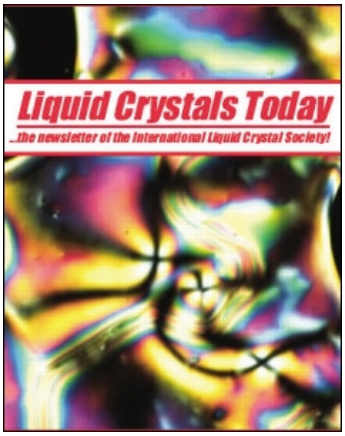


Liquid Crystals Today
Publication details, including instructions for authors and subscription information:
http://www.informaworld.com/smpp/title~content=t713681230

AROUND THE LIQUID CRYSTAL WORLD FOCUS ON: ITALY

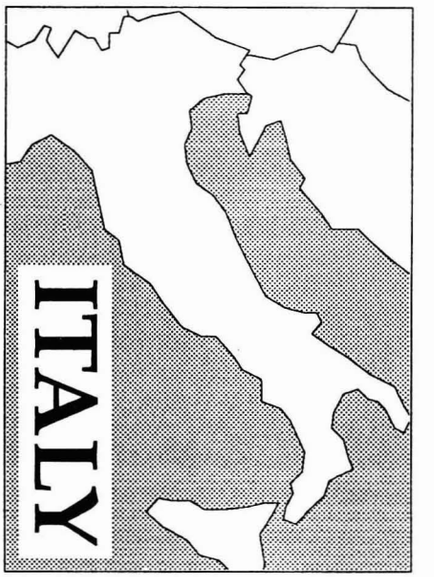
Marco Fontana[a]
[a] Universita di Parma,

To cite this Article Fontana, Marco(1991) '*AROUND THE LIQUID CRYSTAL WORLD* FOCUS ON: ITALY', Liquid Crystals Today, 1: 2, 4 — 7
To link to this Article: DOI: 10.1080/13583149108628574
URL: http://dx.doi.org/10.1080/13583149108628574

AROUND THE LIQUID CRYSTAL WORLD

FOCUS ON:

From Marco Fontana,
Universita di Parma



Research in liquid crystal science and technology is relatively recent in Italy, if we compare our history with that of countries such as France and Germany, where the field has been cultivated for almost a century. Thus only in the last twenty years have we witnessed a substantial growth in the physics and chemistry of this fascinating state of matter.

Liquid Crystal Community in Italy

As more investment and manpower were devoted to the growth of liquid crystal research in Italy, there appeared a need for closer contact among the researchers involved, given the lack of tradition in this field. Thus the Gruppo Nazionale Cristalli Liquidi (GNCL) was born, as a totally informal group to which all interested researchers could belong, where they could exchange information, and plan scientific or educational activities in all fields related to liquid crystal science and technology. In the Italian situation it was necessary to do quite a lot of work to make the scientific and industrial community aware of the potential (and the realities) of liquid crystal research. It was clear to the GNCL that a priority would be to publicise liquid crystal research through Conferences, Schools etc. First efforts in this direction culminated in the very successful Physics of Liquid Crystals Summer School which was held in Cosenza in September 1981. The Proceedings of this School were published by CLUP (Torino, 1982) and are still a good general reference for those who wish to approach the field.

The Cosenza School signalled to the Italian scientific community that indeed a new and interesting field of research had opened and was actively being pursued on an international level in Italy. There followed a period of consolidation and strengthening of the original research groups which lasted for about ten years. In this time the liquid crystal community in Italy grew qualitatively and quantitatively to include about 200 researchers in physics, chemistry and also engineering and the medical sciences. Although the large majority of researchers were from universities a small but significant number came from Italian industrial laboratories.

Each year over 400 papers are published in the main scientific journals by Italian researchers. Furthermore our community has been particularly active in recent years in organising international meetings Besides the European Meeting ECLC 91, we have organised the first three International Topical Meetings on the Optics of Liquid Crystals, the first two Italo-Soviet Symposia, and we shall be organising the International Conference of 1992 at Pisa.

Molecular Behaviour

The investigation of liquid crystals at a molecular level has been pursued by various groups in Italy, both theoretically and experimentally. In a molecular investigation the emphasis is on the description of the structure of a liquid crystal phase in terms of order parameters and of its dynamics in terms of correlation functions and correlation times. We can identify three main areas of activity: theory, spectroscopy and computer simulations. The theory of rotational diffusion in liquid crystals has been developed by P L Nordio and his group (particularly U Segre and G Moro) in Padova and has been applied to various kinds of spectroscopic studies and notably to magnetic resonance. More recently the Padova group has concentrated on the dynamics of flexible molecules and has investigated diffusion in smectic phases.

C Zannoni's group in Bologna has developed the theory for the fluorescence depolarisation of a dye molecule due to its rotational motion in liquid crystals or in various biological structures that have a local liquid crystal order, such as membranes or nerve fibres. Experimental studies of time dependent fluorescence depolarisation anisotropy are performed in Bologna with A Arcioni, R Tarroni, and in Parma by M Fontana's group.

More recently C A Veracini in Pisa has joined this field and introduced phase fluorimetry. Other spectroscopic techniques employed to study dynamics and order parameters are polarised Raman scattering used by M Fontana in Parma while infrared is used both in Parma and by G Zerbi's group in Milano. The Parma group has determined orientational correlation functions of first and second rank in liquid crystals combining these two techniques.

Magnetic Resonance

Nuclear Magnetic Resonance investigations are performed in various universities. Structural and order parameter determinations of a large number of organic molecules dissolved in liquid crystals using various nuclei — notably proton and deuteron — have been performed by the groups of C A Veracini in Pisa and by P Bucci, G Chidichimo and M Longeri at UNICAL. Recently the Pisa group have developed (in collaboration with C Zannoni's group) a maximum entropy method to obtain torsional distributions for flexible molecules in the fluid phase.

Electron spin resonance investigations of liquid crystals using spin labelling techniques have been performed in Padova, Bologna and Pisa. The Pisa group of M Giordano, D Leporino, M Martinelli, and L Pardi has developed experimental techniques for studying ultra-slow motion via non-linear ESR spectroscopy, and these are now being applied to polymeric liquid crystals. The study of the structure of lyotropic phases has been carried out by the UNICAL group of G Chidichimo. They have focussed on the influence of molecular segregation as a driving force for systems with non-constant curvature. Recently this group has been very active in the development and study of an exciting new class of liquid crystal devices: Polymer Dispersed Liquid Crystals (PDLC). These materials consist of micron or sub-micron liquid crystal droplets embedded in a polymer matrix. A suitably prepared PDLC film can be switched and has applications in large area electro-optic displays. The

molecular organisation inside PDLC droplets has been studied by the UNICAL group in collaboration with J W Doane (Kent State, USA) with deuteron NMR and has recently been studied by Monte Carlo simulations by Zannoni's group (Bologna).

Simulation and Spectroscpy

Computer simulations of model liquid crystals are performed in Bologna by C Chiccoli, P Pasini, F Semeria and C Zannoni with the aim of developing methods of studying anisotropic observables and investigating the nematic-isotropic phase transition. S Romano (Pavia) has investigated spin lattice models with long range interactions.

Spectroscopic studies of liquid crystal oligomers and polymers are carried out in Milan by G Zerbi's group using Fourier Transform Infrared Interferometry, Fourier Transform Raman Spectroscopy, and Multichannel Raman Spectroscopy. In particular it has been found that intermolecular interactions are like conformational solitons or twistons; all such phenomena are also being investigated theoretically. Polymeric liquid crystals are also studied by line shape analysis Raman and IR spectroscopy by the Parma group.

Structure and Lyotropics

The structural and thermodynamic properties of thermotropic and lyotropic liquid crystals are investigated in Ancona by G Rustichelli and his group, using X-ray diffraction, neutron scattering, differential scanning calorimetry and electron microscopy. In particular, organo-metallic liquid crystals are studied in co-operation with Ghedini and Bartolino (Cosenza), and polymer liquid crystals in collaboration with Chiellini (Pisa) and Angeloni (Bologna). Studies are also taking place of polymorphism of lipid systems interacting with exogen molecules like anaesthetics, drugs, and enzymes with implications for biology medicine and the cosmetic industry. Lyotropic mesophases of nucleic acids and their derivatives are investigated in collaboration with Gottarelli(Bologna). Finally the structural properties of Langmuir-Blodgett films are being studied using an original method to determine the electron density distribution.

Research on phase diagrams of microemulsions is carried out in Firenze by D Senatra and his group, using dielectric techniques, electro-optical and magneto-optical methods, quasi-elastic light scattering and thermal analysis. Investigated systems are of four components: oil, surfactant, cosurfactant and water. In particular the properties of bulk water and interphase water are studied, as well as the hydration process. Mathematical models of multicomponent lyotropic systems are being developed in Catania by A Raudino and his group.

Chiral Systems

Molecular and supramolecular chirality is studied by Gottarelli (Bologna), by synthesis of chiral thermotropic liquid crystals, by studies of the association of oligonucleotides and DNA, and of reactivity in liquid crystalline phases. Main chain and side chain liquid crystalline polymers are synthesised and characterised by Angeloni and his group in Bologna. Particular attention is given to LCPs containing the photoresponsive azobenzene group, when the macro-molecular structure and properties are studied as a function of chemical constitution, length of spacer group and type and length of the substituents attached to the aromatic core. Such systems are studied through the behaviour of the macroscopic parameter by Grasso and his group in Catania.

Organometallics

Organometallic thermotropic liquid crystals are being synthesised and characterised by Ghedini (Cosenza). A new class of compounds with azobenzene-like groups complexed with palladium is of great interest. Such materials are studied by Bartolino (Cosenza)using a variety of techniques, including optical and electron micro-scopy, light scattering and non-linear optics. Electro-optic effects are studied both in MOLCs and PDLCs. Phase transitions and instabilities are also being studied in lyotropic systems. Bartolino's group is also involved in the study of surface effects and thin films. Particular attention is given to bistability effects due to metastable anchoring at glass plates with controlled oblique SiO_2 evaporation. Finally, strong optical non-linearities have been observed in PDLCs and more so in MOLCs.

Polymer Liquid Crystals

In Genova Marsano's group studies thermotropic and lyotropic liquid crystals: aromatic polyamides, natural polymers, block copolymers with rigid and flexible parts, and chain polyesters. The rheology of LCPs is studied by Marrucci (Napoli), both by theoretical modelling and by the development of novel rheological techniques, such as intermittent shear or oscillatory and steady shear superposition.

Non-linear optical effects are studied in Napoli by Santamoto, Abbate and collaborators. Among the novel effects studied are the optical transistor effect and the incoherent interaction between the two optical beams; the Self-Induced Stimulated Light Scattering effect has been studied experimentally and modelled theoretically. Non-linear optical effects in PDLCs are also studied in Napoli by Simoni and his group. In the same group, LC parameters are measured by non-linear optical methods and the feasibility of optical switching and bistability for application to optical devices is being investigated. *(cont. on p7)*

Petrarch and Liquid Crystals

On this page we review liquid crystal science in Italy, and we can also reveal that the earliest recorded reference to liquid crystals is in a sonnet by the Italian writer Petrarch. This discovery was announced to great acclaim by Martin Schadt at the European Liquid Crystal Conference in Courmayeur in March of this year.

The Florentine writer Francesco Petrarca (1304 - 1374) is regarded as the founder of humanism, and his writings ranged across many disciplines. One of his contributions to the Renaissance was to develop a substantially new Italian language, and we can thank Petrarch for coining the phrase "liquid crystal". This appears in the first stanza of the delightful sonnet No. 181 reproduced here:

> *The morning songs of birds on their sad themes*
> *at daybreak fill the dene with echoing calls,*
> *and there's the sigh as liquid crystals fall,*
> *pouring in brisk and chilly shining streams.*

The original Italian "liquidi cristalli" is translated as "clear or limpid spring waters", but who knows what Petrarch had in mind when he wrote the piece. A reference to limpid fluids also occurs in a story by Edgar Allan Poe, who is often credited with the first description of a cholesteric liquid crystal — see the article by H Stegemeyer and H Kelker on p 3. Thanks are due to Alistair Elliot (Newcastle, UK) for providing a moving English translation of the sonnet, and to Marion and Peter Maitlis (Sheffield, UK) for research.

SOCIETY NEWS

GLENN BROWN AWARD for PhD THESIS

The Planning and Steering Committee of the International Liquid Crystal Conference instituted a prize in honour of Professor Glenn Brown, for an outstanding PhD thesis in the field of liquid crystal research. The laureate is selected prior to each conference in the biennial series of International Liquid Crystal Conferences and will deliver the Glenn Brown lecture at the Conference.

The Award Committee consists of S Chandraskhar (Bangalore); S Kobayashi (Tokyo); H Sackmann (Hallé) and S T Lagerwall (Chairman) (Göteborg). The next award will be presented at the 14th International Conference in Pisa, Italy, June 21-26 1992. Nominations should have reached the Chairman before 10 January 1992.

There are no restrictions regarding the subfield, thus theoretical, experimental or applied work is equally welcome on both thermotropic and lyotropic systems. A thesis can be nominated by anyone and should not be more than three years old.

The nominating person should state his name and affiliation as well as those of student and thesis adviser. In the nomination the full thesis — which will not be returned — has to be accompanied by a four-to-five page abstract in English. If the thesis itself is not written in English, German or French, the abstract should be about twice this length.

Correspondance should be sent to: Prof S T Lagerwall, Physics Dept, Chalmers University of Technology. S-412 96 Göteborg, Sweden.

Membership

Applications for membership continue to arrive and we now have well over 200 registered members.

There are many more liquid crystal scientists who are expected to join, and we look forward to receiving YOUR application (membership form enclosed). We hope that a significant source of income will be through sustaining membership, and if you are in a company with liquid crystal interests perhaps you will propose it for sustaining membership. About 25% of our membership is in countries with non-convertible currencies. We have not yet finalised arrangements for collection of dues from these areas, but hope that an arrangement will appear in the next issue of *Liquid Crystals Today*.

National Societies or groups which have affiliated so far are those from Canada, Italy and the United Kingdom, and we look forward to receiving affiliation applications from other national societies. According to our constitution, affiliation ensures regional representation on the Board of Directors of the ILCS.

Liquid Crystal Science in Italy *(continued from page 5)*

Liquid Crystals as Solvents

The synthesis and characterisation of PLCs and model compounds of low molecular weight is carried out by Sirugi and his group in Napoli. Systems studied include MOLCs, and reticulated LC model compounds. The reactivity of liquid crystalline phases is studied in Palermo by De Maria and his group. In particular LCs are used as solvents to produce organic reactions which otherwise would proceed with difficulty.

The possibility of using lyotropic LCs for this purpose is also studied. Mechanical properties of LCPs are studied in Pisa by Magagnini and his group. Chiellini 's group synthesise and characterise LCPs, with particular emphasis on structural modifications and correlations between chirality and other properties. Surface properties of LCs are researched in Pisa by Faetti and his group by interface ellipsometry, along with the determination of elastic and viscosity properties.

Optical Properties

Phase transitions in LCs are studied by Scuderi and his group in Roma. In particular photothermal and calorimetric critical measurements are made to study the universality classes of different phase transitions in LCs. Non-linear optical effects are being measured in liquid suspensions of dielectric microparticles. Several macroscopic properties, particularly of thin layers and interfaces, are the object of research by Oldano and his group in Torino. Theoretical work is also being done on the statistical mechanics of phase transitions, on the optical behaviour of thin layers and on continuum behaviour. Experimental work on surface characteristics (anchoring energy, surface polarisation), optical properties of a-chiral and chiral systems, noise analysis, dielectric and thermal properties is also beingstudied.

In conclusion liquid crystal science in Italy is alive and well, and has risen to a high level of competence and expertise in a comparatively short time. ❑

Scientific Notes

"New Short-Pitch Bistable Ferroelectric (SBF) Liquid Crystal Displays"

J Fünfschilling and M Schadt,
F Hoffmann-La Roche,
Central Research Units,
CH-4002, Basel, Switzerland

A new type of bistable electro-optical device based on ferroelectric S_c^* liquid crystals exhibiting a short pitch and a large spontaneous polarisation has recently been reported (Japanese Journal of Applied Physics, Vol 30, 1991). SBF-LCDs have short switching times (25 μs) at room temperature, contrast ratios > 35 as well as high multiplexing ratios (> 1000). On-state brightness is large due to memory switching angles of 44°, while response times and memory tilt angles only have a weak temperature dependence.❑