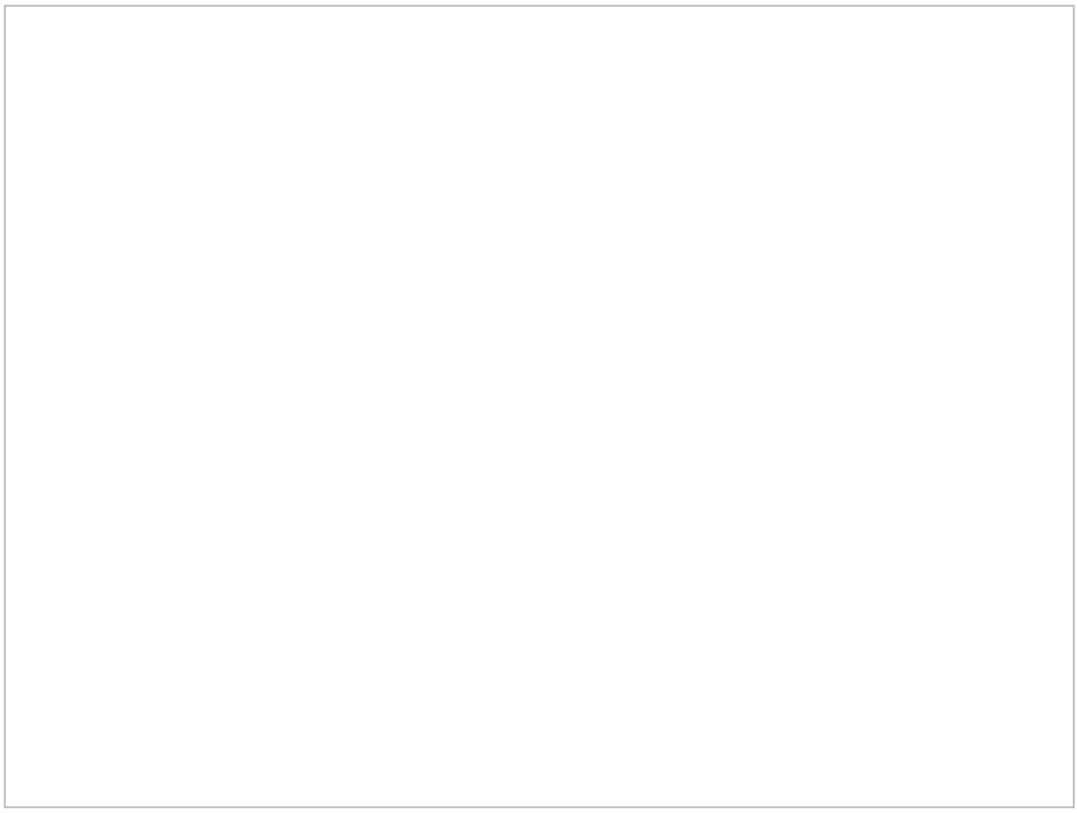
The Royal Photographic Society

HOLOGRAPHY GROUP

Newsletter January 2004



Stephen Benton 1942 – 2003

Holographic stereogram originated and embossed by Toppan Printing Co Ltd
from parallax images originated by Zebra Imaging

Editorial

The scientific world, especially the smaller world of holography, has been saddened by the death of Stephen Benton, protagonist on the holographic stage for more than thirty years. He died a few weeks short of his 62nd birthday, following a long fight with a brain tumour. A one-day symposium that had been arranged at MIT as a celebration of his work, and attended by over a hundred enthusiasts worldwide, became a valediction. His widow spoke movingly of his qualities, and a number of other participants praised his achievements, none more eloquently than Nick Phillips, whose address is quoted in this issue. I have added my own personal reminiscences of this pioneer of modern holography. No doubt the whole holographic fraternity will wish to add their condolences to Jeannine Benton and their two children, as well as to Steve's other 'family', the members of the Spatial Imaging Group at MIT, whose inspiration he was.

On a happier note, our Group has received a further promise of a substantial sum by the Shearwater Foundation towards the staging of another one-day conference on progress in creative holography. This subsidy will allow us to again hold the conference in the attractive venue of the Royal College of Art, and to invite speakers from overseas. At a recent committee meeting a possible date was discussed, and it was felt that a spring date would be the most attractive; to give us sufficient time to make the necessary arrangements the earliest date would probably be in April or May 2005. Our Treasurer Jonathan Ross, who runs a private art gallery in Earls Court, has agreed to host an exhibition of contemporary holography to coincide with the conference. A press release by Jonathan is included in this issue.

In the meantime we have a number of meetings lined up with some notable figures in three-dimensional presentation, and once these have been finalised the details will appear in the Journal and on our Website www.holography.co.uk. Don't forget the Focus exhibition at the NEC, Birmingham, on 22–5 February. I shall be on the RPS stand throughout, and there will be a number of lectures on photographic topics (including, needless to say, holography).

Finally, I am pleased to be able to report that the third edition of my book Practical Holography is now out, published by Institute of Physics (IoP) Publishing at £55.00. They have made a marvellous job of it, with improved illustrations and a much better layout than the previous editions. There is plenty of updating too, owing (among other things) to the advent of reliable diode lasers and new materials, plus (thanks to Jeff Blyth) a complete account of the way to make and coat a holographic emulsion in your own kitchen (after dark!). Oh yes; no less important, you can get copies direct from me at the reduced price of £30 plus postage (RPS members only). I'll sign them, too.

And a happy and successful New Year to all our members!

Graham Saxby

Stephen Benton, a tribute

Stephen Benton was a founder member of the MIT Media Lab, and Head of the Spatial Imaging Group from its inception. His death marks a sad loss for the optics community in general and holographic science in particular. Steve completed his PhD at Harvard, and under Edwin Land made significant contributions to the understanding of photographic granularity. Around 1968 he became fascinated by holography, and this interest culminated in his discovery of the principle of the white-light transmission hologram. Using this technique, the artistic community was able for the first time to see fiercely bright images that could be manipulated in an artistic context. This signified the beginning of commercial holography as a whole, and, most important, led to the mass replication of such holograms by an embossing process, the basis of all present-day security holograms. In addition, Steve was one of the pioneers of holographic stereograms made from series of photographs, thus linking photographic and holographic science in a unique way.

Searching for a method of producing more refined images than embossing could produce, Steve, working with Michael Klug, developed a method for producing machine-fabricated holograms with full parallax. In spite of initial concerns about manufacturing limitations, the world eventually saw large reflection holograms in colour, recorded in photopolymer material on a pixel-by-pixel basis.

Steve Benton was a great physicist with a teaching ability to match. Any complex question from a student, whether related to physics or chemistry, would be guaranteed a prompt, correct and clear answer. He was a major polymath and a great raconteur. His inventions will go down in history as worthy of the same degree of respect as those of Gabor, Leith and Denisyuk. He will be sorely missed by the optics community.

Nicholas J Phillips
(Abridged, with permission, from his address to the MIT conference, 11 November 2003)

Steve Benton: a personal recollection

I first met Steve when we were preparing the RPS's exhibition of holographic art in 1983. While most of us were in a state of near panic, he was a rock of unflappability. Later, when I was visiting the USA, he invited me to his lab at MIT. On arrival I found his entire group waiting expectantly in the lecture room. He announced that this was Graham Saxby, who had come here especially to tell them all about holography in the UK. Having thus been given about three seconds warning I was a little taken aback, but I managed to stammer out a few words, and fortunately there were plenty of helpful questions. I subsequently discovered that this was one of Steve's favourite tricks on unsuspecting visitors. Having duly sung for my supper I was rewarded with a slap-up meal in Boston's top harbourside restaurant.

It was largely Steve's information that enabled me to complete the trickier parts of the first edition of Practical Holography; he even wrote an enthusiastic foreword to the book without having seen more than a preliminary draft. On one of his visits to the UK we spent a heavily beer-fuelled hour or two discussing his newly discovered geometries for focused-image holograms – though in the sober light of the following morning our carefully sketched diagrams on paper napkins and beer mats proved to be almost unintelligible. At one of Tung Jeong's Lake Forest Symposia, Nick Phillips and I went out with Steve for a few beers (in that part of the world served in gallon jugs). After a few hours of Steve's anecdotes it was nearly midnight and the bar was closing. Undaunted, we drove across the adjoining State boundary, where it was permitted to serve drinks with breakfast – and breakfast started at 0001 hours! It was broad daylight when we got back. Steve chaired the morning meeting two hours later with his usual aplomb.

On my next visit to MIT I was invited to a beach party some fifty miles up the coast, where Steve and some other staff members owned a beach house. This was to celebrate the discovery of a comparatively simple method of producing rainbow holograms in full colour, and on arrival everyone was presented with a T-shirt bearing the appropriate ray diagram. Steve had brought a croquet set, and assumed that as an Englishman I would know the rules. In fact I hadn't played croquet since I was twelve, but we got by somehow. The party went on well into the night, and most of the guests bedded down inside (or outside) the beach house. I had a plane to catch next day, and Michael Klug also had to be back early, so he drove me back to Cambridge – at white-knuckle speed – where we made up for our previous (comparative) abstemiousness by finishing my bottle of duty-free single malt.

Steve was as generous with his academic discoveries as he was with his anecdotes, and he was immensely helpful when I was preparing my books, sending pre-publication details of everything his lab was doing. I was delighted when the RPS Awards Committee selected him to be the first recipient of the new medal for progress in three-dimensional imaging. When I heard of his death I had recently completed the new edition of my Practical Holography, and though I would have wished to include a dedication to his memory it was too late, as the book was already in the process of being printed. However, the dedication will appear in any future reprint.

In any group of enthusiasts Stephen Benton's personality shone out. He had a multitude of friends, and I feel honoured to have been one of them.

Graham Saxby

The Jonathan Ross Hologram Collection on CD-ROM

This disc results from a collaboration with Andrew Pepper. It explores what to the general public is still the relatively unfamiliar medium of holography, within the better known classifications of still life, portraiture and abstract art, drawing on examples from my collection. My intention has been to reveal holography as belonging to a tradition of art practice rather than being some bizarre phenomenon out on its own, and to promote the concept of holography exhibitions to the museum world, which in recent years has largely ignored it.

I hope that to the curious it will be an informative introduction to a fascinating visual medium, and that for the knowledgeable it will provide a valuable reference source. Its appeal should extend to collectors, curators, artists, designers, educators and visually aware individuals of all persuasions.

My collection of holograms was formed during what I consider the first Golden Age of holography, a period during which I was privileged to watch the medium evolve from experiments in the science laboratory to displays in supermarkets and museums. This introduction to the collection concentrates on fine art and display holography, and includes many classic holographic creations, as well as some lesser-known works.

The CD-ROM works on both Mac and PC computers that have a modern Web browser installed; it includes an animated version that requires the Flash plug-in and a classic version for a faster tour. The full text can be printed out, and details of all the holograms illustrated are included.

To preview the CD-ROM and to order a copy, visit the Website at http://www.holonet.khm.de/jross. The price is £12.50 plus postage.

Jonathan Ross, jross@gallery286.com.

Department of Partly-Baked Ideas

Some few Newsletters ago the Department was concerned with combination of mirrors and the way they can (or can't) reverse images. To recap on the fundamental mirror fallacy, everyone 'knows' that a mirror reverses right and left. Of course it doesn't: it reverses front and rear. If you move to one side, the image moves in the same direction; but if you move away from the mirror your image moves in the opposite direction. Point made, I hope. Pace Lewis Carroll, when you hold a piece of writing up to a mirror it only looks as if it is reversed. You have reversed it yourself when you turned it round to face the mirror, as you can see if you look through the paper. You can answer the equally false-premise question 'If a mirror reverses right and left, why doesn't it reverse top and bottom?' in the same way. Instead of turning the paper right to left, turn it top to bottom: it should hardly surprise you that the mirror has also reversed top and bottom.

Some people are good at reversed 'mirror-writing'. Leonardo used it all the time, and you can probably do it tolerably well with your left hand, if you are right handed. Try this little experiment: hold a piece of paper on the underside of your desk or table, and write your name on it, fairly large, from underneath. You will have produced a fairly good example of reversed writing.

It's easy to construct a mirror that does reverse right and left. You simply put two mirrors together at right angles and look into the corner. When you move sideways the image moves in the opposite direction. If you rest a third mirror on the other two and look up into the corner you will see an image of your face that apparently doesn't move at all! It is inverted, but it does have full normal parallax.

A more sophisticated way of producing such a reflecting combination is to take a cube of optical glass and cut the corner off it symmetrically. The solid you have cut off is a tetrahedron with three orthogonal faces and the fourth at 45º to each. It is called, rather obviously, a corner cube. It works just like the three-mirror combination, but operates by total internal reflection. Within its operative angle any beam of light that enters it is reflected back along the same path.

You can cut eight corner cubes from the original. What you are left with is a truncated cube with six octagonal faces and eight equilateral triangular faces. If you count the number of faces (F), vertices (V) and edges (E) of the original cube, add F to V and subtract E you will get $6 + 8 – 12 = 2$. And if you do the same count for your corner cubes you get $4 + 4 – 6 = 2$. And if you do it again for the remaining truncated cube you get $14 + 24 – 36 = 2$. In fact, for any polyhedron, no matter how you hack it about, the count is always the same: 2. This principle was first stated by the great 18th century mathematician Leonhard Euler, and is named after him. More About polyhedra and Euler's theorem in the next Newsletter.

But to return to our corner cube. Jeff Blyth recently showed me a corner cube only about 10 mm across, so small that it reflected only the image of one eye. But which eye? If you closed your left eye you saw the image of your right eye, and vice versa. Which eye do you see if you keep both eyes open? The DPBI is intrigued by this, and by the question of what you would see in a large array of such devices. Such arrays do indeed exist: one was positioned on the Moon by an early expedition, to reflect laser beams back to Earth for ranging (how do explain that, you unbelievers?). Nearer to home, most reflectors on cycles and cars are of this type (but not cats' eyes, which use a different optical principle).

A further problem, arising from this, exercises the DPBI. Would a Denisyuk hologram of a corner cube work like an original? It seems it probably would, as you can readily make a hologram of a tilted mirror. But what would happen when you reversed the hologram? A 'pseudoscopic' corner cube image is a tricky construct. A real corner cube, of course, doesn't work in reverse: it simply behaves as three prisms, and transmits the deviated light beam in three different directions. Would the hologram work the same way? The DPBI would like to hear from anyone who has tried this.

Partly-baked ideas are always welcome; if you are keeping one warm, let us know, and the DPBI will cook it a bit further.