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### Introductory Remarks Liquid Crystals: Present and Future

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## **Introductory Remarks Liquid Crystals: Present and Future**

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My first and very pleasant duty is to thank the Association of Super-advanced Electronic Technologies and the British Council for their co-organisation and valued backing of this Seminar and to express my gratitude and that I am sure of all the delegates to the following Institutions for their support:

The Ministry of International Trade and Industry  
The Japanese Liquid Crystal Society  
The British Liquid Crystal Society  
The Society of NICE Devices  
The Institute of Electronics, Information and Communication  
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would never have been possible and our grateful thanks is extended to each of them.

I would like to say next how very honoured and privileged I feel personally to be here, to be sharing with Professor Okano the role of Seminar Chairperson and to have been given this opportunity to make a few Introductory Remarks. These remarks will not be concerned with new science, because at my age, my days of doing and directing investigative research are past, but through my on-going duties as Editor of the international journal *Liquid Crystals* and through my close contacts with several academic and industrial centres in the UK, I am very much aware of the focal points of activity and progress in the field of Liquid Crystals and so my comments have been billed as "Liquid Crystals: Present and Future".

Before moving on to this, I would like to say that because of my professional involvement in research in liquid crystal materials for application in display systems, I have made many visits to Japan over the years since the early 1970s. Coming to Japan is not, therefore, a novel experience for me, as I think it is for several of the UK delegates, but no matter how frequently I come here, I always look forward to my visits with pleasure and anticipation. Indeed I like Japan and the Japanese people very much, and I admire greatly how a nation that is so advanced technologically has been able to preserve so many of its valuable traditions at both the national and the family levels.

Japanese science and Japanese industry has, of course, honoured me greatly in the past for my own contributions to the technological development of liquid crystals. Here I refer, of course, to the memorable occasion in Kyoto in 1995 when I was awarded the Kyoto Prize Laureate and Gold Medal instituted by the Inamori Foundation and later in Tokyo, following an audience with your Emperor, I was honoured by being made a Foreign Member of the Japanese Academy of Engineering.

It is very natural, therefore, that I feel very closely related to Japan and its people. Most of my time in Japan has been spent in the South, in Kyoto, Osaka and Kobe, or further north in Sendai, but last year I spent some time in Tokyo as a member of a delegation, led by my Lord Jenkin of Rodin, from the United Kingdom Foundation for Science and Technology, the object of that visit being to illustrate the mutual benefits that can arise through collaboration between Industry and University. This type of collaboration is traditional and strong in the UK, but for historical reasons is only now developing in Japan.

The Seminar in which we are about to participate has, however, a wider remit, namely to encourage and promote collaboration in the field of liquid crystals between scientists in the United Kingdom and Japan, irrespective of whether they are in the University or the Industrial sphere. This is expressed well in the Seminar Preface where it states

“A bilateral forum (of this kind) provides the ideal forum within which research groups (industrial or academic) can identify common areas of interest and through their complementary expertise identify new research areas.”

We have in effect two groups of twelve leading researchers in the liquid crystal field from Japan and from the UK providing a stimulating programme of oral presentations on a wide variety of topics in the field of liquid crystals and their applications, together with poster sessions at which some 60 posters will be displayed, again on topics of leading interest in the field.

Indeed, looking back at the coverage of the subject given by last year's 17<sup>th</sup> International Liquid Crystal Conference in Strasbourg and by last month's European Conference in Crete, it is surprising how well the oral and poster presentations to be made at this much smaller, two country meeting reflect the focal areas of interest and progress in the liquid crystal field as a whole. This must tell us I think that the state of liquid crystal research and development in our two countries is a healthy one. That is encouraging and provides a good basis for

hoping that well found Anglo-Japanese collaborations will develop from our efforts during the rest of this week.

As a reflection of today's central areas of research in the field of liquid crystals, the statistics of the programme for this Seminar are rather typical, therefore. The oral and poster presentations fall conveniently into nine areas

- 24 Device related – including alignment, photoalignment, and anchoring
- 14 New materials and molecular interactions
- 13 Physical properties of new materials
- 7 Biological, lyotropics, supermolecules
- 5 Composites and gels
- 5 Liquid crystal polymers
- 5 Simulation
- 4 Chirality
- 3 Free standing films
- 3 Mixtures
- 2 Photo-optical effects

constituting a total of 85 presentations.

Not surprisingly, the largest coverage goes to display devices. I say not surprisingly because this is an area in which Japanese technology excels and because, of course, if it were not for the applications of liquid crystals in display systems, they would not have received the enormous research impetus, and indeed most of us here today would be operating in some other area of research and technology.

Papers on materials and new liquid crystal compounds are really very well represented, although it has been noted recently by some that synthetic effort in liquid crystals may be on the decline. There could be two reasons for this, if it is so. An excellent job has already been done by chemists in providing the Liquid Crystal Display industry with materials which operate exceptionally well in displays. Secondly, a greater concern for all of us is that applications for

support of research proposals that are to be successful must include a statement about “how well this work will help to advance technology, industrial marketing and quality of life.” It is much easier to be convincing in such a statement if you are proposing some new technique which will improve and advance the quality of a device or indeed initiating some new display mode, than if you are saying “I want support for the synthesis and study of this new range of materials which might, if we are lucky, have properties that could possibly lead to applications in the following areas.” In other words, materials programmes fall more into the category of fundamental research rather than specific mission oriented research, and this sadly makes funding for them more difficult to achieve.

Next to devices, materials and physical properties of materials, it is good to see a fair representation of contributions on biological systems, large molecules and lyotropics (also becoming strong in Strasbourg), with presentations on liquid crystal polymers, composites and gels, simulation and chirality not far behind.

So we have an exciting programme to look forward to and the only thing I have not mentioned is the future of liquid crystals. Looking into the future, of course, would require a “crystal ball”, rather than a “liquid crystal ball”, and as a scientist I am reluctant to base statements on other than fact. However, in asking about the future of liquid crystals, the questioner really has one concern in mind and that is “where is the next major application of liquid crystals going to come from?” Of course, if I knew the answer to this, I would be unlikely to speak about it in public, but the concern behind the question is real. Researchers in the field do worry about the following scenario:

Research funding in liquid crystals is strongly tied to applications and technology.

Technology of liquid crystals is predominantly related to display systems.

What will happen if displays reach such a peak of perfection that further research is not required or if some alternative display technology supplants liquid crystal displays?

My personal view is that such displays will go on for a long time yet. There is always room for development and improvement, and stemming from fundamental research, new possibilities keep emerging. These same worries about the future of liquid crystals were around some fifteen years ago, since when we have had ferroelectric possibilities followed by antiferroelectric displays, not to mention the potential for in-plane switching devices and electroclinic applications, and current activity in photo-optical effects and light emitting liquid crystal polymers continue to fuel the fire of progress. Also DERA/Screen Technology Limited this week demonstrated the first photoluminescent device doing away with colour filters and potentially reducing the cost of TFT/TN devices.

We must always remember, however, that the current situation in liquid crystal displays only came about through ideas, principles and materials developed in the course of fundamental research studies of liquid crystal systems. It is unlikely that the phenomenon of the Liquid Crystal Display Industry will ever happen again in some other area of liquid crystals, but if other, even only niche, applications are to emerge, these will only do so through basic, fundamental research by good scientists with the ability to see how the new knowledge they discover may be applied, given the relevant technology, for the benefit of society; they will certainly not fall from heaven like manna.

In this context therefore, it is good to see that an expanding effort in the field of liquid crystals is being given to topics such as:

Biological systems. In the 1960/70s this was a very strong area which did not develop into a wider pursuit of knowledge about the role of liquid crystals in living systems. Perhaps the medical fraternity was not ready for the concept. Maybe it now is.



Large molecules and elastomeric systems. This is a strongly developing area.

Free standing films. This is the subject of a recent monograph by A. A. Sonin.

Composites and confined systems. This includes, for example, liquid crystal/aerosil systems and their role in the area of rheology.

Simulation and modelling. How can we start to treat molecules as they really are, beautiful creations, each with its own personality, dynamic not rigid, and adaptable to their environment? At ELCC '99, in Crete, it was encouraging to see bananas being replaced by dolphins – a better if still primitive analogy to real molecules. But if moving forward from hard rods and discs makes computer time too expensive, is the alternative to return to fundamental theory and calculations involving more molecular parameters? But will this in turn be too time consuming?

The future I am sure holds much for all of us to do and to discover, but the really important point is that the new knowledge which may lead to new applications and profitability can only come if we are free to pursue a substantial amount of untied research devoted to fundamental science. It must be a continuing duty for all of us to keep making the point loudly and clearly to those who determine the policies of grant giving bodies that the preservation of fundamental research is a vital prerequisite for future success in establishing new technologies and applications.

With this message I conclude these opening remarks to this unique and special meeting.