

HOLOGRAPHY TIMELINE 1947–2012

1947:

- While improving upon a standard electron microscope, the British/Hungarian scientist Dennis Gabor invents the theory of holography. His theory describes how a three-dimensional image of the information pattern encoded in a beam of light can be stored on photographic film. Gabor's invention requires an instrument which could produce a high enough light coherency with a fixed wavelength. These characteristics define the distance over which light maintains a single wavelength, a feature needed to produce a stable interference pattern. The length of the light's coherency correlates to the depth of the scene which can be recorded on the hologram. Sunlight and light from conventional sources, however, contain too many wavelengths and are not precise enough in their application to translate Gabor's theory into reality.

1960:

- US physicist Theodore Maiman operates the first pulsed ruby laser (acronym for Light Amplification by Stimulated Emission of Radiation), a device whose optical amplification generates a pure, intense light. Maiman's invention not only provides an adequate light source for Gabor's theory, but the pulsed ruby laser proves to be specifically relevant for pulsed holographic portraiture in the future due to the laser's exceptionally short (a few nanoseconds), powerful emission of light, which allows the capturing of high-speed events.

1962:

- Yuri N. Denisjuk, a physicist from the USSR, combines his work on the design of optical instrumentation with 1908 Nobel prizewinner Gabriel Lippmann's work in color photography to create a white light reflection hologram. Unaware of Gabor's work, the Soviet physicist creates a hologram that can be viewed in the light of an ordinary lightbulb but lacks actual depth, limiting Denisjuk's images to reproductions of coins or mirrors.

1962–63:

- For the first time, holography becomes reality. Emmett Leith and his junior colleague, Juris Upatnieks, become aware of the similarities between their radar-related work at the University of Michigan and Gabor's theory of holography. Intrigued, they proceed in duplicating Gabor's theory by using an "off-axis technique," borrowed from a side-reading radar development they've been working on and a laser as the light source. It results in the first laser transmission hologram of a 3-D object (a toy train and a bird). Although the transmission hologram (as it comes to be known) produces a clear image with realistic depth, a laser light is required to view the holographic image.

1966:

- Leith and Upatnieks collaborate with photographer Fritz Goro to create a hologram for *LIFE* magazine. Compared to the hologram of the toy train and the bird, Goro conceives a more dramatic image consisting of geometric solids. The subject matter, as well as the newly employed, larger-than-average photographic plate, which captures a wider perspective, creates a greater sense of three-dimensionality than the previous holograms. It is the first hologram deliberately designed to demonstrate the medium's ability to show objects from different angles and hence emphasizes its information-storage properties.

1967:

- With technical success comes the commercial exploration of holography's potential, led first and foremost by Conductron Corporation in Ann Arbor, Michigan. Kingsport Press's commission of 500,000 laser transmission holograms for their 1967 *Science Yearbook* (a four-by-three-inch transmission perspective of chess pieces on a board, viewed with a flashlight through a supplied red filter) becomes the first, major, commercial hologram in mass production.

- Larry Siebert, who works at Conductron, uses a self-designed pulsed laser to produce the first hologram of a person. From this year onwards, the company aids artists' exploration of holography. In future years, artists such as Bruce Nauman and Salvador Dalí conceive and execute holograms in collaboration with Conductron.

- T.A. Shankoff and K.S. Pennington introduce dichromated gelatin as a holographic recording medium. This allows the recording of a hologram on any clear, nonporous surface. In subsequent years, Rich Rallison applies this technique to produce a large number of glass sandwich dichromate holograms used for objects such as jewelry, key chains, paper weights, and other small items.

1968:

- Bruce Nauman produces his "First Hologram Series: Making Faces (A-K)" using the pulsed laser at Conductron. The series of eleven holograms feature the artist's face manipulated into a variety of expressions.

- Stephen Benton invents white light transmission holography, also called *rainbow holography*, at the Polaroid Research Laboratories. The name is derived from the rainbow spectrum of white light that is apparent in the hologram and this particular type of holography is visible in ordinary light. Thanks to the brilliance of its image and depth, it soon becomes the preferred technique for artists who overlay subtle hues and sophisticated effects in their holographic artworks.

- Lloyd G. Cross, a laser physicist disenchanted by the applications of laser research, founds Editions Inc. in Ann Arbor, the world's first nonindustrial holographic studio focused on producing, exhibiting, and selling art holograms.

1968:

- Bruce Nauman displays his first series of holograms at Nicholas Wilder Gallery in Los Angeles followed by an exhibition including his holograms at the Leo Castelli Gallery in New York in 1969.

- Initially a painter, the British artist Margaret Benyon becomes the first woman to use holography as an art medium. While her main aim is to take holography out of the science lab and expand the boundaries of fine art in order to include holography, a feminist strand runs through Benyon's work.

- Harriet Casdin-Silver follows Benyon's example and becomes one of the leading figures in the artistic world of holography. Her major innovations are of a technical nature, such as the first artistic frontal-projection hologram, the first exploration of white light transmission multicolored holograms, and the first exhibition of outdoor, solar-tracked holograms.

1969:

- Nauman produces an additional ten holograms under the title "Second Hologram Series: Full Figure Poses (A-J)." This marks the end of his artistic holographic activity.

- The Swedish painter and sculptor Carl Fredrik Reuterswärd is one of the pioneering artists making use of holography and the laser beam. His activities are limited to Sweden, where he holds his first exhibition featuring holograms in 1972 at the Moderna Museet, Stockholm.

- Editions Inc. organizes the exhibition "The Laser: Visual Applications" at Cranbrook Academy of Art in Detroit, which includes a selection of holograms.

- Benyon presents an exhibition of her holograms at Nottingham University Art Gallery.

1970s:

- Conductron closes its pulsed laser facility due to financial struggles during the recession.

1970:

- Cross and Pethick develop a cost-saving sand-table system for making holograms that grants stability without the use of expensive isolation tables. This revolutionizes the availability of facilities for amateurs and artists alike, making holography more commercially feasible.

- Editions Inc. holds its second holography art exhibition, "N Dimensional Space," at Finch College Museum in New York. The show incorporates holograms by Robert Indiana, George Ortman, Leith, Allyn Lite, Nauman, and Pethick.

- The Cartier jewelry store in New York commissions artist Robert Schinella to produce a hologram of a hand holding a jeweled necklace (*Hand in Jewels*). Pedestrians are able to view the hand projecting out from the shop window across the pavement on Fifth Avenue.

1971:

- Gabor is awarded the Nobel Prize in Physics "for his invention and development of the holographic method in 1947."

- Cross and Pethick cofound the first ever School of Holography in San Francisco.

1972:

- Cross develops the first integral hologram, also called the multiplex hologram, merging white light transmission holography with a conventional 35mm still camera. Two-dimensional movie footage of a rotating object or person is recorded on holographic film, causing the visual effect to be a moving three-dimensional image.

- Continuing from the success of the San Francisco School of Holography, acclaimed holographer Tung Jeong offers holography summer workshops for non-physicists at Lake Forest College in Illinois.

1972–73:

- South African jazz drummer and holographer Selwyn Lissack enthusiastically informs his close friend Salvador Dalí of Cross's latest invention. Together, they construct a rotating twelve-inch-high, 360-degree multiplex hologram of the rock star Alice Cooper wearing a diamond tiara and holding a Venus de Milo statue, accompanied by a plaster brain stuffed with a chocolate éclair and ants suspended behind his head. Cross produces the actual hologram in San Francisco. Later that year, Dalí gives holography further recognition by exhibiting more of his holographic designs at Knoedler Gallery in New York.

1975:

- The International Centre of Photography (ICP) in New York City presents "Holography '75: The First Decade," a show dedicated to the artistic, scientific, and historical values of holography. Jody Burns and Posy Jackson oversee a show that features artists from France, West Germany, the USSR, Switzerland, Venezuela, and the US. Artists include Benton, Casdin-Silver, Burns, Abe Rezny, Bill Molteni, Dan Schweitzer, Sam Moree, and Kenneth Dunkley.

1975:

- After attending the holographic show at the ICP, Rudie Berkhout starts cultivating his interest in holography and produces his first holograms. Throughout his career, Berkhout produces abstract and geometric holograms himself, sometimes developing new holographic processes such as a multicolor technique.

1976:

- In contrast to the individually financed research in the United States, the Soviet Union heavily invests in state-funded holographic laboratories. Victor Komar's prototype for a projected holographic movie is particularly noteworthy at this time. A pulsed holographic camera at twenty frames per second allows Komar to screen a forty-seven-second-long movie on a holographic screen. While the public-oriented approach allows viewers to see the three-dimensional image without special glasses, Komar's audience never surpasses three people. Plans to expand length and audience size for the three-dimensional movie in the subsequent decade never materialize due to the lack of state funding with the beginning of perestroika.

- Following their successful exhibition at the ICP, Burns and Jackson found the Museum of Holography at 11 Mercer Street in New York. Attracting more than 100,000 visitors a year, the museum is dedicated to the display and explanation of holographic activities in its entirety, from scientific purposes to artistic creations.

- As part of a Smithsonian Institute program to provide 3-D images of decaying artifacts, Benton modifies his white light holographic transmission technique in order to create black-and-white images. His first achromatic hologram is a portrait of a mummy's skull named *Pum II*.

1977:

- The Royal Academy in London stages the "Light Fantastic" show. Holograms are exhibited along with elaborate laser demonstrations made by a group consisting of Nick Phillips, Anton Furst, and John Wolff, collectively known as Holoco.

- German artist Dieter Jung realizes his first holographic poem while at the New York School of Holography (opened in October 1973), whose director is Burns. In his career as a pioneer of the holographic art, Jung works at the Center for Advanced Visual Studies at MIT in Boston under the direction of Otto Piene.

1982:

- Holographic art proliferates in Brazil where artist Moysés Baumstein, who attended Jung's holography workshop, collaborates with other Brazilian artists and poets interested in holography (Augusto de Campos, Décio Pignatari, Julio Plaza, and José Wagner Garcia). They view holography as a way to express themselves and to renew the Concrete poetry movement (also known as shape poetry).

1983:

- MasterCard International, Inc. and VISA become the first companies to use rainbow holograms on security documents. The VISA dove has since been decorating the company's credit cards for thirty years. Benton's technology guarantees the uniqueness of the represented object, which makes a successful reproduction of the small-sized hologram a challenging endeavor and hence possesses an intrinsic security value.

1984:

- The March edition of *National Geographic* magazine features a two-and-a-half-by-four-inch embossed rainbow hologram of an eagle on its cover. It becomes the first major international publication to have a hot-stamped hologram on its cover, with nearly eleven million copies sold throughout the world and marking a pivotal event in the field of commercial holography.

1985:

- Due to the high demand of the first holographic cover, *National Geographic* features a second hologram of the two-million-year-old skull of the African Taung child on their November issue, illustrating the feature article "The Search for Early Man."

1988:

- National Geographic* produces its third and last holographic cover to date. It is by far the most ambitious, with the front cover consisting of a double image of an exploding Earth, three-dimensional lettering along the spine, and a holographic McDonald's advertisement on the back. Final production ends up costing around twenty-five cents per cover, causing the magazine to lose several million dollars and the editor Bill Garrett to lose his job.

1991:

- The Whitney Museum of American Art features its first exhibition of holography "New Directions in Holography." Artists included in the show are Berkhout, Susan Gamble, and Michael Wenyon.

- Sports Illustrated* follows *National Geographic's* example and features a hologram of Michael Jordan as sportsman of the year on its December cover.

1992:

- In March, the Museum of Holography in New York closes following budget cuts and mounting financial pressures. At this stage, it possesses the most comprehensive collection of holograms in the world.

1993:

- In January, the MIT Museum acquires the complete collection of the Museum of Holography.

1994–98:

- Artists Ron Mallory and Matthew Schreiber oversee a program in which with technical experiments with holographic technology. The program, called the C-Project, attracts artists such as Ann McCoy, Chuck Close, Dorothea Rockburne, Ed Ruscha, Eric Orr, James Turrell, John Baldessari, Larry Bell, Larry Rivers, Louise Bourgeois, Malcolm Morley, Marisol Miyajima, Richard Artschwager, Robert Ryman, and Roy Lichtenstein.

1996:

- The Royal College of Arts in London auctions off its holography equipment and all four art school holography courses in the UK are closed.

1999:

- Geola, a Lithuanian-based holography company, patents the world's first printer for color digital hologram printing with pulsed lasers.

2000s:

- Agfa-Gevaert discontinues its sole supply of silver-halide materials, essential for holography.

2000:

- Frank DeFreitas publishes the *Shoebox Holography Book*, a step-by-step guide to making holograms with inexpensive laser pointers. The number of amateur holographers rises dramatically as DeFreitas demonstrates how to replace the highly expensive 5mW laser (\$1200) usually used for holography with a cheap semiconductor laser (\$5).

2003:

- Benton, inventor of the rainbow holograms, dies in Boston, MA.

- MIT Media Lab starts developing an electro-optical technology that enables the graphics processor in a PC to generate holographic video images in real time on an inexpensive screen.

2005:

- Leith dies in Ann Arbor, Michigan.

- Companies such as Optware and Maxell produce a 120mm disc that uses a holographic layer to store data to a potential 3.9 TB, which they plan to market under the name Holographic Versatile Disc.

2006:

- Denisjuk dies in St. Petersburg, Russia.

2009:

- James Turrell displays his latest series of fifteen large-scale transmission holograms at Pace Wildenstein Gallery in New York. Turrell's dichromate reflection holograms allow light to become the primary subject.

2010:

- Rallison, pioneer in the production of glass sandwich dichromate holograms used primarily in the production of smaller objects, dies at the age of sixty-five.

2012:

- Zebra Imaging, a holography company from Austin, launches a public web interface for uploading 3-D data to produce full-color, 360-degree, holographic prints. It is the first service that creates holograms from digital data rather than a real life subject, overlaying several thousand three-dimensional images on a single panel.

