Analytical ultracentrifugation

at Nottingham, Leicester and the National Centre for Macromolecular Hydrodynamics

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On 26–27 March 1998, the fifth UK Analytical Ultracentrifuge Users Meeting was held at the National Centre for Macromolecular Hydrodynamics (NCMH), located at the University of Nottingham's Sutton Bonington campus. This was a meeting of the Techniques Group and Protein and Peptides Group of the Biochemical Society, in conjunction with the British Biophysical Society. An extremely pleasing feature was the attendance of more than 100 delegates from the UK, continental Europe, USA and Australia (Figure 1). Contrast this with the attendance of only 12 delegates at the inaugural UK Analytical Ultracentrifuge Users Meeting, held at the University of Leicester in September 1988. After languishing in the doldrums for many years, analytical ultracentrifugation has clearly experienced a return to favour during this last decade of the 20th century.

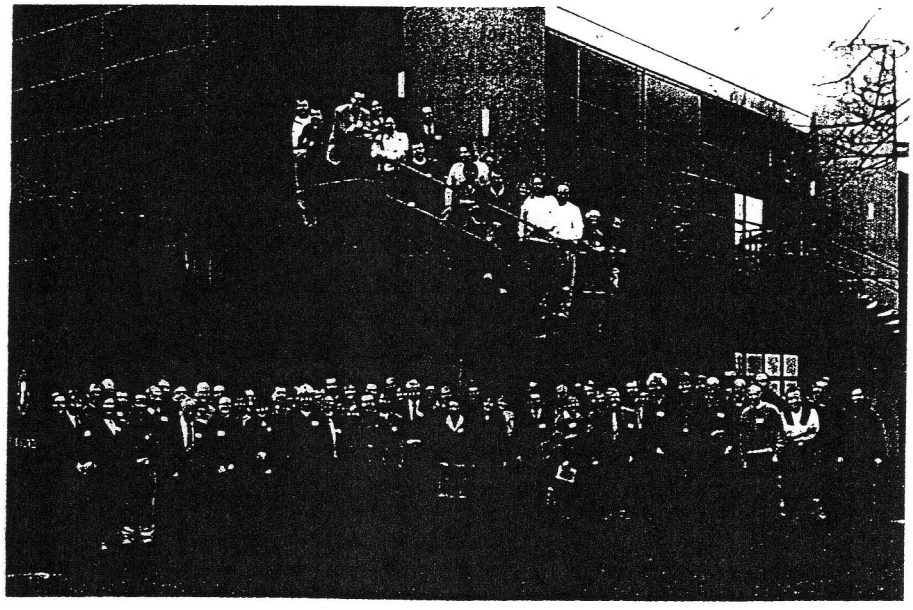

Figure 1. Participants at the 5th UK Analytical Ultracentrifuge Users Meeting held at NCMH in March 1998.

The National Centre for Macromolecular Hydrodynamics

The NCMH, a UK/North European facility supported by the Biotechnology and Biological Sciences Research Council and the Engineering and Physical Sciences Research Council, hosted the meeting in celebration of 10 highly successful years of the Centre as a joint venture between laboratories at the Sutton Bonington campus of Nottingham University and the Department of Biochemistry at the University of Leicester. The meeting also heralded the imminent move (in September 1998) of the Leicester laboratory to join the rest of the NCMH at Sutton Bonington. NCMH provides a facility for researchers in an academic or industrial environment who are working on biomolecules and biomolecular technologies for:

- determining macromolecular sizes, oligomeric composition and molecular mass distributions;
- determining the conformation of macromolecules and macromolecular assemblies in solution; and
- assaying for macromolecule–macromolecule and macromolecule–ligand interactions — determining the stoichiometries and strengths of equilibrium reactions.

Besides providing a facility, the NCMH has been at the forefront of developing hydrodynamic methodologies in collaboration with colleagues in Spain, Germany, USA and Australia. Analytical ultracentrifugation forms the

cornerstone technique, together with light scattering [dynamic and SEC-MALLS(size-exclusion chromatography coupled to multi-angle laser light scattering)] and high-precision viscometry. Supporting methods, involving the use of rotational diffusion probes (e.g. NMR), electron microscopy, X-ray crystallography and surface biophysical probes, are available in surrounding laboratories.

A meeting to mark the retirement of Arthur Rowe

Figure 2. Arthur J. Rowe.

The meeting also marked the retirement of Dr Arthur J. Rowe (Figure 2) as Senior Lecturer in Biochemistry at the University of Leicester and his appointment as Special Professor in Biomolecular Technology at the University of Nottingham. Arthur has had a distinguished research career which started in the old Colloid Science Laboratories in Free School Lane, Cambridge, where he was a PhD student and a Post-doctoral Associate with Dr Paley Johnson. Further postdoctoral stints with Professor Hugh Huxley at the Laboratory of Molecular Biology in Hills Road, Cambridge, and with Professor Ian Gibbons at Harvard University, preceded his appointment in 1966 to the staff of the Biochemistry Department set up by Professor Hans Kornberg (now Sir Hans) at the University of Leicester. Among Arthur Rowe's many successes was the first visualization of antibody structure by electron microscopy, with Dr Arnold Feinstein[1], and the discovery made with Dr Maria Maw of the triple-strandedness of myosin filaments[2]. At Nottingham, Arthur will be Executive Director of the newly established NCMH Business Centre; he will also continue his activities in developing ultracentrifuge methodology for application to specific biological problems — activities for which he has acquired a distinguished reputation in the field.

50 years of analytical ultracentrifugation at Nottingham: the Jordan and Creeth years

Figure 3. Dennis Oswald Jordan (1914–1982).

Nottingham has had a much longer pedigree in analytical ultracentrifugation than many realize — 1998 is the 50th Jubilee of the University of Nottingham, which was an external college of the University of London prior to receipt of its Royal Charter in 1948. At that time, a group led by D.O. (Doj) Jordan (Figure 3) in the Physical Chemistry Laboratories at Nottingham was one of a number of research groups chasing after the elusive structure of DNA: the group was equipped with the standard physicochemical equipment of the day — pH meter, viscometer, electrophoresis apparatus and a Sharples ultracentrifuge (loaned from ICI), to be replaced by one of the first Beckman Model E ultracentrifuges (serial no. 11, secured with a personal grant from the Rockefeller Foundation in 1949). Working with J.M. Gulland and PhD student, J.M. (Michael) Creeth (Figure 4), Jordan used pH titrations, streaming birefringence and electrophoresis to demonstrate the existence of hydrogen-bonding in DNA structure (see, for example, refs 3 and 4), which, together with evidence appearing to show the value of unity for A/T and G/C[5,6], provided the groundwork for the Watson and Crick discovery. In their full paper on the double-helix structure, Watson and Crick[7] used the fact that DNA chains were known to be thin rods (20 Å in diameter and many thousands of angstroms in length), the credit for that information being a reference by Jordan[8] which involved intrinsic viscosity and sedimentation coefficient measurements,

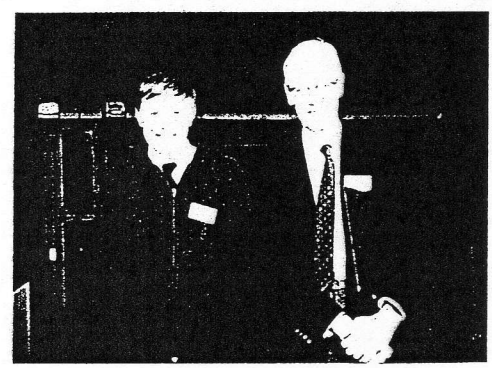

Figure 4. Les Sarcoe and J. Michael Creeth (right) at the 5th UK Analytical Ultracentrifuge Users Meeting.

the latter by the analytical ultracentrifuge. It is interesting to speculate whether this final step in the discovery of the double helix could have been made at Nottingham. The tragic loss, however, of Gulland in a 1949 train crash was a contributing factor to the disintegration of the Nottingham research group by the time that Watson, Crick and Wilkins matched Jordan's observations with X-ray diffraction patterns to establish the double-helical structure of DNA. Jordan moved to Adelaide at the end of 1953 to become Head of the Department of Physical and Inorganic Chemistry, and remained there until his retirement in 1979. Creeth arrived a year after Jordan, fresh from a stimulating postdoctoral stay in Wisconsin with L.J. Gosting and J.W. Williams; he returned to the UK in 1960 to join the Lister Institute of Preventive Medicine. When the Lister Institute closed, Creeth moved to the University of Bristol; he retired in 1984. During his time as a Senior Lecturer at Adelaide University, Creeth first began training postgraduates and he supervised the PhD of one of us (DJW); another of us (SEH) was the last to gain the benefit of experiencing the Creeth approach to analytical ultracentrifugation — as a Postdoctoral Fellow (1980–1982) at the University of Bristol. We therefore had personal grounds for delight that the earlier Nottingham ultracentrifuge era was represented by the attendance of Michael Creeth and his wife, Pat. The other guests of honour were the Schachmans (Howard and Ethel), who provided a link with the USA ultracentrifuge heritage.

After an absence of 30 years, Model E ultracentrifuges returned in force to the University of Nottingham in October 1984. The instruments have now been equipped with laser light sources and on-line cameras/computers, and have been joined by the new-generation XL-A and XL-I ultracentrifuges. The University of Nottingham has regained the international status in ultracentrifugation that it enjoyed half a century ago, and this meeting provided an admirable and most-enjoyable opportunity to link the old and new ultracentrifugation eras.

We thank Dr John Coates (the former PhD student who made the Nottingham–Adelaide transfer with Jordan and the Model E), Dr Harold Booth (who recently retired from the Department of Chemistry at Nottingham), Dr Michael Hey (from the same department) and Shea Smith (Secretary of the Department of Physical and Inorganic Chemistry at Adelaide throughout the Jordan era) for their valuable assistance with the compilation of this résumé.

Further information about the Jordan years can be found at the following website: http://www.asap.unimelb.edu.au/bsparcs/aasmemoirs/jordan.htm

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