

the substrate exceeds the linear critical velocity ( $v_c$ ) of the film. There is, as yet, no theoretical explanation of these differences.

Although many features remain to be investigated in further more precise experiments—it would, for example, be useful to determine accurately the extent to which the angular velocity of the film outside  $r_c$  lags behind that of the substrate—it is evident that this work has provided the first useful insight into the rotational behaviour of a two-dimensional superfluid.

## Chemists and physicists in resonance

from J. A. S. Smith

When Ponce de Leon first landed on the Atlantic coast of Florida on April 3 1513, he is said to have been seeking "a never failing spring of such marvellous efficacy that when the water is drunk, it makes old people young again". The 105 participants at the 3rd International Symposium on Nuclear Quadrupole Resonance Spectroscopy who assembled in Tampa, Florida, just 462 years and 11 days later, were not perhaps expecting such a dramatic change in their lives, but in any event they almost certainly experienced a scientific rejuvenation.

ONE common theme of a number of papers was the investigation of static and dynamic critical phenomena at phase transitions. Quadrupole and magnetic resonance studies of frequencies, line-widths, and relaxation times now provide an important method of study, and the expected cusp (both maximum and minimum) in the relaxation rate,  $T_1^{-1}$ , as a function of temperature was shown to occur in a number of instances, such as  $^{23}\text{Na}$  relaxation in  $\text{NaNO}_2$  and  $^{75}\text{As}$  relaxation in  $\text{NH}_4\text{H}_2\text{AsO}_4$  (F. Borsa and A. Rigamonti, University of Pavia). In related papers, R. L. Armstrong (University of Toronto) showed the importance of anharmonicity effects in the perovskite  $\text{CsPbCl}_3$  by combining  $^{35}\text{Cl}$  quadrupole resonance studies with neutron inelastic scattering spectroscopy, and H. Chihara (University of Osaka) presented further examples of displacive processes in the phase transitions observed in chloranil and ferroelectric  $\text{NH}_4[\text{H}(\text{CICH}_2\text{COO})_2]$ . The theme was continued in a number of contributed papers concerned with such diverse structures as  $[\text{CH}_3\text{NH}_3]_2\text{PtCl}_6$  (D. Nakamura *et al.*, Nagoya University),  $\text{SbCl}_3$  (R. J. C. Brown *et*

*al.*, Queen's University, Kingston, Ontario),  $\text{NaSH}$  (K. R. Jeffrey, Queen's University), and  $\text{NaNO}_2$  and  $\text{NaNbO}_3$  (A. Avogadro *et al.*, University of Pavia). A related topic of much current interest is that of molecular motion and relaxation: A. Tzalmona (Hebrew University of Jerusalem) reviewed his applications of the sudden-jump approximation to such studies. Using  $^{14}\text{N}$  quadrupole resonance, Y. Abe and his coworkers (Tokyo University of Education) demonstrated the presence of at least two molecular modes in ethylenediamine, in one of which the molecule twisted between two equivalent *gauche* configurations; T. A. Scott *et al.* (University of Florida, Gainesville) discussed the librations of the nitrogen molecule in both the pure solid and *p*-quinone clathrate; the motions of the  $\text{PCl}_3$  group (I. G. Shaposhnikov *et al.*, Perm University, USSR) and  $-\text{BCl}_3$  and  $-\text{CCl}_3$  groups (S. Ardjomand and E. A. C. Lucken, University of Geneva) were also discussed in a number of molecules. E. Schempp (University of Pittsburgh) mentioned several crystals in which the acoustic phonon branches appear to dominate the negative temperature dependence of the frequencies at low temperatures, giving rise to a  $T^4$  dependence.

The calculation of nuclear quadrupole interactions and electric field gradients in solids was reviewed by T. P. Das (State University of New York, Albany); in non-cubic metals, pseudo-potential calculations have been applied in recent years with limited success to evaluate the contribution of the conduction electrons. An important conclusion of these calculations is that the electric field gradient depends on the whole electron distribution, not just on those electrons near the Fermi surface which dominate the Knight shift. With solids such as Te, Se and S, tight-binding wave functions built out of atomic orbitals on the atoms need to be used, and even in non-cubic ionic crystals, recent work has shown the importance of allowing for the distortion of electronic orbitals by neighbouring ions through overlap and covalent bonding effects.

On the experimental side, the increasing importance of pulse techniques was evident in many papers. Among these, we may refer to the success of double resonance methods; R. Blinc (Institute J. Stefan, Ljubljana, Yugoslavia) reviewed very thoroughly these techniques and demonstrated that their sensitivity was now sufficient to detect  $^{14}\text{N}$  quadrupole resonance of the peptide nitrogens in polyglycine. J. L. Ragle (University of Massachusetts, Amherst) discussed the elegant experimental methods by which he has detected  $^2\text{H}$  quadrupole resonance with

good resolution ( $<1$  kHz) in many halogenated hydrocarbons, with a sensitivity sufficient to detect deuterons 5 to 6 Å away from the marker nucleus (for example the  $\beta$ -deuterons in the pyridine ring of  $\text{C}_5\text{D}_5\text{N}\cdot\text{CDCl}_3$ ). Other workers reported the double resonance detection of  $^{55}\text{Mn}$  quadrupole resonance in carbonyls and  $^{14}\text{N}$  quadrupole resonance in transition-metal glyoxime and bipyridyl complexes (T. L. Brown *et al.*, University of Illinois, Urbana), and  $^{27}\text{Al}$  quadrupole resonance in  $\text{AlBr}_3$  (N. Weiden and A. Weiss, Technische Hochschule, Darmstadt). Another new development is the revival of interest in high-pressure studies; in the alkylammonium halides (G. Jugie and J. A. S. Smith, University of London), chlorocyclophosphatrienes (W. H. Dagleish and A. L. Porte, University of Glasgow) and trihalides of As and Sb (G. C. Gillies and R. J. C. Brown, Queen's University), the observed pressure shifts were related to changes in the intermolecular bonding.

In chemical applications of the technique, there is clearly a tendency to widen the range of nuclei that are studied. We have referred earlier to the deuterium,  $^{27}\text{Al}$ ,  $^{55}\text{Mn}$ , and among others we may mention  $^{51}\text{V}$  studies of  $\text{V}_2\text{O}_5$  (V. A. Gubanov *et al.*, Ural Science Centre, Sverdlovsk) and the attempts now being made in several laboratories to study the structure of organometallic compounds by quadrupole resonance, for example  $^{187}\text{Re}$  resonance in trimethylsilyl and trimethylgermyl perrhenates (H. Schmidbaur *et al.*, Technische Universität, Munich),  $^{59}\text{Co}$  resonance in dicobalt octacarbonyl and its alkyne derivatives (M. C. L. Gerry *et al.*, University of British Columbia, Vancouver), and  $^{69,71}\text{Ga}$ ,  $^{115}\text{In}$  studies of group III organometallic compounds (T. B. Brill *et al.*, University of Delaware, Newark).

The widening range of problems now being studied by nuclear quadrupole resonance and relaxation was very evident, which is perhaps a consequence of the close liaison which exists between chemists and physicists in this branch of radiofrequency spectroscopy. The Florida symposium did much to forward this collaboration.

## High pressure living

from A. L. Rice

HYDROSTATIC pressure increases in the sea by one atmosphere for every 10 metres or so in depth, so that in the deepest parts of the oceans pressures well in excess of 1,000 atmospheres prevail and almost nine tenths of the ocean bed experience pressures of 100 atmospheres or more. Until a little over a century ago these stupendous pressures, along with the other 'inhospit-