BRITISH LIQUID CRYSTAL SOCIETY

LIQUID CRYSTAL NEWS

July 2004

GW Gray Medal for 2004
Bill Crossland: A device pioneer

Professor Bill Crossland FIEE Ceng is the Research Professor of Photonics at Cambridge University Engineering Department. The chair was originally sponsored by Nortel Networks and more recently by DERA.

Before joining Cambridge University over 10 years ago he spent more than 25 years in the telecommunications industry in the UK, working for Standard Telecommunication Laboratories (STL), originally part of the US company ITT and then STC. Later it became part of Bell Northern Research subsequently renamed Nortel Networks.

Bill trained as a chemist at Queen Mary College, London. Whilst at QMC he was concerned with using work function measurements to study the surface hydrogenation of metals. He continued to use similar techniques whilst at STL from around 1965 onwards but applied them to the oxidation of metals which was topical at the time. However after a spell working on atmospheric degradation of relay contacts Bill was invited to apply his skills to a newly emerging area: Liquid crystals.

Bill cut his liquid crystal teeth helping improve the production of simple direct drive numeric and alphanumeric nematic displays at the STC factory in Leeds in the mid to late seventies. Subsequently he worked on nematic multiplexed displays and then smectic A dynamic scattering displays.

From 1979 to 1982 he was responsible for the first reported liquid crystal over silicon (LCOS) display devices using the dyed phase change electro-optic effect with cholesteric liquid crystals. The first ferroelectric liquid crystal (FLC) micro-displays were made in collaboration with Edinburgh University in 1988. This activity has resulted in the emerging international micro-display industry and in many of the spatial light modulators that are starting to create new possibilities in telecommunications and optical information processing. . Most of the initial demonstrations of these capabilities in telecommunications and in adaptive optics used multiplexed FLC devices made by Bill's group.

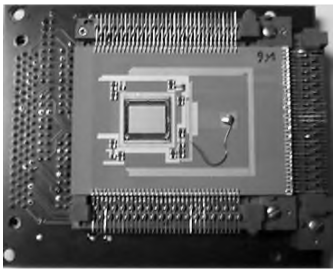
Also in the field of displays he proposed and led the UK JOERS-Alvey project to develop large panel displays using ferroelectric liquid crystals (FLCs). Between 1987 and 1989 this project built one of the first A4 FLC displays and originated one of the most important addressing schemes for FLC displays (the so called $V\tau_{min}$ scheme). Recent work on displays includes the development of a new class of liquid crystal display called photoluminescent liquid crystal displays (PLLCDs), a version of which was subsequently developed by a spin-off company Screen Technology Ltd.

With DERA he also pioneered active tiling of projection displays using optically addressed spatial light modulators for the purpose of making ultra-high resolution displays and holographic and autostereoscopic 3D display systems. With industrial sponsorship from small startup companies, he is pursuing potential new micro-display systems employing massive electronic processing on the silicon VLSI backplane and employing liquid crystal phase modulators for projecting either 2D images or 3D holograms.

His interest in free space photonic switching systems has been advanced through a number of projects. Most of these have been industrial academic partnerships. He was the founder and a major participant in the DTI LINK project "Optically Connected Parallel Machines, OCPM (July 91 to June 95). He initiated and became principal investigator at Cambridge in the EPSRC interuniversity project ‘POETS’ “Parallel Opto-Electronic Telecommunications systems (Dec.93 to Jan 97). He was co-originator of UK LINK project ‘ROSES’ “Reconfigurable Optical Switches for Aerospace and Telecommunications Systems (97 to March 99). This has led to the very recent industrial partnership under the LINK project ‘THORNS’ “Terabit Holographic Routing Network Switches (2001-2003)” This work continues with ‘MOPS’ “Multiwavelength Optical Processors” (2003-). High capacity packet switches and optical interconnections have been addressed in the EPSRC project VIVALDI “VCSEL based Very High Capacity Photonic Packet Switches”. This project aims to move LCOS devices into the mainstream of telecommunications applications.

At STL he was the winner of the Joe Evans Memorial Award for Innovation in recognition of his contributions to many patents and he was leader of the group that won the Finniston Award for the most outstanding product based on a recent scientific advance in 1985 for a new liquid crystal display, based on the dynamic scattering smectic A.

He has published more than 100 papers and has given a large number of invited and plenary presentations at national and international conferences, generally on the topic of liquid crystal device technology. He has had about 100 patents granted in this and related areas.



Perhaps Bill’s best quality is his enthusiasm for whatever projects he and his groups are engaged in. That this enthusiasm has transmitted to those around him explains why he is leaving such large footprints for others to follow.

Tony Davey & Neil Collings

BRITISH LIQUID CRYSTAL SOCIETY

First Announcement

The BLCS Annual Conference 2005

University of Exeter

22nd-24th March, 2005

The 2005 BLCS annual meeting (AGM) and conference will be held on 22-24th of March at the University of Exeter, under the chairmanship of Garry Lester. The main emphasis of the conference is for students and young researchers to present their latest work along with invited talks and the Sturgeon lecture. Papers are requested on any topic related to liquid crystal materials and their applications.

For more information please see the website:

Materials Congress 2004
The Institute of Materials, Minerals and Mining

30th March to 1st April 2004

Materials Congress 2004 was an action-packed international meeting held over 3 days from 30th March to 1st April 2004. The term 'materials' covers a massive range of scientific activities, and the Materials Congress 2004 provided a stage for all these areas in a huge number of parallel sessions. The Congress was the fourth to be held since the first in 1998, and in fact was held in the same magnificent setting of Carlton House Terrace, London as the previous event in 2002.

The large, varied and exciting programme included around 40 plenary and keynote lectures, hundreds of other valuable contributions in the form of oral and poster presentations. Sessions included rather dry sounding areas, but nevertheless important, such as 'Mineral Reserves and Mineral Resources - Reporting and Estimation', and other sessions such as 'Composites - The Cutting Edge', 'Smart Packaging and Smart Materials', 'Biomaterials and Tissue Engineering' and 'Wide Bandgap Semiconductors' which sounded far more inviting.

Many delegates such as myself could not afford the time to attend the full meeting, and so just attended for part of the meeting to enjoy their favoured session(s). There were in fact several sessions that could have been most interesting to those working in the area of liquid crystals, however, one session, 'Self-organised Liquid Crystal Semiconductors' was perhaps the obvious one to attend.

The 'Self-organised Liquid Crystal Semiconductors' symposium was held on Wednesday 31st March, and was organised and chaired by Professor Richard Bushby of the SOMS Centre at the University of Leeds. The symposium offered speakers from around the world, Germany, USA, Japan, Holland, Poland and UK. The coverage of the talks was interestingly spread in covering aspects of the design and synthesis of materials to the various techniques used to evaluate the performance of the materials in terms of their conductivity, and included the modelling of important features, such as trapping and hopping. The symposium was very well attended considering the vast number of other parallel sessions and I would estimate around about 50 delegates attended the symposium.

Certainly, the title of the symposium is immediately suggestive of discotic liquid crystals and columnar mesophases, and certainly that was the main focus of the symposium. Research into disc-shaped liquid crystals was intense about 10 or 15 years ago, and this intensity certainly died down somewhat, but interest has seemingly surged again over the past couple of years as the importance of organic semiconductors intensifies. Presentations included modifications to the basic hexaalkyloxytriphenylene core system, in terms of basic alkyl chain length, alkylsulphanyl chains, fluoro substituents (as part of the aromatic core and also as part of the terminal chains).

More recent research into liquid crystals that exhibit conductivity centres around calamitic materials that exhibit disordered crystalline smectic phases such as E and B phases, and there were several interesting talks on such materials. Most notably this research has involved phenylnaphthalenes, which are of particular interest to me because I synthesised such materials in the late 1980s as part of a programme on high birefringence nematic liquid crystals, but because these materials only exhibit E and B phases and so were of no interest to us at that time!

The symposium was held on what was most certainly the best day of the year so far with lots of warm sunshine. A rather long break across lunchtime provided an excellent opportunity to see St James's Park, the London Eye, and Buckingham Palace, before returning for the afternoon session.

Richard Bushby should be congratulated for organising and chairing such an exciting, stimulating and valuable symposium, with an excellent selection of speakers and research areas.

Mike Hird

BLCS Young Scientist Lecture 2004

Liquid Crystals, Optics and Vision

NICK ROBERTS

Nonlinear and Liquid Crystal Physics Group
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Our understanding of liquid crystal optics is providing us with new ways of investigating how the light sensitive cells of the retina interact with light.

Introduction

Over the last twenty years, LCDs have dramatically changed our lives. We see LCD technologies almost everywhere, in mobile phones, household appliances, and laptop computer displays. One of the main reasons for this success has been efficient way liquid crystalline materials manipulate and control light. However, the subject of liquid crystals really grew out of more biological beginnings. It is often quoted that in 1888, the Austrian botanist Reinizter first saw evidence of a new mesophase in a derivative of cholesterol, the new phase turning out to be a cholesteric liquid crystal. But from these beginnings, we now understand the importance of liquid crystals in biology and how the properties of a variety of liquid crystal phases underlie many diverse areas, from describing the structure of cell membranes to ordering of DNA. In the early part of the nineteenth century it was also discovered that liquid crystal phases were not just involved in “biological structure,” but that they gave rise to some spectacular optical effects [1]. For many years biologists had marvelled at the iridescent reflections exhibited by a variety of beetles, but we now know that the cuticle hardens from a cholesteric liquid crystal phase, locking in the helical structure and the mechanism for reflecting light so strongly. However, there is also another biological system that not only combines liquid crystalline properties of self assembly, order and the ability to interact with light in a variety of different ways, but shares several of the principles behind some of our modern day displays

Liquid crystal 'Cells'

The highly specialized light sensitive cells of the vertebrate retina are called photoreceptors and within the retina there are two different types, rods and cones, with both showing model examples of a lamellar liquid crystal phase. The part of the cell that contains the visual pigment is made up of a stack of several hundred lipid bi-layers. An excellent description of the cell physiology is given in reference [2] The typical structure of the cell is illustrated in Figure 1 with an electron micrograph and schematic diagram of a rod photoreceptor. In rods, each of the lipid bi-layers form double membrane discs or flattened saccules and in cones the lipid bi-layers form from in-foldings of the outer cell membrane. An opsin protein and vitamin A derivative chromophore make up the visual pigment (called rhodopsin) with each molecule spanning the individual bi-layers. As such, the photoreceptor structure is actually analogous to a guest-host liquid crystal device, the chromophore orientated by the liquid crystal host and maximally absorbing light polarized linearly to the chromophore’s long axes. Although in this case, the long axis of the chromophore is orientated perpendicular to the director.

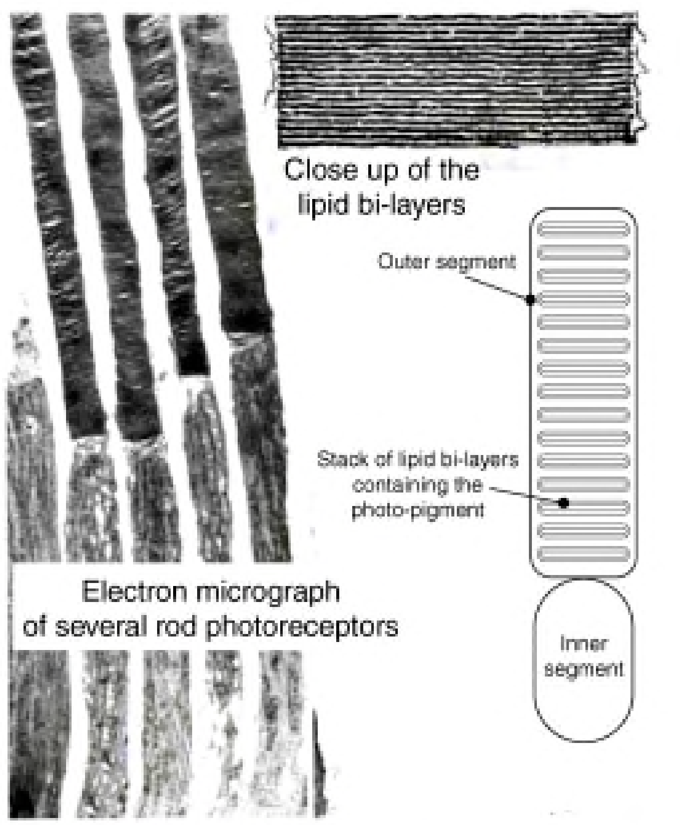

Figure 1 An electron micrograph and schematic diagram of a rod photoreceptor illustrating the photo-pigment containing lipid bi-layers in the outer segment.

How light is absorbed

To understand how the photoreceptors' liquid crystalline structure affects the way they absorb light, we can model the spectral absorbance with the commonly used 4x4 matrix technique, a technique typically used to predict the selective reflection spectra seen from a variety of chiral liquid crystal phases. Normally an approximation is made by splitting the system up into several thousand layers to account for the rotating dielectric tensor. However, this approximation is not needed for this real layered system, where the series of matrix multiplications describe the alternating anisotropic bi-layers and surrounding isotropic fluid. With the correct description of the bi-layer dielectric tensor, in this case a complex biaxial tensor due to the weak dichroic absorption, the method then allows solutions of Maxwell's equations to be deduced. Transmitted and reflected intensities are then calculated as a function of the illumination geometry and incident polarization. As we are also interested in the absorbance, *A*, as a function of wavelength, this can then be calculated using the formula

$$A = \log\left(\frac{I_R}{I_M}\right)$$

where I_R is the light intensity incident on the photoreceptor (reference measurement) and I_M is the intensity transmitted by the photoreceptor. A detailed derivation of the theory involved has been given recently in references [3,4].

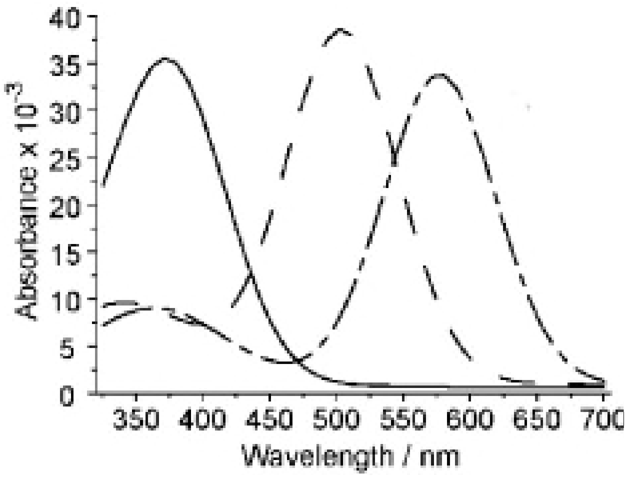

Figure 2: Example calculations of the absorbance spectra from a UV sensitive cone, rod and long wavelength sensitive cone

Figure 2 illustrates calculated absorbance spectra for a model ultraviolet cone, rod and long wavelength sensitive cone photoreceptor at absorbance maxima of 372nm, 505nm and 575nm respectively. In these calculations the outer segment diameters were modelled to be 3∝m. Qualitatively, the profiles of the curves are typical of absorbance spectra measured experimentally by microspectrophotometry (MSP), clearly showing both the α- and β-absorbance bands. Quantitatively, the magnitudes of absorbance also compare well to experimental results. For the modelled rod, the absorbance at λ_{max} was approximately $38x10^{-3}$ for a 3∝m diameter outer segment. This equates to a specific absorbance of 0.013OD, which lies within 0.008~0.017OD, the range generally measured across a wide variety of vertebrate species.

To further investigate how closely the profiles of the calculations agree with experimental MSP measurements, we can directly compare the results with experimental absorbance spectra of rods from (Fig. 3A) Bufo bufo [5, redrawn from Fig. 1C] and (Fig. 3B) Oncorhynchus kisutch [4].

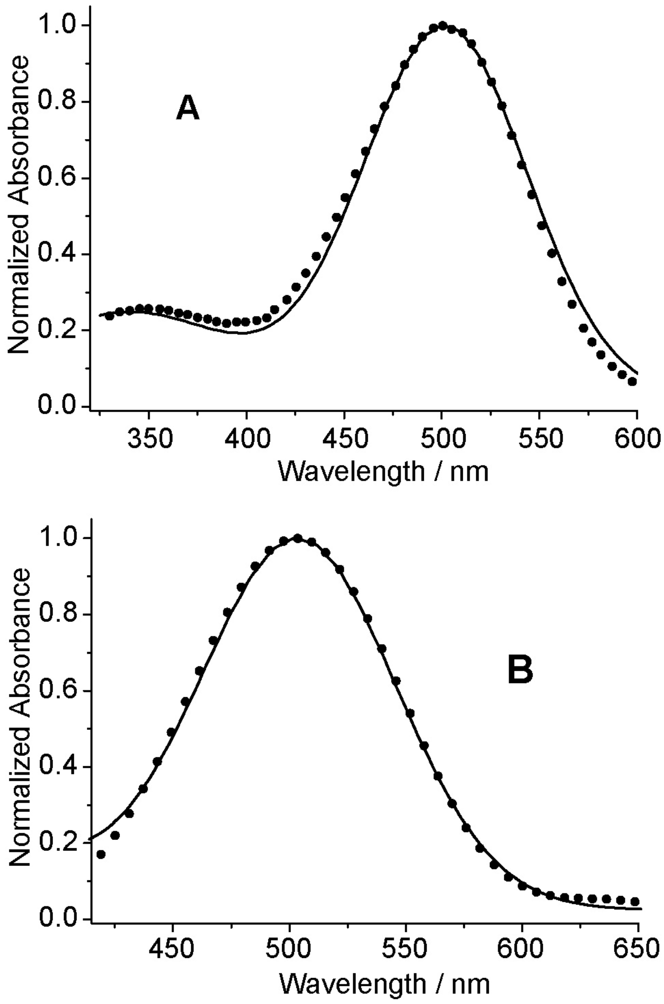

Figure 3 Comparisons between experimentally measured (points) and calculated (line) rod absorbance spectra. (A) experimental data of *Bufo bufo* measured by Govardovskii [5] and (B) experimental data of *Oncorhynchus kisutch*[4].

In order to calculate the absorbance spectra with a similar λ_{max} to the experimental results, $\lambda_{max-\alpha}$ of the complex part of the refractive index was chosen accordingly. Both sets of calculated data are also normalized to account for the unknown outer segment diameters. Considering the assumption associated with the complex refractive index dispersion, the comparison between spectra is remarkably good. The deviations between the calculated and experimental measured spectra can be solely attributed to the Gaussian form of the modelled complex dispersion not accurately describing the exact physiological function.

The lamellar structure of the outer segments are also noted for exhibiting form birefringence when viewed from the side. Form birefringence (as opposed to the intrinsic birefringence of the lipid bi-layers) occurs due to the ordered arrangement of the membranes where the thickness of the membranes and dimensions of the outer segment are smaller and larger respectively than the wavelength of light. By considering the differing boundary conditions for when the electric field vector is either parallel or perpendicular to the plane of the membranes, the resulting formulae for the dielectric tensor demand that such a structure must exhibit negative form anisotropy. This is in fact directly analogous to refractometer measurements of made on chiral nematic liquid crystals. Muller and Stegemeyer showed how refractometer measurements should relate to the "true" refractive index values if the system were in a nematic phase. Calculations of form birefringence have also been undertaken many times before on different lamellar lyotropic systems, an example being given in reference [8]. Deriving the correct formulation of the dielectric tensor by considering the boundary conditions between the bi-layers and surrounding isotropic medium, we can calculate the effect form birefringence has on the photoreceptor absorbance.

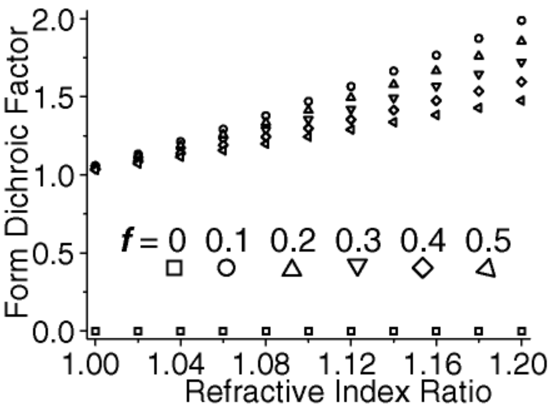

Figure 4 The calculated form dichroic factor and a function of the refractive index ratio and f the volume fraction of the bi-layer in the outer segment.

Two previous studies had attempted to model the form birefringence of the outer segments, but with limited success [6, 7]. Both Harosi and Israelachvilli predicted a strong form birefringence component for the membrane volume fraction equal to zero. Of course if their are no membranes and the system is isotropic, there can be no form birefringence. Defining a dichroic ratio as the absorbance ratio of light polarized perpendicular and parallel to the long axis of the cell, Figure 4 illustrates that the factor by which the dichroic ratio changes due to the form birefringence and shows that this factor is indeed significant. It's worth noting that the form dichroic factor as not yet been measured experimentally.

The lessons we are still learning

It seems that in recent years the subject of animal optics has begun to receive the recognition it deserves, not only for inspiration in new optical technologies and design, but in understanding that many of our modern day photonic systems really were 'thought of' or evolved in the animal kingdom a very long time ago. Recent articles such as Pete Vukusic's in the February edition of Physics World [9] have done much to highlight some of the important lessons we have learned from "500 million years of R&D". And liquid crystals are still playing a central role in this continued development. Recently, iridescent liquid crystal security features have been implemented worldwide in the production of bank notes. Photoreceptors really do share the same story, with their many similarities to liquid crystal guest host devices. And with the ability of many animals to 'see' polarized light, perhaps there are still some new lessons to learn in designing efficient polarization analysers.

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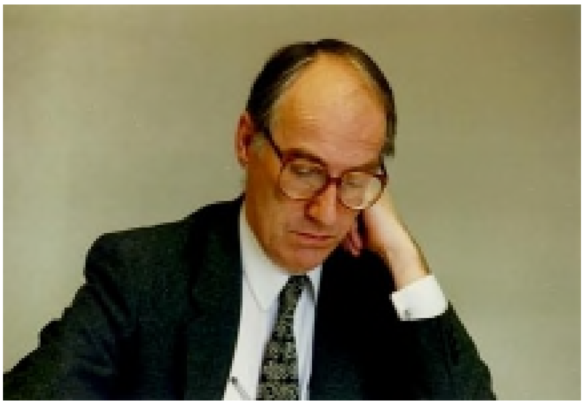
International Honours for Geoffrey

Geoffrey Luckhurst has been made an Honoured Member of the International Liquid Crystal Society. This award is made to ILCS members for outstanding contributions that have significantly advanced the science or technology of liquid crystals. He becomes only the second BLCS member (after George Gray) and the eleventh person worldwide to be awarded the title and joins the exclusive roster of Honoured Members that also includes Patricia Cladis, Jerald Ericksen, Atsuo Fukuda, Pierre-Gilles de Gennes, Wolfgang Helfrich, Shunsuke Kobayashi, Helmut Ringsdorf and Alfred Saupe.



The citation for Geoffrey's award is "….. ***in recognition of your pioneering studies of the molecular physics of liquid crystals, your conception and foundation of the journal Liquid Crystals and for your outstanding achievements during your Presidency of the International Liquid Crystal Society***". Indeed there can be few, if any, other scientists who have contributed more to the development of the subject and the liquid crystal community than Geoffrey. The first conference organised by Geoffrey was a Faraday Symposium on Liquid Crystals in 1971 and he has been the driving force behind many highly successful meetings since then. Geoffrey has been especially active in the area of scientific publishing, co-founding the journal Liquid Crystals with Ed Samulski as noted in the citation, as well a being editor of Molecular Physics for a number of years. Additionally Geoffrey has edited to his exceptionally high standards many volumes of Conference Proceedings. Perhaps the most famous amongst these is *The Molecular Physics of Liquid Crystals*, edited with George Gray, which recorded the proceedings of a landmark NATO Advanced Study Institute held in Cambridge in 1979. Geoffrey was the second President of the International Liquid Crystal Society from 1992 until 1996, a period which, under his guidance, saw the establishment of the Society as the international focus of the liquid crystal community. Of course Geoffrey has also contributed greatly to liquid crystal activities in the United Kingdom as well as internationally and served as Chairman of the BLCS between 1995 and 2001.

To record the scientific achievements made by Geoffrey would require a whole book, but it is true to say that Geoffrey's scientific reputation is internationally outstanding and some recognition of this is demonstrated by the recent award of a prestigious Leverhulme Emeritus Fellowship by the Leverhulme Trust. These Fellowships are highly sought after by retiring academics, with only 30 being awarded nationally each year across all subject areas. Although this year marks Geoffrey's formal retirement, the award of this Fellowship and Geoffrey's continual enthusiasm for the field will ensure his presence (and probing questions) at future BLCS and ILCS meetings.

There was a two day symposium to celebrate Geoffrey's 65th Birthday on 29th-30th July. This symposium focused on the major advances that Geoffrey has made to the field of liquid crystals. The speakers were drawn from Geoffrey's long list of collaborators, friends and former students.

Further information is available at http://www.slci.soton.ac.uk.

Martin Bates and David Dunmur.

Liquid Crystal Art:

The artistic exploits of John Goodby

The following are excerpts from recent articles on the liquid crystal art recently produced and exhibited by Prof. John Goodby. The articles are from several sources and have colour pictures which are difficult to reproduce in this newsletter. The original articles can be found on the BLCS website.

Liquid crystals have transformed our world and are at the heart of new developments in media and medicine, reports Elizabeth Cripps - The Guardian 11th May 2004

Science, technology, even art, liquid crystals, which fall, academically speaking, under the ambit of organic chemistry, are integral to the newest telephone, TV and even medical technology. In the hands of Professor John Goodby, head of organic chemistry at Hull and president of the Inter-national Liquid Crystal Society, they have also become works of fine art, displayed at the university. "Everyone knows of three states of matter," explains Goodby. Take water. "You can freeze it to get ice, or heat it to get steam, and water is the liquid in the middle'" Liquid crystals are the "in-between states" - whole new states of matter between the solid and the liquid phase. Little was known about them until 1972, when Professor George Gray, in Goodby's words, "invented the materials that found their way into watch displays and calculators". Or, in the vocabulary of the chemist, cyano-biphenyls.

In the three decades since then, liquid crystals have made them-selves very useful, facilitating innovation after innovation. To take an almost sci-fi example, much research is now being done into 3-D holographics. We are moving, Goodby says, "towards 3-D TV in the long run". More immediately, as well as digital cameras, widescreen TVs and a host of other gadgets, liquid crystals are being developed for the telecoms industry. "If you want to have lots of lines for telephones, you may have to use liquid crystals,"

Goodby says. "We have to make new materials." Which is exactly what he does. Goodby holds some 80-plus patents. His 20-strong team at Hull spends its time on organic synthesis of new products with physical properties to match their applications, custom-made chemical structures for an international client base. As well as the European Union, the Engineering and Physical Sciences Research Council and the Leverhulme Foundation, Goodby's team has funding from Comit (Communications and Mobile Information Technology), from QinetiQ, and from Kingston Chemicals. Gray's original research was funded by the Royal Signals and Radar Establishment.

Away from the multimedia gadgets, the Hull team is developing new materials for MRI imaging for the radio treatment of cancer. "The best treatment for cancer is still radiotherapy," Goodby says. "Modern X-ray machines can write X-rays in 3-D space and can work around the tumour: for example, they can go deep into the brain to remove a tumour. Hull Royal Infirmary has a new system but between the MRI it and the treatment, they don't have a way of evaluating what the dosage should be." Goodby's team is developing artificial patients, whereby X-ray machines radiate gel to allow them to calculate the dose for a real patient.

On top of the day job, Goodby turns liquid crystals into art as a hobby, displaying first photographs and, most recently, complex collage images of the "beautiful structures" revealed under the microscope. It is easy to understand the fascination the subject has for Goodby: he was in on it from the beginning. He was an undergraduate and then PhD student at Hull when Gray in-vented his cyano-biphenyls and 'the whole thing took off':

"It became the best thing since sliced bread," Goodby recalls. "It was patented by the Ministry of Defence and earned the UK government millions in licences alone." Goodby did his PhD in liquid crystals, then moved to the liquid crystal growing department at AT&T Bell Laboratories in the US, where he remained until he was asked back to Hull in 1988. Author of two textbooks on liquid crystals, he is also an adviser to the Erato programme on nanoscale structuring in liquid crystals in Tsukuba, Japan.

Professor's computer art is crystal clear - Bulletin June 2004

Professor John Goodby from the Department of Chemistry is putting a new form of art under the microscope - he's capturing the beauty of liquid crystals and turning them into impressive works of art.

"After years of studying liquid crystals for scientific reasons, I realised the images were every bit as good as the kind of art you see in most galleries," said John. Liquid crystals are an intermediary form of matter - neither liquid nor solid, they fluctuate between the two states depending on their temperature. As we alter the temperature on the liquid crystals, we can see their structure changing before our eyes, and when we are magnifying the structure by a hundred times through the powerful microscopes we have in the department, the changes in form are really quite dramatic."

John first started to combine work and art in the 1990's when he photographed the liquid crystals for publishing houses who wanted the images for book covers. But the art side of things really took off properly a couple of years ago when I was asked to produce some pictures to decorate the lobby for the International Liquid Crystals Conference in Edinburgh, I took it a step further when I managed to get three of my photographs exhibited in the Ferens Art Gallery last summer."

Over recent months John's artwork has progressed from simple photographs of the structures towards more complex collage images. "I've started using photographs of different liquid crystal textures to build new images, using image manipulation software on my computer. I was asked to create a Christmas card for the department, and I made it on the computer, using liquid crystal textures to colour-in the shapes. I enjoyed doing it, and I've now produced all kinds of images - including fish, birds and landscapes. I'm just manipulating nature to make art really. A lot of people in the fine art world tend not to be keen on artwork created on a computer, but I think it's just as valid. Its just a new form of artistic expression."

An exhibition of Johns work was displayed at Middleton Hall during the spring.

A fluid definition of art- Viewing images of liquid crystals as art raises complex questions. NATURE, 3 June 2004

When does an image made by a researcher for scientific purposes become art — if at all? Over the ages, the beauty of scientific images has been widely recognized. Reading Robert Hooke’s Micrographia (1665) gives us a sense of his aesthetic thrill faced with the wondrous images in the new device of the microscope. Like many of his contemporaries, Hooke would have recognized such miracles as the eye of the fly as the product of God’s, or nature’s, artistry. But does this mean that they are works of art in the normal sense of the term?

The question is implicitly raised by many of the striking products of modern scientific imaging techniques. And it is overtly posed by the claims of chemist John Goodby of the University of Hull, UK, that his microscopic images of liquid crystals (shown on page 7) are “every bit as good as the kind of art you see in most galleries”. Leaving aside the question of what is meant by “good” (and good for what?), his decision to start exhibiting his pictures as works of art plays into a complex series of shifting definitions of art in the modern era.

Until the twentieth century, the issue would not have arisen within the institutionalized definitions of art and science in post-Renaissance Western culture. But when artists decided to display every-day objects in art galleries - such as the signed urinal entitled Fountain by Marcel Duchamp in 1917 - the definition of art became very wobbly.

The exhibiting of such ‘ready-mades’ and their enshrining in galleries and museums, in the collection of Duchamp’s works in Philadelphia, for example, leaves us with a definition that extends little beyond the claim that anything is art that an artist claims is art - as is anything that viewers can look at as art.

Goodby’s claims are of course more specific than merely saying that because he exhibits the liquid-crystal pictures as art, then they are art. He is implicitly setting his images in the context of modernist abstraction, in which paintings or sculptures are devoid of figurative subject matter and narratives. Indeed, the way that the great masters of abstraction have transformed what we are pre-pared to consider as art has radically enhanced our ability to appreciate the marvellous natural configurations revealed by modern scientific techniques.

The amount of artistic contrivance in Goodby’s images far exceeds that in Duchamp’s urinal. The selection of certain liquid crystals at certain stages in their intermediate state between solid and liquid, the setting up of the microscope to deliver certain visual qualities, and the choices involved in rendering and printing the pictures (regarding colours, textures, plasticity, scale and framing, for example) are all done to create the best effect. This is to say nothing of the way Goodby collages his images to produce images of birds and flowers.

I wonder how many scientists who use visual images prominently in publishing their work have not made some kind of aesthetic choice at some time or other. Certainly anything that features on the cover of *Nature*, in its current format, is designed to attract attention in ways that are comparable to the use of a painting on the cover of an art journal.

In the final analysis, should we worry about whether something is art or not? If it excites us, isn't that enough? My answer is drawn from a long historical perspective. The set definition of art as an aesthetic product devoid of practical function is actually comparatively recent (dating back to the late eighteenth century) and is limited to Western and Westernized societies. The art world has performed increasingly unconvincing conceptual gymnastics to accommodate everything that artists have recently thrown at it. If we stop being bothered by the question of whether something is art, and instead respond openly to the visual products that we are capable of making, we will
be able both to agree with Goodby that his works are as 'good' as art, and say that any implicit com-petition between artists and scientist as makers of wonderful images is rather beside the point.

Martin Kemp is professor of the history of art at the University of Oxford, Oxford OX1 1PT, UK, and co-director of Wallace Kemp Artakt.

Report on the BLCS Winter Workshop 2003

The British Liquid Crystal Society Winter Workshop was held from lunchtime Monday 15th December to lunchtime Wednesday 17th December 2003.

As I am sure everyone is aware, the Workshop is designed for new entrants to the field of liquid crystals, particularly PhD students, but post-docs, technicians and industrialists also have much to gain from the event. Areas covered by the Workshop include a general introduction to liquid crystals, the synthesis of liquid crystals, identification of liquid crystal phases by optical microscopy, differential scanning calorimetry, and X-ray analysis, liquid crystal polymers, the physics of liquid crystals, liquid crystal devices, and modelling of liquid crystals. Theory and practical work is included, and there is ample opportunity for social activities. All participants are provided with notes from each of the topics covered.

The three-day format of the Workshop is now well established, and appears to be very popular and successful, despite the greater costs over and above a two-day format.

This year the University accommodation was not available because of changed Semester dates, a situation likely to continue in future. Accordingly, hotel accommodation was used which was much more expensive (£40- pppn B+B) than the University accommodation (£20- pppn B+B last year).

The support received by the Winter Workshop has proved to be very good over the past few years, however, the number of industrial delegates was much lower. The 2003 Workshop was (eventually) extremely well attended with a total of 45 delegates; 4 industrial delegates, 34 academic delegates and 7 non-residential delegates from Hull. The Workshop attracted 4 delegates from Trinity College, Dublin, but all others were from Britain. All of the delegates seemed to enjoy themselves, and I am sure that they all benefited from the academic and social programmes.

For 2003, the cost of the Workshop was increased by £20- for academic delegates to £140, but held at £240- for industrial delegates. Despite this increase in price, the extra cost of hotel accommodation and fewer industrial delegates caused a rather large deficit. British Liquid Crystal Society Winter Workshop 2003
Accounts

Income	£
Industrial Delegates Registration	960.00
Academic Delegates Registration	4580.00
Hull Delegates Registration	280.00
Total Registration	5820.00
Total	5820.00

Expenditure	£
B+B Accommodation (Hotel)	3280.00
Food	2503.19
Postage	30.00
Printing and Stationery	483.00
Room Hire	252.00
Travel Expenses	38.10
Total Expenditure	6586.29
Defecit Transferred fom BLCS	766.29
Total	5820.00

Mike Hird

British Liquid Crystal Society
Registered Charity (328163)
Balance Sheet at 28th March 2004

Description of Income	**£**	**£**
Cash at Bank		
General Fund	10299.00	
Sturgeon Fund	6111.45	
Total Cash at Bank		16410.45
Subscriptions		
General	147.00	
Merck Group	750.00	
Oxford Conference (2001)	693.00	
Cambridge Conference (2003)	231.00	
Total Subscriptions		1821.00
Oxford Conference 2001		3760.10
Hull Winter Workshop 2002		84.60
Interest (19/4/02 to 31/3/03)		
General Fund	158.54	
Sturgeon Fund	94.08	
Total Interest		252.62
Total Income		**22328.77**

Description of Expenditure	**£**	**£**
BLCS Young Scientist Prize 2003		200.00
GW Gray Medal Engraving 2003		76.97
Sturgeon Lecture Expenses 2003		380.54
Website Renewal (Two Years)		9.99
Hull Winter Workshop 2003		766.29
Obituary for Chandrasekhar		394.80
Cash at Bank		
General Fund	14675.19	
Sturgeon Fund	5824.99	
Total Cash at Bank		20500.18
Total Expenditure		**22025.21**

Treasurer's Annual Report

The General Fund at the start of the financial year showed a reasonably healthy £10299.00 plus a further £6111.45 in the Sturgeon Fund, giving a total of £16410.45. The general fund being about £5000.00 lower than in the previous few years, mainly owing to the payment of bursaries for student attendance at the 2002 International Conference in Edinburgh. Following this successful round of bursaries the Society has now extended the scheme for wider conference attendance (see website). The Sturgeon fund has remained at a very similar level in recent years because Sturgeon Lecturers had not claimed expenses.

The BLCS annual conference at Oxford raised £663.00 in new subscriptions and a surplus of £3760.10. A most welcome bonus for the accounts of BLCS.

The December 2002 Winter Workshop at Hull generated a very small surplus of £84.60, a situation that has arisen because of the more business-like costings of the University. The December 2003 Winter Workshop at Hull ran at a deficit of £766.29, a situation that arose through the need to use hotel accommodation at £40.00 pppn versus £20.00 pppn charged by the University.

Income from subscriptions was substantial this year, largely as a result of the Merck Group subscription (£750.00), and the conference subscriptions that have now been received (£693.00 from Oxford and £231.00 from Cambridge). Hence, not surprisingly, general subscriptions (£147.00) were extremely low this year.

One exceptional item of expenditure (£394.80) was for an obituary to convey the deepest sympathy and utmost respect of the British liquid crystal community on the recent death of Professor Chadrasekhar.

Interest earned on the Society's funds is now back to a reasonable level (£252.62), with the vast majority of the Society's funds in a high interest charity account with Yorkshire Building Society. The Society is a Registered Charity and so all interest is paid without the deduction of tax.

The capital value of the Sturgeon Fund has been reduced slightly to £5823.99 through the expenses of the 2003 Sturgeon lecturer, however, these expenses were very reasonable (for a speaker from the USA) at £380.54.

The Society's General Fund currently shows a very healthy total of £14675.19, largely as a result of the huge surplus provided by the Oxford conference held in 2001. The current total of the Society's funds is £20500.18.

Dr Mike Hird
BLCS Treasurer

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I would like to do an issue earlier in the year, but to do this I need contributions, think of it as a cheap publication!