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Winter 1989
Number 7
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HOLOGRAPHICS INTERNATIONAL

Yuri Denisyuk: a pulsed portrait by Ana Maria Nicholson, 1989. See page 14. Photo: Ronald R Erickson.

Holography goes to work on an egg. See page 30.

Cover: *Hologram courtesy of American Banknote Holographics, 500 Executive Boulevard, Elmsford, NY 10523, USA. Tel: (+1) 914 592 2355. Photo: Martin Taylor.*

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Posy Writes...

Dear Editor,
I have just received a copy of *Holographics International* and find that Susan Cowles' article *MoH: Past, Present and Future* has some inaccuracies which, in the spirit of your editorial, I felt compelled to write to you and correct.

Jody Burns hired me to put on the International Center of Holography exhibition. The show was a joint venture between many people in New York (Abe Rezny, Dan Schweitzer, Luis Remesar, and Ken Dunkley immediately come to mind, although there were certainly others who volunteered vast amounts of time and expertise to the mounting of the show) but was, in fact, produced by Jody, then Director of The New York Art Alliance. The show did not "help to instrument the idea for the formation of a museum of holography" as Cowles states. The show was put on as having come from and been produced by the Museum of Holography. It was already a fact, so to speak, in the summer of 1975. Since Cowles is unclear in stating how the Museum, as we know it, began, allow me to set the record straight (yet again).

Jody ran a business on 20th Street in New York City called the New York Art Alliance, Inc. He also started and ran the School of Holography on West 13th Street in New York. (At the time of the ICP show, Luis Remesar and Abe Rezny were co-directors of the school, working under Jody). In the business space on West 20th Street there was a gallery that exhibited holograms, basically Jody's collection of early works and examples of his and other commercial products then available. The gallery was the New York Alliance's showroom.

One day a writer from the *Village Voice* came by to see the holograms because he had dome a piece on the school and had gotten interested in holography. He toured the gallery with Jody and was tremendously exited by the idea (which was his alone) that this represented some kind of museum of early holography. While Jody protested that it was, in fact, a commercial showroom for an ongoing holography business, this fellow went back to the paper and printed a story about the Museum of Holography. I am sure no one was more surprised than Jody. And he continued to be surprised when people started showing up to see the holograms in the "Museum".

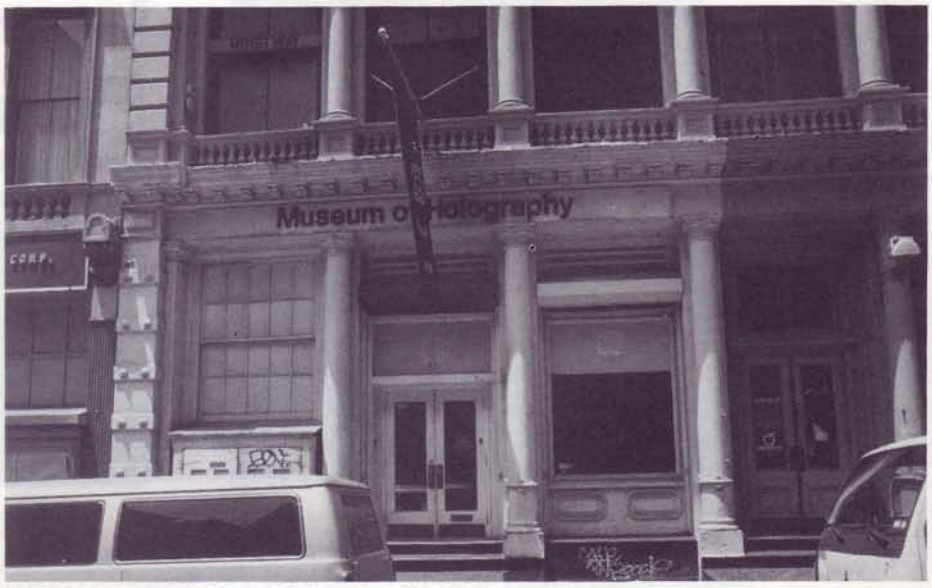
Being a businessman, however, he decided that people should pay to see the show which has cost his business money to produce. He also decided to keep the name "Museum of Holography" because it had already, through the press exposure, become identified with the gallery. I was hired at one point to make frames, graphics and basic improvements to the gallery. I even sat at the front desk from time to time. And, as a practising graphic designer (running a business called Jackson graphics a block away) I was asked to design the logo (which is still the Museum's) and the stationary. And, shortly thereafter, I was asked to put on the ICP show, under the name Museum of Holography.

Let me clarify here that, at this point, the "Museum of Holography" was not a registered business. It was simply what the gallery attached to The New York Art Alliance Inc, was called. To the extent that it was run, Jody ran it. Jody contracted with Cornell Capa to do the ICP show and with Gosta Lilja to do the show at the Kulterhuset in Stockholm several months later. Both were as the "Museum of Holography". I was hired to put on these shows, except that I didn't get paid so it became more of a partnership. Jody and I worked very well together in this regard. Both exhibitions were the result of the best parts of both of us (and a lot of other people, I might add).

Upon our return to New York, Jody decided that he needed to spend all of his time and resources on his business. He made the decision to stop running the School of Holography and the gallery which was now the "Museum of Holography". The school was taken over by others and the collection of holograms which formed the New York Art Alliance Inc showroom remained with Jody. I asked Jody if he would donate the most interesting of these to a museum if I could get a charter from New York State to start one and he agreed.

I set about researching and writing a provisional charter for a Museum of Holography. This document was submitted to the Board of Regents of New York State in February of 1976 and a charter was granted to the Museum of Holography in July of 1976. I went on, with a lawyer, to obtain the necessary New York State Charities registration Certificate, allowing the Museum to raise funds, and the Internal Revenue designation of non-profit status, allowing the Museum to function as a not-for-profit institution and apply for grants from federal and state agencies.

I took out a loan for US$75 000 (my father had died recently and left me a half share in a summer home which I was able to use as collateral on a loan). I hired a wonderfully organized and supremely competent friend who I had gone through art school with, Kathleen Mark (now Bardell) and found the space on Mercer Street. Once the renovations on the space (for the first few years we only had the first floor) were completed, we moved in and opened the Museum to



The Museum of Holography in New York City

the public on December 8th of that year.

Given that background, I will leave the issue of who founded the Museum up to you and your readers. I have no intention of minimizing Jody's importance to the Museum, or to the holography scene in New York and beyond. He was a pivotal figure in the development of the medium and remains one of the unsung heroes of holography as far as I am concerned.

I might add that the Museum of Holography is a trade marked name and that no other museum for this medium can legally use the name Museum of Holography without a designation in the title for a state or country. The precedent for this is the Museum of Modern Art in New York. While there can be other museums of modern art throughout the world, none can be called by that name without another title added to it. So, when you see any other institution calling itself the Museum of Holography you can know that they do so illegally and that they have been asked to cease by the Museum of Holography. It is, likewise, incorrect to refer to the Museum of Holography as the New York Museum of Holography.

To continue, Cowles' article states that the Museum's opening show was *Alice through the Looking Glass*. This is not true. The inaugural exhibition was called *Through the Looking Glass*. Her title is a misquote from a subsequent show that Peter and Ana Maria Nicholson mounted in Hawaii. It is true that the show was mounted without any funding. The Museum operated for two full years without any funding. This is because you could not apply for grants for two years from the New York State Council on the Arts or any federal agency and no corporations or foundations would put money into a new institution until it had proven itself.

The works exhibited to the show were *not* donated to the Museum. I have no idea where Cowles got this information. Several were bought, as were several holograms from each artist who showed at the museum from then on. Very few artists have donated work to the Museum. Several scientists have donated work but very few artists. This is not from a lack of generosity on their part but more a firm policy of mine that artwork be purchased at the *full* retail price so that prices could be set for work in a field where basically no one else was buying.

In Perspective, as many of your readers know, was first installed on the main floor of the Museum. It had a second section that detailed types of holograms and techniques of holography that was installed in the lower level once that space was rented and renovated. The historic exhibition was only fairly recently relegated to the basement and, apparently more recently, totally dismantled.

I regret this nitpicking but I feel it is important, when you are dealing with history, that you do so in as accurate a manner as possible. I regret more that I had to do this, that there isn't more attention paid to detail on the part of the museum(which owns all the files that would have provided primary research material for all the facts misstated in this article) and that I seem to be coming down hard on Susan Cowles whom I both like and respect for her excellent work in the Museum's education department.

I thank Susan for her earnest desire to keep the history of holography alive, for her need to educate us all about the past as well as the present and future. And I wish her and the staff of the Museum the very best in their difficult task of rebuilding what has been torn down in recent years. I know Martha Tomko Well enough to know that she will get it done and I am proud to continue to serve on the Board that assists her in doing so.

Posy Jackson Smith

Editorial

Firstly, I would like to apologise to Posy Jackson Smith for having to cut her letter. In the sections I cut, probably 300-400 words worth, she was largely agreeing with Sue Cowles' article. I thought it more important to include the parts of the letter where she disagreed.

Secondly, I would like to say, in Sue Cowles' defence, that her article was heavily changed and edited by the Museum of Holography before she was allowed to submit it. I know she felt it was a compromise at the time. I was not privy to the discussions that went on before I received the piece and so cannot comment on what was changed and what was not, but I feel she should not take the entire blame for any inaccuracies contained in it.

Next, I would like to thank American Bank Note Holographics and Hologram Industries for giving us editorial holograms. I chose the ABN clown hologram for our first holographic cover because I personally find it enchanting. The density and variety of the colours makes it one of the best embossed holograms I have seen to date. Please contact us if your company has an image which it is particularly proud of and which you would like to see on the cover.

Many thanks also to those who sent in short articles/press releases about their activities along with positive colour slides and black and white prints. Please keep it up.

I hope you all like the cover design and new masthead. I think it is a dramatic improvement on what went before, but am, as usual, open to suggestion. More importantly, however, I am interested in what you think of the new section at the back. Do you find the paper/patent titles useful? Are the applied holography articles pitched at the right level and are they on the right subjects?

As a physicist I find the variety of uses for holograms very exciting. As an editor I find them bewildering. So many interesting papers are published every week that I find it very difficult to try and narrow them down to so few.

To the casual reader, the mixture of science, art and commerce in this magazine must seem somewhat bizarre. As far as I am concerned, that is fine. The whole point of the magazine is to spread ideas and information from one section of the holographic community to another. What I am not sure about, however, is whether readers will only look at stories directly related to their fields? Do you read the entire magazine? If not, why not?

Though many have said that they read my last editorial, in which I criticised holographic jewellery, no one seems to have made any serious comment. Perhaps I was too mild? I expected at least one letter standing up for the manufacturers but I have received no correspondence one way or the other. Someone must have an opinion.

Finally, as we move into the 1990s, I would like to wish all my readers good fortune in the coming decade.

Sunny Bains

Holomart Ceases Trading as Museum Plans Hit Snag

Holomart Plc of Britain has ceased trading after running into financial problems with its proposed museum of holography in London. Baliffs have seized some of the company's property due to an unpaid invoice for work on the museum building.

The company, which recently purchased See 3 (Holograms) Ltd (see last issue), is now trying to raise £300 000 (US$480 000) to complete the conversion work on the building, which is opposite the British Museum.

Managing Director of Holomart, Bruce Snyder, told *Holographics International* that the company's troubles had arisen due to high British interest rates, and a direction from the Bank of England to lenders to be more cautious. Consequently Holomart's bankers, who had originally intended to provide 100% of the building costs, will now only provide 70%. Snyder says that more difficulties were caused when the Finance Director, who was also intending to invest in the company, changed his mind.

Holomart staff have not been paid since August and building work on the proposed museum stopped officially on 22 November. The shareholders have been informed of the situation and the company has now ceased trading, though refinancing proposals are currently being considered.

The bailiffs entered the premises of Premium Technology Ltd, another holographic company in which Snyder has an interest, which are also the registered offices of Holomart Plc. They removed some equipment and stock belonging to Premium Technology, as well as Holomart property. This included holograms, computer equipment, and the company's answering machine. Snyder says he hopes to retrieve the Premium Technology equipment through the courts.

In another complication, action may be taken by Arbuthnot Asset Finance Ltd which lent Holomart funds to buy the See 3 (Holograms) Ltd studio, using the purchased equipment as collateral. Since Holomart has defaulted on the payments, Arbuthnot has made preparations to physically take possession of the equipment, but as yet have not decided on further action.

Snyder says that he is hoping to have completed an interim refinancing agreement by March 1990, but adds that he will still need to find a permanent solution to make the museum viable once the refurbishment is complete. He would like anyone who might be interested in investing in the project to contact him.

Contact Bruce Snyder at 9 Brunswick Centre, London WC1N 1AF. Tel: (+44) 01 833 0998.

So this is what they call a working breakfast...

A display of packages incorporating holograms, at a recent conference on holograms in packaging (see report on page 16).

Live Denisyuk Gets Record Response

An estimated fifteen million young Britons saw Dr Martin Richardson of the Royal College of Art make a Denisyuk hologram on live television this autumn.

During the first part of the children's programme *Motormouth*, broadcast on 23 September, viewers saw examples of Richardson's work and were given an introduction to holography. During the second half he made a hologram live in the studio.

The equipment consisted of a 10mW HeNe laser, a bowl of sand, a paving slab and an inner tube. It is pictured during the programme with Richardson (right).

The resulting bright hologram of the letter M was signed by Richardson and the other guests present in the studio, including the pop group *Erasure*, and offered as a prize to a viewer who could say in which country holography was invented. The TV company, Central Television, said that the response was 5000 entries, the largest ever to such a competition.

Fringe Research Puts on Display in Bloomingdales Hosiery

Detail from Is This What You Want? *by Sydney Dinsmore and Melissa Crenshaw, at Interference Gallery, Toronto.*

Fringe Research Holographics of Toronto, Canada, collaborated with Holographics North of Vermont, USA, to produce a hologram for display in Bloomingdales, the famous New York City department store.

The multi-colour multi-channel large format white light transmission hologram was produced for HUE, a New York hosiery manufacturer, and was hung in Bloomingdales as part of a sales promotion. The art direction and production of the final display hologram were carried out by John Perry at Holographics North in Burlington, Vermont, and the pulsed masters were made by Michael Sowdon and Alan Tate of Fringe Research.

One of Fringe Research's current projects concerns Canadian artist Evergon, who is recording a series of holograms in the Toronto studio. Two of his masters have been successfully printed into large format transmission holograms by Holographics North, and limited editions of the others will also be available. The Interference Hologram Gallery, sister organization to Fringe Research, expects to be able to mount an exhibition of the work within the next year.

Also to be exhibited next year is work by the 1989 Fringe Research Artists-in-Residence, who are Carl Brown, Deborah Duston, Howard Gerry, Alan Letts, Micah Lexier, Andrea Ott and David Wilcox. Four out of the seven have already recorded successful masters.

Recently shown at the gallery was an exhibition of work by Sydney Dinsmore and Melissa Crenshaw, entitled *Choice and Circumstance*. This consisted of two series of images: *Is This What You Want*, which showed studies of a female nude, contrasting classical perceptions of beauty with contemporary views of fashion and taste; and *Choice/What Choice*, which uses flashback to examine the psychological effects of violence. Both pieces are combinations of holograms and large format photographs.

Interference staff have recently produced an introductory booklet on holography for their visitors called *Holography in a Nutshell*. Although aimed at a younger audience, the book is said to be very popular with visitors of all ages. Copies are also available by post.

Interference Hologram Gallery and Fringe Research Holographics are at 008-1179A King Street West, Toronto, Canada M6K 3C5. Tel (+1) 416 535 2323.

Shearwater Makes Awards

Melissa Crenshaw and Marie Andree Cossette of Canada, Paula Dawson of Australia, and Andrew Pepper, Susan Gamble and Michael Wenyon of Britain have been chosen by the Shearwater Foundation to receive its 1989 holography awards.

The foundation, one of the few in the world to identify and support achievement in holography, has also announced support for other holographic activities in the coming year.

Luminescence *by Marie Andree Cossette, one of the recipients of this year's Shearwater Awards for holography.*

Awards of US$10 000 each were made to further the work of the winning artists, who in the judges' opinion have maintained a distinguished record in holography for at least four years, and have attained the highest standards of achievement in their work.

The foundation has also given US$15 000 towards the funding of the 1990 International Congress on Art which is being organized by Douglas Tyler of St Mary's College in Notre Dame, Indiana. A further contribution of US$10 000 is expected next year.

Also to receive money from the Shearwater Foundation is the Museum of Holography in New York, which will get US$5000 towards its Artist-in-Residence programme and US$15 000 as the final instalment of a general support grant for the Museum's activities.

Film Switch For Richmond

Richmond Holographics Studios (RHS) of Britain is to switch from glass plate to silver halide film holograms. A new range, which includes many new images, will be launched before the end of the year. The holograms will be available in international B sizes up to 70x50cm.

Edwina Orr of RHS said there were several reasons for the move. The availability of larger sizes of holographic film, problems with glass plate supplies, and the development of a new production system, all "seemed to make it sensible to switch completely to film", she said.

The film range was due to be released in October, but has been delayed because of delivery problems with both equipment and supplies. Orr said she regretted the delay, but expected to have film released by the end of the 1989.

She would not reveal details of the new RHS production system but claimed it would "cause certain waves" in the industry. "It is a totally new system that will allow mass production and make pricing very aggressive", she said.

Richmond Holographics Studios is at 6 Marlborough Road, Richmond, Surrey, TW10 6JR, Britain. Tel: (+44) 01 940 5525.

Applied Sells Swiss Unit to 3D

Applied Holographics Plc of Britain has sold its origination facility in Switzerland to David Greenaway, who already ran the unit, for £540 000 (US$864 000). The new company is called 3D AG.

The sale was a mutual decision by Applied and 3D, Greenaway says, and it was prompted by his desire to become active in the international market for film holograms. His aim is to provide a complete origination service, from design and origination to shim production. 3D is also able to recombine images for both decorative and security purposes, a facility which Greenaway claims most companies in Europe do not have.

Though the company will continue to work with decorative foils and prismatic and diffraction structures, Greenaway hopes to expand into security-oriented products such as tamper-evident labelling. The company will also look beyond the European market towards the US.

3D intends to maintain its close links with Applied, and Greenaway hopes that the two companies will continue to work closely. He is optimistic about the future: "The foil market will expand in the next few years and we are well placed to take advantage of that".

3D AG can be reached at Gewerbestrasse 17, CH-6314 Unteraegeri, Switzerland. Tel: (+41) 042 724972.

Boyd Wins Fulbright Award

Patrick Boyd, a graduate of the Royal College of Art (RCA) in London, has been awarded the Fulbright Arts Fellowship in Light Transmission for his work in holography. Fellows are provided with a grant to enable them to work, travel or study in the United States.

Boyd is best known for his pulse work, done primarily at the RCA. He has already had several exhibitions, most recently at the Discreetly Bizarre Gallery in London (see last issue), and has also had his work displayed in shop windows in London and Madrid, Spain.

The Fulbright Arts Fellowship is awarded each year to a different area of the arts, and in 1989 it was for "art using electronic media including holography, neon and lasers". Boyd is pictured receiving the award on 13 September from the Honourable Henry E Catto, United States Ambassador to Britain.

Boyd is basing his activities under the award at the Museum of Holography in New York. He will document his time in America by taking photographs and intends to advance his technical knowledge through working with different American holographers.

In addition to the Fulbright Award, Boyd has also received the New Horizons Award from the International Society for the Arts, Sciences and Technology (ISAST). This is presented annually to an artist recognised as innovative in a new medium, and the winner is given US$500 and an opportunity to have an article published in the ISAST journal, *Leonardo*.

Patrick Boyd is presented with the Fulbright Arts Fellowship by the US Ambassador to Britain, Henry E Catto.

US Post Launches Space Stamp

The US Postal Service has launched an envelope stamped with a 2D-3D embossed hologram, produced by American Bank Note Holographics Inc, depicting a space shuttle preparing to dock at an orbiting space station.

The artist who designed the stamp for the envelope, Ken Hodges of Los Alamitos, California, has also designed four other holographic stamps which are to be launched during the *World Stamp Expo*.

The Postal Service has been investigating the use of holograms for several years, Assistant Postmaster General Gordon C Morrison said. He sees the hologram as a unique way to satisfy those customers who have been asking for more colourful and innovative stamps.

The holographic stamp issued by the US Postal Service.

The price of the holographic envelopes, which incorporate a 25 cent stamp, is 30 cents. Boxes of 500 are available for US$136. Orders should be addressed to: Stamped Envelope Agency, Williamsburg, PA 16693-0500, United States. The envelopes are also available overprinted with a return address.

New Ideas Wanted For Colour DCGs

Holographic Products of the US is launching a series of colour DCG holograms in January 1990. Two are already in production, including a starfish hologram, and a further three are planned to folow soon.

Holographer Jerry Heidt says that Holographic Products is still looking for suggestions for new designs to enable them "to do something no-one else has done".

Holographics Products is at 755 South 200 West, Richmond, UT 84333, United States. Tel: (+1) 801 258 2483.

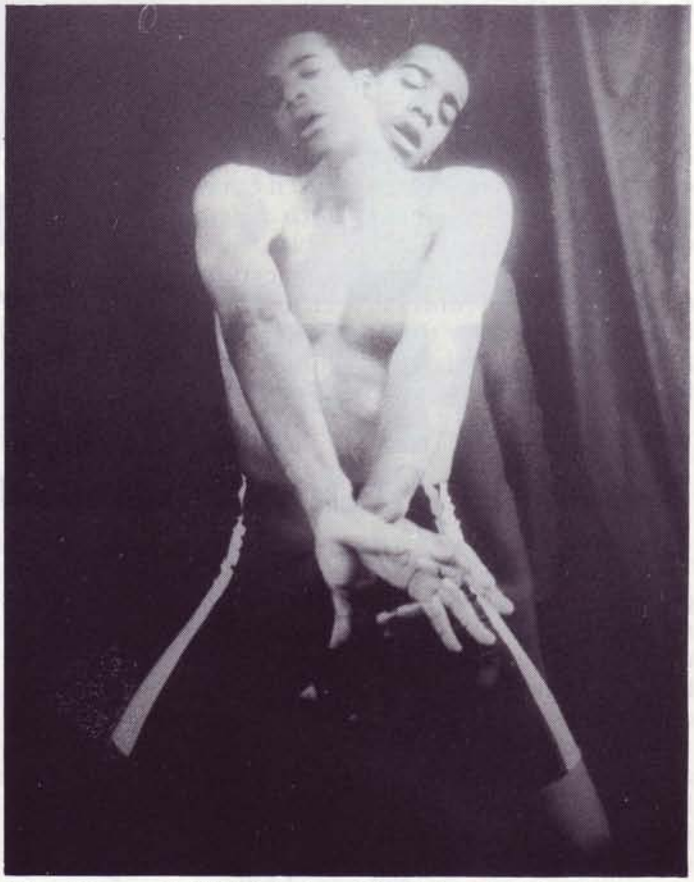
Op-Graphics Takes a Victorian View of Erotica

Op-Graphics Holography of Britain has teamed up with artist James Copp to market a range of white light reflection holograms based on Victorian erotica.

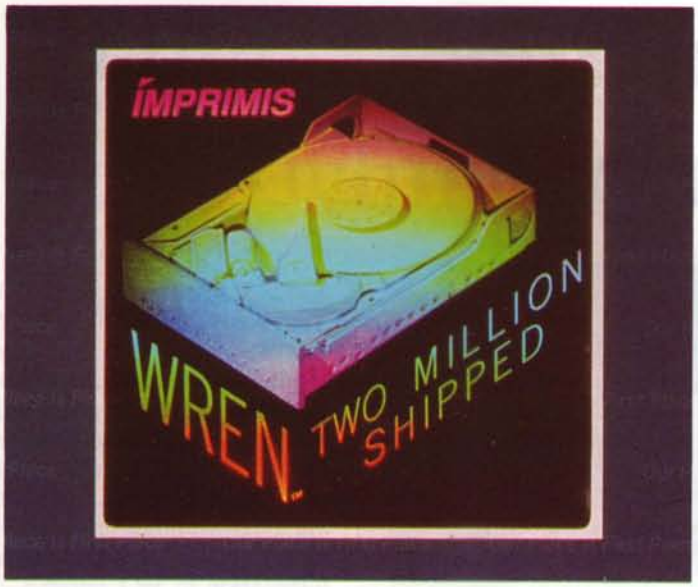
The images used in two of the holograms were originally created as part of Copp's exploration of 3D representations of the human form, and are deliberate imitations of Victorian photographs. The work, says Copp, is "an attempt to bridge the gap between photographs and 3D images". The remaining four images in the set of six were created specifically for the Op-Graphics series.

Copp admits that he did the series "basically to make money", but he shuns the "erotica" label. "People won't find the images erotic in the first instance because they are so unconventional and confrontational in 3D", he says.

He is currently working on montages of male and female figures, creating stereo pairs for animation. He can be contacted at: Copp Design Partnership, School Cottage, Aisthorpe, Lincoln LN1 2SG, Britain. Tel: (+44) 0522 732018. Op-Graphics is at Unit 4, Technorth, 7 Harrogate Road, Leeds, LS7 3NB, Britain. Tel: (+44) 0532 628687.



One of James Copp's Victorian-style photos which has been made into a hologram by Op-Graphics.



Imprimis Technology of Oklahoma City, United States, a manufacturer of computer hard disks, has used 15 000 holograms from Light Impressions on its promotional calendars for 1990 (pictured). Imprimis also used 5000 of the 13x14cm holograms on desk displays and plaques as gifts for customers and staff. The comapany has described the entire promotion as very successful. Light Impressions (US) is at 194-B Josephine Street, Santa Cruz, CA 95060. Tel: (+1) 408 458 1991.

Ballooning Spectratek

Spectratek of Los Angeles, USA, is developing solar window film designed to be used on the windscreens of vans or other vehicles. Samples will be shown at the automotive convention this autumn and production could start in the first quarter of 1990.

The company is also signing a deal with an American balloon manufacturer to put holograms onto mylar balloons, and has already made samples. In another project, workers at Spectratek have designed a high pressure laminate for formica surfaces and hope soon be partnering a furniture manufacturer so that it can be applied to items such as desks and conference tables.

Spectratek can be contacted at 1510 Cotner Avenue, Los Angeles, CA 90025, United States. Tel: (+1 213) 473 4966.

Federation Proposed for Tighter Security

An international association of manufacturing holographers is being proposed by Jeff Blyth of Britain to keep a record of all security holograms, to prevent them from being unwittingly duplicated. He hopes to use the SPIE conference, to be held in Los Angeles, USA, in January 1990 to discuss the matter with people from the holographic companies which would be directly affected.

Blyth, who is a technical consultant on holography for Mastercard, says that together with Visa the credit card issuers have saved something like US$100 million in losses through counterfeiting since they introduced holograms on their cards. However, he feels that the future of holograms as security devices may be threatened if embossing runs are not monitored in some way. Light Impressions Plc has, he says, recently had one of its holograms copied in the Middle East. He feels that this sort of problem would be less likely to occur if hologram manufacturers knew that they were being asked to duplicate someone else's work.

He is putting forward a plan which involves the proposed association, provisionally dubbed the International Federation of Manufacturing Holographers, in three ways. Firstly, it would act as an archive for copies, photographs and designs of security holograms, which would be regularly submitted by each manufacturer. Then, before running a new job, holographers would fax or courier the design of the proposed hologram to the association, which would then check the artwork against designs of existing holograms to ensure that no duplication was taking place.

The association would also collect data on all non-security embossed products, in particular to check for materials which could be used to simulate security holograms. The hope would be that clients would choose holographers who were members of the association rather than non-affiliated companies.

Blyth would be interested in the views of potential members on the practical issues of running such an organization. He can be reached at 7 Bath Street, Brighton, Sussex BN1 3TB, Britain. Tel: (+44) 0273 202069. For those attending the SPIE conference, there is a photograph on page 23.

Soviet Studio Seeks Openings in the West

Technoexan, a Soviet company set up to produce Denisyuk holograms and market them in the west, has established a new holographic studio in Leningrad.

The company was formed as a joint venture between the Physical Technical Institute Joffe (FTI) in Leningrad, where Prof Denisyuk is a department head, and Semicon GmbH of Austria.

The studio is run by Vadim Bryskin, with colleagues and students of Prof Denisyuk. It will specialise in large-scale limited edition pieces, and already has a series of artifacts in ivory and gold, weapons and icons available as subjects.

In future the group hopes to produce holograms of great art works in Leningrad's famous Hermitage and other museums. It will also offer low-run copying for western customers, and also portraiture. The latter is one area in which the studio is especially keen to establish links with western companies.

Bryskin would also like to encourage artists to use the studio, and has recently finished a series of 10 holograms with a young Leningrad artist. Some of Bryskin's own art works are presently on display at the travelling *Images in Time and Space* exhibition in the United States and Canada, and were recently exhibited Madrid, Spain.

For more information about Technoexan holograms or the studio facilities, contact Technoexan's offices in Canada (Tel: (+1) 416 672 7271) or in Austria (Tel: (+43) 0316 38 25 41.

New AIRs at Photon League

The Photon League, a Canadian cooperative facility for artist holographers, will be running an artist-in-residence program from January 1990.

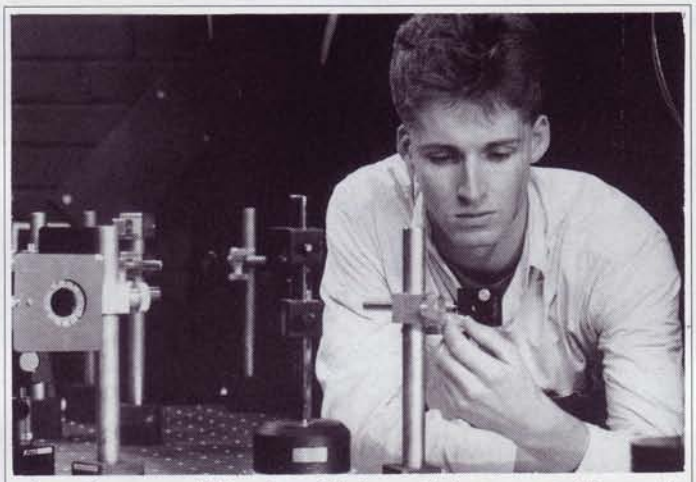
The artists chosen to be sponsored in the first year are Heidi von der Gathan, John B Webster, Ken Vincent, Claudette Abrams and Mary Alton. Each will be allowed to spend up to two weeks in the Photon League lab with all materials supplied.

The lab itself was set up in the spring of 1989 and consists mainly of a 2.5x5 m reinforced concrete table with a steel top and a 50mW HeNe on long-term loan from Michael Jotoff of Ottawa. It has been well used since it opened, and has been the venue for a number of workshops.

Recent lecturers have included Melissa Crenshaw and John Kaufman. Two more introductory workshops have been scheduled for the first half of 1990, as well as an advanced workshop covering techniques in multi-colour reflection holography.

A curatorial committee has been formed and is gathering proposals for an exhibition in late 1990.

The Photon League is at 110 Sudbury Street, Toronto, Ontario M6J 1A7, Canada. Tel: (+1) 416 531 7087.



A student on a "Hands on Holography" course at Newcastle upon Tyne Polytechnic, Britain. Since September, a series of one-day beginners courses and four-day advanced courses have been offered. For details see page 29.

Colour Mastering From Lasersmith

The Lasersmith, of Chicago, United States, has set up a new company to offer holographers a full-colour mastering service.

Called Advanced Holographic Imaging Technologies (AHIT), the company will have a particular interest in computer imaging and full-colour stereograms, and will be capable of producing full-colour embossed and display masters. The Lasersmith itself will continue to act as a production house.

The Lasersmith has also developed several new systems which it hopes to unveil in early 1990. These include computer generation of stereo images with the capability to add graphics, and a stereographic full-colour printer which will produce images ready for transfer to resist or silver halide film.

The company is also completing prototypes for a camera which will eliminate the problem of temporal coherence by exposing the entire optical system simultaneously.

Steve Smith, President of The Lasersmith, said that he was aiming to offer a "service house to the holographic industry". The Lasersmith is on (+1) 312 733 5462.

Leonardo Special Published

Leonardo, the journal of the International Society for the Arts, Sciences and Technology (ISAST), has just published a special issue on "Holography as an Art Medium". Guest edited by Louis Brill, the issue documents the work of the some of the world's foremost holographic artists.

Benyon, Berkhout, Boissonet, Burgmer, Casdin-Silver, Dewar, Dyens, Dinsmore, Gorglione, Jung, Kac, Mitamura, St Cyr, and Vila are among those who have written papers about their work for the publication. There are also general articles by Bainier, Jurewicz, Landuyt, Layer, Lightfoot, Pepper, Speer, Zec and others.

Also on offer from *Leonardo* is the "Art and Holography Theme Pack" which includes copies of the ten most requested articles on art and holography which have appeared in previous issues.

A copy of the special issue can be purchased for US$45 by individual readers. This includes associate membership of ISAST and an annual subscription to *Leonardo*. The theme pack costs US$20 or US$10 for members. For further information please contact *Leonardo* at PO Box 75, 1442A Walnut, Berkeley, CA 94709, United States.

New Holomex Camera

Holomex of Britain has launched a new holographic camera, which it describes as a compact and portable system for the production of holograms.

The Holomex Viewcam 2025 has a fixed laser (10mW HeNe), beam expander, spatial filter and shutter. Different kinds of hologram are made by selecting various optical elements from a control panel.

The device can make single beam reflection holograms in horizontal, vertical and oblique planes, and double beam reflection and transmission holograms in the vertical plane. Transmission masters are possible with an optional collimating lens. It uses either film (holding between glass, or using vacuum or indexing methods) or plates and makes holograms up to 20x25cm. The exposing chamber measures 60x35x45cm.

The camera also offers a facility to view reflection holograms with an built-in tungsten halogen spotlight, and transmission holograms can be viewed using the laser reference beam. Overall the camera measures 90x90x 45cm, and is expected to cost about £8000 (US$12 800).

Further details are available from Mike Anderson at Holomex, 4 Borrowdale Avenue, Harrow, HA3 7PZ, Britain. Tel: (+44) 01 427 9685.

Denisyuk in the USA

Professor Yuri Denisyuk of the USSR visited the United States for the first time this summer on a trip that took him to many parts of the country.

On his way to Lake Forest College, Illinois, he had a short stopover in New York to visit Martha Tomko of the Museum of Holography. At Lake Forest, where he was a guest at Dr Tung Jeong's summer house, Denisyuk attended a reception given for him by the president of the College, gave a public lecture attended by local holographers, and even did some water-skiing.

Subsequently he visited Professor Emmett Leith and gave a technical lecture at the University of Michigan. Leith and Denisyuk then drove to New Hampshire where they had been invited to go to the private Gordon Conference on holography, which was also attended by Dr Stephen Benton of the Massachusetts Institute of Technology.

Among his other visits were the Center for Applied Optics in Alabama, the home of Anait Stephens in California, and Ana Maria Nicholson's portrait studio in the Museum of Holography, New York.

Professors Denisyuk (right) and Leith at the Gordon Conference in New Hampshire.

Gantz Gets Into Bed With Holography

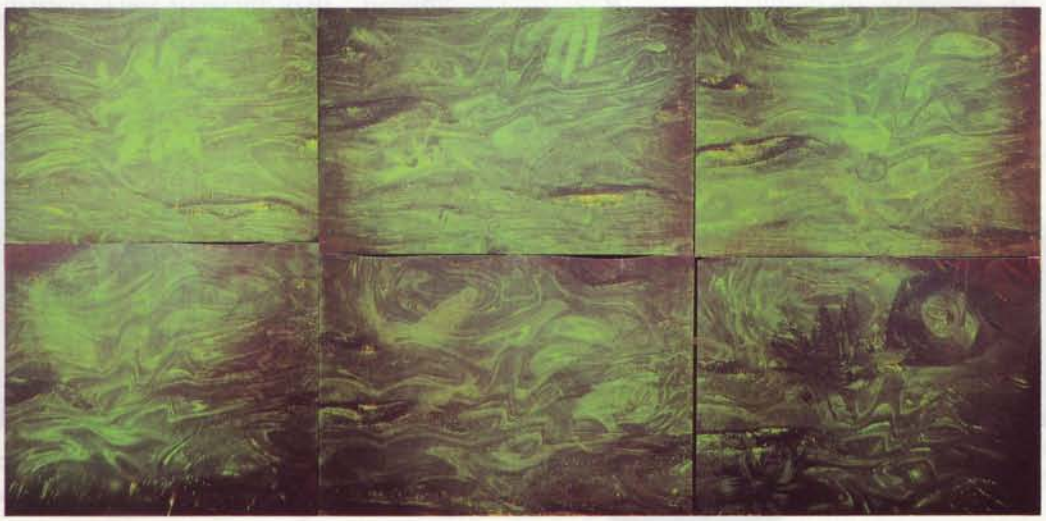
American photographic artist Joe Gantz, known particularly for his controversial and sexually explicit photographs of women, has started making transfers of his first holographic project, which he hopes to show next year.

Gantz started the project more than two years age by taking photographs of couples in bed. In December 1988, during two 5-day sessions at Holoscan in London, Britain, he used human models to recreate the gestures and expressions in the photographs and made 38 60x100cm masters.

Though very pleased with the transmission masters, Gantz said he initially had problems with the transfer stage.

With these overcome, he has now successfully transferred some of the work onto black and white reflection copies and he is now using these to try to convince some of the major European art galleries to exhibit his work. The Ludwig museum in Koln, FR Germany, has already scheduled a show for August 1990.

From the Serpent Series, *a hologram by Nisha Mohammed produced at the New York Summer School (see page 20).*



Water Lillies - after Monet, or Slow Death *by Anait, a recent 4ftx8ft mural of film holograms. Under a gently moving surface of rippling water the viewer sees images of crumpled beer cans, condoms, deas fish, etc, which contrast with the beauty of the surface. The movement is enhanced by hanging the holograms away from the wall so that they move randomly with air currents. The sounds of moving water are relayed through two speakers to complete the effect.*

Pepper PhD Breaks With Tradition

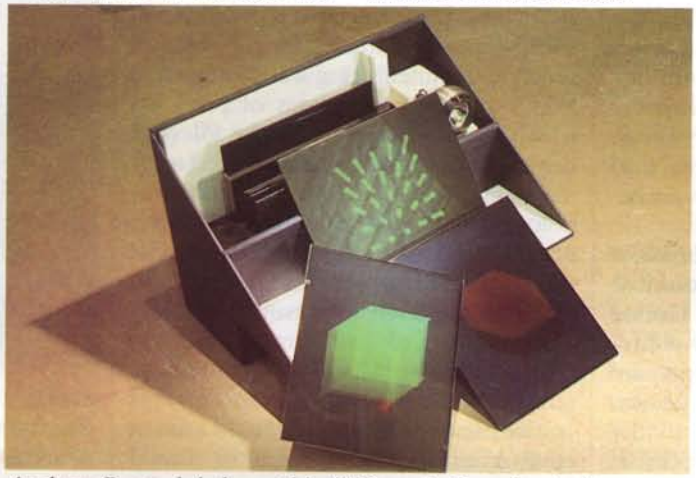
Andrew Pepper has received a PhD degree for his work in fine art holography. The award was made by the University of Reading, Britain, in July.

The work submitted for the award consisted of nine white light refection holograms and a thesis on the history of holography and its relationship to other media. The award is considered unique as it was the first time a candidate has submitted such a large proportion of visual work for a higher degree.

The PhD is among the first to be given specifically for fine art holography by a British university and, unusually, the work was examined by members of both the Fine Art and Physics departments. Prof Stephen Benton of the Massachusetts Institute of Technology in the US acted as external examiner.

The work is available for viewing as part of the Fine Art Department collection at the University of Reading, but examples can also be seen at the Museum of Holography in New York and the Museum for Holography and New Visual Media in FR Germany.

Pepper will continue to work at the University of Reading as the Lienal Robbins Memorial Scholar.



Andrew Pepper's holographic PhD work, Drawing in Space.

Broadway Show

New York City's largest ever public display of holograms will be on view until 16 January 1990 at Broadway Windows, on the corner of Broadway and 10th Street. The works, by Chuck Henry, consist of a series of mosaics made by cutting up copies of a master hologram of geometrical patterns and reassembling them in large-scale installations.

Henry, who is professor of sculpture at Virginia Commonwealth University, has included six pieces in the exhibition, each making use not only of the holograms themselves, but also of either materials such formica and aluminium or some electronic effect such as a video screen or blinking lights. The pieces range in size from 2.3 to 3.7m square. This is his first major New York exhibition.

Detail of a hologram mosaic by Chuck Henry.

Broadway Windows is a non-profit organization founded in December 1984 in conjunction with New York University, and artists from around the world are invited to submit site-specific proposals. The exhibitions can be seen by the public 24 hours a day.

Lightworks on the Move: Studio to be Leased

Peter Miller and Dominic Welby, partners in Laser Lightworks, the London-based holographic studio, have decided not to renew their lease when it falls due at the end of March 1990. Consequently they are looking for new tenants who would like to maintain the unit as a holographic studio.

The reason for their decision to leave the building is nearby construction work, which has necessitated their working solely at night since June 1989 and which is not expected to drop to a tolerable level until Autumn 1990.

They are offering to assign the lease and facilities without premium to any individual or group interested in keeping the studio operational. The three-room unit includes two fully functioning isolation tables: a 4x2m sand table with an inlaid steel plate and a heavy-duty adjustable overhead system; and a 1.3x2.5m steel top table. Ion laser plumbing, three-phase electricity, and darkroom facilities are also offered.

Though the lease runs out in March, interest in the unit has meant that they may want to leave by the end of January 1990. Those interested should get in touch with Miller or Welby at Unit B1a Hatton Square, 16/16a Baldwins Gardens, London EC1N 7RJ (Tel: (+44) 01 430 0028), or at 2 Foxes Lane, Mousehole, Cornwall, TR19 6QQ, Britain (Tel: (+44) 0376 731320). Both holographers are offering their services on a freelance basis until their relocation plans are finalized.

Selling a Packet

The use of holograms on the packaging of breakfast cereals and other products is increasing, and the results of some recent promotions show why. A one-day conference was recently held in Britain on this subject.

The PIRA Packaging Division in Leatherhead was the venue for the conference, entitled *The Use of Holograms in Packaging*, on 5 December. Chaired by Ian Lancaster, former director of the Museum of Holography in New York, the conference was an opportunity for hologram manufacturers to explain the potential of the medium to likely users, and to answer questions about practical aspects of using holograms on packaging.

Among the companies paying £165 a head to hear how holography could be of service were Courtaulds, ICI, United Distillers, Shell Research Ltd, St Ivel Ltd, The Nestle Company Ltd, Reckitt and Coleman, and Her Majesty's Stationary Office.

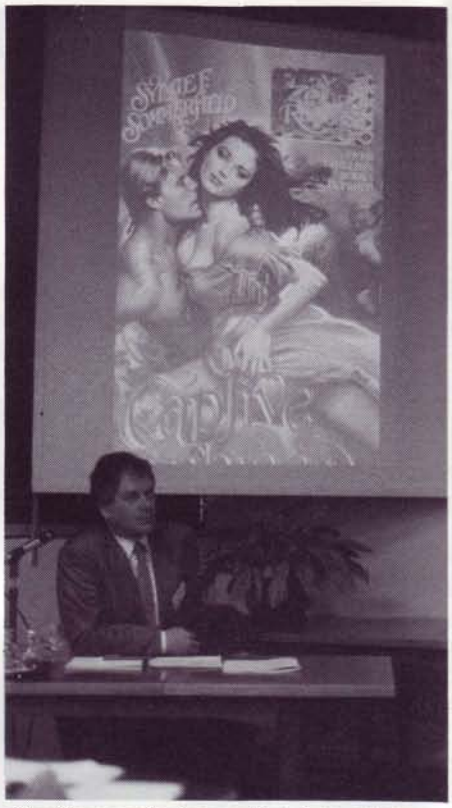
The speakers included Hamish Shearer, who brought the audience up to date with new developments made by Applied Holographics. This included details about their new wide-web materials, of which he showed as a sample a diffraction grating pattern of small circles in squares, designed using a computer.

He showed some slides of products which had been selected as the "Best of British Packaging", and suggested ways in which the subtle and restrained use of holography might have added to the overall effect of the award-winning designs. Another speaker was T Hitchins, who explained what his company, Markem Systems Ltd, had learned about the use of holographic foils since they entered the business.

The use of packaging to guard against counterfeiting was covered by Philip Hudson of Amblehurst, who gave a detailed analysis of the different ways in which holographic authentication stickers and tamper-evident labels could potentially save manufacturers millions of dollars. He showed ways in which holography and conventional security printing techniques could be used together to make highly secure devices, arguing that holography has a long-term role in security.

Throughout the day the audience was shown photographic slides of holograms on packages, rather than the real thing, until John Brown of Light Impressions Europe paid a quick visit to his offices, just a couple of hundred yards away, to collect a whole batch of samples. On his return he put on a good display of work from several manufacturers, being careful to give credit to each in turn (which was not true of all the presenters).

Brown also provided information on some marketing success stories, such as that of Ralston Purina in the US which had "a dead brand of breakfast cereal" until it allocated its total advertising budget to buying a "Ghostbusters" licence and hot foil blocking a series of three ABN holographic images onto the box. The market share increased so dramatically that the company decided to keep the holograms on the pack permanently! Now with new images from the "Ghostbusters 2" movie, it has contracted to run holograms on the pack for at least the next five years.



Conference chairman Ian Lancaster with a sample of holographic packaging.

The similar success that Kellogg's has had in Britain with the "Tony the Tiger" holograms was also described by Brown. Such was the effect on the brand's popularity that the company is keeping the marketing information secret, but the fact that it started another promotion, with six new images on "Rice Krispies", only weeks after the first one came to a close shows that the holograms must be proving very effective.

David Pizzanelli

Scott Lloyd

In a review of the publication *Holography Marketplace* in our last issue, it was suggested that Scott Lloyd was the author of some editorial material on holography contained in the publication.

We have been asked to point out that although Mr Lloyd did write some material for Ross Books, publisher of *Holography Marketplace*, it was substantially edited prior to publication, and at his own request he was not credited as author.

Now until May 20
Chicago Museum of Holography, 1134 W Washington Blvd, Chicago, IL, USA. Tel: (+1) 312 226 1007.
Equus/Underwater, a "thematically integrated story told through holography", by Nancy Gorglione and Greg Cherry.

January 27 - March 3
Interference Hologram Gallery, 008-1179A King St W, Toronto, Canada. Tel: (+1) 416 535 2323. Open Wed-Sat, 12 noon to 6pm.
Group show on the theme of the representation of the human figure, curated by Heidi Von der Gathen.

March 8 - April 14
Interference Hologram Gallery.
If you can't make it good, make it big, exhibition of portriats by Michael Sowden and Alan Tate of Fringe Research Holographics.

March 12-14
The Hague, Netherlands.
ECO3, Third Annual International Conference on Optical Science and Engineering, and Interoptex 90 exhibition. Details from SPIE, PO Box 10, Bellingham, WA 98227, USA. Tel: (+1) 206 676 3290.

April 19 - June 2
Interference Hologram Gallery.
Solo exhibition by holographer/sculptor/artist Jean François Cantin.

May 1 - July 29
Holos Gallery, 1792 Haight St, San Francisco, CA, USA. Tel: (+1) 415 221 4815.
Show by members of the Laser Arts Society for Education and Research, to mark the society's 10th anniversary.

May 19 - July 8
Royal Photographic Society, The Octagon, Milsom St, Bath BA1 1DN, Britain. Tel: (+44) 0225 462841.
Solo exhibition with a Spanish theme by Martin Richardson.

May 22-24
Beijing, PR of China.
International Conference on Holography Applications, with exhibition. Details from Prof Hsu Dahsiung, Beijing University of Posts and Telecommunications, Beijing 100088, PR of China. Telex: 222341 BUPTF CN.

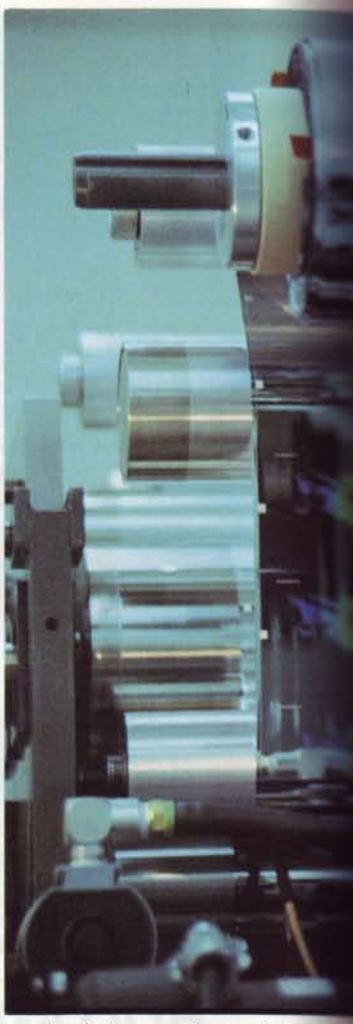
June 7 - July 28
Interference Hologram Gallery.
1987 Artist-in-Residence group show.

August 12-16
Garmisch-Partenkirchen, FR Germany.
International Conference on Optics in Life Sciences. Details from G von Bally, University of Muenster, Kardinal-von-Galen-Ring 10, D-4400 Muenster, FR Germany. Tel: (+49) 0251 83 6861.

September 28 - November 3
Interference Hologram Gallery.
New British holography, curated by Dr Andrew Pepper.

November 4-7
Baltimore, Maryland, USA.
Society for Experimental Mechanics (SEM) Conference on Hologram Interferometry and Speckle Metrology. Details from Dr Karl A Stetson, SEM, 7 School St, Bethel, CT, USA. Tel: (+1) 203 790 6373.

Hologram Industries: A One-Stop Service



The commercial holographic industry has seen the recent emergence of a few larger companies offering their customers a "one-stop" service, from conception and design to mass production. In the first of an occasional series of profiles of leading companies, *Holographics International* takes a look at Hologram Industries of France.

Within the last year, Hologram Industries has moved into new premises double the size of its previous building, and has also doubled its sales. It expects sales to double again next year. The company's brief but eventful history illustrates the explosive growth that is possible in the commercial holography market given the right approach.

The company was founded in 1984 by Hugues Souparis and Denis Lachaud, who were both working as consultant engineers for the Paris City of Science and Technology, a large scientific museum. Souparis had previously founded another holographic company, Media-Laser, which closed in 1983. Lachaud had worked on holography with the large French engineering company Thomson.

They soon concluded that the widespread use of holograms in communications and marketing depended on their use being as simple as that of photographs. Holographic companies must also offer better quality products and a higher standard of service to their customers, they realised.

Actress Jenifer Beals in a 10x15cm black and white stereogram for a special effect in a movie.

The first commercial products of the new company were cylindrical integral holograms, of which sales started in 1985. By the following year they were routinely producing these up to 60cm in diameter. In 1986 they also completed their first embossing projects, with production contracted to a US firm.

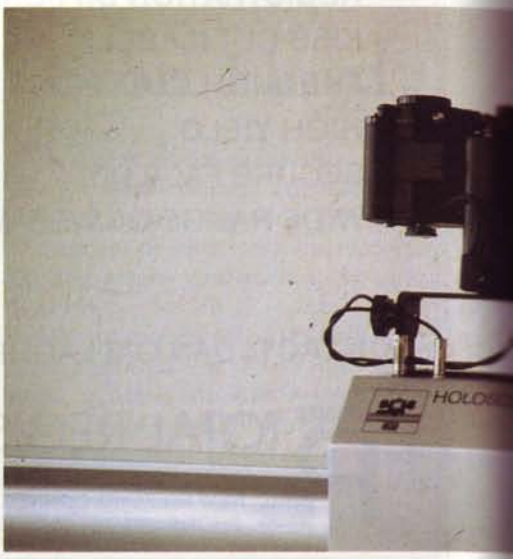
They continued to research new products, and early in 1987 the company started to produce both photoresists and large format stereograms. It was clearly time to expand their marketing efforts, and a full-time salesman was taken on. An advertising campaign was also started. By September they were producing photoresists commercially.

The company's technical strength was boosted by the recruitment in 1988 of Jean-Francois Moreau, who had previously helped to set-up another French company, AP-Holographie. By now Hologram Industries had six employees.

Sales continued to increase, and now included many embossed holograms for magazine covers, brochures, badges, greetings cards, etc, as well as several large format stereograms. But real progress was also being made on the technical front with the development of the company's *Holoscope* system.

It was this breakthrough, announced in July 1988, which led to the company's rapid expansion. A market study was carried out, which showed the potential for the new system. The company decided

The Holoscope, below, is a modified Nikon F3 mounted on a tracking rail.



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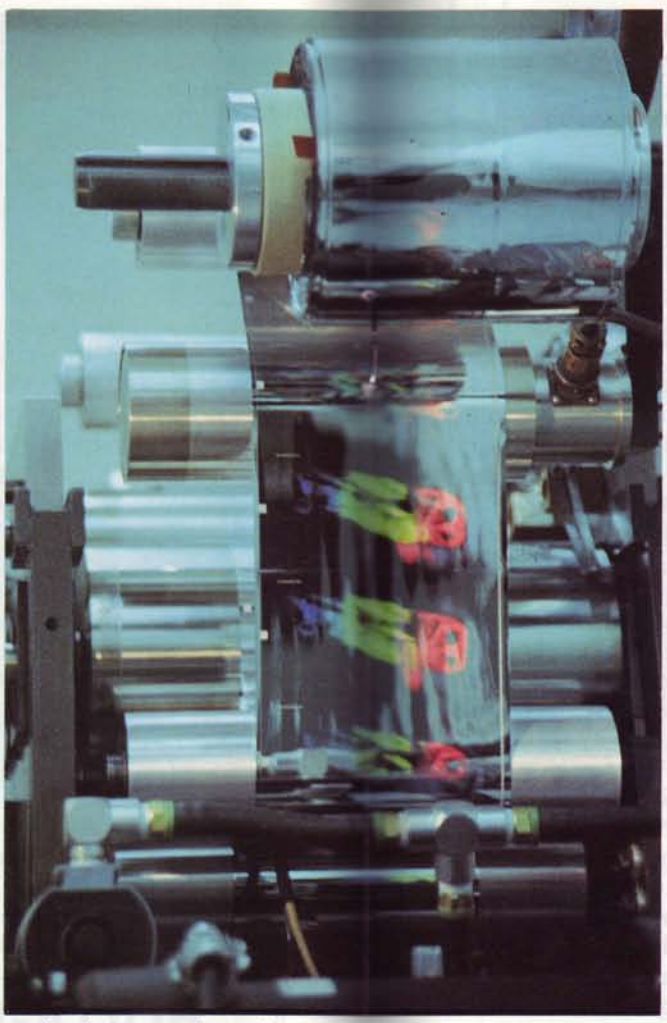

Embossing in progress.

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It was this breakthrough, announced in July 1988, which led to the company's rapid expansion. A market study was carried out, which showed the potential for the new system. The company decided to acquire its own embossing facilities to enable it to become an integrated producer of holograms for both display and security applications. Negotiations with potential financial backers started early in 1988.

Banque Saga, a French business bank, was chosen as the financial partner, and now owns 20% of Hologram Industries. A large investment programme totalling FFr 6 million (US$ 1 million) took place in 1989, and has dramatically increased the company's capabilities.

The company now has four in-house systems for producing holograms, including those for large format stereograms (up to 80x60cm), and photoresist mastering transfer (up to 40x30cm). It also has electroforming and web embossing facilities, and cutting and slitting machines.

The new premises meet the security requirements of banks, and the whole process from studio work to finished holograms can now be carried out in a secure environment. Recent work has included credit card holograms and other security applications.

The company also believes that by controlling all operations in-house it has been able to dramatically increase the quality of its products to the highest standards anywhere in the world. Delivery time has also been improved, with projects routinely completed within four weeks.

All 3D work is ca *Holoscope*, which is holographic camera. corded on location, Industries or by the range of stereograms The company offers possibilities, includin colours and even th photographs into th ground of 2D hologr

Holoscopes are avail ling customers to sh ages from which H can make either emb mat holograms. The tly looking for partn tries to market its serv *loscope* to record ima mers. This will allow the customer to have contact with a local company for the design and shooting process, while making use of the facilities of Hologram Industries for production of the holograms.

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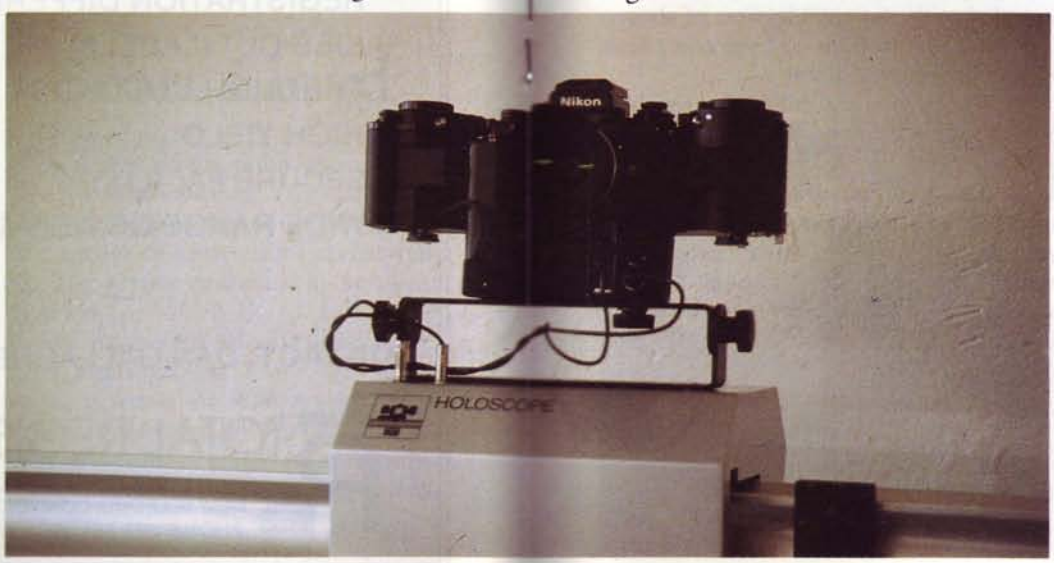
The Holoscope, below, is a modified Nikon F3 mounted on a tracking rail.



Embossing in progress.

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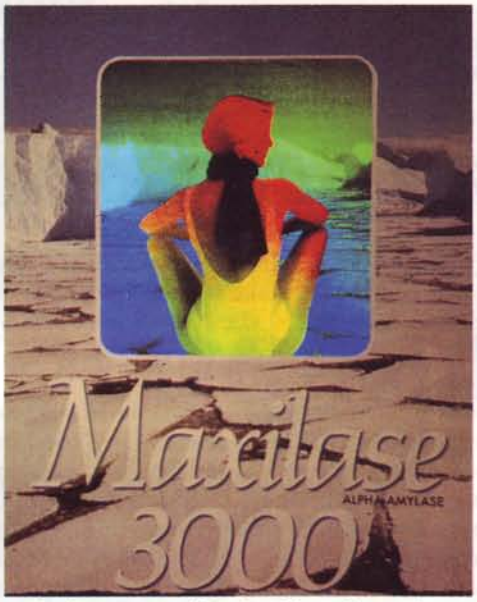


A hologram combined with a photo of a woman, used on a drug brochure.

All 3D work is carried out using the *Holoscope*, which is best described as a holographic camera. Images can be recorded on location, either by Hologram Industries or by the customer, and a full range of stereograms can be produced. The company offers a range of creative possibilities, including the use of several colours and even the incorporation of photographs into the surface or background of 2D holograms.

Holoscopes are available for sale, enabling customers to shoot their own images from which Hologram Industries can make either embossed or large format holograms. The company is currently looking for partners in other countries to market its services by using a *Holoscope* to record images for local customers. This will allow the customer to have contact with a local company for the design and shooting process, while making use of the facilities of Hologram Industries for production of the holograms.

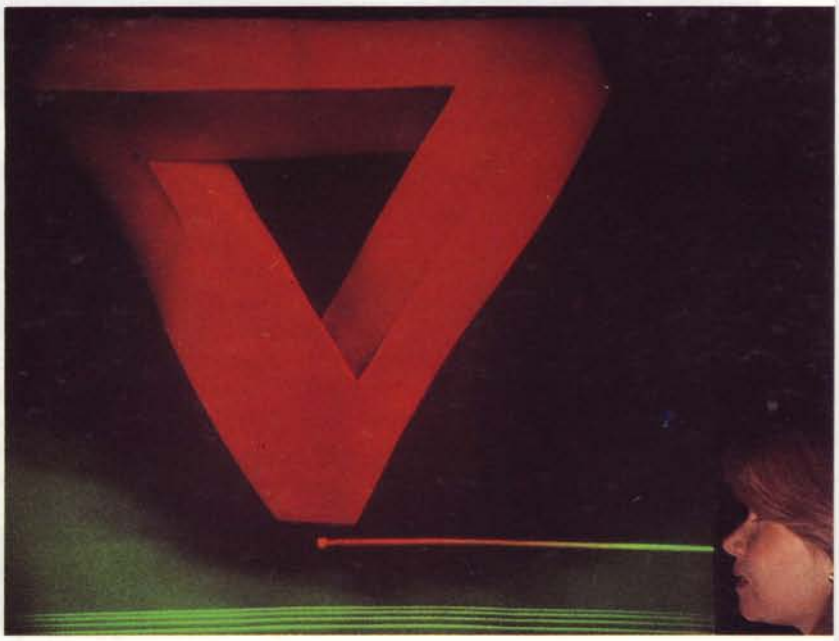
In its short history, Hologram Industries seems to have gone a long way to fulfilling the aims of its founders to offer better products combined with more professional service. The company is continuing to devote considerable resources to research and development, and further improvements can be expected.

There have been criticisms in the past, often justified, that commercial holography companies have not been able to offer the products and the quality of service necessary to interest potential users of holograms. Hologram Industries is one of a small number of companies in Europe and North America which now appear to be answering this criticism. The growth of the commercial holographic industry may well be set for take off as a result.

Martin Taylor

Hologram Industries is at 42-44 rue de Trucy, 94120 Fontenay S/Bois, France. Tel: (+33) 1 43 94 19 19.

The same model and master were used to make the 1 m² stereogram below and 20 000 embossed holograms, right.



Another Creative New York Summer

One of the greatest pleasures of teaching is to watch fresh minds take an idea, turn it over, mould it, bend it and make it their own. For close, intense interaction between teacher and students, the New York State Summer School for the Arts provides a quintessential arena

Held every summer for the past twenty years on the campus of the State University of New York at Buffalo, the six-week immersion programme is funded by the New York State Department of Education. Gifted high school students selected from across the state choose among workshops in colour photography, film-making, video, creative sound, digital arts (computer graphics), and holography.

Now in its third year, the holography workshop has grown in number of students, scope of projects, and the level of programme support. For the first time this summer, the holography workshop found a home in the Physics Department with a good isolation table. The initial shooting problems have been solved by investment in much-needed equipment.

In class, technical parameters were discussed with a practical emphasis, including polarization and coherence length of the laser, and optimum recording geometries for low-power laser set-ups. A hands-on approach dominated lab instruction for, as holographers know too well, trouble-shooting affords the most valuable lessons.

Lab work was balanced by ongoing discussion of the aesthetics and concepts related to holography, as well as by video and slide presentations of artists using not only holography, but also light, sound, energy, motion and new technology in their work. The students were particularly curious about colour and depth perception, and displayed a remarkably sophisticated interest in the use of language and text as a subject for their work.

Studio work began with the class setting up a camera for reflection shadowgrams which create silhouettes of objects in space, therefore freeing the imagery from the vibration problems of many holographic subjects. Once the camera was working, pseudo-colour testing started, using swelling of the holographic emulsion to layer two or three additive colours on a single plate.

Several unorthodox methods of mixing colour proved intriguing to the students. They tried dripping, splattering and spilling triethanolamine, and deliberately towelling the emulsion during drying, to attain mottled fields of colour.

The next table project was a transmission shadowgram set-up, which also left plenty of latitude in the silhouetted subject matter. Multiple rainbow exposures could overlap, with a slight shift in recording geometry, so the red part of one rainbow could cross and mix with the blue or green part of another.

The Summer School's evening events included critiques of students' work, as well as screenings, exhibitions and concerts by visiting artists and members of the teaching faculty. There were also lectures on visual culture by the Director, Dr Gerald O'Grady. Special emphasis was given to work representing new technologies, new international developments, and minorities.

The programme was fortunate to have Ken Vincent of the Photon League, Toronto, to act as my substitute for the first three weeks, as well as two other visitors who were a boon to the workshop. Susan Cowles, the workshop's instructor for its first two years, came to give a lecture on her work. Walter Spierings of Dutch Holographic Laboratories joined the workshop for its fourth week and presented a lecture on his work with computer-generated holograms to a joint meeting of the computer graphics and holography workshops.

The workshop students were also invited to visit the on-campus Earthquake Testing Laboratory, one of just two in the United States. At the centre of the facility is a huge concrete slab, which is isolated from its surroundings to induce movement. Five types of computer-controlled gyration simulate various earthquake effects on quarter-scale building structures. We discussed the possible applications of holographic interferometry to analyse structural stress.

A highlight of this year's workshop was a field trip to Fringe Research in Toronto, to give the students a chance to shoot images of their own design on a pulsed laser. The students made one or two test exposures and a 8x10 inch plate for use in their final projects.

Matt Stanley, a student at Shaker Junior High in Latham, New York, is also a brown belt in karate. For his pulsed hologram he chose to break a board with a karate chop. The timing was perfect, thanks to Michael Sowdon's hair-trigger reflexes. Matt calls his hologram *Contact*. He says: "I first started working in holography because of its striking reality. It is in this reality that I try to capture experiences and ideas. I have succeed here better than ever before because of the new techniques available to me. The use of the pulse laser was especially useful."

While in Toronto, the students enjoyed the chance to see Andrew Pepper's show at Interference Hologram Gallery, which included a project piece with coloured screens, as well as 20 reflection holograms. Rounding out a full agenda, the students also visited the facilities of Toronto's Photon League, a holographic co-operative which is worth watching.

Back in Buffalo, to complete their studio experience the students worked with the laser-viewable pulsed master holograms to create reflection image-plane transfers. They often combined the copy process with techniques learned earlier, to enrich the content of the images.

The programme culminated in a final show, and naturally the students responded to the dire inspirational force of a deadline. They created innovative displays, with one student, Sean Sutherland, incorporating specially created sound, holograms and clothing into an installation with an anti-war message. The learning experience of mounting a holographic display in a short time was coupled with the gratification of showing the work to their parents and peers in a gallery environment.

It is particularly fulfilling to teach a workshop that has become a seed programme. All the students go back to their schools' holography classes and clubs and teach others. With inventiveness and energy, they move beyond the techno-gimmick and appeal to the viewer with the directness of fresh vision.

For more information about the New York State Summer School for the Arts, contact Dr Gerald O'Grady, Director, Department of Media Study, 201 Wende Hall, State University of New York, Buffalo, NY 14214, United States. Tel: (+1) 716 831 2426.

Doris Vila

Red Sensitive DCG: A Recipe

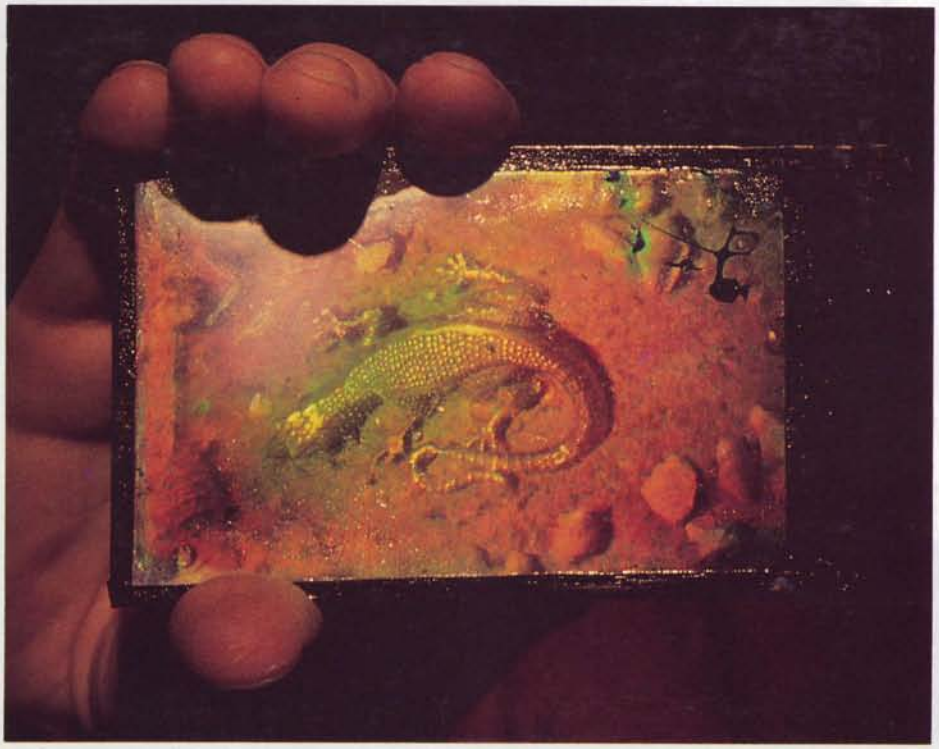
by Jeff Blyth

The author's research has uncovered a readily available chemical which enables him to obtain a dazzlingly bright reflection hologram of an object 2.5cm in diameter, say, after an exposure of only 1 minute from a 10mW HeNe (with the beam spread to about 4cm diameter to give even illumination of the object). With a 35mW HeNe, a 10x12.5cm hologram can be produced with an exposure time of about 4 or 5 minutes. Here he tells how its done.

This technique opens the way for all holographers to produce their own holographic plates and get brighter single beam results than they could get by purchasing expensive silver halide plates. It also enables them to coat curved surfaces such as wine glasses. I hope many of you will carry out the recipe below because it really does work and can be great fun. Unlike conventional DCG recording material, this one remains sensitive for weeks at room temperature and yet it contains only a small fraction of the quantity of dichromate normally used.

The approach taken in the instructions below is to enable you to produce remarkably good coatings at minimal cost. There is however one item that would be very helpful. Control of the pH to a value of about 9 is really important in this system and therefore a pH meter would be much easier than using pH papers. (I note that portable pH meters for swimming pools are relatively cheap these days.)

Full panchromatic sensitisation is also possible with this system but this will be the subject of a later article.



Hologram made by George Clare using Blyth's red sensitive DCG method.

The following instructions will produce approximately 100cc of material. The toxicity of the formulation is much *less* than that of normal DCG formulations because of the very low hexavalent chromium content.

The new discovery centres on 1,1,3,3-tetramethylguanidine (TMG - Aldrich cat no 24176-8). This is a considerable advance over other similar systems [1], possibly because this molecule exists as a number of resonance structures in dynamic equilibrium. (See diagram over).

Once TMG is neutralized with acetic acid and added to the gelatin formulation it is a reasonably innocuous substance. However, the pure chemical is a volatile and caustic liquid which should not be inhaled and eye protection should be worn when using it. The first 2 preparations below are best done outside so that the fumes disperse easily.

Preparation of stock solution of 25% v/v TMG:

- 1,1,3,3-tetramethylguanidine: 50cc.
- Deionized water: add until total volume reaches 200cc.

Preparation of stock solution of TMG acetate:

- 25% stock solution of 1,1,3,3-tetramethylguanidine: 80cc.
- Glacial acetic acid: 8cc (approx). This quantity should be added very slowly while stirring and adjusted if necessary to give pH of roughly 7. (Some fuming occurs as the two vapours combine.)

Preparation of stock solution of 5% w/v potassium chromate:

- Potassium chromate (K_2CrO_4): 5.0g.
- Deionized water: add until total volume reaches 100cc.

Preparation of stock 0.4% methylene blue solution:

- Methylene blue: 2.0g
- Deionized water: 500cc. Any undissolved impurity can be filtered out.

Preparation of coating solution

The coating solution is prepared using the stock solutions, as follows.

To 80cc of cold deionized water add 12g of gelatin. Use a good quality cow gelatin rather than pig gelatin - it needs to have a low "iso-electric point" of about 4 to 5. I use limed ossein from Croda Gelatin Ltd. Good quality cooking gelatin has also given excellent results. I've been using photographic grade gelatin, but some of the holograms pictured were done by George Clare using cooking grade gelatin.

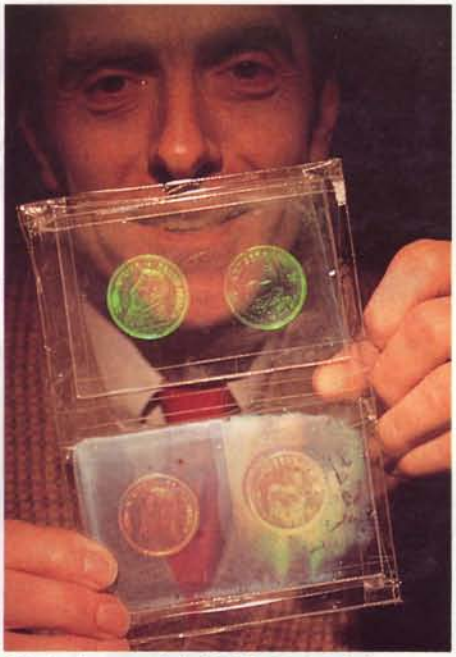
Place container in a water-bath and heat up contents to between 45°C and 50°C while stirring slowly. This may require 20 minutes or more. Check that no undissolved gelatin remains.

Maintaining the temperature between 40°C and 45°C, add 1.0cc of stock 5% potassium chromate solution, and 16cc of stock TMG acetate solution. Note that this quantity of TMG acetate may produce a bright green image. As the quantity is increased the light sensitivity increases but so also does the shift in colour to the blue. Unexposed and unprocessed coating may become tacky because TMG is hygroscopic. There is no tackiness in the finished hologram.

From this point on, before adding the methylene blue, it is *very important* to maintain the pH between 9.0 and 9.4. The adjustment is carried out by very carefully adding stock 25% TMG solution drop by drop while the solution is well stirred. If the pH rises above 9.5 it should be brought back at once by a drop of acetic acid. It is not possible to give a precise value of the quantities of either of these reagents at this point because it will depend on the batch of gelatin being used. I found that it took 1.8cc of stock 25% TMG to get pH 9.1. It is a big advantage to use a pH meter rather than pH paper strips. (A useful calibrating solution is 3.80g of borax crystals in a litre of distilled water. This has a pH of 9.2 at room temperature.)

Finally, under green or dim yellow safe-light, add 6cc of stock methylene blue solution. This quantity is for a coating thickness of between 4 and 5 microns. If you are going to double the thickness of coating by using methods other than the simple one described below, then the methylene blue quantity may need to be reduced. This is because the blue colour in the dried coating needs to be low enough to allow roughly 90% of red light to pass through to make a Denisyuk hologram.

However, if you do not see any sign of a blue coloration when your dried, unexposed film is resting on white paper, then that probably means you have let the pH drop too low and it will have no sensitivity to red light.



Blyth shown with HeNe DCG hologram. The upper half was made without reaching the yield point. For the lower it was exceeded. Hologram by George Clare.

(In my earliest formulation I used ammonium dichromate, but found that it caused wide variation in the pH of the coating depending on its state of dryness and how much free ammonia had escaped. Methylene blue forms a useless precipitate with dichromate ions unless the pH is well above 8. Accordingly this problem was eliminated by using the alkaline salt potassium chromate instead of ammonium dichromate.)

This formulation can remain active for several weeks at room temperature, although it is best to store it in a cold place. It should not be frozen.

Very simple trial coating method: "Veil Coating"

Under green safe-lighting (brighter than would have to be used for silver halide holographic recording):

1) Warm the solution to between 40°C and 45°C in a beaker with a spout. Do not overheat.

2) Hold a clean and *warm* glass plate upright at an angle of about 80° with its base resting in a flat and clean tray which is as small as the glass edge will allow. With a 10x12.5cm plate it is best to put the 10cm side upright.

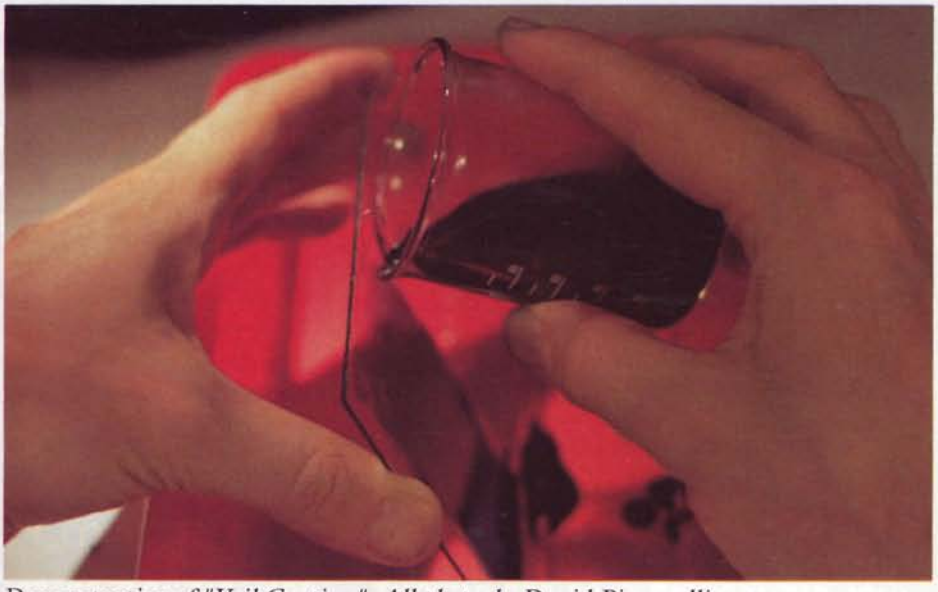
3) Position the spout of the beaker at a point about 1cm from the top of the glass and 1cm from the edge closest to you. (See photo).

4) Start to pour out the solution and at the same time move your arm slowly parallel with the top of the glass plate. The liquid should fall like an evenly spread veil on that side of the glass at least up to the last centimetre from the edge.

5) Keep the plate upright and allow the bottom edge to drain for a minute. (The balance between gravitational and surface tension forces can give a surprisingly even coating.)

6) After the coating has gelled, the thick layer at the bottom edge of the plate can be either wiped off or removed by dipping the bottom edge in warm water. Pour the tray contents back into the beaker.

The coating is now best left to dry for at least 24 hours in a darkened room. It should be possible to coat over 20



Demonstration of "Veil Coating". All photos by David Pizzanelli.

10x12.5cm plates with 100cc, the effective area being about 10x10cm.

Exposing

To make a bright Denisyuk hologram of an object 2.5cm in diameter may need about 60 seconds exposure to a 10mW HeNe laser with its beam expanded just sufficiently to give a reasonably uniform illumination of the object. Firstly, a trial-and-error test on exposure levels is essential. The first trial should preferably contain a range of exposure levels on one plate. Note that doubling the diameter of the object will increase the exposure time needed by a factor of four.

Processing

It is very helpful to keep the following mechanical model in mind. If one hangs weights on the end of a steel extension spring, then removing those weights will result in the spring recovering its original unextended length, unless the weight reaches a critical value which is the spring's "yield point". When such a weight is removed the spring normally never completely recovers its original unextended length, but remains permanently distorted. Had the material of the spring been a little stiffer, however, then that particular weight would not have stretched the spring beyond its yield point. But if the temperature of the stiffer spring were to be raised, then that weight may again take the spring beyond its yield point.

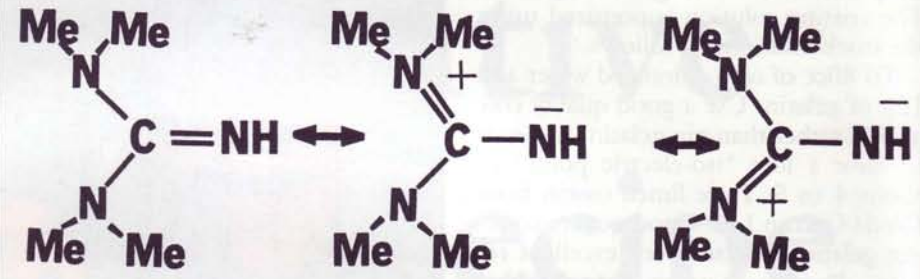
DCG in water behaves similarly to the stretched steel spring. At a certain temperature, the stretching forces due to swelling in water may take the gelatin beyond its yield point. Had the water temperature been lower, then the gelatin would not have reached its yield point.

The art of making the most noise-free and yet bright DCG holograms is to take the gelatin as close as possible to its yield point without exceeding it. Stretching gelatin beyond its yield point creates noise in the finished hologram, although the results are extra bright due to a broadband replay. Using the onion layer analogy of Curran and Shankoff [2], the holographic fringe layers might resemble dried out onion with crinkled-up layers if the yield point is exceeded.

Simple Processing Method

It is strongly recommended that this simple method is tried before other methods you may know of. No meaningful tests should be carried out until the coating is at least 24 hours old.

The first trial hologram is best processed so that the yield point of the gelatin is just exceeded, and some noise or scatter is generated deliberately in the finished hologram. This is necessary to be sure that any lack of hologram after processing is not due to insufficient swelling in the first water bath and therefore must be due to insufficient exposure or relative movement between the object and holographic plate. Once one has established the necessary exposure level then one can produce holograms devoid of any noise by processing at a level which takes the gelatin just below its yield point.



The resonating structures of 1,1,3,3-tetramethylguanidine.

After exposure, the sample should be left for a few minutes before processing.

1) The sample should first be swollen in water at 26°C for about 1 minute.

2) Shake off excess water droplets and plunge plate into cold iso-propyl alcohol. Agitate vigorously for at least 1 minute. (The water content of this bath can be allowed to be up to 10%.)

3) Put plate into another iso-propyl alcohol bath but this time ensure that its water content is less that 1%. Agitate for 2 minutes at least. (Insufficiently dry alcohol in this bath will result in drying marks which replay in the blue.)

4) Blow alcohol off the plate with a strong blast of *tepid* air.

Prolonged inhalation of the alcohol vapour is harmful and hence the drying process should be carried out with air extraction. The alcohol baths should also be covered. Remember that the alcohol rapidly absorbs moisture from the air.

No image may be visible until all the alcohol has escaped from within the fringes, a process helped by leaving the sample in a warm dry place.

If the finished result is completely clear and shows neither scatter nor hologram, then the chances are that the fringe voids or cracks have not formed properly in the alcohol bath by the "Shankoff effect" and the hologram simply needs reprocessing using water at a higher temperature in the first bath. If the hologram is noisy or "milky" then that means that the gelatin has had its yield point exceeded and nothing can be done about the noise except to shoot another plate and process it at say 18°C so that the yield point is not exceeded. Plates which are a month old and have been left at room temperature may need a water temperature of about 35°C. Getting the water temperature just right can produce the most noiseless and bright single-beam holograms you could possibly achieve with anything.

Finished holograms should be thoroughly dried for several hours at around 60°C. Once treated like this, they seem to be able to withstand ambient relative humidity below 85% indefinitely. One should seal them if they are going to be carried around. Otherwise a cold hologram brought into a warm room can create surface moisture and cause the notorious disappearing trick of DCG holograms. (They can be reprocessed in water and alcohol if that happens.) Note that sprays should not generally be used as sealants since they can penetrate into the fringes. Viscous UV curing resin and a glass backing sheet seem to work well.

References

[1] *R Changkakoti., SSC Babu, and SV Pappu,* ***Role of External Electron Donor in Methylene Blue Sensitised Dichromated Gelatin Holograms****, Applied Optics 27, p324 (1988).*

[2] *R Curran and T Shankoff,* ***The Mechanism of Hologram Formation in Dichromated Gelatin****, Applied Optics 9, p1651 (1970).*

Note: The author has made patent applications on the use of guanidine derivatives as electron donors in dye-sensitised recording in DCG.

Acknowledgement: The author wishes to thank George Clare who has made many independent tests of formulations.

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Heat Is On With New Du Pont Photopolymers

E I du Pont de Nemours & Co of the United States has introduced a new photopolymer which, it says, has all the benefits of dichromated gelatin (DCG) with the added advantages of optional dry processing, long shelf-life, wide spectral sensitivity, good photo speed and insensitivity to humidity and temperature after processing.

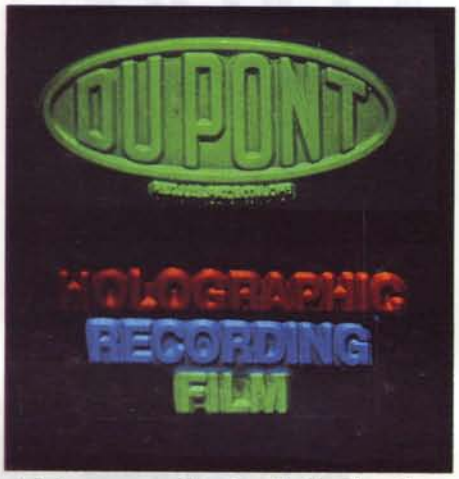
Du Pont researchers unveiled the new materials at the *Holographic Systems, Components and Applications* conference in Bath, Britain, organised by the Institution of Electrical Engineers (IEE) in September. They said they hoped to have their HRF series of photopolymers on sale by the middle of 1990.

In terms of the basic mechanisms, the new photopolymers are similar to Du Pont's earlier materials. Initially the material consists of monomers, which polymerize when exposed to light, thus causing shrinkage. The shrinkage causes monomers which were initially outside the exposed area to diffuse in, and they become polymerized also. The end result is that the polymer is concentrated in the exposed areas and there are gaps left in the unexposed material because of the migration of the monomers.

The difference in polymer density causes the index modulation, which is the recorded hologram. The process of polymerization, shrinkage and migration continues until the gel hardens. At this point the hologram is stable to further exposure. A final blank exposure, over the entire plate, causes any remaining monomers to be polymerized.

One of the advantages of the new photopolymers is that, because heat increases the dispersion of the monomers into exposed regions, the index modulation of the plate can be increased by baking. For example, in the case of HRF-700 film when recording a transmission hologram at 514nm, the index modulation was increased by over 250% to 0.0088 after heating at 100°C for 30 minutes, and the diffraction efficiency was increased from 16% to 77%. Earlier photopolymers usually produced an index modulation of around 0.003.

The new photopolymers are web coated onto a clear solid Mylar film substrate (Du Pont's brand name for its polyethylene terephthalate material), with a removable thin sheet of Mylar on top to protect the tacky photopolymer from dust and handling. Stored in light-tight containers at room temperature, the materials have shown little or no change in performance for up to a year.



A hologram produced with Du Pont's new photopolymers, the HRF series.

Du Pont has so far published experimental results for five compositions, shown in the tables. Although they can be used for recording in both reflection and transmission, some compositions work particularly well in one mode or the other. HRF-150, for example, will give 99% efficient results for a green transmission hologram without any heat processing, but 88.7% for heated reflection.

The mechanism which determines whether a material will work better in reflection or transmission relates to the different fringe spacings in these two types of hologram, the former being considerably longer than the latter. In the case of HRF-150, Du Pont researchers believe that its active element diffusion properties allow the monomers to travel the long distances relating to transmission fringe spacing. In the same way, the reflection films tend to allow diffusion over the shorter distances required for the narrow reflection fringe spacing.

All of the films can be sensitized to include near ultraviolet, blue, green and red wavelengths, or a combination, depending on the dye sensitizer used. The hologram pictured was made using a polymer sensitive to red, blue and green.

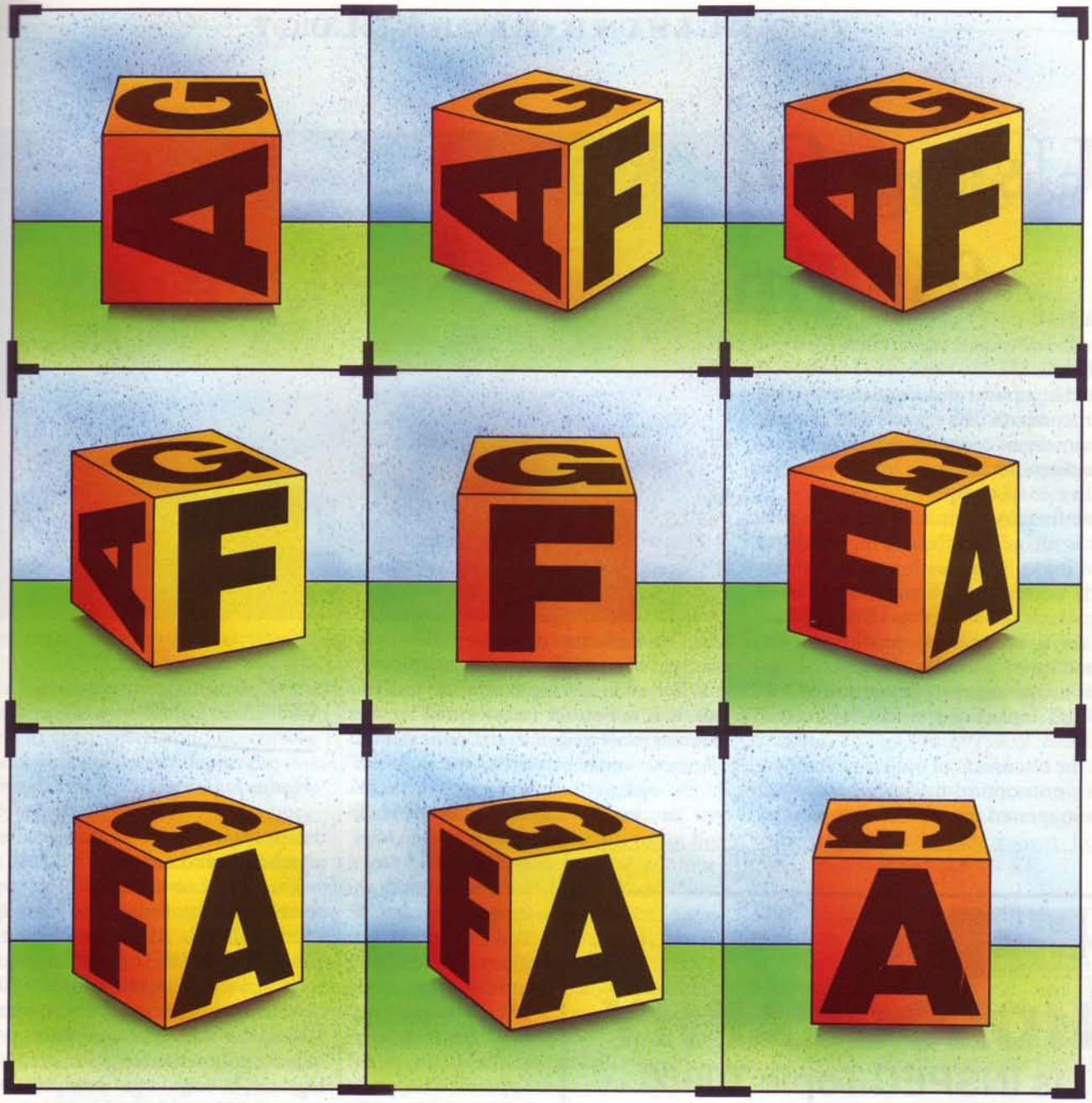
For further information about these materials, please contact Joyce Harkey, EI du Pont de Nemours & Co Inc, Imaging Systems Department, Experimental Station Laboratory, PO Box 80352, Wilmington, DE 19880-0352, USA. Tel: (+1) 302 695 4893. Or see WK Smothers, TJ Trout, AM Weber, and DJ Mickish, *Hologram Recording in Du Pont's New Photopolymer Materials,* IEE Conference Publication Number 311: Proceedings of the Second International Conference on Holographic Systems, Components and Applications, 1989.

Film Type	Film Thickness (microns)	Imaging Wavelength (nm)	Film Speed (mJ/cm^2)	Probe Wavelength (nm)	Diffraction Efficiency (%)	Index Modulation Δn
HRF-150	38	514	100	632.8	99	0.0076
HRF-150	78	514	100	632.8	24 (100 + 76)[b]	0.0066
HRF-700	24	514	80	632.8	16	0.0034
HRF-700	24	514	80	632.8	77[c]	0.0088[c]

Table 1: Transmission hologram recording in HRF films. ([b] Overmodulated. [c] After heat processing at 100°C for 30 minutes.)

Film Type	Film Thickness d (microns)	Imaging Wavelength (nm)	Film Speed (mJ/cm^2)	Playback Wavelength λ_0 (nm)	Reflection Efficiency η (%)	Bandwidth FWHM (nm)	Index Modulation Δn
HRF-150	34	514	60	502	88.7	8	0.008
HRF-352	26	514	20	507	99.98	16	0.030
HRF-352	6.5	514	20	507	70.00	17	0.030
HRF-410	26	633	100	624	99.17	15	0.024
HRF-420	25	550	50	541	99.66	13	0.024
HRF-700	18	514	10	502	>99.99	28	0.068
HRF-700	4.5	514	10	500	91.35	32	0.068

Table 2: Reflection hologram recording in HRF films.



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Using Optical Disk Storage for Image Correlation

Now that optical disks are in everyday use in compact disk players and as optical memory in conventional computers, researchers are looking at its possible uses in optical computing.

One function that such disks can perform is image correlation, ie. matching up an input image with a stored image which corresponds to it. This allows data, which can sometimes become garbled in a computing process, to be cleaned up by checking the garbled signal or image against a set of stored images and replacing it with the correct one.

In the discussion of optical neural networks, non-optical methods have often been suggested to perform this correlation task. However, researchers at the California Institute of Technology (CIT) in the United States have recently described optical image correlators which use Fourier transform (FT) holograms.

The simplest of their systems is the Van der Lugt correlator, shown in figure 1. The images are stored as computer-generated FT holograms (CGHs) on the disk. The photo (opposite) shows an example of a CGH when reconstructed.

When an image is put into the system, half of it is Fourier transformed by the lens and projected onto the optical disk. The input image pattern is superimposed on the disk pattern, and every time the two line up the light is reflected back through the lens and Fourier transformed so that an image appears in the correlation plane. When the input image and reference patterns are the same, a correlation peak appears. This peak is detected by a 2D detection array and the position of the peak identifies the matched stored image.

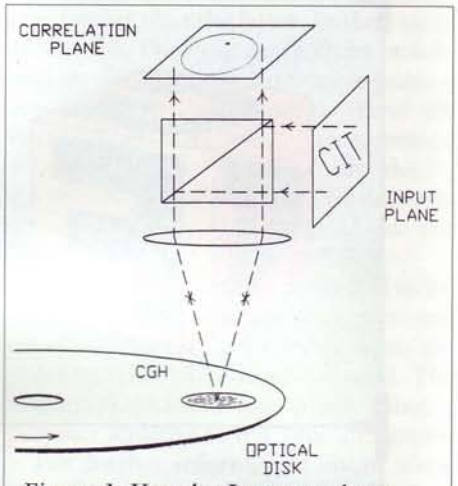


Figure 1: Van der Lugt correlator.

The main advantage of this type of correlator is its potentially high speed. Demetri Psaltis, Mark Neifeld and Alan Yamamura of CIT have calculated that such a system could perform 400 000 correlations per second for an image of 100x100 pixels. However, because of its reliance on computer-generated FT holograms, a very large amount of computer time is needed to record the disks.

Another disadvantage is the import-

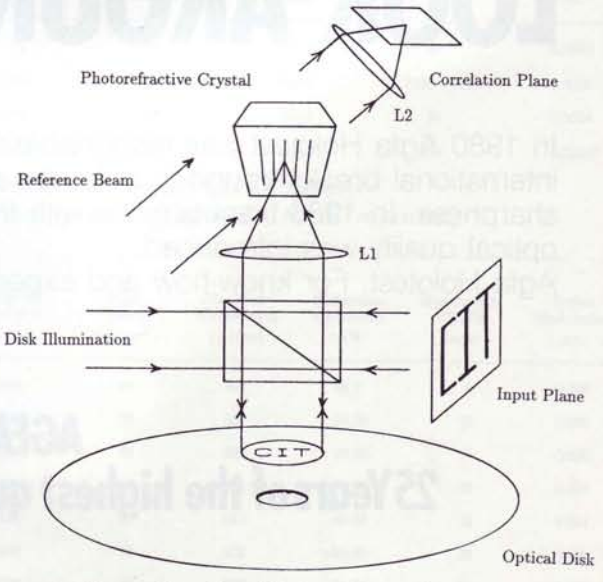
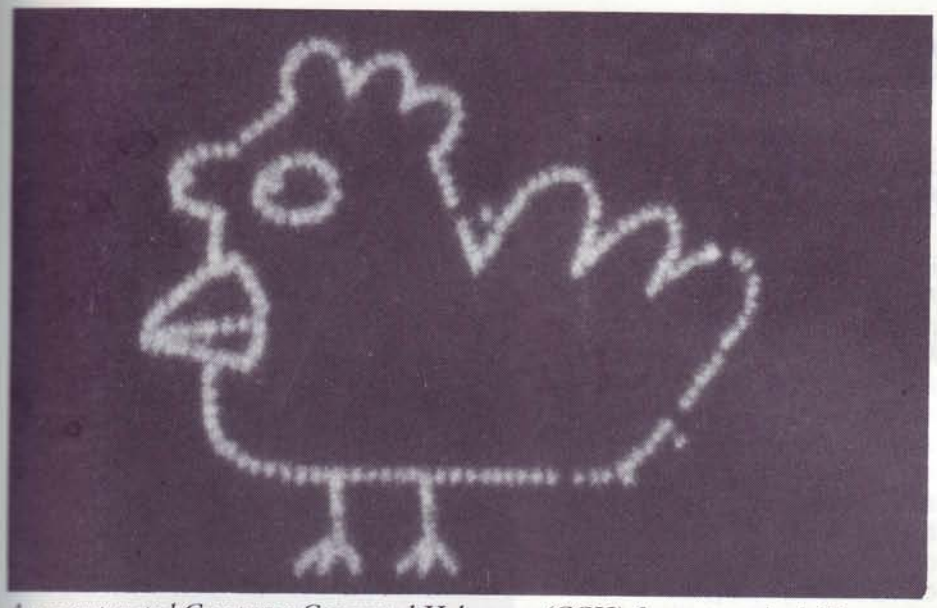


Figure 2: Photorefractive disk-based correlator.



A reconstructed Computer Generated Hologram (CGH) from an optical disk.

ance of the alignment of the disk. As the disk rotates, the positioning of the holograms and their corresponding correlation peaks can be altered due to the disk wobbling or the centre of rotation being slightly off-set. The Sony "write-once, read-many-times" (WORM) disks which the CIT team used allowed up to 1 degree wobble and up to 15 micrometres off-set between the intended and actual axes of rotation of the disks. The alignment of the holograms had to be within 1 micrometre.

The alignment problem can be dealt with by using feedback and compensation methods already used in disk drives, but the computer time required remains a problem with this correlator. However, another system has been developed at CIT which does not need large amounts of computer time because the image itself is stored, not a CGH (see figure 2).

In this system, the input image is first illuminated with the disk information blacked-out. Using a reference beam, a real-time FT hologram is made in a photo-refractive crystal. The input image beam is then cut out and the disk is illuminated so that a second FT hologram is created. The product of the input and reference holograms, which is formed within the crystal, is then inverse transformed to give the correlation output.

If the photo-refractive crystal is replaced by a thin hologram, the output is the exact 2D correlation required. However, because of Bragg selectivity, a thick hologram will only produce a 1D slice of the pattern. In the system shown this is not a problem because, as the disk rotates, all of the slices are obtained in sequence.

The CIT researchers have tested the system using a thin hologram and obtained the correct correlation peak. Though this correlator does not have large computer overheads, the optical alignment of the disk is still critical.

For further information on using holographic memory for optical computing, see Psaltis, Neifeld and Yamamura, "Image correlators using optical memory disks", *Optics Letters* 14, no. 9, p 429, 1 May 1989. Also, "Optical memory disks in optical information processing" by the same authors, submitted for publication to *Applied Optics* for its special issue on optical computing, to be published in January 1990.

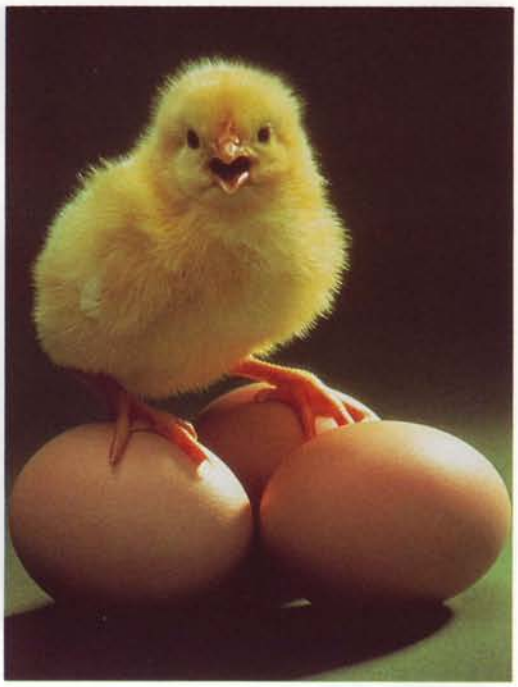
Courses

July 8 and July 15
Lake Forest Holography Workshops I and II. Details from Holography Workshops, Sheridan and College Roads, Lake Forest, IL 60045, USA. Tel: (+1) 312 234 3100.
These workshops, each lasting 1 week, will be the nineteenth in the annual series. Workshop I gives hands-on experience in making basic holograms of various kinds, and Workshop II features advanced techniques with prominent lecturers.

April 7 and June 2
Hands on Holography Basic Courses at Newcastle Polytechnic. Details from Dr AE MacGregor, Physics Department, Newcastle upon Tyne Polytechnic, Ellison Place, Newcastle upon Tyne, NE1 8ST, Britain. Tel: (+44) 091 232 6002 ext 3655.
One-day courses for beginners, covering the fundamentals in a practical way with students producing their own holograms. Fee £70 plus 15% VAT.

April 23-26 and September 3-6
Hands on Holography Advanced Courses at Newcastle Polytechnic (details above).
Four-day courses for people with some prior experience of holography, covering transmission, reflection, rainbow and pseudocolour holograms. Fee £325 plus 15% VAT.

The Secret Life of a Chick



Going cheep: hatching out is hard work.

One frustration for those interested in the behaviour of developing bird embryos is the fact that they can't see through the shell. Recently, researchers at the Swiss Federal Institute of Technology Laboratory of Stress Analysis have developed a technique of recording embryo movement using holographic interferometry which leaves the shell intact.

Previously it had been necessary to cut a window out of the shell in order to see what was going on inside. One method involved cutting the shell above the airspace, leaving the inner membrane intact. This membrane was then painted with warm vaseline to make it transparent. Though this certainly made it possible to see, it disturbed the embryo's behaviour patterns and reduced its chances of surviving to full term.

A second approach involved using a transducer and x-y plotter. Though the shell was left intact, this was only able to map movements during the active and inactive phases of the embryo.

Pramod Rastogi, Leopold Pflug and Raymond Delez of the Swiss Federal Institute of Technology decided to see whether a non-invasive holographic method could provide more information about each embryo movement. A diagram of the pilot set-up for their experiment is shown in figure 1.

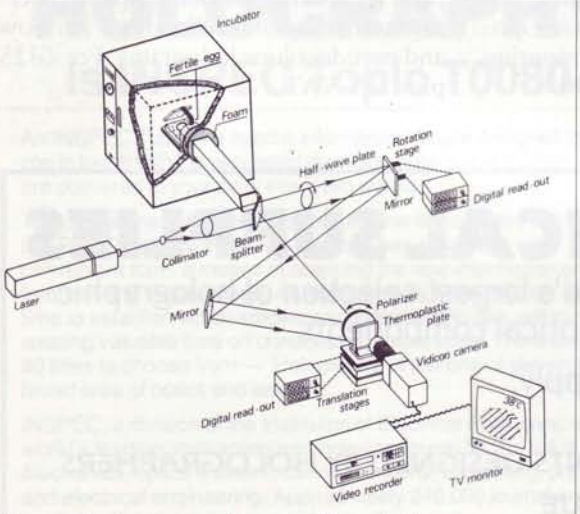


Figure 1: Apparatus for watching chick movements.

The egg to be observed is placed loose on a support filled with sawdust, which is placed inside an incubator thermally isolated form the rest of the set-up. An initial hologram is made and processed in-situ and then left. Live fringes, created by the superposition and interference between the real egg and image egg, are recorded using the video camera.

The activity of the embryo creates instability in the fringes, and the amplitude, duration and periodicity of the fringe movements can be directly interpreted as movement within the shell. Rotatory movement of the embryo is detected by the sudden appearance of a set of parallel rectilinear fringes, with the direction of rotation around the axis along which the fringes are aligned. The amplitude of rotation is directly proportional to the fringe density. Figure 2 shows an interferogram depicting a microrotation of 4.2×10^{-4} radians along an axis joining the sharp and blunt ends of the egg. Often the embryo will twist after a burst of vigorous activity and the rotation fringes can be seen to appear and disappear, corresponding to the chick's to and fro movements.

The holographic method can also detect when a limb is propped up against the shell. These movements cause a microscopic bulge in the shell which the fringes then contour. Figure 3 shows simultaneous movement of two limbs, suggesting coaction.

The most dramatic demonstration of the effectiveness of this method is the clear representation of the final pecking motions of the chick when it is ready to hatch. Stress concentrations caused by the repeated blows of the chick are shown by fringes bunching around the weakened zones of the shell. The chick can be seen pecking at a rate of about 49 blows per minute before microcracks occur and the shell finally breaks. All movements, because they are recorded on video, can be examined and re-examined at leisure.

The eggs incubated by the Swiss group all hatched normally and showed no ill effects during the six weeks they remained at the lab. The team is now looking at other eggs, including those of ducks and especially geese, where the pattern of embryo behaviour is even more important. The intention is to monitor embryo behaviour in response to changes in short-term external conditions such as temperature and radiation.

For more information, see PK Rastogi, L Pflug and R Delez, *Non-invasive observation of embryonic behaviour in chicks using holographic interference*, Applied Optics, vol 28, no 7, April 1989.

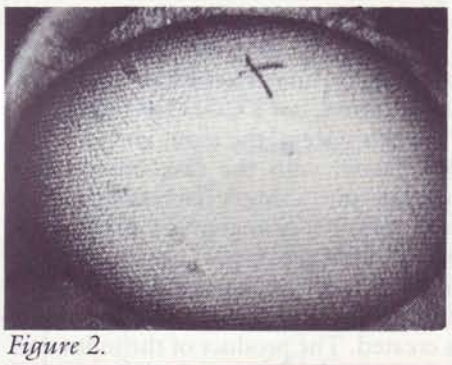


Figure 2.

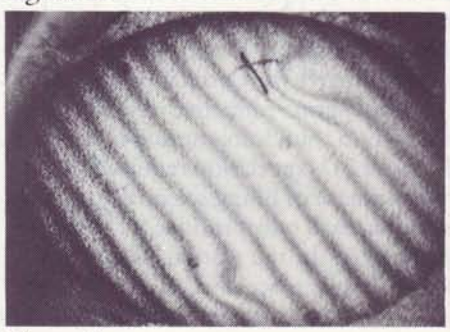


Figure 3.

Matching Indexes Gives Distortion-Free Fish

Using holographic interferometry to test the safety of structures on land is a well known technique. However, it has been a problem to use the same techniques at sea, at least until now. A collaboration in Britain between the Central Electricity Generating Board (CEGB) and Aberdeen University has lead to the development of a very simple means of using underwater holography to good effect.

The benefits of using interferometry for stress analysis are obvious. With the safety of off-shore drilling stations being critical, any means of gaining extra information about, say, the stress on one of the platform legs is more than welcome. The problem has been that though it is fairly straightforward to record a hologram in a medium other than air, the change in refractive index when the finished hologram is viewed in air distorts the image, just as one sees image distortion when looking into a swimming pool from outside.

If a hologram is made with a laser beam with wavelength λ_A in air, $v_A=f\lambda_A$ (f=frequency, v=speed of light through the medium). In a medium with a higher refractive index than air the light will be slowed down, but the frequency, because it is determined by the light source, will remain the same. This means the wavelength will become shorter. Because $v_A/v_W = n_A/n_W$, the hologram will appear to have been made in $\lambda_W = \lambda_A n_A/n_W$.

Underwater holography is obviously inherently unstable, so a pulse ruby laser with a short (30ns) pulse of high energy would be needed for a successful exposure. This would make λ_A=694.3nm. If the refractive index of water at 20°C is taken as 1.3304, then the appropriate construction wavelength, if n_A is taken as 1, is 521.9nm. Using the 514nm line from an argon ion laser should therefore replay an image which is as distortion free as would be needed in all but the most accurate work.

This method of working requires only that the emulsion thickness is small enough so that the Bragg condition is *not* satisfied. This will lessen the image brightness but should give virtually aberration free results.

Another problem with underwater holography would seem to be that, unless you surround the camera with air and some transparent medium like glass, its insides will get wet. If the camera does look through an air/glass window, however, some distortions will be created by the difference in the refractive index between the air, the glass and the water. In their paper, *Reduction of Aberrations in Underwater Holograms*, IA Armour of the CEGB, and JM Kilpatrick and J Watson of the University of Aberdeen, go on to explain that this problem too can be easily overcome.

By choosing the correct ratio between the distances the light has to travel through the air and through the glass, d_A/d_G (equals $\{n_G^2-n_W^2\}/\{n_W^2-1)n_G^3$, where d_A and d_G are the distances through air and glass respectively and n_G and n_W are the refractive indexes of glass and water), the aberrations caused by these two media will cancel each other out. This happens because air has a lower, and glass a higher, refractive index than water. To carry out this technique, the distances that the light has to travel through the air and glass should be small, and the glass window should be parallel to the holographic plate.

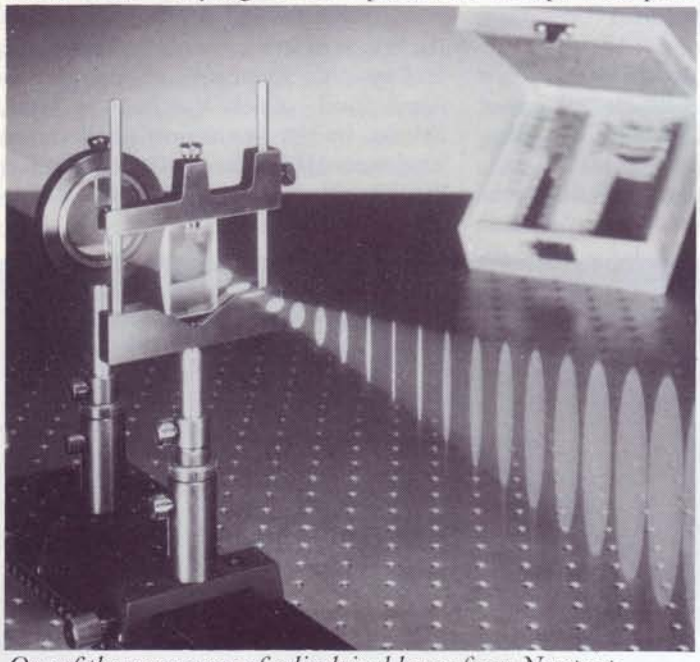
Armour, Kilpatrick and Watson's paper can be found in the proceedings of the Second International Conference on Holographic Systems, Components and Applications which was held in Bath, Britain, by the Institution of Electrical Engineers (IEE), Savoy Place, London WC2R 0BL. Tel: (+44) 01 240 1871.

Underwater holography in action: the distortion caused by the different refractive indexes of air, glass and water can be overcome.

New Ranges From Newport

Newport Corporation of the United States has recently introduced several new ranges of optical equipment, including kits containing cylindrical lenses and mounts, *Optisets* containing a variety of components, and an optical components kit which the company says is ideal for a teaching laboratory.

The new cylindrical lenses (pictured) come in standard sizes with varying focal lengths, so reducing the number of mount sizes needed. Made of grade A, BK7 glass, the lenses can be bought with a reflective mirror coating or an anti-reflection coating which reduces reflection to less than 0.25%. Marked on each lens are numbers referring to the focal length and, as with many Newport kits, a part number which is also recorded on the hardwood case the equipment is supplied in.



One of the new range of cylindrical lenses from Newport.

Optisets consist of mirrors, filters, lenses, beamsplitters and microscope objectives which are held on their edges in foam-surrounded wooden trays inside a protective case. There is extra space inside the case for other components to be stored safely.

Newport has also launched the MK-2 Components Kit, which contains an assortment of their most popular standard and mini-series positioning and fixturing equipment. Among the 82 items included are kinematic mirror mounts, universal bases, a rotatable platform, clamps and post holders. All are professional-quality components which Newport says will stand up to years of use. With the addition of a laser, simple optics, and a breadboard or table, the kit contains enough equipment to construct interferometers, collimators, telescopes and microscopes.

Newport Corporation is at 18235 Mount Baldy Circle, PO Box 8020, Fountain Valley, CA 92728, USA. Tel: (+1) 714 963 9811. Or contact Newport Ltd at Pembroke House, Thompsons Close, Harpenden, Herts AL5 4ES, Britain. Tel: (+44) 05827 62655.

Laser Power Monitor Avoids Interference

Laser Instrumentation of Britain has just introduced a new laser power and energy monitor which, the company says, combines very high immunity from laser power supply interference with very high accuracy at low cost.

The 9000 Series has full scale measurement ranges of 30 µW to 1 kW and 3 mJ to 100 J. Once in service, the system can be re-programmed, allowing new requirements to be met without the need to buy a new monitor.

The monitor has a 1 second response time and 1% accuracy, and comes with either a moving coil or LCD display. It runs from a battery with a life expectancy in excess of 1000 hours, and a mains power supply is also available.

Laser Instrumentation Ltd is at The Forge, The Street, Binsted, Alton, Hampshire GU34 4PB, Britain. Tel: (+44) 0420 22464.

Fringe Stabilization System Enters New Generation

MEI of the United States has just released the second generation of its fringe stabilization system, known as the Stabilock II.

President Jeff Brown says that the new system will greatly improve fringe stabilization in holographic set-ups because it incorporates an ultra low noise detector and pre-amp to eliminate the 60Hz jitter common to existing first generation equipment.

Among other features, the new model stabilizes long term drift and adjusts for vibrations from DC-500 Hz. It has differential sensors, graph displays for detectable signal and mirror position, and adjustable mirror position. The dynamic range is 100 to 1 and the typical fringe stability is the wavelength/20.

The standard price of the Stabilock II is US$950. MEI can be contacted at 270 North 400 West, Hyrum, UT 84319, United States. Tel: (+1) 801 245 6911.

Spin-Coated Plates Have Improved Sub-Layer

Towne Laboratories Inc of New Jersey, USA, is offering spin-coated photoresist plates of up to 45x45cm which contain a sub-layer which it says not only absorbs up to 75% of backscattered light but also enhances the adhesion of the resist during electro-plating.

The plates, coated with striation free S-1400-30 photoresist, contain an iron-oxide (Ferroxoplate) layer which acts as an efficient absorber. The plates can be dip-coated in larger sizes and Towne says they are virtually pinhole free. Polished on both sides, the substrates are optical grade soda-lime float glass, in a range of thicknesses. Coating thickness is up to 2.5 microns +/-10%.

Towne can be contacted at PO Box 460, One US Highway 206, Somerville, NJ 08876, United States. Tel: (+1) 201 722 9500.

Patents, Please

All the patents shown here are assumed to be written in English. The format is as follows: (Country code) (Date: DD-MM-YY) #(Patent Number), (Authors/Company), *(Title)*. Country codes are as follows: AU, Australia; EP, European Patent; GB, Great Britain; NZ, New Zealand; SU, USSR; US, USA. These refer to the jurisdiction for which the patent was applied. The date given is that on which the patent was *published*, not submitted. Papers run from 23-05-89 to 27-09-89 where data was available.

- AU 15-06-89 #585201, Karl Rubenberger, ***Producing and Reproducing Holograms.***
- AU 20-07-89 #28477/89, EI Du Pont de Nemours & Company, ***Process of Forming Reflection Holograms in Polymerizable Layers.***
- AU 17-08-89 #29859/89, American Bank Note Holographics Inc, ***Non-continuous Holograms, Methods of Making them and Articles Incorporating Them.***
- AU 17-08-89 #28379/89, Ciba-Geigy Acti Engesellschaft, ***Contact Copying of Reflection or Volume Holograms.***
- AU 07-09-89 #31028/89, Ciba-Geigy AG, ***Method of Preparing a Hologram.***
- EP 31-05-89 #318148, International Business Machine Corporation, ***Holographic Recording in Photorefractive Crystals.***
- EP 07-06-89 #152113, Kabushiki Kaisha Toshiba, ***Ultrasonic Diagnostic Equipment.***
- EP 14-06-89 #101507, University of Dayton, ***Holographic Optical Processing Method and Apparatus.***
- EP 19-07-89 #324496, Yeda Research and Development Company Ltd, ***Method of Producing Holograms Particularly for Holographic Helmet Displays.***
- EP 19-07-89 #210926, Farrand Optical Co Inc, ***Infra-red Laser Shield.***
- EP 02-08-89 #244357, Ciba-Geigy AG, ***Black-backed Holograms.***
- EP 02-08-89 #272218, Ciba-Geigy AG, ***Method of Preparing a Hologram.***
- EP 02-08-89 #272219, Ciba-Geigy AG, ***Method of Preparing a Hologram.***
- EP 02-08-89 #207156, Hughes Aircraft Company, ***Side Lobe Suppression in Holograms.***
- EP 09-08-89 #225852, Ciba-Geigy AG, ***Processing Holograms.***
- EP 09-08-89 #225853, Ciba-Geigy AG, ***Holograms.***
- EP 09-08-89 #226542, Ciba-Geigy AG, ***Holograms.***
- EP 09-08-89 #230208, Ciba-Geigy AG, ***Processing Holograms.***
- EP 13-09-89 #207992, Hughes Aircraft Company, ***Flare Reduction in Holograms.***
- EP 20-09-89 #333644, Ilford Ltd, ***Contact Copying of Reflection or Volume Holograms.***
- GB 05-07-89 #2176628, Gillian Margaret Davis, Ian Norman Ross, ***Method and Apparatus for the Production of High Resolution Images.***
- GB 05-07-89 #2211646, Yazaki Corporation, ***Holographic Multi-Display Apparatus.***
- GB 12-07-89 #2211957, The General Electric Company Plc, ***Holographic Projection Printing.***
- GB 02-08-89 #2212935, Leningradsky Institut Yadernoi Fiziki Imeni B P Konstantinova Akademi i Nauk SSSR, ***Holographic Diffraction Grating.***
- GB 02-08-89 #2212964, Yazaki Corporation, ***Holographic Multi-Display Apparatus.***
- GB 09-08-89 #2178191, STC Plc, ***Dynamic Hologram Recording.***
- GB 06-09-89 #2214651, STC Plc, ***Holograms.***
- GB 13-09-89 #2215078, English Electrical Valve Company Ltd, ***Apparatus for Producing Holograms.***
- GB 20-09-89 #2215484, Holtronic Technologies Ltd, ***Improvements in the Manufacture of Integrated Circuits using Holographic Techniques.***
- NZ 27-09-89 #220026. The British Petroleum Co Plc, ***Phase Conjugate Mirror of Poly Acetylene.***
- SU 23-05-89 #1428060, Yaroslavskij G Pedagogicheski J I IM.K.D.Ushinscogo, ***Apparatus for Recording Holograms.***
- SU 15-08-89 #1187140, Inst Fiz an USSR, ***Method of Recording IR-Holograms.***
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- SU 15-08-89 #1500965, Grodnenskij G Universitet, ***Method of Generating Fringe Pattern.***
- US 23-05-89 #4832424, Stephen P McGrew, ***White Light Viewable, Cylindrical Holograms and Method of Spatially Filtering Wavefronts.***
- US 23-05-89 #4832426, Zumbach Electronic AG, ***Process for the Production of a Telecentric Light Beam, Device for carrying out this Process and Process for the Production of an HOE.***
- US 23-05-89 #483427, Nippon Denso Co Ltd, ***Holographic Display System.***
- US 23-05-89 #4832445, American Banknote Holographics Inc, ***Security Diffraction Devices Difficult to Duplicate.***
- US 30-05-89 #4834475, Anthony J Robinson, ***Holographic Analogue Indicating Means.***
- US 30-05-89 #4834476, Massachusetts Institute of Technology, ***Real Image Holographic Stereograms.***
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- US 06-06-89 #4837425, The General Electric Company Plc, ***Security Arrangement.***
- US 13-06-89 #4839250, Polaroid Corporation, Patent Department, ***Method of Replicating Volume Phase Reflection Holograms.***
- US 20-06-89 #4840444, Brian Hewitt, ***Composite Holographic Elements.***
- US 27-06-89 #4842353, Instruments SA, ***Diffraction Apparatus with Correcting Grating and Method of Making.***
- US 27-06-89 #4842968, Sony Corporation, ***Hologram Recording Medium.***
- US 25-07-89 #4850662, Saginaw Valley State University, ***HOE and Indirect Method of Constructing Same.***
- US 01-08-89 #4853306, Hughes Aircraft Company, ***Method and Apparatus for Dehydrating Dichromated Gelatin Holograms.***
- US 15-08-89 #4857425, Holtronic Technologies Ltd, ***Manufacture of Integrated Circuits using Holographic Techniques.***
- US 22-08-89 #4859548, Gerhard Heise, Ulrich Wolff, Richard Matz, ***Method for Generating a Lattice Structure with a Phase Shift on the Surface of a Substrate.***

Next Issue

Holographics International is always glad to receive news about exhibitions, technical developments, new products, courses, etc. The deadline for publication in the next issue is **March 2 1990**. Please include photographs if possible, black and white prints or colour slides. We also welcome longer articles, please contact us first to discuss your ideas.

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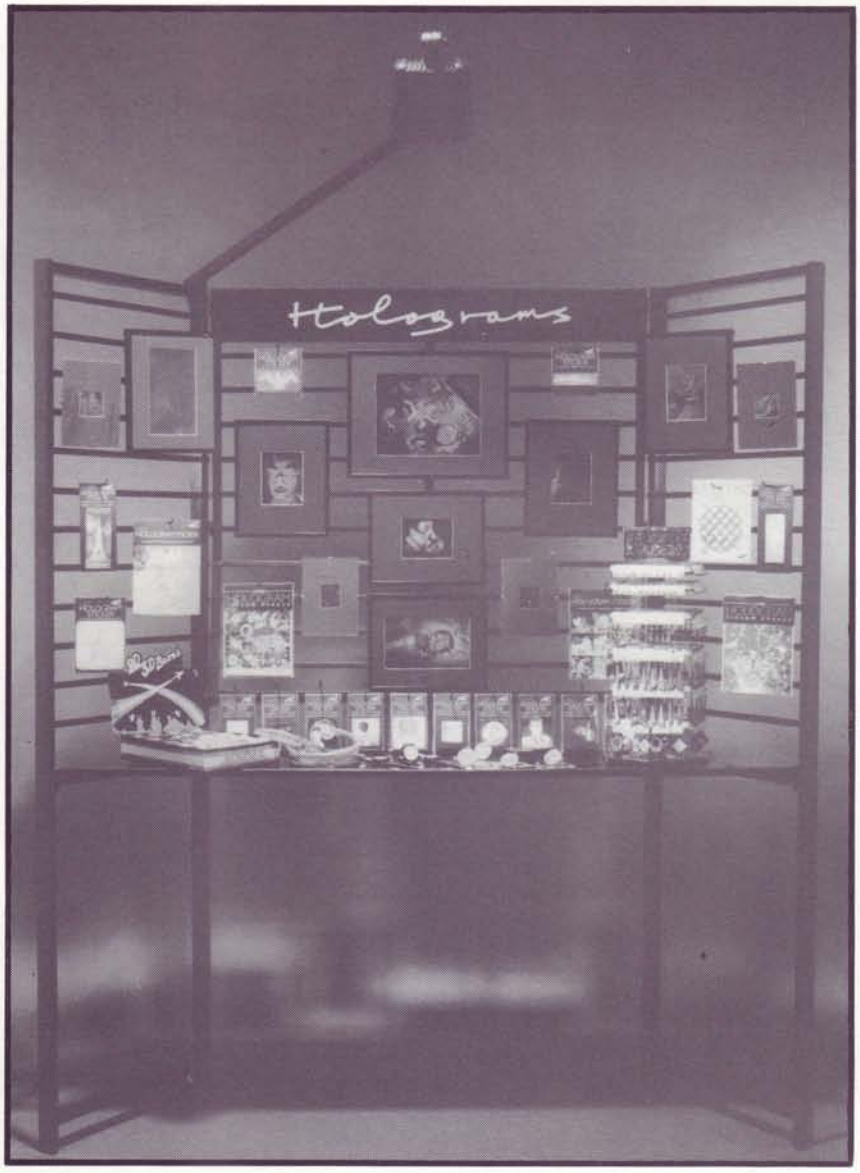

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