

## HOLOGRAPHY - AN INTRODUCTION

Holography is more than a new dimension. It is a new sense. It is sight sharpened, acutized. It is an elaboration of perception. In much the same way that our approach to painting has changed dramatically following cubism, our entire apprehension of visible objects takes a quantum leap in discernment following holography.

More than the flat height and breadth of an object perceived, holography adds to it the dimension of space, the depth, revealing more of the universe surrounding the object. Isolated objects reproduced holographically swim in space. It is an almost mystic achievement. Objects are more of what they are. Every dimension, every state of material life has been faithfully and proportionately reproduced. A chair, a body, an object exist in the full expanse of their height and breadth and depth. It is the square squared into the cube. It represents a revolution that shatters every concept and aspect of our traditional representational visual traditions.

Unlike painting, print, photography and other traditional flat plane mediums, holography is the nearest to sculpture in the presentation of the natural dimensions of any existence portrayed. Gone forever are the framed two-dimension representations of three dimensional objects that exist in flat perspective and static relationships. It has begun to change our ways of seeing. It is causing us to re-evaluate our visual traditions. It will lighten the load on our imagination to look into, beyond and around an object. Holography now does this for us as no two-dimensional medium can. Before holography when we looked at a photograph, a painting or a print of some living or inanimate object, we saw it outlined on one plane with the illusions of space and movement created by the use of mathematics, color and surface relationships.

The rest of this existence in a space was left to our imagination. Objects reproduced holographically can be viewed and are themselves totally three-dimensional. They can be seen from any angle and a sophisticated change in relationships is noticeable when viewed from different positions. They exist in the reality of space.

Holography has been called the most revolutionary visual medium since the prehistoric cave paintings. It carries us well beyond the traditional visual literacy based on the flat plane or surface, bordered, bottomed and focused on one static surface, giving the eye but one visual path to follow. Materially our involvement with reality idealistically abstracted has been and for the most part still is through sculpture and environmental works. In the graphics we are most informed and rewarded by realism and super realism. Now thanks to science and technology we have another open door--holography.

GALLERY 1134

FINE ARTS AND HOLOGRAPHIC RESEARCH CENTER

Contributors

HOLOGRAPHY: TECHNOLOGY AND ART

Gallery 1134

20 May - 3 July 1977

Andaloro, Anthony		untitled	transmission holograms
Benton, Stephen	X	ENGINE # 9	reflection hologram
Benton, Stephen	X	HOLOGRAPHY	white-light transmission hologram
Berkhout, Rudie		"MILKSHAKE"	transmission holograms
Berkhout, Rudie		"ALMOST WHITE-LIGHT"	white-light transmission hologram
Billings, Loran		"INTO ONE"	laser light environment
Bjelkhagen, Hans Poem: Hans Weil	X	"SIOLENCE"	transmission hologram
Bjelkhagen, Hans and Ake Sandstrom	X	"TOMORROW"	white-light transmission hologram
Boesche, John A.		"2 INVESTIGATIONS"	words, photographs, transmission holograms
Campoli, Cosmos and Tom Cvetkovich		"APROPOSFORTHESHOW"	reflection hologram
Campoli, Cosmos and Tom Cvetkovich		"BEE THEATRE"	transmission hologram
Claudius, Peter	X	"DR. EINSTEIN'S CHESSBOARD"	multiplex hologram
Cvetkovich, Tom		"THEATRE ALIF"	diffraction gratings/ sculpture construction
Diamond, Mark		"HOLO DALI: CRYSTALIZED"	transmission hologram
Dunkley, Kenneth		"THOUGHTS"	transmission hologram
E.R.I.M. scientists (USA)		TRAINS	transmission hologram
Gardiner, Bob	X	"THE WORLD'S FIRST HOLOGRAPHIC SCULPTIMATION"	multiplex hologram
Gaventa, Deborah		"THE TRANSITIONS OF LIGHT/ LIFE; and the void is not empty"	laser and sunlight installation

Jeong, Tung H.	X	HORSE	cylindrical hologram
Jeong, Tung H.	X	INTERFEROGRAM	transmission hologram
Jeong, Tung H.	X	"SEE NO EVIL, ..."	multiplex hologram
Jeong, Tung H. and Hal Snyder	X	CATHEDRAL	computer generated integral hologram
Jeong, Tung H. and David Wender	X	"COUNT 'EM AGAIN..."	transmission hologram
Jeong, Tung H.		"TIME AND SPACE"	transmission hologram
Lacy, Lee		MIKE ROYKO	multiplex hologram
<del>Lacy, Lee</del>	X	DRACULA	multiplex hologram
Nemtsov, Scott E.		"CRÈME DE MOTION #3"	reflection hologram
N.I.K.F.I. scientists (USSR)	X	LION	reflection hologram
M.I.K.F.I. scientists (USSR)	X	RUSSIAN JEWELRY	reflection hologram
N.I.K.F.I. scientists (USSR)	X	HOLOGRAPHIC MOVIE FRAMES	transmissions holograms
Nuñez, Ruben		"RED SUN"	reflection hologram
Nuñez, Ruben		"title F"	reflection hologram
Nuñez, Ruben		"EXCAVATION MIRROR"	reflection hologram
Nuñez, Ruben		"CELESTIAL MIRROR"	reflection hologram
Pethick, Jerry		"SPACEMAN"	white-light transmission hologram
Rallison, Rich		LITTLE WATCHES and WATCHPARTS	dichromate reflection holograms
Rhinehaart, R.		PORTRAIT OF DENNIS GABOR	transmission hologram
Silberman, Rick		"GYROSCOPE"	reflection hologram
Stephens, Anait		"SPHERE AND COLLAGE"	reflection hologram
Stephens, Anait		"SPACE GRAFFITI I"	multiplex hologram

Walter, Will

PORTRAIT OF PUM III

white-light transmission  
hologram

Zabka, Britton

"THE FIRST 360° CELL  
ANIMATION"

multiplex hologram

Zabka, Britton

"THE KNIGHT SHOT"

X

multiplex hologram

## HOLOGRAPHY

HOLO- /hō-lō-/ *COMB FORM* (ME, FR. OF, FR. L, FR. GK, FR. *holos* WHOLE): COMPLETE.

-GRAPHY /g-ra-fē/ *n COMB FORM* (L -GRAPHIA, FR. GK, FR. *graphein*): WRITING OR REPRESENTATION IN A (COMPLETE) MANNER OR BY A (COMPLETE) MEANS.

ORIGINALLY CONCEIVED BY DR. DENNIS GABOR IN 1947 AT THE RUGBY ELECTRICAL CO., SCOTLAND. FIRST PROPOSED AS A METHOD OF IMPROVING ELECTRON-MICROSCOPY.

A HOLOGRAM IS A COMPLETE REPRESENTATION, RECORDING THE FULL DEPTH QUALITIES AS WELL AS THE RELATIVE BRIGHTNESS OF A SCENE.

## LASER

LASER//lā-zər/ *n Light Amplification by Stimulated Emission of Radiation:*

A DEVICE THAT UTILIZES THE NATURAL OSCILLATIONS OF ATOMS FOR AMPLIFYING OR GENERATING ELECTROMAGNETIC WAVES IN THE VISIBLE REGION OF THE SPECTRUM.

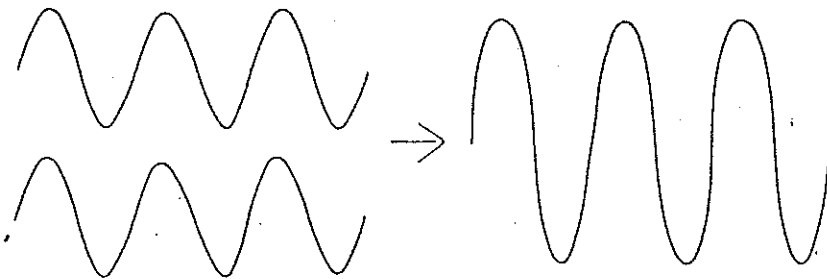
A SOURCE OF LIGHT WHICH IS FREQUENCY COHERENT (MONOCHROMATIC, ALL WAVES ARE THE SAME LENGTH), SPATIALLY COHERENT (UNIPHASE, ALL WAVES ARE IN STEP), AND COLLIMATED (PARALLEL, IN A TIGHT BEAM).

FIRST OPERATING LASER REALIZED IN 1960 BY DR. THEODORE H. MAIMAN AT HUGHES AIRCRAFT CO., CALIFORNIA. MADE PRACTICAL OPTICAL HOLOGRAPHY POSSIBLE.

# INTERFERENCE

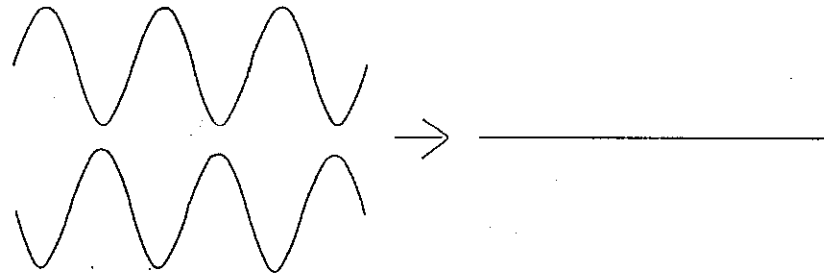
A HOLOGRAM IS A PHOTOGRAPHIC RECORD OF INTERFERENCE BETWEEN COHERENT LIGHT WAVES (BEAMS) FROM TWO DIFFERENT SOURCES; A REFERENCE BEAM (CARRIER WAVE) AND OBJECT BEAM (SIGNAL, IMAGE).

WHEN WAVES INTERFERE IN PHASE (I.E. CREST TO CREST OR TROUGH TO TROUGH) CONSTRUCTIVE INTERFERENCE OCCURS. THIS FORMS A COMPOSITE EFFECT EQUAL TO THE SUM OF THE COMPONENT WAVES.



CONSTRUCTIVE INTERFERENCE

WAVES OUT OF PHASE (I.E. CREST TO TROUGH AND VICE VERSA) CREATE DESTRUCTIVE INTERFERENCE. THIS NEGATES THE EFFECT OF THE COMPONENTS.



DESTRUCTIVE INTERFERENCE

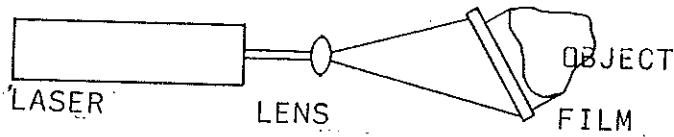
CONSTRUCTIVE INTERFERENCE EXPOSES THE FILM WHILE DESTRUCTIVE INTERFERENCE LEAVES IT BLANK. A HOLOGRAM IS THE COMPLETE RECORD OF ALL LIGHT FROM THE OBJECT AS IT INTERFERES WITH THE REFERENCE BEAM.

# "WHITE-LIGHT" REFLECTION HOLOGRAM

WIDELY USED AS IT CAN BE VIEWED UNDER ORDINARY WHITE LIGHT FROM A POINT SOURCE (SUN, SPOT LIGHT). FIRST REALIZED BY Y. N. DENISYUK OF THE U.S.S.R.

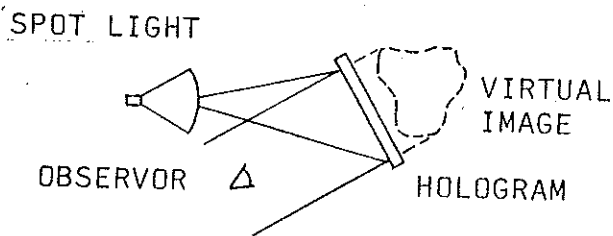
INTERFERENCE PATTERNS ARE FORMED BETWEEN OBJECT AND REFERENCE BEAMS FROM OPPOSITE SIDES OF THE FILM.

SIMPLE ONE-BEAM REFLECTION HOLOGRAMS ARE CONSTRUCTED BY SPREADING THE LASER LIGHT WITH A LENS, SHINING IT DIRECTLY ONTO THE FILM (AS REFERENCE BEAM) WHILE PASSING THROUGH THE TRANSPARENT FILM TO ILLUMINATE THE OBJECT AND RETURN TO THE FILM (AS OBJECT BEAM).



REFLECTION HOLOGRAM CONSTRUCTION

ILLUMINATING THE DEVELOPED HOLOGRAM WITH A POINT SOURCE OF WHITE LIGHT FROM THE SAME ANGLE AS THE ORIGINAL REFERENCE BEAM RECONSTRUCTS THE IMAGE.



VIRTUAL IMAGE RECONSTRUCTION

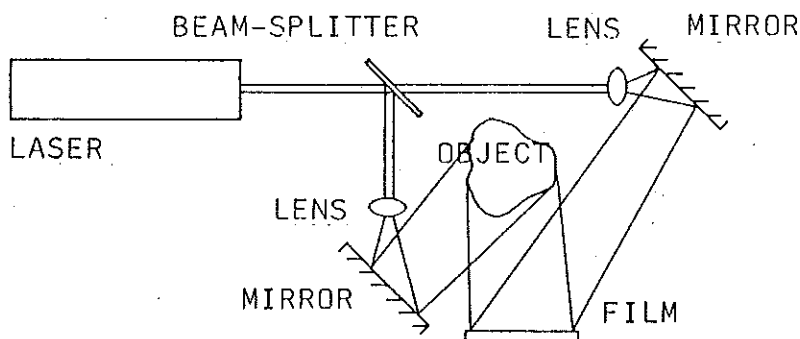


# TRANSMISSION HOLOGRAM

THE "CLASSICAL HOLOGRAM" (C. 1962). FIRST REALIZED WITH LASER LIGHT BY EMMETT LEITH AND JURIS UPATNIEKS AT THE UNIVERSITY OF MICHIGAN.

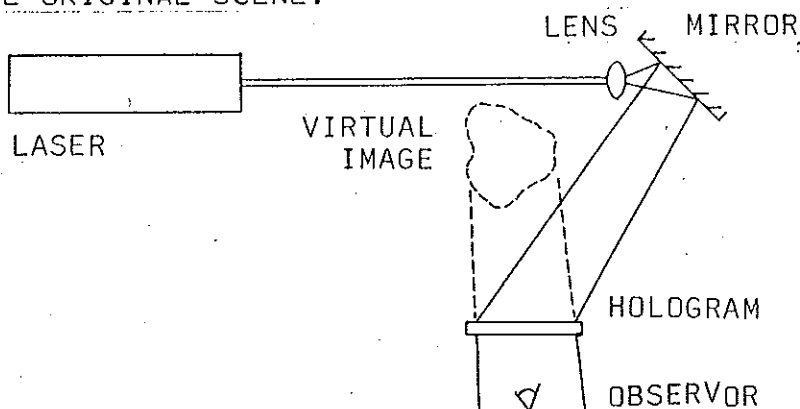
CREATED BY FORMING INTERFERENCE PATTERNS BETWEEN OBJECT AND REFERENCE WAVES FROM THE SAME SIDE OF THE FILM.

A BEAM-SPLITTER (PARTIALLY REFLECTING, PARTIALLY TRANSMITTING MIRROR) IS USED TO CREATE THE TWO BEAMS FROM ONE LASER. LIGHT IS SPREAD BY LENSES TO ILLUMINATE OBJECTS AND FILM, AND FRONT SURFACED MIRRORS DIRECT THE BEAMS.



TRANSMISSION HOLOGRAM CONSTRUCTION

THE DEVELOPED HOLOGRAM IS ILLUMINATED BY THE REFERENCE BEAM ALONE, AND DIFFRACTS (BENDS) THE LIGHT AS THOUGH IT WERE EMANATING FROM THE ORIGINAL SCENE. THIS VIRTUAL IMAGE APPEARS IN CORRECT SIZE AND RELATIVE POSITION TO THE FILM, RETAINING ALL THE OPTICAL PROPERTIES OF THE ORIGINAL SCENE.



VIRTUAL IMAGE RECONSTRUCTION

## WHITE-LIGHT "RAINBOW" TRANSMISSION HOLOGRAM

A MAJOR CONTRIBUTION IN MAKING HOLOGRAMS MORE EASILY VIEWED. THIS TECHNIQUE WAS DEVELOPED BY DR. STEPHEN BENTON OF POLAROID CORP. IN 1968.

BY ILLUMINATING THE FILM WITH ONLY A SLIT OF REFERENCE LIGHT AN OTHERWISE NORMAL TRANSMISSION HOLOGRAM IS FORMED. WHEN VIEWED WITH ANY POINT SOURCE OF WHITE LIGHT (SUN, INCANDESCENT BULB, CANDLELIGHT) THE WHITE LIGHT IS DIFFRACTED INTO ITS COLOR COMPONENTS (AS THOUGH BY A PRISM) RECONSTRUCTING THE IMAGE.

## MULTIPLEX HOLOGRAM OR "INTEGRAM"

INTEGRATING SEVERAL TECHNIQUES, THIS METHOD TRANSDUCES MOTION PICTURE FOOTAGE CIRCUMSCRIBING A SCENE INTO A STEREOSCOPIC 3-D IMAGE. THIS TECHNIQUE ALLOWS THE USE OF MOVING SUBJECTS ILLUMINATED BY ANY LIGHT AND CAN EMPLOY ANY STANDARD CINEMATOGRAPHIC EFFECT. COMPUTER GENERATED FILMS CAN BE USED AS THE IMAGE SOURCE, CREATING THREE-DIMENSIONAL MOTION IMAGES OF SCENES WHICH DO NOT ACTUALLY EXIST.

## VISIBLE INTERFERENCE PATTERNS

IN THIS DEMONSTRATION THE INTERFERENCE OF TWO WAVEFRONTS OF COHERENT LIGHT CAN BE SHOWN TO PRODUCE VISIBLE INTERFERENCE "FRINGES."

THE COHERENT LIGHT FROM ONE LASER IS SPLIT INTO TWO PARTS WHICH FOLLOW SEPARATE PATHS. WHEN RECOMBINED AND SPREAD BY A LENS, CONSTRUCTIVE AND DESTRUCTIVE INTERFERENCE CAN BE SEEN AS BANDS OF LIGHT AND DARK.

BY ADJUSTING THE TWO EXPOSED SCREWS ON ONE MIRROR, THE PATH OF ONE WAVEFRONT IS ALTERED TO FORM OBSERVABLE CHANGE IN THE INTERFERENCE PATTERNS.

