

The Royal Photographic Society

HOLOGRAPHY GROUP

Newsletter March 1998

Hologram kindly donated by Chris Levine/iC

Editorial

To use a well-worn (though here appropriate) cliché, there is at last light at the end of the tunnel. Several companies have moved in to fill the gap left by the disappearance of Agfa holographic materials. Plates and films are now available in all spectral sensitivities, and the good news is that they are far more noise-free than the previous generation of materials. The bad news is that the price has had to go up again because of small production quantities, packing and shipping costs - then there is VAT; but Agfa themselves always claimed to be losing money over their holographic material. Details of the available materials are given in this Newsletter. Amanda Ranalli, late of Duncan Croucher's (also late) holographic sales staff, is in the process of setting up an agency for the UK for all holographic materials. She has circulated a letter to a number of practising holographers, and a copy of her letter is reprinted here, with an update. If any of you can offer help or advice, please get in touch with Amanda.

Another piece of good news is that Dr. Hans Bjelkhagen, who recently gave up his business interests in the USA, is now working with Nick Phillips's research group at De Montfort University, Leicester. As you probably know, Hans is the author of the standard work on holographic processing chemistry. He is also one of the foremost practitioners of natural-colour holography using three laser wavelengths. He is now a member of the RPS, and has joined the Holography Group. He has offered to address a Group meeting in the near future on the subject of his latest research, Lippmann photography: no doubt this subject will also be of interest to many members of the Historical and Imaging Science Groups. We'll tell you more when the date is fixed. Before that, though, Hans will be taking the chair at our forthcoming one-day symposium postponed from last October and now due to be held on Saturday 30 May in Imperial College, London.

Speaking of the symposium, we still have room for more papers, so if you have something to offer on any subject related to holography and/or three-dimensional (including computer-based) imaging, and would like to have your fifteen minutes of fame, contact Kevin Brown on 0171 610 1078.

By the way, there is a completely new set of holograms in the permanent holographic exhibition on the first floor of the Octagon in Bath, and a new catalogue available to all visitors. We offer our thanks to Bob and Molly Gibson and Jonathan Ross, who undertook the installation of the exhibits.

I wish all our readers a (somewhat belated) Happy New Year, in the confidence that holography will once more be on the upturn in 1998.

Graham Saxby

Out and about

Committee member Joyce Peck is taking part in a multi-media exhibition bringing together fourteen artists of disparate disciplines and philosophies at a number of venues around London. Joyce's installation will be showing at the Quaker Gallery, St Martins Lane from 22-28 June 1998. It incorporates diffracted laser light playing on crystals, prisms and a hologram within a glass tank. There is to be a private viewing on Tuesday 23 June from 6 – 9 pm. All Group members are invited.

John Gates has sent us a copy of his paper 'Reviewing the promises of research and development in optics', to appear in the April 1998 issue of '*Photogrammetric Record*'. A summary of John's conclusions will appear in the next Newsletter.

Andy Pepper recently held an exhibition of his recent holographic work at Coventry University. He seems to have taken some undeserved stick over the distribution of free Agfa film bought by the Shearwater Foundation, an American charity that offers grants to holographic artists. The Foundation bought \$50 000 worth of film, Agfa's last stocks. It sounds a hell of a lot, but in fact amounted to only 67 boxes. So 67 artists received one box each. As more than 200 people applied for the free film, more than 133 were disappointed. So if you were one of the latter, don't blame Andy – he had only half the film, to be distributed throughout Europe (Tung Jeong had the other half for the USA and Far East).

The latest issue of *Interferenzen* covers the 1997 Lake Forest conference in some detail, at least as far as the fine-art side is concerned. *Interferenzen* is a bilingual magazine published by the Deutsche Gesellschaft für Holographie e.V. (German Holographic Society). The address is c/o N.Moller, Marienstrasse 28, D-06108 Halle (Saale), Germany. tel 49 345 202 6751. Membership (including magazine) is DM30 (Euro 18) per annum. The German version is stylish, but the English translations are sometimes hilarious. For example: 'By using the Kodak D19 developer holograms have a slight light intensity, well founded on the high portion of sodium sulphide [sic]. Sodium sulphide saves the developer for... oxidation but touches the emulsion.' However, one mustn't be unfair. Roughly half the articles are written in English to start with; and the magazine is crammed with information about what is going on in the world of display holography.

Please let us know of any events in your area, or any news relevant to holography that we can put in this column.

Department of partly-baked ideas

This reminiscence from the Winter 1984 *holosphere* is particularly apt in view of Hans Bjelkhagen's defection to the Old World, as it concerns both colour holography and Lippmann photography.

It is possible (I wrote) to produce any colour by a suitable mixture of red, green and blue light (colour TV does it this way). The trouble with a similar technique for holograms, using red, green and blue laser light, is that you are using single wavelengths, whereas most objects show their colour by reflecting a broad band of wavelengths. With just the three wavelengths the colours would often be noticeably falsified. Using, say, a krypton laser, you could record up to five strong lines (the Kiev Museum has done so); but each successive exposure on the same emulsion weakens the image contrast. In the extreme, you could produce an image in absolutely true colours by exposing the emulsion to coherent light from a tunable laser, in a spectral *portamento*, but the image would then be degraded to the point of invisibility!

But would it be? In the last decade of the nineteenth century Gabriel Lippmann did something very similar, though his aim was a colour photograph rather than a hologram. His photographic plate was backed by a mirror, so that light passing through the emulsion was reflected back to form standing waves. On development of the plate these produced sheets of metallic silver parallel to the plate's surface, separated by one half-wavelength of the hue being recorded at each point in the image. But how does a broad band of spectral light form a viable set of interference planes? One of the simplest answers is that some of the interference is suppressed by the overall thickness of the emulsion, which allows only a limited set of resonances – but there is more to it than that, and this forms part of Hans's research project.

The same issue of *holosphere* records 'How We made a Hologram of the Albert Memorial'. The Royal College of Art was currently holding an exhibition in honour of Prince Albert, and one of its star exhibits was the architect's original model of the Albert Memorial, a marvellous creation in silver, gilt and enamel. Martin Richardson, Kevin Brown, Michael Langford and I shot a single-beam reflection hologram of this object, at dead of night without any stabilisation, using a borrowed 25 mW laser on a camera tripod at the top of a short flight of stairs, watched by a very apprehensive Palace official. We processed the plates in the ladies' loo, and by the third plate got a reasonable image. But the Palace was not much impressed, and our plans to make holographic portraits of the Royal Family evaporated. What it did prove was that you don't need a stable platform to make Denisyuk holograms, as long as the subject matter and the emulsion are well coupled. A footnote to this article reads 'Flushed with success. the team is now ready to begin negotiating to make a hologram of the

Statue of Liberty.' As you know, somebody eventually did just that, but not by the Denisyuk technique!

In the following issue the DPBI tackled the subject of sonic holograms. Because sound waves interfere in the same way as light waves you can produce a similar sort of interference pattern in space, using ultrasound, as with a conventional hologram using a laser. Ultrasound doesn't travel far in air, so you have to do the operation under water, and because sound travels so fast in water the wavelength is more than 100 times that of light. So though it is possible in theory to reconstruct an acoustic hologram using visible light, in practice the mismatch results in a huge depth error, so that you have to view the image through a telescope to get it back into normal perspective.

The DPBI suggested generating a phase diffraction grating in air instead, using two synchronised transducers facing each other to form standing waves of alternately compressed and rarefied air. This could be used in laser displays, with pairs of transducers in the X and Y directions. By frequency-modulating the vibrations using a suitable computer program a hologram could be written into the airspace between the transducers. This would produce an image when transilluminated by a laser beam.

This suggestion proved to be prophetic. When Stephen Benton's team developed their holographic video system they used an acousto-optic modulator (AOM) for reconstruction. Rather than air, this device uses an optically-active crystal as the grating-generating medium. This system managed with only a single transducer, with the travelling waves generated being followed by a synchronised laser beam. As there was to be no vertical parallax there was no need for a Y-direction transducer.

Graham Saxby

And now ... the good news!

In the last Newsletter we intimated that several companies were gearing up to fill the breach left by the cessation of Agfa's supplies of holographic material. Richard Birenheide is now trading under the company name of Holographic Recording Technologies GmbH, or HRT for short. The address is Am Steinbach 19, 36396 Steinau, Germany, tel 49-6663-7668, fax 7463. He produces plates from 2.5 in sq to 50 X 60 cm. Small plates are in packets of 20, medium size in 10s, and the largest in 2s @ DM420 per pair including packing but ex VAT. They are available in either blue/green (BB-520) or red (BB-640). Richard says he is almost ready to put a ruby pulse emulsion on the market.

The Slavich material is now freely available from the General Optics Laboratory (GEOLA), PO Box 343, Vilnius 2006, Lithuania, tel 370 2 232 737, fax 838. They supply backed and unbacked green- and red-sensitive plates and unbacked triacetate-based film for transmission masters, ultrafine-grain red-sensitive and panchromatic plates and film for reflection transfers and recording, and DCG plates ready for exposure. Plate sizes go up to 30 X 40 cm and film is in 115 cm wide rolls. GEOLA also supply optical components for holography, lasers (including green pulse lasers), complete holography set-ups, customer training and studio hire facilities. All prices are in American dollars.

Now, you can deal directly with either of these companies (both have speakers of good English), but the currency business can be a bit of a hassle (roll on the euro!). However, Amanda Ranalli is in the process of setting up a UK franchise for both firms, and any others who may be interested in a UK market (yes, there are several others). Amanda has sent a letter to a number of professional holographers concerning this: her letter is reprinted below, with a brief update.

Holography – the hybrid has-been?

Since Agfa-Gevaert have ceased to manufacture holographic products I have become aware of the current dilemma threatening holographers using silver halide plates and film in the UK and elsewhere. The higher cost of the new photopolymer products and the more powerful equipment required to produce images will incur virtually prohibitive expense to most holographers obliged to replace their existing equipment, which is already tied up in investment capital. The effects will be damaging in all areas of the application of this hybrid – science, industrial non-destructive testing, security, teaching, research, archiving, commercial, leisure and fine arts. Therefore, I have been sourcing alternative suppliers of silver halide materials with a view to importing them into the UK. The holographic importing company will trade as Holographic Materials Distributors (HMD).

The intention is to supply holographers using small quantities of materials. Enabling them to purchase as and when required removes the problem of storage and reduces their capital investment tied up in stock. The onus of importing and distribution is borne by HMD and the buyer deals direct with the UK office for orders, enquiries and customer service. HMD would also supply to the period (annual/half-year/quarter) buyer where larger quantities are required.

However, as I am obviously intending this venture to be a business, before committing any capital investment I need to know the

immediate market requirement and any potential growth estimated for the next two years.

If you could contribute any volume/annual consumption figures, information regarding products currently used or comments, it would be very much appreciated and, I think you will agree, in all our interests.

Please communicate via the address, telephone or fax below. Thank you; I look forward to hearing from you.

Amanda Ranalli

38 Arlington Road, Southgate, London N14 5AS.

Tel 0181 368 6425

Fax 0181 361 8761.

Amanda adds (3 March):

HND will be fully operational as a distributor of holographic silver halide plates and film as from the latter half of this year. Full technical specifications of the products and associated chemistry will be available in May 1998. At that time details regarding price structures, terms and conditions of business, order procedures, delivery lead times, etc. will also be confirmed. In the meantime any urgent enquiries should be directed to the address or phone/fax numbers above.

Note: Amanda will be speaking on the subject at the symposium on 30 May, so if you want to know the latest, make sure you don't miss it!

Dichromated gelatin for holograms

If you treat a colloid with a dichromate solution it becomes insoluble in water if exposed to short-wave light. This is the basis of the so-called gum-bichromate process, used for over a hundred years for making photographic prints and slides of rare delicacy of tone by incorporating pigment in the colloid coating. Without the pigment this process can be used to make excellent holograms of very high brightness and clarity. We use gelatin rather than gum, as it is much tougher after processing. The emulsion is cheap, and you can make it yourself. It is much less sensitive to light than silver halide (it needs about 100 times the exposure), but Jeff Blyth has found a way of sensitising it to red, so you can use it with a 5 mW HeNe laser, provided you are prepared to give 5 min exposure to a 5 cm disc. The following formulation is Jeff's own.

Stock solution A

1,1,3,3-tetramethylguanidine (TMG) 25 cm³
Water to make 100 cm³

Stock solution B

TMG (stock solution A) 50 cm³
Water to make 100 cm³

Add very slowly, with stirring,
Acetic acid, glacial (about) 16 cm³
until the pH of the solution is between 7 & 8.

If the pH falls below 7 add a little of stock solution A to bring it above 7 again.
Test the solution with a pH meter or with a narrow-range test paper (pH 7.0 – 8.0).

Note: Prepare this solution in a well-ventilated area!

Stock solution C

Potassium chromate (K₂CrO₄) 5 g
Water to make 100 cm³

Stock solution D

Methylene blue 0.4 g
Water to make 100 cm³

Stock solution E

Gelatin 75 g
Water to make 500 cm³

The best gelatin is limed ossein, Bloom strength 260, though cooking gelatin will do. Heat the gelatin and water to 50°C in a water bath until dissolved (about half an hour). Then take 80 cm³ and add 10 cm³ of stock solution B and 1 cm³ of stock solution C. Now add stock solution A drop by drop, with constant stirring, until the pH is between 9.0 and 9.5; use a pH meter or a narrow-range test paper (pH 8.5 – 9.5). Keep the solution at 50°C.

Remove the solution to a darkroom, and, in a fairly dim green light, add

Stock solution D 6 cm³

Store in a dark container in a cool place (don't freeze). The material will keep for several weeks. Before use liquefy it by immersing the container in a hot water bath.

Coating plates

Large plates have to be coated using a whirler, or a Meyer bar (a steel bar wound with wire) drawn across the surface. Anything under 4 X 5 in is easily coated by pouring. Work under a green safelight and keep the solution at 40 – 45°C in a beaker, standing in hot water. Take a warmed glass plate, hold it almost upright in a plastic tray, and pour a steady stream of solution along the top of the plate, so that it runs down the plate. Allow it to drain for a minute or so, then take the gelatin bead off the lower edge with a matchstick and return the surplus fluid to the beaker. Leave the plates to dry in the dark for at least three hours, and if possible, wait at least 24 hours before using them.

Exposing and processing

As suggested above, the exposure on a 2 in square plate with a 5 mW laser will be about 5 min. With a 4 X 5 in plate and a 15 mW laser the exposure will be 8 – 9 min. The sensitivity of the material is about 5 - 7 mJ/cm³ (Agfa film was about 70 mJ/cm^3). After exposing, leave the plate for about 5 min. Then immerse it in a 1% solution of sodium dithionite ($\text{Na}_2\text{S}_2\text{O}_2$) at about 20°C for 2 min to remove the dye and residual chromate. (Have the extractor fan on!) Rinse in running water, and immerse in plain water at about 25°C for 1 min, then in 90% propan-2-ol (isopropyl alcohol) at 20°C for 2 min, with agitation. Finally, transfer the plate to a bath of 100% propan-2-ol at 20°C for 5 – 10 min, with occasional agitation. Blow-dry with a hair-drier set to 'medium'. Finally, leave the hologram in a warm oven (70°C) for several hours to stabilise the emulsion.

DCG material is very sensitive to atmospheric moisture, so you need to seal the hologram with a cover glass using optical-quality UV-curing cement. Pour an elongated puddle of the cement on the hologram and squash down the cover glass, squeezing out any bubbles. Cure the cement by exposure to sunlight or a UV lamp.

Owing to the long exposures required, DCG holograms are best made as single-beam reflection holograms with the subject matter in close contact with the plate. They look particularly good lying on a coffee table with an overhead spotlight.

You can get all the necessary chemicals from Rayco Chemical Co., 199 King St, Hoyland, Barnsley, West Yorks, tel 01722 327242, fax 412322.

Preventing oxidation in developers during storage

Photographic developers and fine wines have one thing in common; they are both ruined by oxidation if a partly used bottle is stored for more than a couple of days. I solved the wine preservation problem a long time ago by using vacu-vin® stoppers which allow you to pump air out of the bottle to create a partial vacuum and slow down the rate of oxidation. Although I was impressed by the effectiveness of these vacuum stoppers in preventing my wine from going off, it took me some time to realise that I could use the same technique to preserve my developer. Like many photographers, I use one litre of developer in a 10 X 12 dish to process 8 X 10 prints and I use the same arrangement to handle my holographic plates as there's just enough room to get my fingers (I use gloved hands) round the plate to lift it out of the dish. I had noticed that wine was available in corked one-litre bottles and thought that these bottles would make ideal containers for my developers, once I had consumed the wine. Extensive field trials showed that some of the wines that are packaged in this way are quite palatable. There is no doubt that this is a superior method for preserving developer during storage in the bottle and even bottles that are not completely full keep for a long time. It seems strange that there has been no mention of this technique in the photographic press although some of my holographic colleagues were not aware of problems with half-empty wine bottles!

Whilst preparing this article for the Newsletter, I thought that I ought to include some quantitative data, so I decided to measure the vacuum that could be obtained using the vacu-vin® pump and stopper. I did not have a vacuum gauge, so I decided to fit the stopper into the end of a long transparent plastic tube and, standing on the roof of my house, use the pump to suck water up the tube from a bucket at ground-level. I was surprised to find that I was able to raise the column of water to a height of twenty-eight feet before the tube collapsed.

I have noticed that many wines are now available in 1.5 litre bottles and I intend to start more field trials in the near future.

Bob Gibson

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