The Royal Photographic Society

HOLOGRAPHY GROUP

Newsletter November 2004

Editorial

The big news this time is the holographic portrait of the Queen on display at Buckingham Palace. Plenty of important people have had holographic portraits made, including the late Ronald Reagan, but this is the first royal one. It is a stereogram, larger than life size, illuminated from behind by a vertical line of blue LEDs. It was commissioned by the Jersey Heritage Trust as part of the celebrations of the island's 800 years of allegiance to the English Crown.

The job went, more or less by default, to Chris Levine (professional holographers are thin on the ground in the Channel Islands), who understandably went to the experts, Rob Munday and Jeff Robb of Spatial Imaging, for the realisation of the project. Rob undertook the development of a new and greatly improved 2.5 m linear-rail digital camera system shooting the images at 30 frames per second with the camera rotating to point towards the subject, and with new software to correct keystoning effects. The project attracted wide publicity, particularly for Chris himself, but the role of the others has been seriously underplayed in the media – not only that of Rob and Jeff, but of Nina Duncan, who was responsible for the lighting, Richard Bainbridge who enhanced the raw images, and John Perry of Holographics North in the USA, who carried out the mastering. The Trust has produced a DVD about Jersey, featuring the making of the hologram, but although the protagonists appear fleetingly in the recording of the event and their names appear in the final credits, they are not mentioned in the commentary. The DVD isn't generally available, as it was put together before the project was complete, but I understand that a final version will eventually be released. Full details of the way the project was carried out appeared in Holography News Vol 18 No 7 (Aug 2004).

As this is the last Newsletter before the festive season (which in my town seems to start in mid-September), I should like to take the opportunity on behalf of all the Committee members of wishing you all the very best for Christmas and the New Year, and may your lasers never grow dim!

Michael Talbot: Holographic Universe

Harper Perennial, pbk, ISBN 0-06-092258-3, $11.20 from Amazon

A few weeks ago a correspondent drew my attention to an anonymous essay entitled The Universe as a Hologram, which appears on a number of websites, for example http://twm.co.nz/hologram.html, where it is suggested that it may have been written by one Michael Talbot. I discovered that Talbot had written several books, in particular one called Holographic Universe, and obtained a copy of it. Although plainly not about holography per se, in view of its philosophical connections with holography I thought it needed a critical review.

First, a bit of background. From Isaac Newton to Linus Pauling, distinguished scientists have often held odd beliefs that have been widely accepted at the time, largely owing to the standing of the person concerned. Some lesser lights, such as René Blondlot, perpetrator of the M-ray scandal of the early 1900s, even acquired an international reputation (albeit brief) entirely through their eccentric ideas. David Bohm, a brilliant physicist formerly associated with the development of atomic energy, and no doubt in line for a Nobel Prize until McCarthy's inquisition forced him to resign his post (he refused to betray his friends), finished up at Birkbeck College in London, where his work on entanglement theory earned him an FRS. His particular obsession was what he termed 'the implicate order'. The hypothesis was that underneath the complexities of quantum physics, with its inexplicable uncertainties, awkward paradoxes and uncomfortable infinities, lay a kind of continuum – the implicate order – that involved everything that existed in the universe, including human consciousness. He invoked the hologram as a metaphor to illustrate his thesis (though perhaps Carl Jung's 'universal unconscious' might have been a better one). This 'universal hologram' concept was taken up by a number of other people and applied to disciplines other than cosmology and quantum physics. One of these was Karl Pribram of Stanford University, a neuropsychologist whose main research was into the memory of trivial lists by visualisation. He had been much influenced by the work of Karl Lashley, who in a lifetime of research had spectacularly failed to find specific centres in the memory (of rats), and had concluded that memory was distributed more or less uniformly over the whole brain. Pribram hypothesised that memory was stored in the brain literally in holographic form. In spite of this misunderstanding about the nature of holographic coding, which isn't uniform (in a primary hologram the viewpoint is coded locally, and in an image hologram everything is coded locally), Pribram's beliefs have gained some public currency, particularly in the United States. The anonymous website postings may be contributing to this: apparently the answer to life, the universe and everything is a hologram. [Note: Hitchhiker aficionados are aware that the correct answer is 42, and the ultimate question was 'What do you get if you multiply 6 by 9?' This makes sense if you appreciate that the lifeforms who asked the question had seven fingers on each hand and thus counted in fourteens.]

Michael Talbot's book manages to draw a tuna-sized red herring across this whole murky area. The book is not about holography, although the words 'holography' and 'hologram' appear on almost every page. It is almost entirely devoted to discussions of psychical phenomena: precognition, telepathy and psychokinesis, along with out-of-body and near-death experiences, all matters on which Talbot is an authority. Each of these subjects is dealt with in considerable depth, with numerous anecdotal examples and copious references. He ties in all these phenomena with an extradimensional continuum that he calls 'the universal hologram', apparently taking Bohm's metaphor literally. The reason for this is hard to understand, as he begins the book with an excellent description of the way a hologram is made and the image reconstructed. I suspect that he may have had some help over this, as he later uses terms such as

‘frequency’, ‘radiation’ and ‘energy’ in a way that shows he has little or no understanding of their scientific meaning. Apart from this misuse of scientific terminology, however, the book is well written and self-consistent. The author claims to be a sensitive, and to have had a large number of psychical experiences himself. The 500-odd references quoted are almost all from publications on psychical matters or from personal communications, including a number from both Bohm and Pribram.

Although the early discussion about the ‘universal hologram’ looks at Bohm’s metaphor in perhaps too literal a way, it is Pribram’s model that holds sway over most of the book. The trouble is that if one takes a holographic model and tries to use it to predict phenomena (for that is what a model is used for) it simply doesn’t work, either for the filing of information in the brain or for its retrieval. Recent research has shown that information in the human brain does have a high degree of localisation (pace Lashley), and that a model of a computer database, while still not entirely satisfactory, answers more questions than a holographic model can.

By the way, David Bohm’s thesis, to which New Scientist was moved to devote a long and serious article, is expounded comprehensively in his book Wholeness and the Implicate Order (Routledge & Kegan Paul). Unless you have more than a nodding acquaintance with quantum physics you may find you need to skip some bits. You can find out more about Pribram on http://twm.co.nz/Pribram.htm.

Graham Saxby

Holograms in Print

In June 1983 a new era in illustration began when Amateur Photographer published its first three-dimensional hologram cover, a small two-colour image designed by Ken Harris. The following year The National Geographic Magazine used an embossed hologram of the American eagle on its cover, and with a circulation of several million the concept spread worldwide. These examples were not quite the first, as Science Year had included a laser transmission hologram as early as 1967, and in 1971 Les Prix Nobel had a silver halide reflection hologram bound in to mark Denis Gabor’s Nobel award, but these were comparatively small-scale publications. National Geographic’s special on holography was followed in November 1985 by a holographic image of a two-million-year-old skull, and in December 1988 by a full holographic cover marking the beginning of their second century of publishing. Significantly, holography was not mentioned in either issue, by now being taken for granted.

In the meantime there had been some landmark publications. The Mirrorstone, published by Jonathan Cape in 1986, included a number of embossed holograms that were hot-foil stamped as part of the illustrations. New Scientist included a holographic image of Isaac Newton on the cover of an issue featuring

applications of holography, and the reggae group UB40 released an LP album with a limited edition cover sporting an embossed hologram containing the album's title 'UB44' and nothing else: it quickly became a collector's item. Zebra Books in the USA began to use a small holographic logo on the front of their pulp fiction, to distinguish their work from imitators. In November 1988 the RPS Journal was largely devoted to creative holography, and featured a mass-replicated silver halide hologram by the fledgling Applied Holographics Company.

It soon became clear to the comic book trade that holography and comics were made for each other: the flashy silver foil and rainbow colours of embossed holograms blended well with action-packed graphics and bold typography. Designers could now integrate holography with other artwork in a truly imaginative fashion. A number of British publishers took up the idea, using holographic illustrations in children's books in a more gentle style. Science fiction and horror were also natural bedfellows for holography, and quite a number of paperbacks appeared containing two-channel images of dinosaurs, aliens and ghouls. In the more specialised realms, various holographic journals and trade magazines used holograms as part of their content and for advertising purposes.

Holography, perhaps more than other media, is at the mercy of the vagaries of fashion. Apart from the omnipresent security labelling and fancy packaging there seems to have been a lull in the use of holograms in printed matter; but since, in my opinion, illustration uses holography in one of its most appropriate ways, I hope and expect it to regain its rightful place before long.

Jonathan Ross

Editor's note: The full text of this article, with illustrations, can be seen on Jonathan's website http://www.holonet.khm.de/jross/holosinprint/index.html

An unusual method for lighting small holographic subjects

The arrival of the twentieth anniversary of the infamous Brighton Bomb reminded me of what I was doing when I heard the news over the radio (Brighton is my home town). At the time I was working on a curious holographic experiment in a converted stable in the serene surroundings of Braxted Park, Essex.
At that time Applied Holographics Plc (now AOT) were pioneering on that site the world's first mass production of small Denisyuk holograms on Ilford holographic roll film, using ruby pulse lasers and a step-and-repeat exposure regime in what was essentially a holographic photocopier, the 'object' being a master Denisyuk hologram. In order for such a master to reconstruct a bright image when illuminated with the original laser wavelength it is necessary to use

a processing method that doesn't distort the fringe structure in any way; I had developed the appropriate chemistry a year or two earlier.
(Note: The usual processing formulae for a display reflection hologram shrinks the emulsion and 'chirps' the fringes, i.e. varies their spacing slightly throughout the emulsion thickness, so that with white-light illumination a broader range of wavelengths is diffracted and the image is brighter than it would be with a more monochromatic image.)
Applied Holographics was interested in my idea of being able to use a horizontally positioned master hologram as a means to illuminate the sides of a small solid object placed on it without the need for auxiliary reflectors, so that comparatively rapid production runs could be made. Thus the master hologram could be made specifically to act as a holographic optical element (HOE), if processed as described above to resonate at a matched wavelength. So for several days I was given the use of an outhouse equipped with an isolation table and a reliable HeNe laser, and the assistance of their young physicist Dinesh Padiyar, to show that the idea would work. As I wanted to make the initial demonstration as mundane as possible I chose to use as my starting object an ordinary white plastic coffee cup from the drinks machine, and made a Denisyuk master hologram (H1) using a single beam from almost overhead, with the laser temperature-stabilised to give maximum coherence length, in order for all the multiple reflections inside the cup to register. I processed this master hologram using my non-shrink formula. I then made a copy of this H1 turned over in pseudoscopic mode with a gap between the two plates sufficient to give an orthoscopic real image (H2) of the cup.

I then needed to see how these holograms would work as reflectors, with a small object placed inside my (holographic) coffee cup, when I made a further single-beam hologram (H3). As object I chose two AA batteries standing up side by side on a horizontal glass plate under an almost vertical expanded collimated beam. Naturally, with the laser as the sole source of illumination the battery images would be completely dark on the side away from the beam; but if the supporting glass were to be a real-image reflection hologram, the image itself would provide fill-in illumination for the object. This illumination proved very feeble from the H1 virtual image, and even more so from the H2 orthoscopic real image, but it was greatly improved when I used the H1 turned over to give a pseudoscopic real image.

Analysing that situation, one cannot expect the orthoscopic real image cup to behave like the original cup, which had tapering walls that would scatter light onto the object, plus light back-scattered from the cup floor, whereas with the real image any light can only come up from the plane of the hologram by diffraction. The image of the cup floor was focusing light only round the base area, and the image of the tapering walls was contributing very little, although when viewed from overhead it looked as if the object were sitting in the original cup (in that wonderfully clear illusion that you get when looking at a laser-lit reflection hologram). On the other hand, the illumination from the pseudoscopic H1 image would undoubtedly be better, because the floor of the cup had now

become the roof of a tower-like image that focused light to a central plane some inches above the hologram. Thus the hologram, here used as an HOE, was an improvement on the actual cup.

In realising this technique I have to acknowledge the earlier work of John Webster, then at the CEGB Marchwood laboratories, who had published the idea of making a hologram of a diffuser plate and using this as a diffuser for laser light that would not depolarise the light as would the original diffuser plate (unpolarized illumination produces inefficient fringe formation). In the same way, my holographic cup was itself acting as an efficient diffuser without causing any depolarising of the illuminating light.

Jeff Blyth

Holography in the field

For some time we have been planning to demonstrate simple hologram making to children, and working towards making a basic kit capable of being transported, set up and used to make a Denisyuk hologram in a variety of venues and under different conditions. Our first experiments used a modified laser pointer and some old Agfa film cut into 2.5-inch square pieces, held between two pieces of 5 × 7-inch glass (from clip frames) hinged together with tape. We didn't use index-matching fluid, as this was a complication we wished to avoid. The film holder was placed in a horizontal frame with the object on top, and the laser was positioned about 12 inches below the frame to project a divergent beam at an angle of about 45º to the film.

The film was pre-swelled in 5% triethanolamine (TEA) to increase its sensitivity and shift the image colour towards green. The exposure was 5 seconds, and the film was processed in ascorbic acid/metol developer and rehalogenating bleach.

The results obtained in the darkroom were fairly good, so, with a camping weekend planned for the August public holiday, we thought we would try under more difficult conditions. The 'field' where we camped was in the middle of a wood, off a minor road in Dorset, with a muddy stream but otherwise no water, nor any electricity supply. The awning of our caravan was used for the experiment, so we had to wait till well after sunset, but before the full moon rose over the trees. The 'safelight' was a fluorescent torch with a green gel wrapped round the tube.

The result was not the brightest hologram in the world; but the object, which included some text in white Letraset on a glass plate, and a representation of the Olympic rings made from five steel washers, was clearly visible. Has anyone

else made a hologram in a field, with no running water or electricity – or was this a world first?

Bob and Molly Gibson

Department of Partly-Baked Ideas

A couple of issues ago the DPBI discussed corner cubes (which, as Jeff Blyth pointed out, should really be called ‘cube corners’) and other polyhedra. Owing to a temporary breakdown of communication between brain and fingers, part of this item was garbled. The corrected version is that Euler’s theorem states that if you take the number of faces of a polyhedron and add it to the number of vertices, the answer is always two more than the number of edges, so for a cube we have (for F + V – E), 6 + 8 – 12 = 2. (The rest was correct.) I don’t know the proof of the theorem, but there are two somewhat curious exceptions, namely the great dodecahedron and the small stellated dodecahedron. These are duals of each other: a dual of a polyhedron is obtained by replacing the vertices with sides and vice versa, a simple example being a cube (F = 6, V = 8) and an octahedron (F = 8, V = 6). The two polyhedra are produced by extending the sides in the former case, and the edges in the latter, until they meet, which means that although each has 12 sides and 30 edges as in a simple dodecahedron, the sides intersect one another and there are only 12 vertices in each.

They are elegantly beautiful solids, and have appeared more than once in the works of both Salvador Dali and Maurits Escher. In spite of the re-entrant angles you can construct each from a single sheet of cartridge paper. But if you take F + V – E the answer comes, not to 2, but to – 6. This led the Swiss mathematician Ludwig Schläfli (co-inventor of elliptical geometry) to assert, somewhat rashly, that they could not exist. Mind you, if you count all the re-entrant faces, edges and vertices separately the answer comes out right. If you want to know more about this fascinating area, including how to construct these polyhedra, you will find the whole works in Mathematical Models, by HM Cundy and AP Rollett (Tarquin Pubs) (copies available from Amazon).

It has often been said that you can make a hologram of anything you can see, given the right equipment (and a good many things you can’t see, too). This applies to holograms of optical components: a reflection hologram of a concave mirror will focus light just like the original. However, if you make a straight Denisyuk hologram of a corner cube it doesn’t behave like the original device, and the DPBI is intrigued by this. As mentioned in an earlier report, when you look into a corner cube you see an inverted image of your eye. But this doesn’t seem to happen with its hologram. Something seems to be going on between the various sets of fringes generated by the multiple reflections, and the result seems to warrant some further head scratching at the DPBI.