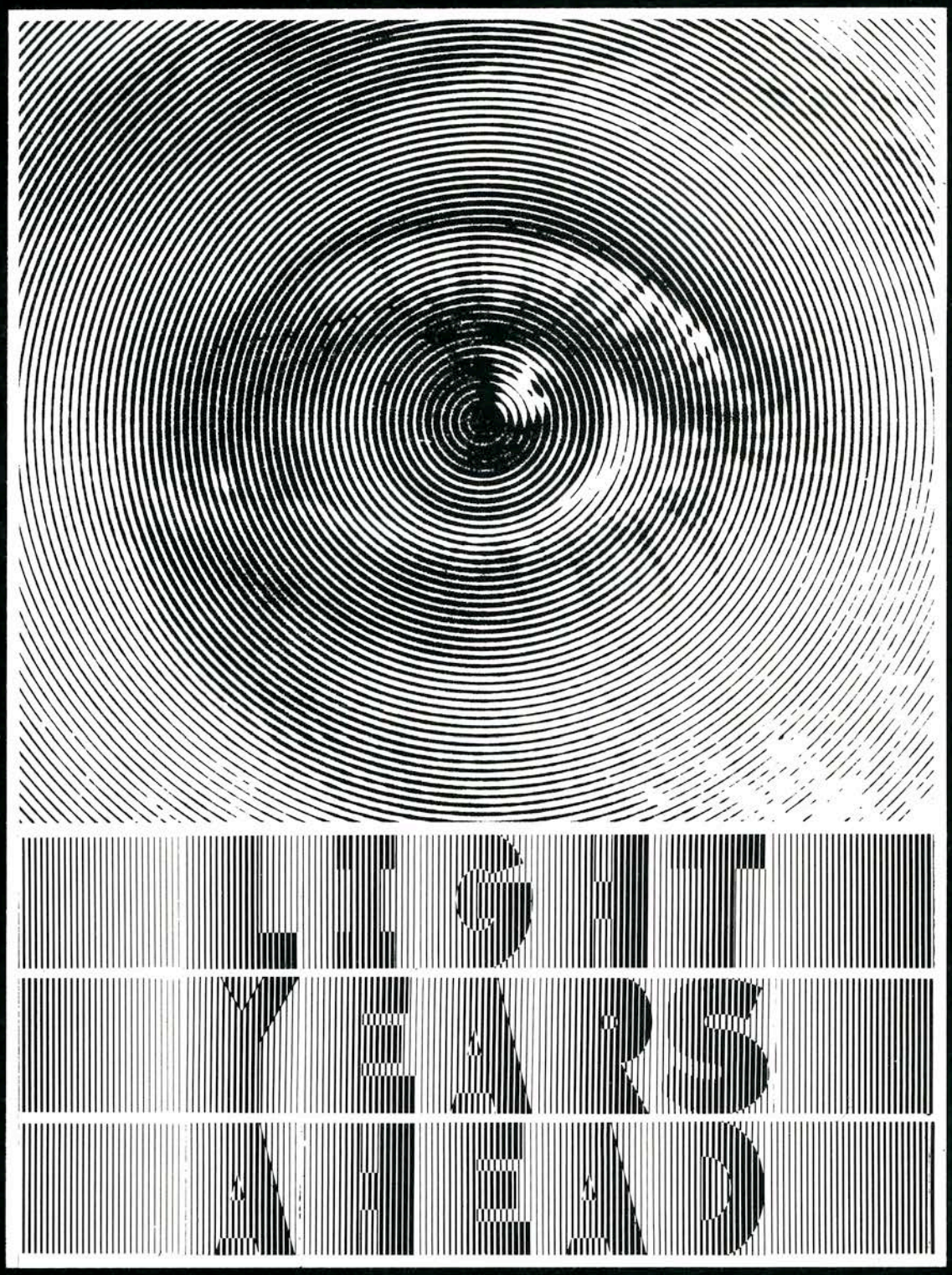

International Holography 1
At The Photographers' Gallery
8 Great Newport Street, London WC2
December 15 - January 16

December 15 - January 16

LIGHT YEARS AHEAD

International Holography 1

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Acknowledgements

The Photographers' Gallery wishes to thank the following people and companies for their invaluable help in getting this exhibition together:-

Richard Payne for the loan of his unique collection;

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And the assistance and support of many others in the holographic community and otherwise, without whom this show would not have happened;

And foremost to the memory of Denis Gabor; we celebrate his spirit.

Introduction

This exhibition began life as an attempt to show new technological breakthroughs that might be of interest to photographers who can often find uses for manufacturers' advances in ways un-thought of by their inventors.

In the event, we have an exhibition about three-dimensional work which should be of interest to sculptors as well as painters and photographers. This may be partly because manufacturers are much shyer nowadays about sharing any breakthroughs they come up with but I also feel that the industry is really concentrating on improving established products at the moment rather than making any major changes.

The exception is perhaps the firm of Nimslo who do have an idea which has not been marketed before and although there is not a lot of work to be seen as yet, I hope that the small selection of prints we have here will be of interest to a wide audience and the idea is definitely to make the process available to the general public rather than just the professionals.

The Holography on the other hand, which makes up the major part of the exhibition is at a most exciting stage of development and while it is not easily available to every-one, there are a growing number of courses where it can be studied and a number of universities are making their facilities available to accredited holographers. Probably the most visible difference is the increasing use of White Light Holography which means it is no longer necessary to install a laser to view the work and this makes the finished pieces much more accessable to the general public and purchase to hang in the home a real possibility.

As with other forms of photography, Polaroid have again been one of the first and most consistent firms in their policy of allowing artists access to equipment and it is to be hoped that as more equipment is available in England other companies may follow suit.

The majority of work in the exhibition has been created by artists and although technical help is necessary, the conception and continued presence of the artist during the process has ensured that the possibilities are being stretched further than ever before.

The work is truly international, coming as it does from Russia and the United States, Australia, Sweden and France as well as Canada and Britain. Many of the artists trained in other media and the growing combination of sculpture and holography may well be a pointer for future developments. It is an altogether exciting experience and I am most grateful to Eve Ritscher in particular and to all the other people who have guided us in the search for pieces and for the funds and equipment to display them.

Sue Davies
Director
Photographers' Gallery

Introduction

by Eve Ritscher - Holography Consultant, Administrator Richard Payne Collection, with acknowledgement and thanks to Rosemary Jackson, Director of the Museum of Holography, New York, U.S.A.

Holography - the word conjures up a myriad different meanings, from high technology - some process from the sci-fi future, to the sensationalism of 'real live' ghosts. Holography is a term often misunderstood and overpublicised.

The reality is a new medium of visual communication and experience, not one created out of a void, but one which has its roots in a very definite history of vision. Holography is born out of an era in which information technology, for better or worse, has invaded our daily lives, and altered them radically as a result. It is a medium which offers many of the communication needs and desires of our time.

Holo, from the Greek word meaning whole, graphy, the Greek for message. What is it and what does it offer so new?

Firstly, it is a means for reconstituting or replicating fully three dimensional images with light - but on a two dimensional, flat surface. Previously we were given two dimensional information on a two dimensional medium such as print, painting, photography or film, and the mind, like a computer, would fill in the 'reality' of the original subject from that given information. With holography the mind is freed of that function: it is direct communication.

Secondly it has volume. The holographic plate, be it glass or film, can be considered as a window pane, with volume both in front of and behind it. The image can, as in reality be placed anywhere within the viewing zone, either in front (real image), behind (virtual image), or across it (image plane). Several images can exist simultaneously on a multitude of focal planes, and can even be superimposed on the same one (spacial superimposition).

Thirdly, the hologram can record the inner volume of the object and depict the notion of the 'hole' that the object occupies in space; it can record the volume 'inside out' (pseudoscopic): negative space. It can equally record things invisible to the naked eye, such as air or sound, and solidify and thus metamorphose such elements as water and smoke (frozen instant). So with holography, we have a medium which opens up a wealth of possibilities hitherto unavailable.

With few exceptions, the makers of holography were until recently so preoccupied with technique, that the content of the imagery was banal; it was the scientific aspect, and still more so the element of the marvellous which attracted the public. Used as an art medium however, holography is taking its first steps into a new vocabulary of vision and experience. It has creatively just reached its first decade, and with more artists using it, holography is being tested to its limits, the artists, constantly in the search for new possibilities and consciously exploring the medium's capabilities. Like most technologies and all art forms, holography is a true craft. It is an exacting and demanding technique which takes a good deal of time to master. Its eventual visual character is still unknown since the medium is still in the process of becoming. Artists have learned to create rather than copy reality, as technology is catching up with their imagination. It is a multi-faceted pioneering effort of vast proportions; holographers have been contributing to the technical development of the art medium as well as creating the visual language for describing and understanding the medium as an artistic tool: a true marriage of art and technology.

We are fortunate enough to be able to show for the first time in London, a fine group of works by leading international holographers, to present these early steps into a new perception. From abstract holograms, by their nature highly graphic and frequently kinetic, with their dramatic use of dimensional form, multi-exposures and saturated colour, to symbolic imagery making full use of the medium's reality to add the weight of form to the intellectual content, surrealism turned hyperreal, the materialised dream. From collage, with painting and etching, each artist finding a personal use of particular techniques available to them in holography to express their own individual style. Many have been criticised for using a technological medium, as has the medium itself, but then hasn't that been the case with all new forms and media. The disassociation of artists with changing ways of life would be fatal indeed. Holography's present practitioners remain highly individualistic pioneers, both in the medium they have chosen and in the methods they have chosen with which to express their art, until now largely ignored by other media mostly through lack of exposure. This exhibition represents their early search for what is viable holographically as art, as well as some of the further technical possibilities from some of the scientists who help enable that vision. The high quality of the work produced during the first decade clearly shows that holography as a creative medium, and holographers as visual artists, have won their place in the continuum of art history.

Holography: From Theory to Display

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Display holography, the broad category into which creative holography falls, had its beginning in 1962, when Emmett Leith and Juris Upatnieks at the University of Michigan first began to produce holograms with high degrees of clarity and sharpness. By then, holography as a theory was already fifteen years old and had been thoroughly researched.

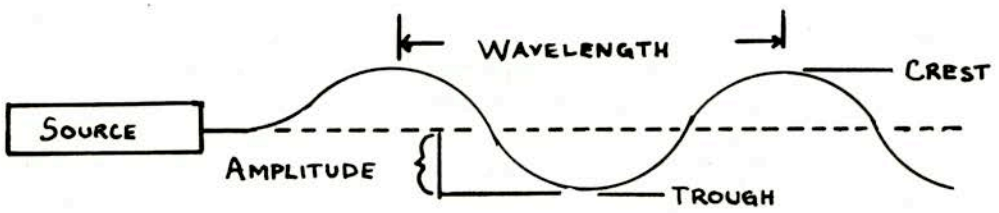
In order to appreciate the development from the theory of holography formulated by Dr. Dennis Gabor to the first practical display holograms, one has only to compare the early experiment of Gabor with the first laser-made holograms. This provides an understanding of the basic principles of holography and illustrates the significance of the laser in the holographic process. Moreover, it shows the importance of the image making technique developed by Leith and Upatnieks which has become the basic method for display holography (an overview of the modifications in the method that have occurred since, and a more detailed discussion of the principles can be found in Leith's instructive article, "White Light Holography", in Scientific American, October 1976).

Understanding Gabor's initial experiment requires a familiarity with four principles: wave motion, interference, coherence and diffraction. These are the basic concepts upon which holography rests.

LIGHT AS WAVE MOTION

In physics, light is described with two different models, one dealing with light as infinitesimally small units of moving energy known as photons, the other describing light as a form of wave motion. The latter is most illustrative in discussing holography because the idea of waves is more generally familiar.

The motion of light from a source is similar to the ripples produced by a pebble dropped in a pond. When the pebble makes contact with the water, it causes waves to move across the water's surface in all directions. This movement is made up of high points, or crests, and low points, or troughs. Waves of light also have crests and troughs: crests are bright and troughs, dark. The degree of brightness is determined by the height of the crests, or their amplitude.



LIGHT WAVE (SIDE VIEW)

The different colors of light (red, orange, yellow, green, blue, indigo and violet) are determined by the distance between crests. This distance, known as wavelength, varies with color. For example, red light has a longer wavelength than blue. Wavelength has a reciprocal relationship to frequency, which is the number of crests passing a given point in one second. The longer the wavelength, the lower the frequency. Thus, even though all light travels at the same speed, the differing frequencies are perceived as having different colors.

Because it is one form of electromagnetic energy, light shares these characteristics with the entire range of energy, from large sound waves to exceedingly small x-rays. The main difference is that of wavelength.

COHERENCE

The term coherence is used to describe light (or other energy) that has two kinds of uniformity. The first kind, called temporal coherence, refers to light of one wavelength and, thus, one color. The second, called spatial coherence, refers to the way light emanates from a point source. Spatially coherent light waves move in one direction, are parallel to each other and are in phase, that is, regularly and uniformly emitted by the point source.

Few light sources of even partial coherence exist. For example, the light emitted by an ordinary light bulb contains light of many wavelengths moving in many different directions. This kind of incoherent light is generally referred to as white light.

INTERFERENCE

When light waves of one wavelength intersect, a phenomenon known as interference occurs. At the point of intersection, the waves can meet in a number of ways, from crest meeting crest to crest meeting trough. When crests meet, light intensity increases. When crest meets trough, the waves cancel each other out, resulting in darkness. When this occurs against a surface, bands of brightness and darkness, called fringes, can be seen. When crests meet, it is termed constructive interference. When crests and trough meet, it is termed destructive interference.

DIFFRACTION

As a light wave moves through space, it can be made to change direction in several ways. Some are familiar, such as reflection (light bouncing off a surface) and refraction (light being bent by passing through an object like a lens). Diffraction, less familiar to most people, is the bending of light produced as it moves around the edge of a surface. When this occurs, the light wave is broken down into many smaller waves, called orders, each of which has a slightly different direction. Diffraction can be seen easily by looking at a white surface (such as a wall) and then placing one's hand a few inches away from one's eyes, with the

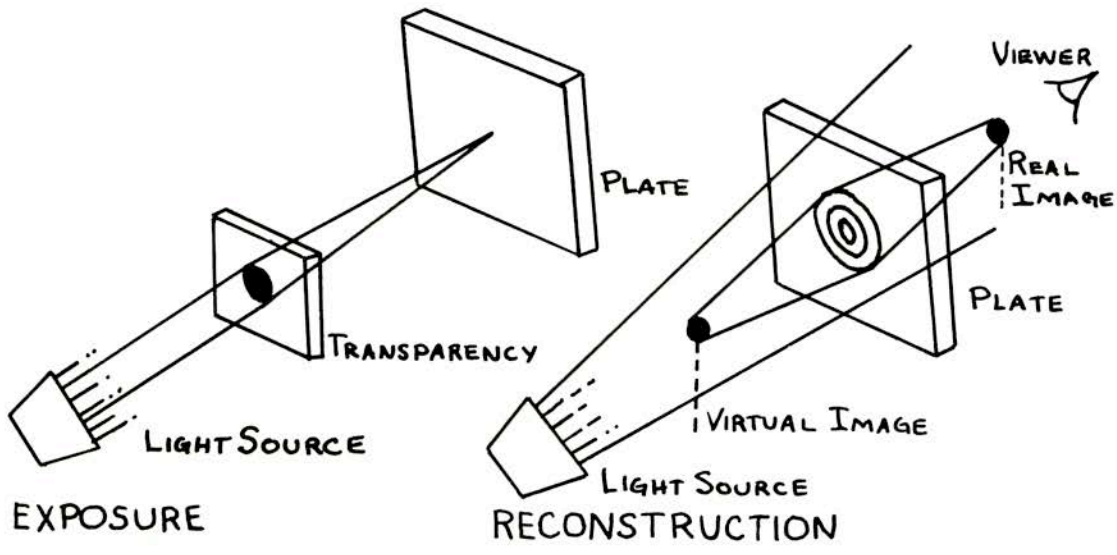
fingers extended and almost touching. If one looks through the spaces between the fingers and focuses on the wall, a number of small gray lines can be seen.

These are the results of light passing around the edges of the fingers.

GABOR'S INVENTION

In 1947, Dr Dennis Gabor was conducting research into ways of improving the image quality produced by electron microscopes, as the photographs made with them did not show sufficient detail. Gabor wondered if any improvement could be achieved by a new kind of photography that used the principles of interference and diffraction. He theorized that it was possible to make an image by recording a diffraction pattern caused by the interference of light.

The following year, Gabor made his historic experiment. He passed the beam of a filtered mercury lamp through a transparency containing an image. It passed through the transparency at right angles to it, reaching a photographic plate on the other side. Some of the beam arrived at the plate relatively unaffected by having passed through the transparency, that is, the waves remained in phase (parallel and one-directional). However, the rest of the beam was diffracted by passing around the edges of the image. Through diffraction, the waves in this beam no longer shared the coherent uniformity of the original beam. As it was broken down into orders, its phase was changed, resulting in changes in the direction of its movement toward the plate. When this diffracted portion of the beam reached the plate, it interfered with the unchanged beam, producing a pattern of fringes (bands of light and dark) that the plate recorded. The resulting diffraction pattern in the developed plate contained information about the shape of the image. Gabor named the plate a hologram, from two Greek words, holo - meaning whole, and gramma, meaning message.



The left sketch on the preceding page shows how one wave of the beam was diffracted by the image and then interfered with one of the undiffracted waves. The two waves were compared, in a sense, and the differences in phase were recorded on the plate.

To view the hologram (right sketch on preceding page), Gabor passed light from the lamp through the plate along the same path as the original beam had followed. The diffraction pattern acted like a lens, bringing the diffracted light to a focus. The light reached the viewer from the direction it had followed from transparency to plate during exposure, creating the effect of an image behind the plate. Because light passed through the plate to form the image, it was named a transmission hologram.

However, Gabor saw a second image as well. A characteristic of interference patterns is that they produce two images when illuminated, one on the side opposite the viewer (the virtual image) and one on the same side as the viewer (the real image). Their precise positions are determined by the angle at which the light meets the pattern during exposure and reconstruction (projecting the image). Gabor's lighting arrangement resulted in having the two images in line with one another. When he tried to look at the virtual image, he had to look through the real image, causing distortion of a kind similar to looking at a photographic slide through a second slide.

Unfortunately, the lighting arrangement could not be altered. Since incoherent light's many wavelengths would be diffracted separately to produce multiple images that created a blur when viewed simultaneously, Gabor used the filtered mercury lamp to create a coherent (one wavelength) light source. But this light began to lose its spatial coherence after a distance of only a millimeter or so. Thus, to use it as efficiently as possible, he had been forced into the in-line arrangement for exposure and viewing.

The in-line method for transmission holography was used throughout the 1950's, as researchers continued to develop the theory of holography. However, as far as display holograms were concerned, the lack of highly coherent light restricted them to the realm of theory.

THE LASER

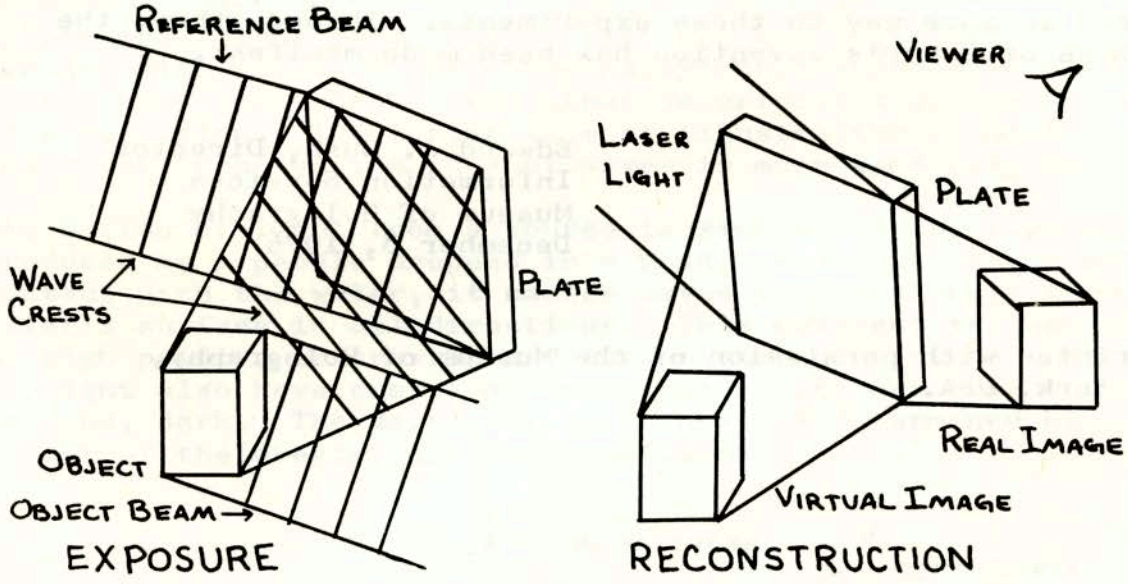
In 1960, Theodore Maiman built the first source of highly coherent light, the laser, for which the theoretical basis had been formulated by Dr. Charles Townes. Within a few years, it was put to use for making display holograms.

The term laser is an acronym for Light Amplification by Stimulated Emission of Radiation. While many different kinds of substances are currently used for producing laser light, the most common is gas, as in continuous wave gas lasers. These lasers emit coherent light continuously, as opposed to pulsed lasers, which emit an extremely intense burst of light for short periods. Continuous wave gas lasers are similar to ordinary fluorescent lights in that both employ gases sealed in a tube that glow when electrically charged. However, a laser emits only one wavelength (color) of light which is ordered by mirrors to form a spatially coherent beam that retains its spatial coherence over a much longer distance.

LEITH AND UPATNIEKS

The first holograms produced with a laser were made in 1962 by Emmett Leith and Juris Upatnieks. The initial images were made from transparencies, as Gabor's had been. But within a year, they were making sharp, detailed images of three-dimensional objects.

The increased coherence length of laser light gave Leith and Upatnieks the flexibility to depart from Gabor's in-line method. They used a technique they had developed for a process of holographic radar (imaging with coherent sound). Generally known as the off-axis method, it changed the positions of the twin images produced by diffraction patterns, permitting each to be viewed separately.



The off-axis method as used in making a transmission hologram of a three-dimensional object is shown above left. During exposure, the laser beam is split into two separate beams. One is directed to the plate, and is called the reference beam. The second, called the object beam, is directed toward the object. As the object beam is reflected off the object, rather than diffracted (when it passes through a transparency), changes in phase occur.

A General Guide to Holography

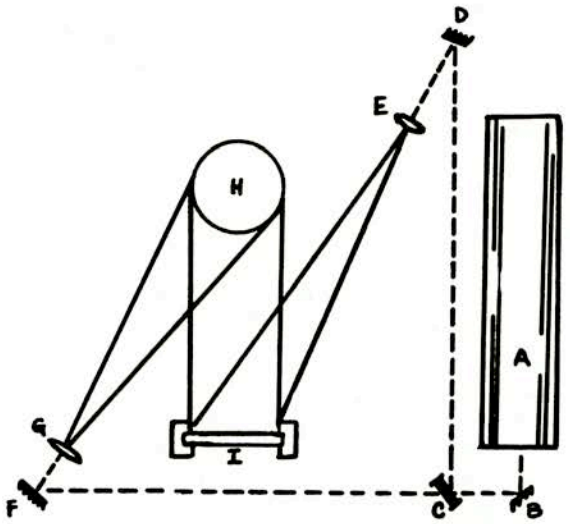
Creative holography currently comprises eight different kinds of holograms, each with distinct characteristics and capabilities. All have been developed since the invention of the laser in 1960. Prior to this, holography was exceedingly limited in its applications and its use as a means of self-expression effectively prevented.

Among the first holograms whose images began to intrigue people in the visual arts were those of Emmett Leith and Juris Upatnieks. In 1962, they began to use their new, off-axis image making technique in conjunction with the laser to produce high-quality imagery. Their technique, now a staple part of every holographer's methodology, works as follows:

MAKING AN OFF-AXIS TRANSMISSION HOLOGRAM

The process begins with laser light from a continuous wave laser. Because it is coherent, that is, of one color and in step, laser light can be used with far greater ease - and success - than white light sources, which emit many different colors.

A. Laser
B. First surface mirror
C. Beam splitter
D. First surface mirror
E. Lens
F. First surface mirror
G. Lens
H. The center of object area
I. The film holder



The beam of laser light is first optically split into two beams (see diagram above). One beam, called the reference beam, is directed toward the photographic plate and expanded (its diameter increased) so that its light covers the plate completely. The second, or object, beam is directed to the object and similarly expanded to illuminate it.

Up to now, the beams have been virtually unchanged. However, when the object beam is reflected off the object, it becomes diffused: each point on the object reflects light to each point on the plate. This reflected light carries with it information about the shape and texture of the object.

When the two beams meet at the plate, the referance beam is modulated, or altered, by the information-carrying object beam. This produces an interference pattern that the plate records throughout its depth. The interference pattern contains all the information carried by the object beam.

After developing, the hologram is illuminated by laser light travelling along the identical path as the original reference beam. The interference pattern diffracts, or redirects, some of the light, reconstructing the path taken by the original beam from object to plate. The result is a viewable image made of light.

BASIC QUALITIES OF HOLOGRAMS

Three dimensionality - Because a hologram records the path of light reflected by every point of the object that is exposed to the plate, it displays the image in full size at the same distance from the plate as the object had been during exposure. This gives the image its three-dimensional aspect. The amount of depth a hologram can show is largely dependent upon the power of the laser and the coherence length of its beam. Coherence length is simply the distance a laser beam can travel before it begins to disperse, or break up.

Parallax - This is the seeming difference in the positions of an object as seen from different points. Thus, as one changes viewing positions (e.g. head-on, from left to right, top or bottom), different perspectives of the object can be seen. For this reason, holograms are frequently compared to windows. When looking through a window, the view changes as one changes position. Because each point on the hologram has been exposed by light from each exposed point of the object, the hologram's interference pattern reconstructs an image which can be seen from as many angles to the plate as possible.

The Whole Message - Since each part of the plate "sees" the entire object, it records the entire image from every point on the plate. If one were to break a hologram into pieces, each piece would show the whole image, albiet from a different angle of view. To use the window analogy again, it is as through one were to block out part of the window with a shade. Through the uncovered portion, the entire view could still be seen.

Virtual and real images - The hologram just described contains a virtual image; it appears on the side of the plate opposite the viewer . A combination of both virtual and real imagery produces an image which straddles the plate.

Multiple imagery - Because a plate can be selectively exposed, any one hologram can carry more than one separate image. Each image is viewed independently. Holograms of this type are termed multi-channel.

TYPES OF HOLOGRAMS

Generally, there are two broad categories of holograms. Transmission holograms are illuminated by passing light through them, toward the viewer. Reflection holograms reflect light off their front surfaces.

Transmission holograms

1. Off-axis transmission holograms - noted for the amount of depth they can display, these holograms can be viewed only with laser light or heavily-filtered, intense white light sources.

2. Cylindrical transmission holograms - the image can be seen from all sides. Illumination is similar to off-axis transmissions.

3. Pulsed holograms - with the aid of a pulsed (as opposed to a continuous wave) laser that emits an extremely brief, intense burst of light, living organisms and moving objects can be holographed in much the same way as a photographer takes a picture with a flash bulb or strobe unit. Illumination is similar to off-axis transmissions.

4. White light transmission holograms. These holograms can be illuminated by light from any incandescent light source, such as a common clear light bulb or even a candle but are not viewable under laser light. There is no vertical parallax, that is, the perspective does not change as the angle of view moves from top to bottom; however, horizontal parallax can be seen. At present, there are three kinds:

A. White light transmission holograms - the image can be seen in the colors of the spectrum as the viewer changes position.

B. Achromatic white light transmission holograms - the image appears in black and white.

C. Integral white light transmission holograms - Integrals are the first practical holographic movies. Each one is really hundreds of holograms made from frames of ordinary movie film, thus making possible a hologram of almost any imagery that can be recorded with a conventional movie camera.

Reflection holograms afford ease of viewing since they can be illuminated with either white or laser light.

1. Basic reflection holograms - these can show up to 11" in depth.

2. Dichromate reflection holograms - these differ from simple reflection holograms because of the recording medium.

Dichromates are recorded on a gelatin that can be applied to any irregular, non-porous surface, a glass jar, for instance. Although they can show only a few centimeters of depth, dichromates are very bright and can be viewed with any light source.

EAB

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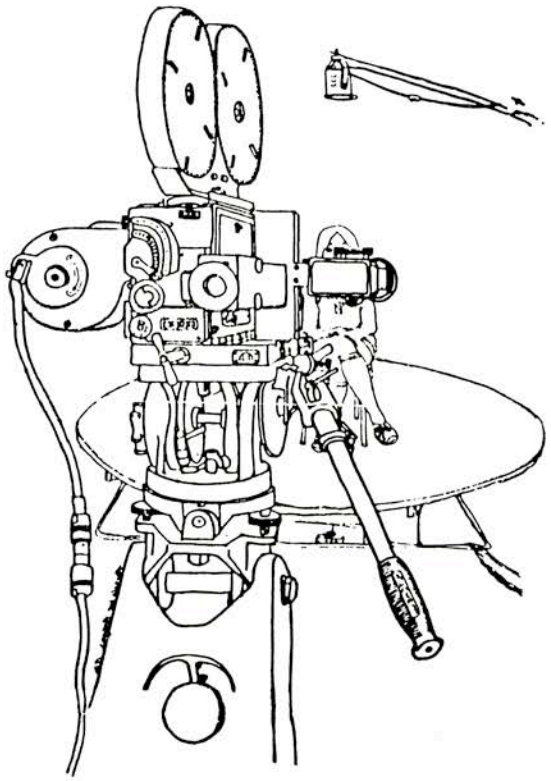
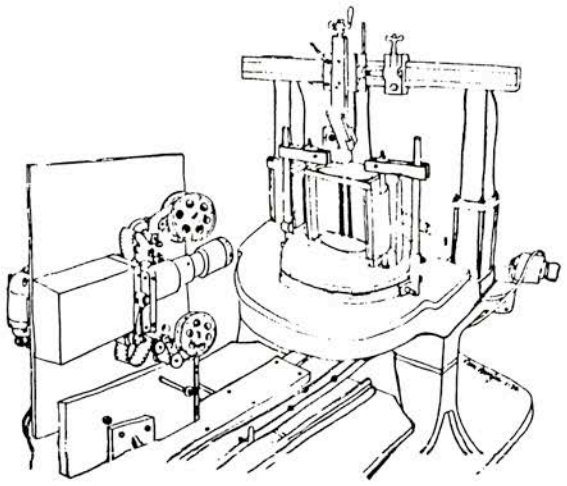
INTEGRAL PROCESS (Trade Mark MULTIPLEX)



1. CINE CAMERA & TURNTABLE

A 35mm movie is made of the subject rotating on a turntable so that views are recorded one third of a degree apart. There are 1080 35mm frames contained within a 360° hologram. This is made with conventional film, camera and lights.



2. MULTIPLEX OPTICAL PRINTER

The processed movie film is put into a special holographic printer and projected through a cylindrical lens onto a narrow vertical section of $9\frac{1}{2}$ by 19 inch holographic film. This process is repeated until 2160 holograms (each frame is printed twice) are recorded onto a 360° multiplex hologram resulting in a completely reconstructed moving, three dimensional image.

Holography Chronology

The following list enumerates some of the key events in the early development of holography, as well as more recent ones of importance to creative optical holography.

EAB

1947 Dr. Dennis Gabor, a research engineer at the Rugby Electrical Company of British-Thompson-Houston in Scotland, conceives the idea of using coherent light to improve the sharpness of images produced by electron microscopes.

1948 Gabor makes the first hologram, an "in-line" transmission hologram, during experiments using a filtered mercury lamp as a light source.

1949-1959 Although limited in their investigations by the lack of a coherent light source, a number of scientists in the United States and Britain continue to study holography, among them: Albert Baez, James Dyson, H.M.A. El-Sum, Michael E. Haine, Paul Kirkpatrick, Emmett Leith, T. Mulvey, Gordon Rogers and George W. Stroke.

The theoretical concepts for the laser are developed independently by Dr. Charles H. Townes of the United States, and A.M. Prokorov and N. Basov of the Soviet Union. In 1964, they were the joint recipients of the Nobel Prize in Physics.

1960 A pulsed ruby laser, the first laser of any kind, is built by Theodore Maiman at the Hughes Aircraft Company Research Laboratories in California.

1961 Trion Instruments Inc., founded by Lloyd Cross, sells the first commercially-built pulsed laser to Texas Instruments, Inc.

Y.N. Denisyuk of the Soviet Union develops white light reflection holography.

1962 Leith and Juris Upatnieks at the University of Michigan, Ann Arbor, use the off-axis radar imaging technique with a laser light source to create off-axis transmission holograms.

1965 Stroke and his colleagues at the State University of New York, Stony Brook, further develop and promote Denisyuk's white light reflection holography.

1966 L.D. Siebert of the Conductron Corporation (no longer in business) uses a pulsed laser to make the first successful hologram of a human subject.

1967 T.A. Shankoff of Bell Laboratories, Murray Hill, New Jersey, and Keith Pennington develop the use of dichromated gelatin as a holographic recording medium.

The first of many holographic movie systems are experimented with by IBM, TRW in California, Bell Laboratories and others.

1968 Stephen A. Benton of the Polaroid Corporation, Cambridge, Massachusetts, develops the white light transmission hologram, given the nickname "rainbow" because of its prismatic coloration. It is easily viewed, as illumination can be provided from any incandescent light source, even candlelight.

About this time, holograms containing more than one discrete (separate) image begin to be produced. Each image can be viewed independently.

Artist Gerry Pethick invents the sandbox vibration isolation system for making holograms. Because it is inexpensive and easy to build, it helps to make holography more accessible to laypeople.

Four holograms, each 24" x 18", are produced by the Conductron Corporation for display at the opening of the General Motors Building in New York City. They are among the first holograms used promotionally. One of them, showing separate images of a coach and a car, can still be seen daily.

1970 The first holographic art exhibition is held at the Cranbrook Academy of Art, Bloomfield Hills, Michigan. Shown are 27 holograms by Cross, Alan Lite, Pethick and others.

1971 Gabor is awarded the Nobel Prize in Physics for his discovery of the principle of holography.

The first school of holography opens in San Francisco, under the direction of Cross.

1972 "N-Dimensional Space", an exhibition of holograms, is held at the Finch College Museum of Art.

Cross and Dave Schmidt experiment with the integral holography technique developed by Robert V. Pole at IBM, a method of producing holograms in thin lines, or slits, in an attempt to develop a feasible method for making holographic movies. Their efforts result in the first practical motion picture hologram and the formation of The Multiplex Company in San Francisco to produce them.

1973 The New York School of Holography opens in New York City, under the directorship of Joseph R. Burns, Jr.

1974 Computer graphics and holography are combined for the first time in a holographic motion picture of a computer-generated image. The result of a joint effort of several people at Columbia University, New York, including Cyrus Leventhal, Hart Perry and Christos Tountas, it was produced by Burns' firm, The New York Art Alliance, Inc., New York City.

Bention invents a new developing process for reflection holograms that improves overall image quality and increases brightness.

1975 Benton modifies the white light transmission process to make black and white (achromatic) images.

"Holography '75: The First Decade" is held at the International Center of Photography, New York City. Produced by Burns and Posy Jackson, it is the largest show of holography to date.

1976 The Museum of Holography is granted a charter by the State of New York and opens in New York City on December 8th under the direction of Jackson.

First holography exhibition in Stockholm, Sweden, comprising of the Museum of holography's (N.Y.) travelling show. Title: "Holografi, Det 3-Dimensionella Mediet".

Agfa-Gevaert produce new HD range of improved emulsions.

1977 N. Phillips & J. Porter develop a new compound for bleaching and find a new commercial developer which greatly improves the image quality of reflection holograms.

The NIKFI group of scientists led by Victor Colmar shows the first truly holographic 70mm movie in prototype form.

General consolidation of optics and chemistry throughout holography.

Dr Stephen Benton produces his IEDT process, improving image quality of white light transmission holography.

First holography show in the UK at the Royal Academy of Arts. Title "Light Fantastic". Presented by Holoco Ltd, showing the work of Nick Phillips, Senior Lecturer at Loughborough University.

First holography exhibition in Strasbourg, France. International scientific and creative work. Title "Sculptures de Lumiere" presented by the European Photonic Association.

First creative exhibition "Picture this" at the Museum of Modern Art, N.Y.

1978 First holography show in Tokyo, Japan. Presented by the Isetan Department store. Title "Alice in the Light World".

School of holography opens in San Francisco under Lloyd Cross.

Second Light Fantastic, Royal Academy, London.

Dr Stephen Benton finds improved technique for integral holograms eliminating most of the inherent distortion of that process.

1979 N. Phillips improves on his bleaching and processing techniques still further, reaching equal standard of noise free holograms as the USSR works, yet on inferior quality emulsion.

Opiem '79 conference at the European Parliament in Strasbourg, France, where Dr Stephen Benton first demonstrates his first successes into full colour holography.

First creative course opens in UK at Goldsmiths' College of Art.

Museum of Holography opens in Paris.

Museum of Holography & New Media opens in Pulheim, Cologne, Germany.

Second large show in Japan at the Seibu Museum.

First Ideecentrum shows in Holland

Denis Gabor, inventor of holography, dies on the 9th February, aged 78.

First showing of fine art holography in England, Liverpool at the Walker Art Gallery as part of the Peter Moores Project V: The Craft of Art. The Richard Payne Collection.

First holography show in Berlin "Holographische Bilder, Ein Neues Medium".

1980 N. Phillips develops new noise suppression techniques producing still clearer images and starts the first large scale pulsed system.

Steve Magrew develops the first mass production printed hologram at a commercially viable rate and fine image quality.

First international creative holography show in London at the Photographers' Gallery. Title "Light Years Ahead".

NICOLE ABISCHER

LOBE

"PORTRAIT OF VIENNOT" 1978, Besancon, France.
With the collaboration of Nicole Aebischer
Pulsed reflection, 8" x 10" glass plate.
Collection L.O.B.E.

"PORTRAIT OF NICOLE" 1978, Besancon, France with Nicole Aebischer. Pulsed reflection. 8" x 10" glass plate.
Collection L.O.B.E.

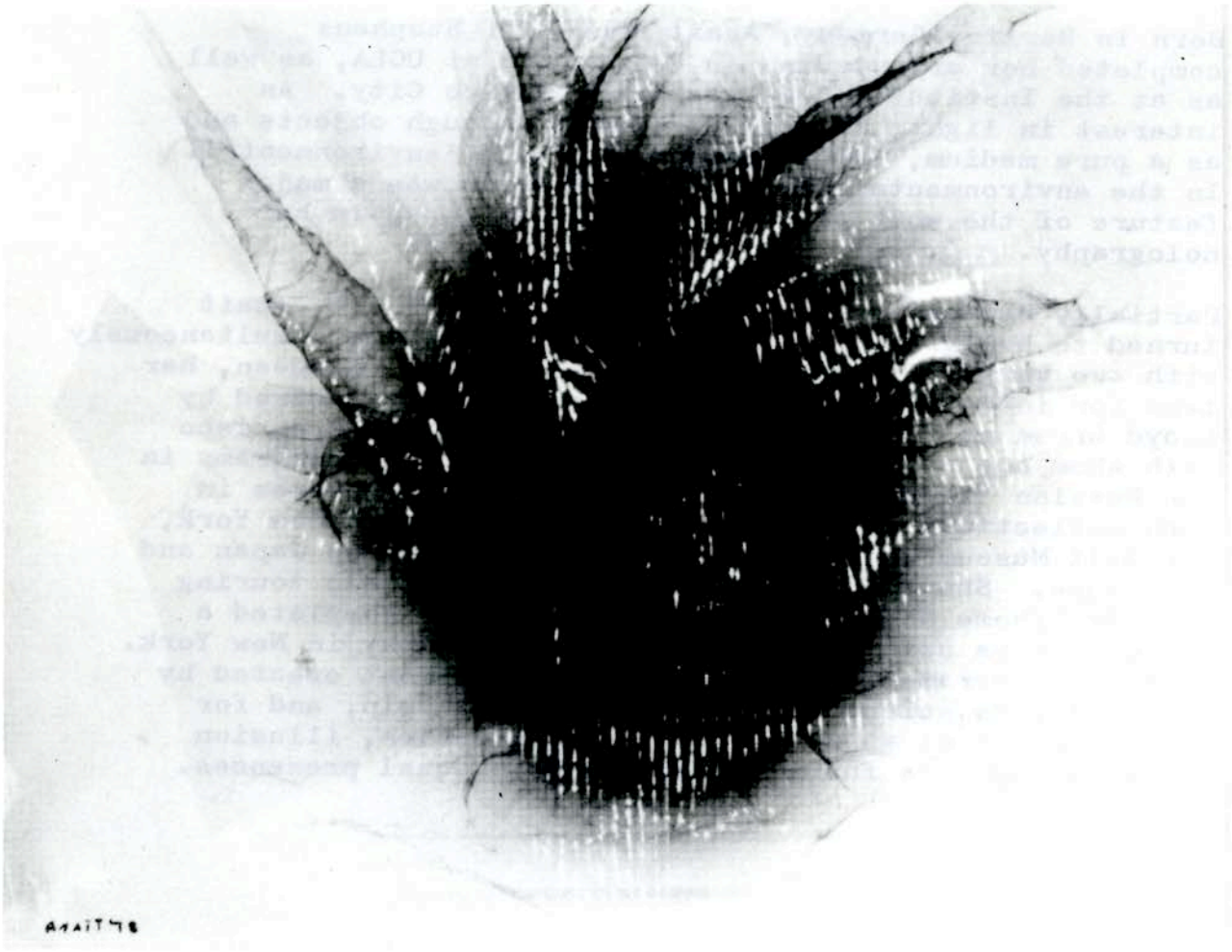
Prof. VIENNOT - LOBE

The traditional line of activities of the LOBE (Laboratoire d'Optique de BEsancon) stands between Research and Development in engineering optics,and comprises about 50 people, including research workers, teaching staff, guest scientists, engineers, technicians and candidates for PhD. At present the main projects in progress deal with analogue and digital image processing, space-time optics, optoelectronics and instrumentation, and speckle phenomena in polychromatic light. LOBE possess several different facilities such as ruby lasers, high powered ionic lasers, high speed cameras, acousto and electro optical modulators, high resolution spectrometers, vacuum coating units, holographic set ups, etc. The applications range from the extraction of significant data in images, to information communication via fibres illuminated in white light, non-destructive measurements of displacements or deformations, surface roughness testing and are therefore closely linked with industry and medical research.

LOBE is headed by Jean Charles Vienot (DIC, PhD, Dr es Sc). Born in 1930 in France, he was educated at the University of Besancon, the Institute d'Optique, Paris and Imperial College, London. He worked on Optical Transfer Functions, then Solid State Lasers, and for the last two decades, with Optical Processing and Holography. He is currently engaged with Space-Time Optics. Former Secretary General at the International Commission for Optics, Fellow of the OSA and member of various Scientific Organisations, he has published about 130 papers in professional journals and books.

Born in France in 1931, Nicole Aebischer received her BSc at the Institut d'Optique of Paris. She is now resident Research Engineer at the LOBE where her main research has been micro-densitometry, interferometry, optical instrumentation and photographic multiplexing. For the last four years, she has worked in holography, namely holographic settings, transmission of reflection holograms and colour holography. In 1978 she invented the principle of a type of cine-holography, based on multiple holograms, such as animated portraits, in which she is assisted by her colleagues Claudine Bainer and Bernard Carquille.

ANAIT



Linda Law

"GOLDEN SPHERE" - 1979, Santa Barbara, USA.
Unique piece. Reflection hologram & collage.
11" x 14" framed.
Part of the Richard Payne Collection.

"UNBROKEN SQUARE" - 1975, Santa Barbara, USA
Unique piece. Reflection hologram & paint.
11" x 14" framed on perspex.
Part of the Richard Payne Collection.

ANAIT

Born in Berlin, Germany, Anait Arutuboff Stephens completed her art studies in California at UCLA, as well as at the Instituto de Bellas Artes Mexico City. An interest in light, both as it passes through objects and as a pure medium, led to some remarkable 'environments'. In the environmental pieces participation was a major feature of the work and it continues to be so in her holography.

Partially because of her love of paradoxical art, Anait turned to holography in 1970. She experimented simultaneously with two very different types of holography: holodean, her term for integral white light holograms and pioneered by Lloyd Cross at the School of Holography in San Francisco with whom she also studied, and in reflection holograms in the Russian 'Denysiuk' technique. Her work features in such collections as the Museum of Holography in New York, the Dali Museum in Figueras, Spain, the Seibu in Japan and many more. She also has the first and only solo touring exhibit "Theme and Variation", and has just completed a retrospective solo at the Museum of Holography in New York. Anait's holograms are a remarkable achievement created by the artist-as scientist without technical help, and for the statement of an aesthetic in which optics, illusion and encoding of a fourth dimension have equal presences.

STEPHEN A. BENTON

Linda Law

"RIND 2" - 1977 Boston, USA - Edition 12 of 24.
White Light Transmission 12" x 12" glass plate.
Permanent loan to Eve Ritscher.

"CRYSTAL BEGINNINGS" - 1977, Boston, USA
Edition 10 of 200. White Light Transmission.
12" x 12" glass plate.
Permanent loan to Eve Ritscher.

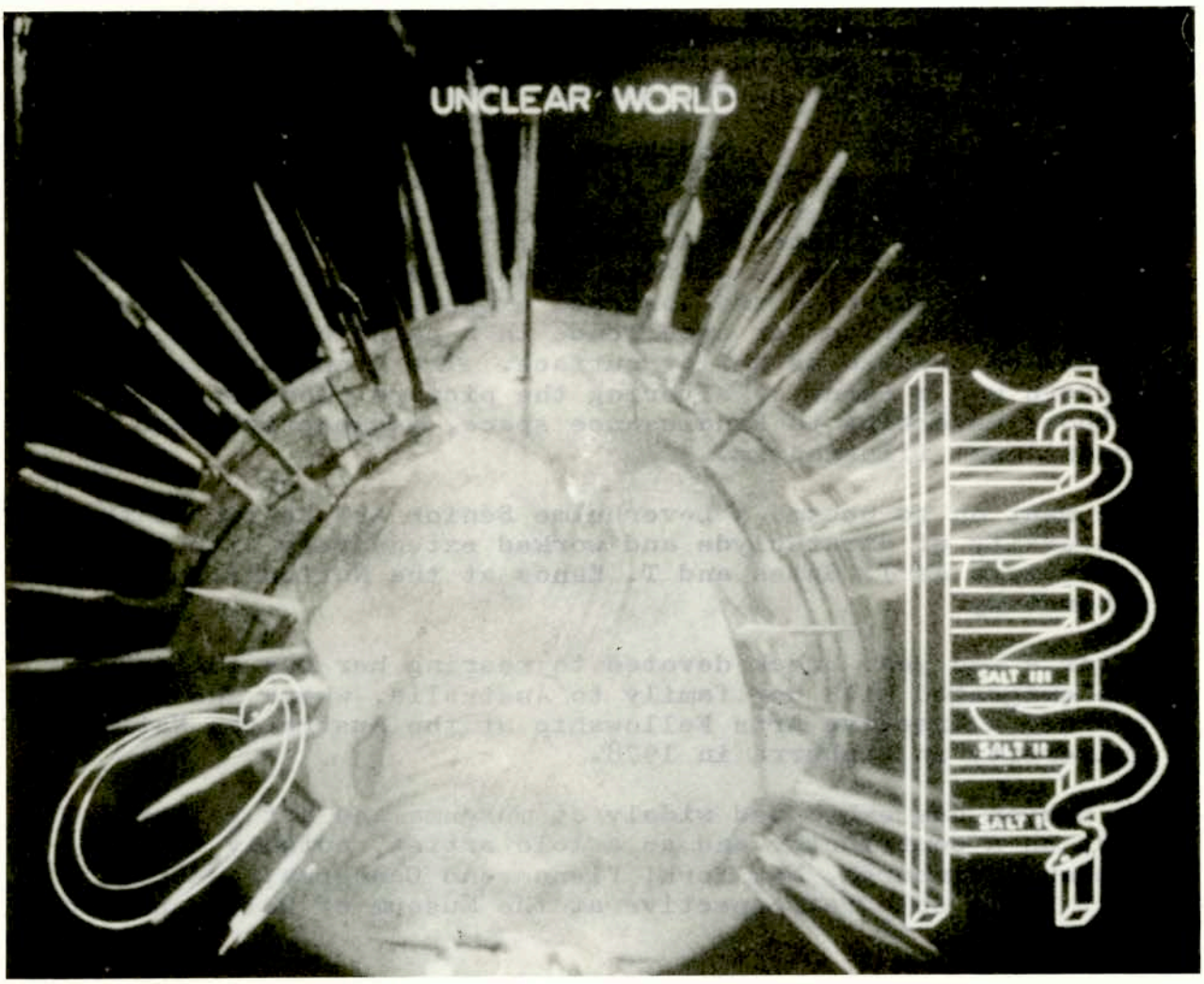
STEPHEN A. BENTON

Dr Benton was born in San Francisco, California in 1941. He left the West Coast to attend the Massachusetts Institute of Technology, where he received the Bachelor of Science degree in electrical engineering in 1963. He continued his studies at Harvard University, receiving the Ph.D. in applied physics in 1968, and remained at Harvard as its first Assistant Professor of Applied Optics from 1968 to 1973. He has been associated with Polaroid Corporation since his undergraduate days and is now a senior scientist in the Research Laboratories. There he has established an imaging physics laboratory, where he conducts research in photographic granularity and the applications of coherent optics to photography, and pursues a long-time interest in holography. He is the author of several papers and patents in optical physics, photography, and holography, and is the inventor of the white-light transmission "rainbow" hologram. His holograms have been exhibited in many cities in the USA and around the world. Dr. Benton has been a president of the New England Section of the Optical Society of America and a consultant to the Holographic Arts Program of the Smithsonian Institution. He is currently a Director of the Optical Society of America, a member of the Visiting Committee of the International Museum of Photography at George Eastman House, a member of the Advisory Board of the Museum of Holography, and was recently appointed to the International Commission for Optics.

As the inventor of the "Rainbow" or Benton White Light technique in holography, Dr. Benton is one of the foremost leaders and innovators in his field and his technique is largely responsible for the growing freedom of composition in the medium of holography.

He is equally one of those scientists whose mind is akin to the artists and, with the assistance of Will Walters and Herb Mingace, he has successfully co-operated with artists, notably in the case of Harriet Casdin-Silver and recently Margaret Benyon. Although he considers his work largely educational, there is additionally a quality of vision in it.

MARGARET BENYON



Margaret Benyon

"UNCLEAR WORLD" 1979, Canberra, Australia, Unique Piece.
Reflection hologram with etching. 8" x 10" glass plate.
Collection of the Artist.

"GREENHOUSE 1" 1979, Canberra, Australia, Unique Piece.
Reflection hologram with etching. 8" x 10" glass plate.
Collection of the Artist.

MARGARET BENYON

Born 1940, Margaret Benyon spent her childhood in Kenya. She returned to England for her education and as a postgraduate at the Slade, she won the Painting Award 1964.

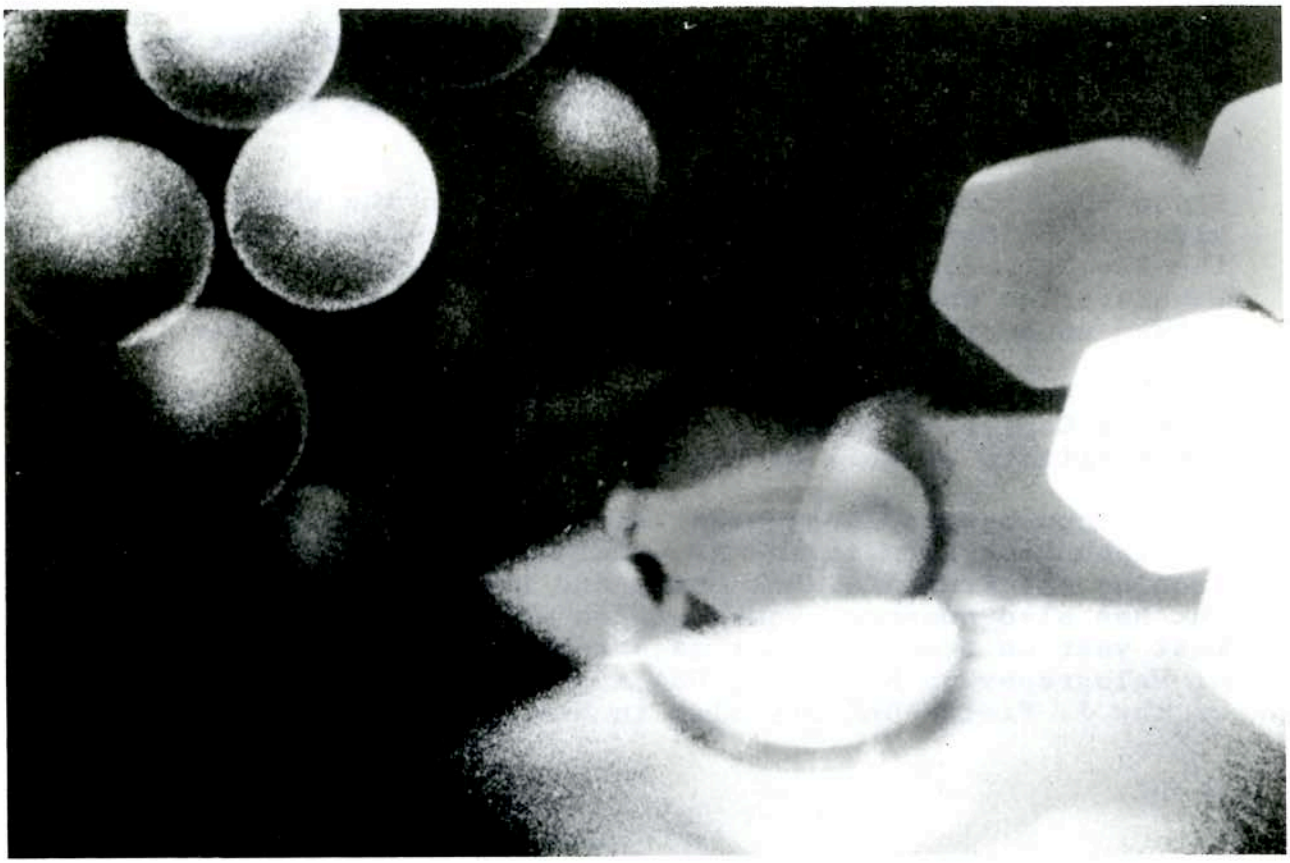
After several years of teaching both full and part time, she became a fellow in Fine Art at Nottingham 1968-71 and started using holography as a logical development from her interests as a painter. As early as 1963-64 she had been using the interference pattern on which holography is based in order to question the abstract expressionists' assumption that the criterion for excellence in a painting was that it should be treated as a flat surface. The graphic interference pattern was a means of altering the picture plane spacially without reverting to Renaissance space, perspective and traditional illusionism.

She went on to become a Leverhulme Senior Art Fellow at the University of Strathclyde and worked extensively with such scientists as J. Gates and T. Ennos at the National Physics Laboratory.

After a two year break devoted to rearing her two children, she emigrated with her family to Australia, where she was awarded a Creative Arts Fellowship at the Australian National University in Canberra in 1978.

Ms Benyon has exhibited widely at museums and art galleries both as a contributor and as a solo artist, notably in London, Edinburgh, New York, Vienna and Canberra, and has just had a solo retrospective at the Museum of Holography in New York.

RUDIE BERKHOUT



Linda Law

"12 MILLIWATT BOOGIE" - October 1978 New York, USA - Edition
White Light Transmission - Tryptich containing 3 x 8" x 10"
Glass plates in wooden frame 34" x 12" mounted on a
photographic tripod.
Part of the Richard Payne Collection

"PHOTON STUDY No 10" - July 1978, New York USA - Edition 5 of 7
White Light Transmission - 8" x 10" Glass Plate
Part of the Richard Payne Collection.

"PHOTON STUDY No 1" - September 1978, New York, USA
Edition 6 of 7. White Light Transmission - 8" x 10" Glass Plate
Part of the Richard Payne Collection.

"PLANET CLAIRE" - June 1979 New York, USA - Edition 2 of 9
White Light Transmission - 8" x 10" Glass Plate.
Part of the Richard Payne Collection.

"SKETCHING AWAY" - June 1979 New York, USA - Edition 4 of 9.
White Light Transmission - 8" x 10" Glass Plate.
Part of the Richard Payne Collection.

RUDIE BERKHOUT

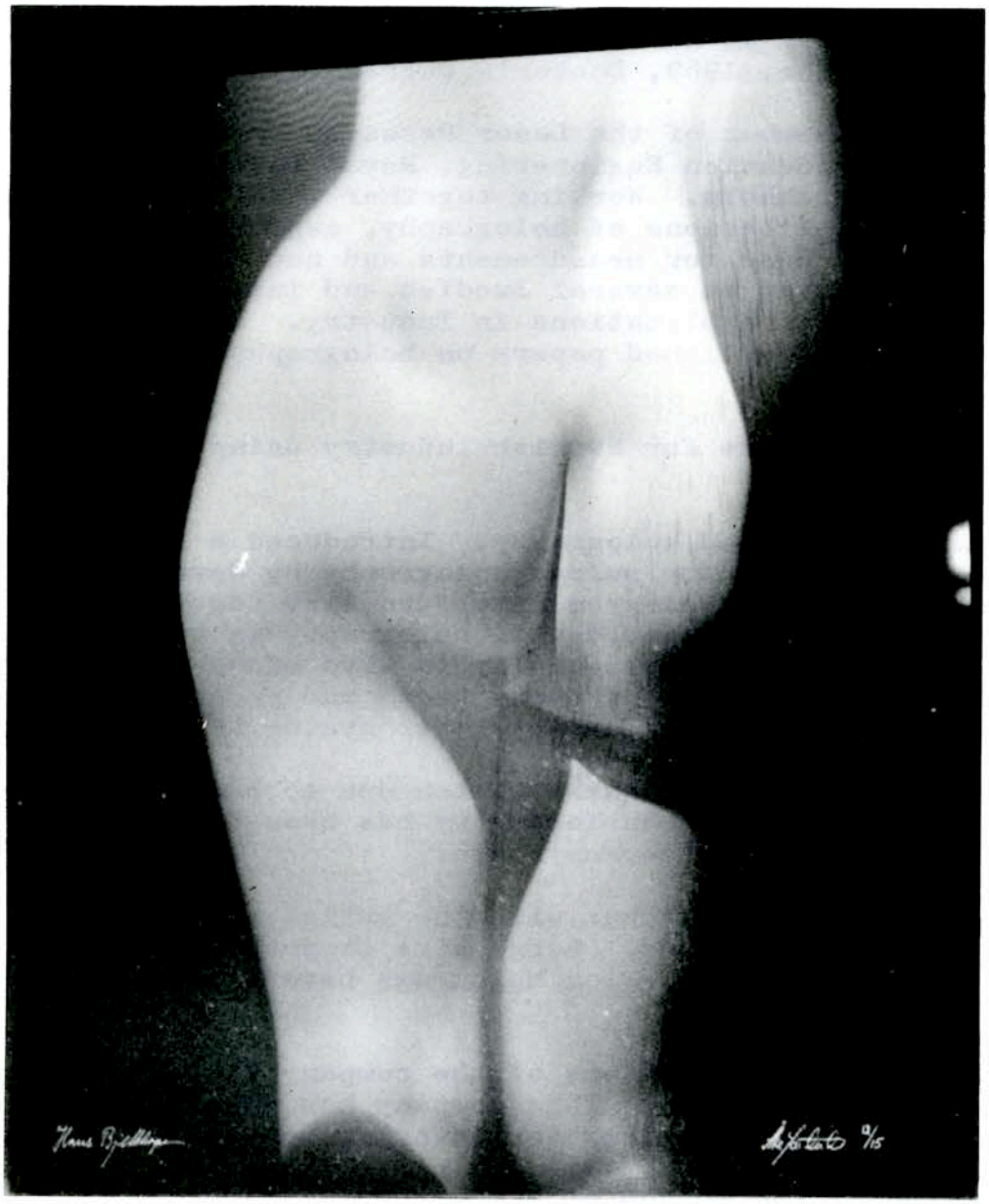
Born in Amsterdam, Holland in 1946, Mr. Berkhout came to the USA in 1974 with a background in engineering and lighting design to study holography at the New York School of Holography.

Since that time he has been researching in the white light viewable holographic techniques and pulsed holography at the New York Art Alliance, the New York Holographic Laboratories and Brown University in Providence, Rhode Island under the sponsorship of Professor M. Gerritsen.

He then went to work designing and constructing a holographic Contact Copier to produce limited editions of holograms for other artists as well as himself.

He has now become independent since he has established his own laboratory/studio and is widely collected by museums such as the Franklin, the Seibu and the Museum of Holography, but has also numerous works placed with private collectors. Last year he had his first major solo show at the Museum of Holography in New York, USA and recently exhibited solo at the J. Fields Gallery also in New York.

HANS BJELKHAGEN



Ake Sandstrom

"TOMORROW" - 1975, Stockholm, Sweden, Edition of 2
White Light Transmission, 18" x 24" Glass Plate.
Collection of the Artist

HANS BJELKHAGEN

Born in Stockholm on March 9, 1945.
Master of Science, 1969, Doctor's degree 1978

Since 1969, a member of the Laser Research Group at the Division of Production Engineering, Royal Institute of Technology, Stockholm. Working together with Dr. Nils Abramson on applications of holography, especially hologram interferometry used for measurements and non-destructive testing. Lecturer at several Swedish and international seminars on Laser Applications in Industry. Nineteen internationally published papers on holography from 1972 through 1978.

Consulting work made for Swedish industry using hologram interferometry.

Specialized in pulsed holography. Introduced a fringe-control possibility for pulsed holography by developing the pulsed sandwich hologram interferometry together with Nils Abramson. Developed dental holography in co-operation with Dr. Paul Wedendal, specially in vivo measurements on the functional dynamics of human teeth and prosthodontic appliances, where a pulsed ruby laser system has been used.

A method for imaging of chest motion due to heart action by means of holographic interferometry has been developed in co-operation with Soemens Elema.

Since 1970 working together with the artist, Professor Carl Frederk Reutersward. Large-size Lippmann holograms and large-scene transmission holograms have been produced for art exhibitions.

Since 1974 one of the owners of the company Lasergruppen Holovision AB in Sweden. This company has specialized in making large-size holograms for advertisements and exhibitions.

Represented at the Museum of Holography in New York by a white-light transmission hologram "Tomorrow" produced in co-operation with Ake Sandstrom and "Finger Language", a set of four Lippmann holograms made together with Carl Frederk Reutersward.

Represented at the Gallery 1134 in Chicago with a transmission hologram that has been made together with Hans Weil.

HARRIET CASDIN-SILVER

Bichajian

"A WOMAN" - 1979, Boston, USA. Edition of 3.
Collaboration of Stephen Benton. Integral.
65" x 12" film mounted on perspex curved mount arc radius 38".
Collection of the Artist

"COMPTON'S BUTTOCKS, ETC" - December 1978, Boston USA
Edition 1 of 6. Integral. 4 x 10" x 10" film in perspex
curved mount. 20" x 22".
Part of the Richard Payne Collection.

"EQUIVOCAL FORKS" - 1977, Boston, USA. Edition of 2
Laser Transmission. 11" x 14".
Collection of the Artist.

HARRIET CASDIN-SILVER

Born in 1935 in Worcester, Massachusetts, USA, she did her postgraduateship at Columbia University, New School for Social Researches in New York City as well as later attending the Cambridge Goddard Graduate School for Social Change in Cambridge, Massachussetts.

Having been a lecturer at Clark University in Worcester, Massachussetts, Ms Casdin-Silver's work in holography began in 1969 when she was introduced to it by Dr. Raoul Van Lighten at the American Optical Research Laboratory during a search for lasers to use in her environmental art pieces. Investigating industrial and advertising applications for holography at the time, Dr. Van Lighten was eager to see what an artist could do with the medium. He gave her the rare opportunity to explore the potential of holography in a fully equipped laboratory and provided technical assistance without impinging on her artistic freedom.

Within a few years her work began to attract attention and in 1972 the Polaroid Corporation asked her to give an exhibition. At Polaroid she met Dr. Steven Benton, the physist who had invented white light transmission holography in 1969. Ms Casdin-Silver and Dr. Benton decided to collaborate. One result was "Cobweb Space" 1972 acknowledged as the first art work made with the white light transmission technique.

In 1973, Dr. Hendrick Gerritsen invited Ms Casdin-Silver to Brown University where she became an Assistant Professor (Research), Department of Physics. Aided in her work by a grant from the Visual Aids Program of the National Endowment from the Arts, she continued to explore and innovate in holography. Currently, Ms Casdin-Silver is a Fellow of the Advanced Visual Center at MIT in Cambridge, Massachussetts, and has twice been awarded a Rockefeller Foundation Grant.

At the Center she conducts a course in holography and is directing the construction of an artists' holographic laboratory. She has taken part in the sculpture "Centerbeam", a collaborative project by CAVS which was shown at Documenta in Kassel, Germany as well as in the Mall in Washington, and has pieces shown and owned in museums around the world such as the Isetan in Japan, the ICP in New York, the House of Sculpture in Stockholm and most recently the Vienna Biennale and the Franklin Institute, Philadelphia. Her most recent work, "A Woman", again in collaboration with Steven Benton, has created a new holographic format, far extending the possibilities of integral holography.

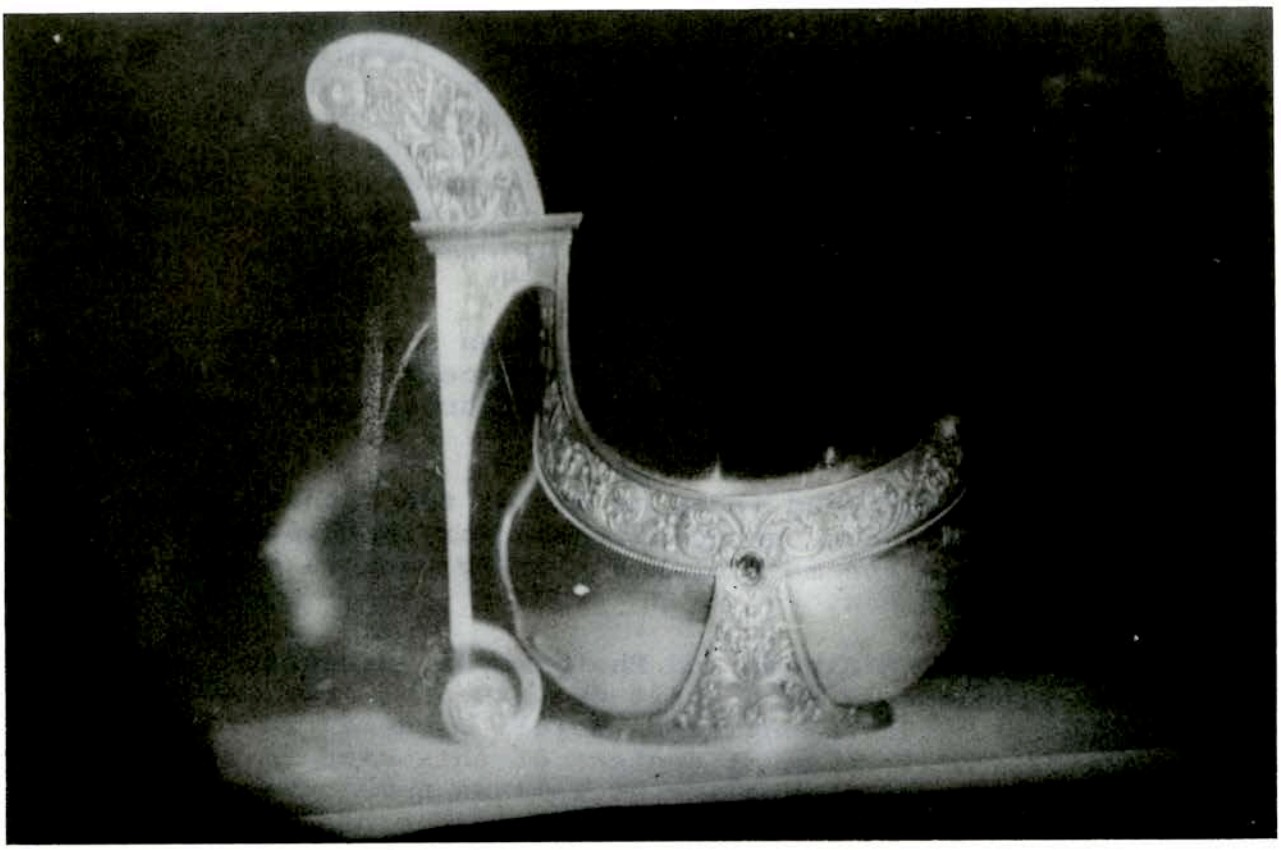
PETER CRESSWELL

Born in England in 1937, Peter Cresswell studies at Middlesborough College of Art and at the Royal Academy Schools. He has exhibited paintings with the Young Contemporaries, the Redfern Gallery, McRoberts & Tunnard, Grabowski, the London Group and the Air Gallery. His one-man exhibitions include the Middlesborough Art Gallery, the Greenwich Theatre Gallery and the Ogle Fine Arts in Eastbourne.

He is at present Head of Fine Art at Goldsmiths' College in London and is Chairman of the Holography Management Committee.

Piece: Dart made 1980. White light reflection hologram made at the Goldsmiths College Holographic Workshop. Size 8" x 10". Collection of the artist.

YURI DENYSIUK



NIKFI

(This piece not presented in the exhibition, but is typical of USSR work).

"TWO KEYS OF CATHERINE THE GREAT"
Denysiuk reflection hologram 1977. 20cm x 30cm
Collection of the European Photoonics Assoc. (EPA)

"TWO SWORDS" Denysiuk Reflection Hologram 1977
30cm x 40cm
Collection of the European Photonics Assoc. (EPA).

NIKFI, USSR

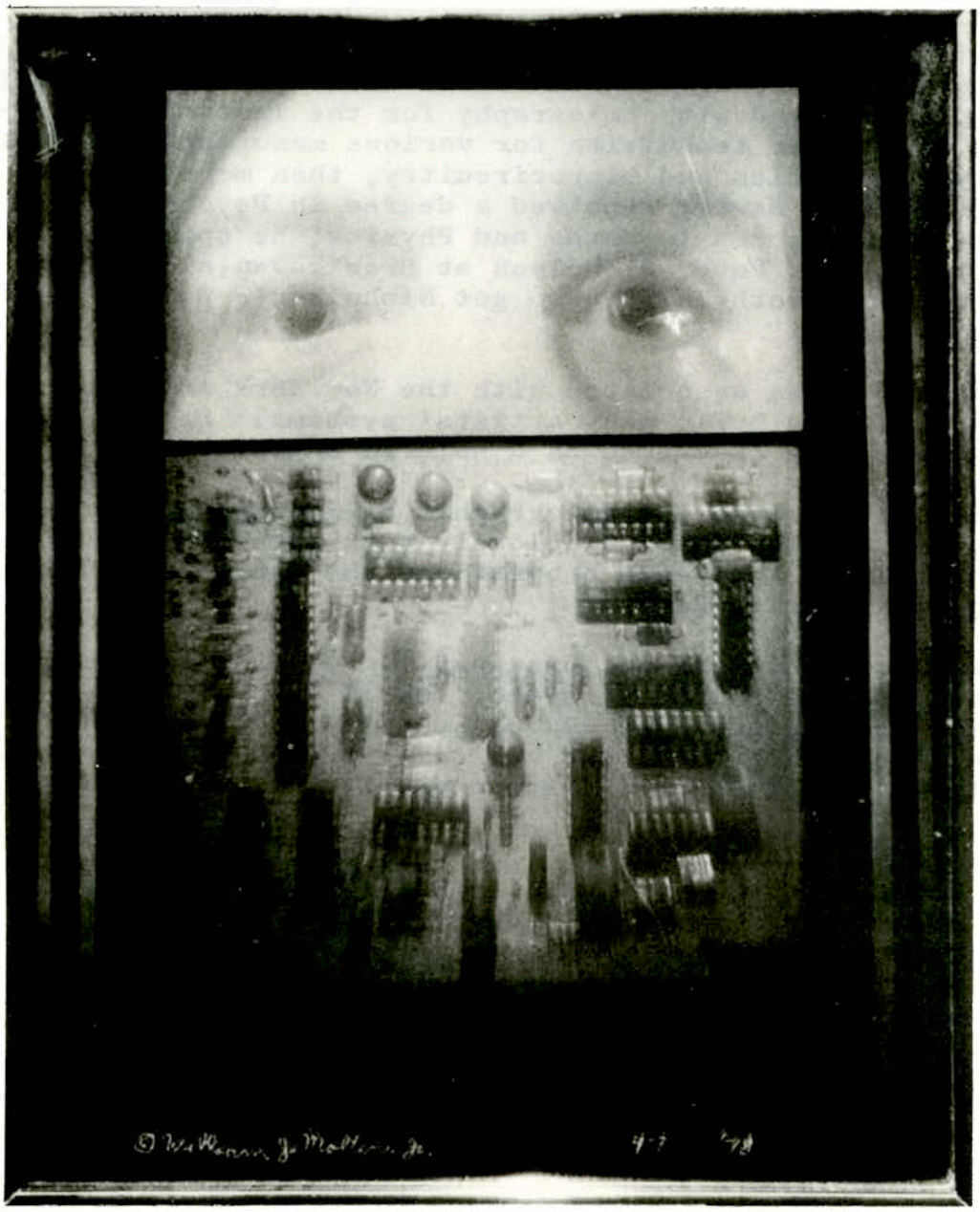
Born in Sochi, USSR, Yuri Denisiuk attended the Leningrad Institute of Precision Mechanics & Optics. Inspired as a young man by a science fiction novel "The Starship" by Ivan Yefrenov, he became fascinated by the notion of 3-D imaging. He continued at the Optical Institute as an Associate under the tutorship of A. Yelkin, where in 1949 having read Denis Gabor's article on holography (Royal Society Proceedings 1949) he started his own line of holographic research.

In 1962, Denysiuk published his now famous paper on in line reflection holography, and in 1970, he received the Lenin Prize for "Holography with Recording in Three Dimensional Medium".

Yuri Denysiuk is regarded today as one of the fathers of holography; he is a corresponding member of the U.S.S.R. Academy of Science and most of his display work is carried out at NIKFI in Moscow.

NIKFI stands for the Cinema and Photographic Research Institute; situated in Moscow, it comprises a large number of scientists and research engineers solely occupied in image research. One of the finest centers of this kind in the world, it produces outstanding quality as well as some of the leading innovations in its field. Under the Directorship of Victor Colmar, NIKFI scientists are the only group in the world to have produced a prototype system for true holographic 70mm moving pictures, destined to possibly revolutionise the film industry and the viewing public of the future.

BILL MOLTENI



Linda Law

"STRIPES" - 1978, New York, USA. Edition 4 of 7.
Silver Backed White Light transmission for reflection viewing - 8" x 10" glass plate.
Part of the Richard Payne Collection.

BILL MOLTENI

Born in Baltimore, Maryland USA in 1949, Bill Molteni obtained a Psychology Degree at the Monmouth College. Bill has been involved with holography for the last eight years, first as a laser technician for various manufacturers dealing mainly with optics and microcircuitry, then more recently as an artist. Having received a degree in Psychology, and having also majored in Maths and Physics, he spent one year with the artist Peter Nicholson at Brockhaven, along with Bill Walters, both helping to get Nicholson's pulsed laser system working.

He has also been associated with the New York Arts Alliance, where he helped build many artists' systems. He has frequently been described as a natural engineer.

Molteni then joined the Holographic Film Company as a partner where he has been involved closely with such projects as the Artists in Residence program and the Cabin Creek Center along with Harriet Perry.

His work concentrates on juxtaposition of texture, and the mix of line and colour in space. He is one of the very few artists who explores the use of Achromatic (black and white) white light holography, and has contributed largely to the development of full colour stereograms.

SAM MOREE

Born in Florida in 1946, Sam Moree comes to holography with a background in acting, painting and video. He has appeared in several feature films and has also performed in many off-Broadway productions and has written and directed "Little Steps", a video piece for Manhattan cable TV. In 1974, Mr Moree designed a painting-sculpture entitled "Lipsink", a piece with four participating artists. After presenting the piece at La Mama, it was subsequently converted into video and shown on cable TV and at the Annual Avant Garde Festival 1975.

Mr. Moree currently is a director and teacher at the New York Holographich Laboratories where he also assists in other holographic artists' work. He is also preparing for his first solo show at the Museum of Holography in New York in the new year.

Linda Law

"SIDEWALK DREAMS" - October 1978, New York, USA
Edition 7 of 20. White Light Transmission.
4" x 5" Film between 8" x 10" glass plate.
Part of the Richard Payne Collection.

"LANSCOPE" - October 1978, New York, USA
Edition 1 of 8. White Light Transmission.
Part of the Richard Payne Collection

RUBEN NUNEZ

Linda Law

"ALDEBARAN" - 1977, New Jersey, USA
With the assistance of Jody Burns.
Unique Piece. Silver backed White Light Transmission.
for reflection viewing.
4" x 5" glass plate on 12" x 12" frame .
Part of the Richard Payne Collection.

"PHOTONICS No 1" - 1978, New Jersey, USA
With the assistance of Jody Burns.
Unique Piece. Silver backed White Light Transmission
for reflection viewing. 4" x 5".
Part of the Permanent Collection of the Museum of
Holography, NY., USA.

RUBEN NUNEZ

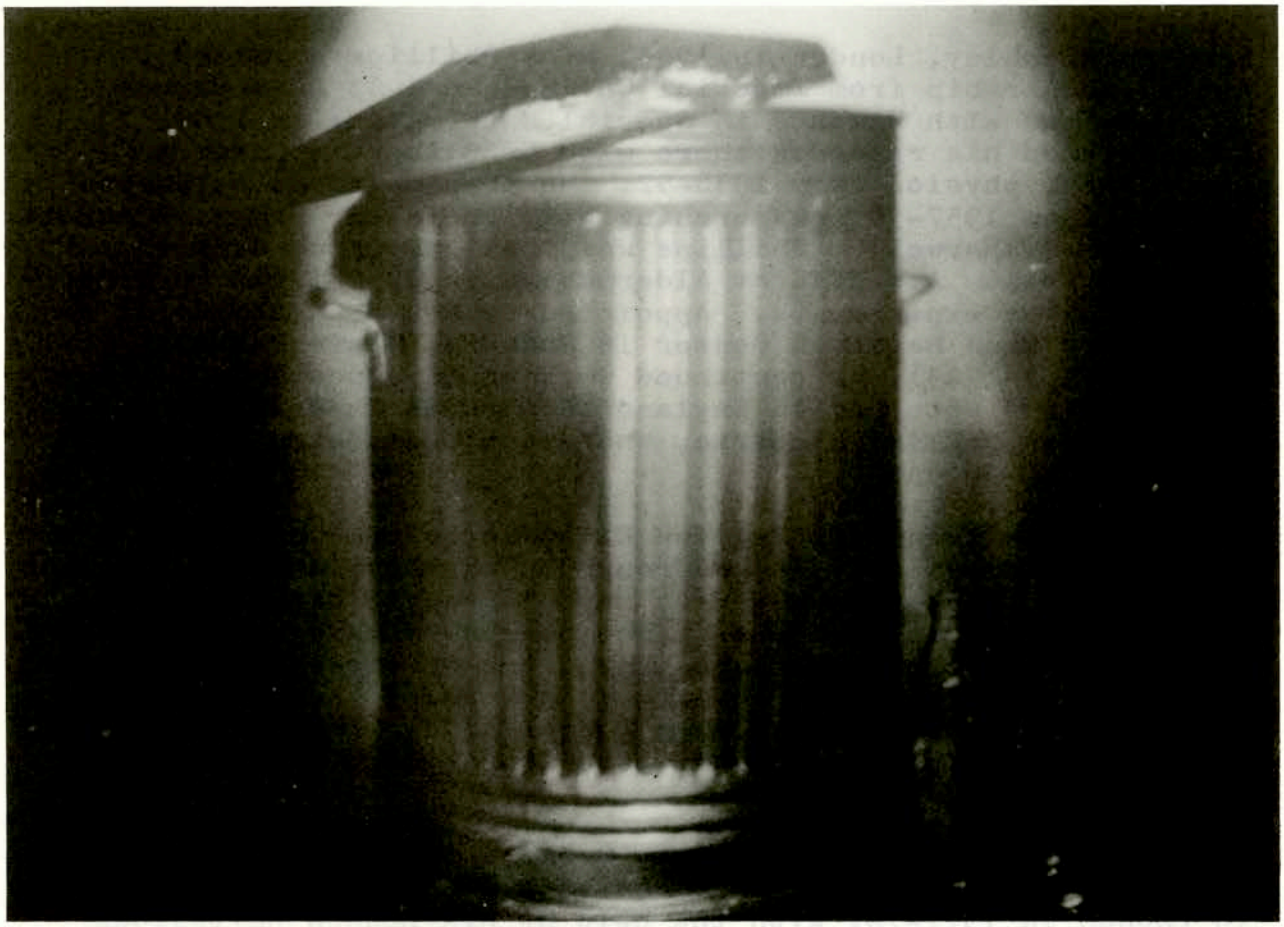
Born in Valencia, Venezuela in 1930, Ruben Nunez has pursued his aesthetic and technical education in a diversity of art forms internationally; studying, working and showing in Caracas, Paris, Murano, London and New York. Best known for his early works in kinetics in Paris in the 1950's, he has also won awards for his work in glass (receiving the Gold Medal in Glass Design in Caracas in 1960) and his film "Space Light". His glass works have been exhibited internationally and have been published in two books by the Corning Glass Company. Ruben's work is represented at the Corning Glass Museum in its permanent collection and in the National Gallery of Art in Caracas, as well as with numerous private collectors throughout the world.

In addition to his work with painting, etching and kinetic sculpture and his many exhibitions of this work, Ruben has also owned a glass factory and been Professor of Design at the Central University and the Newmann-Ince Institute, both of Caracas.

Ruben began his studies in holography in 1974 with Maurice Francin, Medeleine Marquet and Jean Sagaut of the Institut d'Optique in Paris. He came to New York in 1975 to continue his studies at the New York School of Holography, where he influenced numerous younger holographers while pursueing his development of what he calls "holokinetics", an aesthetic he first began developing in Paris a few years earlier.

Nunez is currently working on several holographic pieces at the studios of the New York Alliance Inc. and at the New York Holographic Laboratories in New York City.

NICK PHILLIPS HOLOCO LTD



Holoco

"DUSTBIN" 1980 - Reflection hologram, 1m x 1m.
Collection of Holoco

NICK PHILLIPS HOLOCO LTD

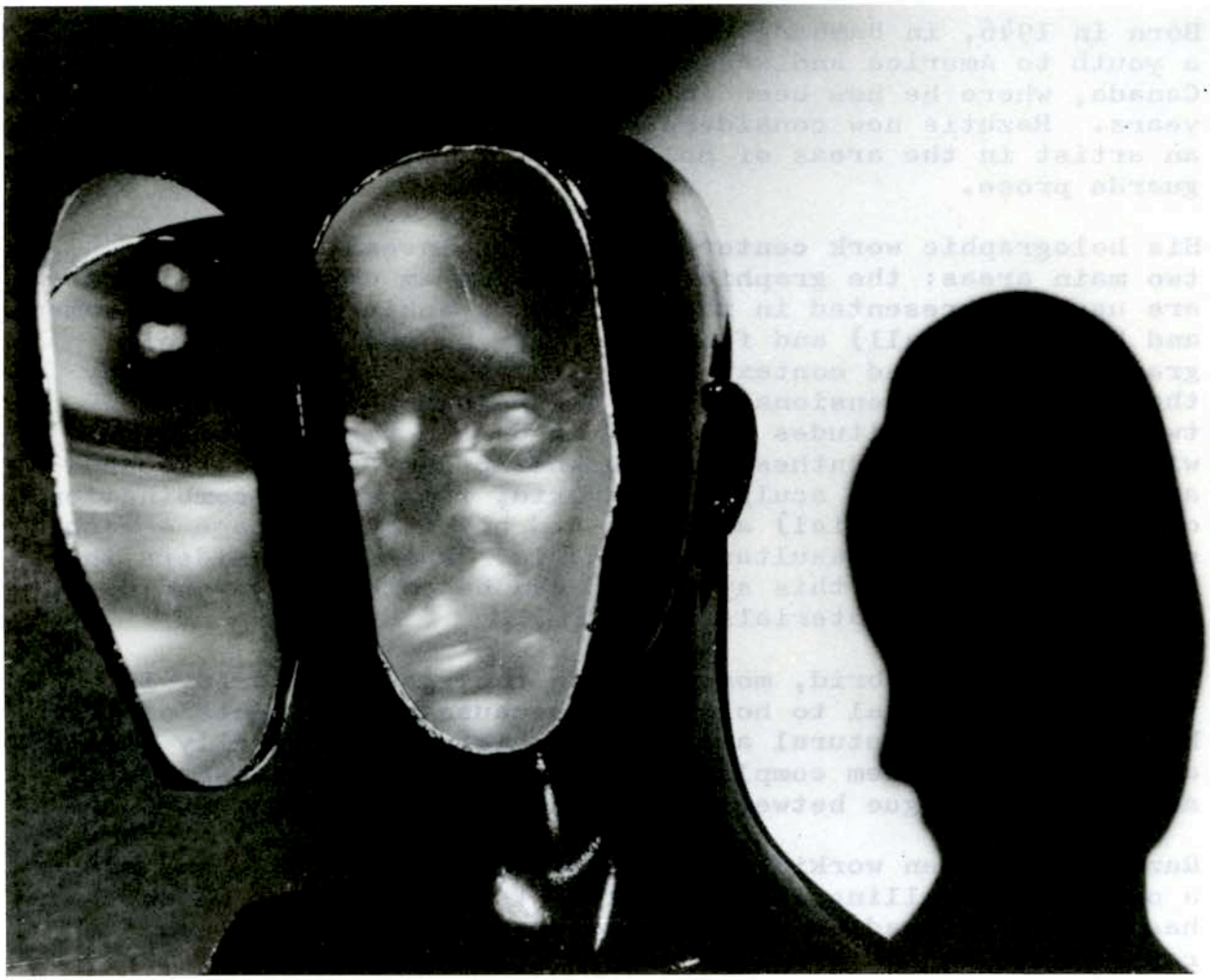
Born in Finchley, London in 1933, Nick Phillips obtained a state scholarship from Imperial College in 1953 from whence he graduated with Honours in Special Mathematics in 1956. He continued his research there with Dr Oliver Penrose in theoretical physics from 1956-57. He then moved on to Fusion Physics from 1957-59, researching with Professor P.M.S. Blackett and A.E.R.E. Harwell. Phillips was then appointed Senior Research Fellow A.W.R.E. at Aldermaston in 1959-1962, working on the fusion experiments. Appointed as Research Scientist at the Sperry Rand Research Center in Sudbury, Massachusetts, U.S.A. (1962-1963), he continued working on aspects of fusion research, and returned to England to work as Theoretical Physicist at English Electric, Whetstone, Leicester (1963-65) with Dr J.W. Gardner.

Nick Phillips then left English Electric to take up a post as lecturer in Physics at Loughborough University, where he gradually developed an interest in holographic displays and their photographic problems. Some ten years have been devoted to empirical photographic studies of the effects of developers and bleach agents on the quality of the image produced. Reflection Holography has largely come of age in the West due to the outstanding development techniques which Philipps pioneered.

With his students, Phillips provided the holograms for the two "Light Fantastic" exhibitions at the Royal Academy of Arts in London in 1977-78, with the help of his London colleagues who set up the limited company Holoco. He has been Technical Director of Holoco since its inception. The group is largely privately funded, but is also backed by the research facilities of Agfa-Gevaert Ltd, who are primary suppliers of holographic materials, and a major research collaboration has developed with the Central Electricity Generating Board at Marchwood in a programme of pulsed laser recording of images of nuclear fuel elements for the inspection of potential in-reactor damage. Holoco now owns one of the most important holographic research laboratories with facilities for large scale holograms both in continuous wave and pulsed laser. Plans are now well under way for Nick to start collaboration projects with several leading holographic artists, thus adding great creative possibilities to his already outstanding classical reproductive display holograms.

Nick Phillips has recently been awarded the Thomas Young Medal and Prize 1980 by the United Kingdom Institute of Physics.

AL RAZUTIS



Al Razutis

"SURROGATE" 1976 - Sculpture on plinth with 2 x reflection holograms. 16" x 16" x 58" - Unique piece.
Collection of the Artist.

AL RAZUTIS

Born in 1946, in Bamberg, Germany, Al Razutis emigrated as a youth to America and was educated there. He then moved to Canada, where he has been in residence for the past twelve years. Razutis now considers himself Canadian, and works as an artist in the areas of Holography, film, video and avant-guarde prose.

His holographic work centers around the investigation of two main areas: the graphic-hybrid hologram wherein the works are usually presented in the familiar graphic format (ie framed and hung on a wall) and feature a play on the flatness of graphic images and context of presentation, as contrasted by the depth and dimensionality of the holographic image; the two aesthetic attitudes are presented as a visual discourse, with a resultant synthesis as aesthetic gesture. The second area is that of the sculptural-hybrid, featuring a combination of sculptural (spatial) artifact and holographic image - each contributing to a resultant synthesis. Razutis considers the subject matter for this synthesis can be extended beyond mere consideration of materials and form.

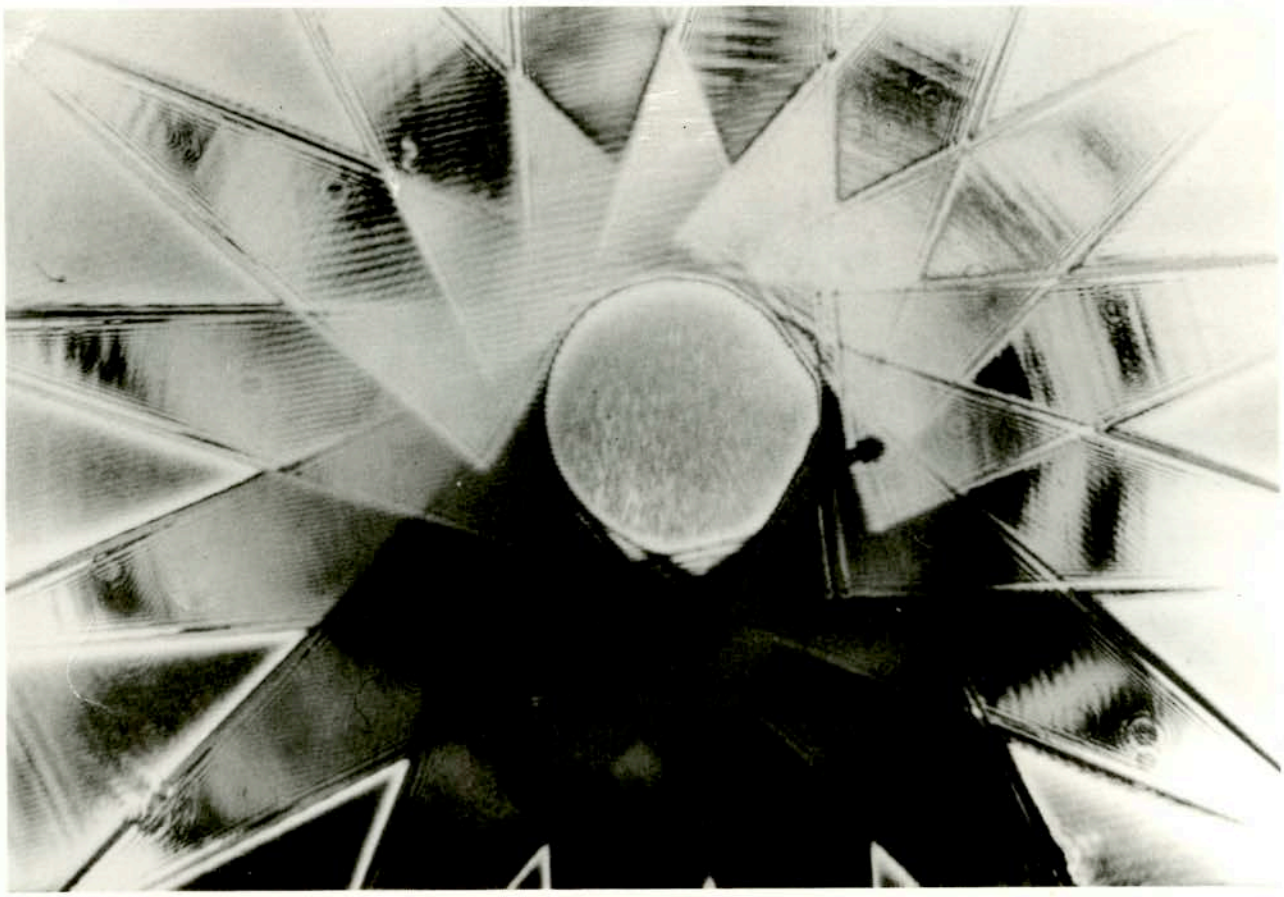
The sculptural-hybrid, more so than the graphic-hybrid, is for him fundamental to holography because both aspects of the hybrid - the sculptural and holographic - are naturally related, and to divorce them completely would amount to a cessation of aesthetic dialogue between matter and light.

Razutis has been working with holography since 1973, and had a one man travelling show entitled "Visual Alchemy" which has toured 7 Canadian cities throughout 1977-78. He was represented in the Franklin Museum's show "New Spaces, the Holographer's Vision" in Philadelphia, U.S.A. 1979.

WILLIAM REBER

Born in New Jersey in 1950, William Reber now lives in Santa Monica, California. He received his Bs and Ms at Rutgers University in New Jersey and is finishing his degree in Engineering at UCLA.

He is presently a Staff Research Assistant at UCLA in Optical Metrology under Michael E. Fourney. His involvement in holography as an art stems from his absorbtion with pure colour which he found when he became involved with the coherence properties of lasers which he used to do his research. He believes in the pure colour change as a dynamic experience.



Linda Law

"MANDALA" - 1979, Los Angeles, USA - Edition 1 of 2
in edition series. White Light Transmission.
5" x 5" Glass Plate.
Part of the Richard Payne Collection

DAN SCHWEITZER

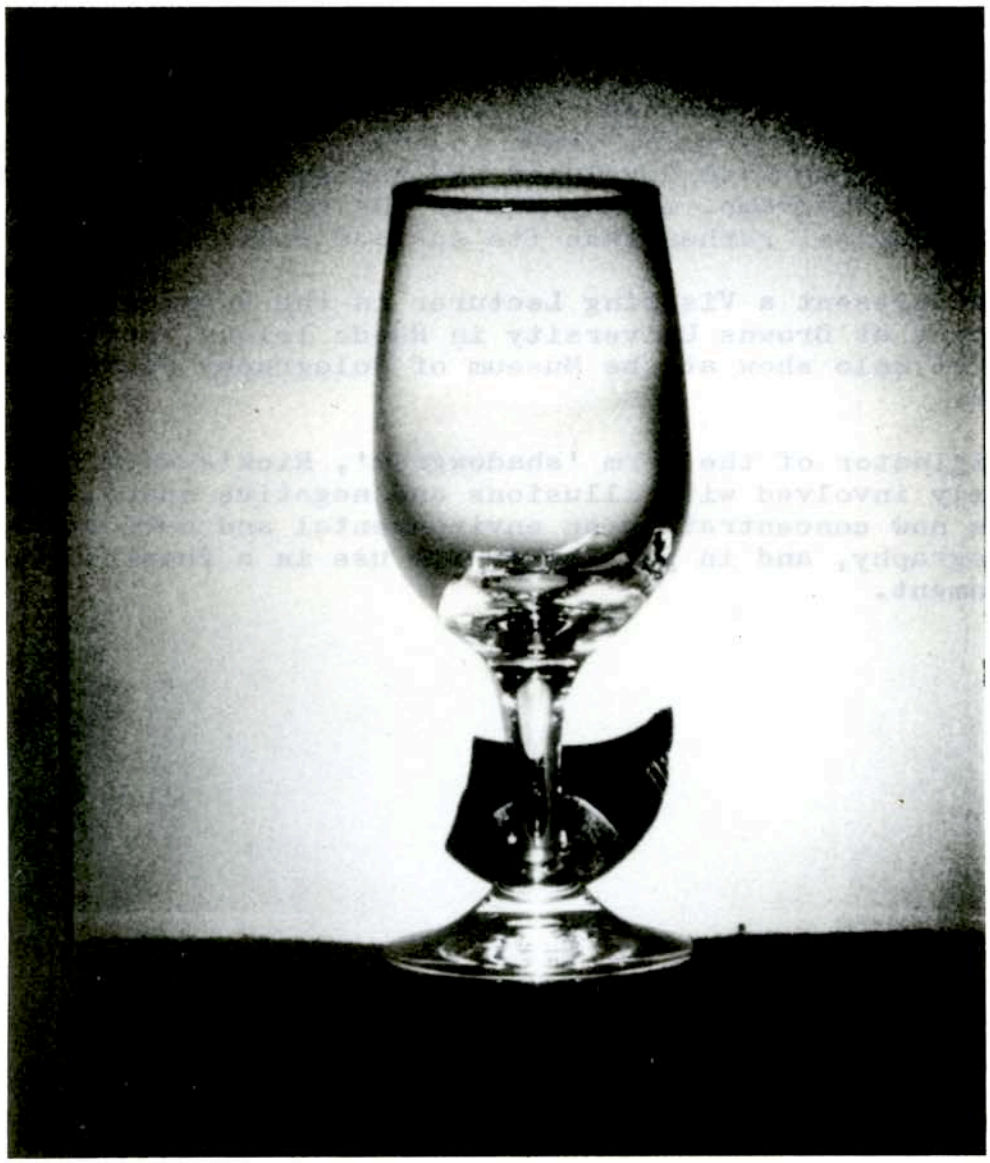
Linda Law

"SHADOWBOX" - October 1978, New York, USA
Edition 8 of 15. White Light Transmission.
15.5cm x 11.5 cm film between 33cm x 21.5cm glass
Part of the Richard Payne Collection.

Born in 1946 in New Jersey, Dan Schweitzer has an extensive background in theatre, arts and film. His diversity carries him into experimental video as well and he has frequently collaborated in such works as "Lipsink" with Sam Moree. To Mr Schweitzer's credit are numerous off-Broadway acting performances. His work in the theatre and video has been at such places as La Mama, Manhattan cable TV and the 1973 Annual Avant Garde Festival.

As a Director and Instructor of the New York Holographic Laboratories, Dan not only teaches workshops in holography, but also assists in other holographers' work. His work has been seen in numerous exhibitions including the ICP in New York 1975, the Museum of Holography in New York many times, and the Franklin Institute most recently. He is presently preparing a solo show at the Museum of Holography in New York in the new year.

RICK SILBERMAN



Nancy Safford

"THE MEETING" - 1979, Providence, Rhode Island, USA
Edition of 9. Reflection hologram with broken glass.
8" x 10" x 6".
Collection of the Artist.

"LIGHT DUTY 1" - 1979, Providence, Rhode Island, USA
Edition of 9. Reflection. 8" x 10".
Collection of the Artist.

"LIGHT DUTY 2" - 1979, Providence, Rhode Island, USA
Edition of 9. Reflection. 8" x 10"
Collection of the Artist.

RICK SILBERMAN

Born in Brooklyn, New York in 1951, Rick Silberman completed his studies at the Media Arts University of New York. He then established his own studio and worked independently for several years in Boston, Massachussetts. During this time Rick developed and concentrated on what is known as shadowgrams, making use of the volume that an object occupies, rather than its surface realities.

He is at present a Visiting Lecturer in the Physics Department at Browns University in Rhode Island, and had his first solo show at the Museum of Holography in New York in 1980.

The originator of the term 'shadowgram', Rick's work has been primarily involved with illusions and negative space. His work is now concentrating on environmental and outdoor uses of holography, and in particular its use in a theatre environment.