The 53rd Hatfield Memorial Lecture, ‘Big Science and Materials – Opportunities, Breakthroughs and the Future’, was presented on 6 December 2005 at the University of Sheffield by Professor John Wood, Chief Executive Officer of the Council for the Central Laboratories of the Research Councils (CCLRC).

The lecture also formed the ninth of a series of Centenary Lectures held throughout 2005 on wide-ranging topics to mark 100 years since the university received its Charter. Professor Wood was welcomed back as a former graduate of the university who, before taking up his present position, held posts at Cambridge, the Open and Nottingham Universities, while interacting extensively with industries and serving on numerous national and Government bodies.

The UK Government spends a significant proportion of its basic science funds on large-scale facilities and on international projects, and the lecture opened with an overview of the CCLRC in its operation of three major laboratories in the UK and its role in expediting international collaboration, and leading or supporting programmes on behalf of the UK science community. While many of the programmes are driven by fundamental science, they are increasingly opening up new insights into the structure and behaviour of engineering and biological materials, creating new opportunities and practical benefits.

The three laboratories of the CCLRC, the Rutherford-Appleton Laboratory in Oxfordshire, the Daresbury Laboratory in Cheshire and the Chilbolton Observatory in Hampshire, all provide facilities with equipment that is too large, expensive and complex in operation to be run within university departments, but made available to them and others to maintain UK research at the frontiers of world science.

To envisage their use, Wood encouraged the audience to ‘Think big, think small – think fast, think slow’. The largest equipment is often necessary to investigate the smallest objects, while observations of dynamic processes at incredibly short time scales need to be replayed at speeds where their mechanisms can be unravelled.

The ISIS machine, designed and built at the Rutherford-Appleton Laboratory, continues to provide the world’s brightest pulsed neutron source. Its neutrons have been utilised to examine antiferromagnetism, phase transformations, hydrogen bonding, quantum fluids, superconductivity, water in biological systems, vortices, catalysts, polymers, surfactants and most recently, proteins. Much new information has also been obtained from the Central Laser Facility.

At the Daresbury Laboratory, the Synchrotron Radiation Source (SRS) provides a versatile supply of photons that have been widely exploited to unravel the structures, phase transitions and structural changes in a huge range of materials. The supercomputing facility has enabled large scale simulations to be run and beautiful dynamic illustrations of some of these, notably of vortex formation from helicopter blade rotation and the dissolution of a crystal, were presented. Many examples were provided of the impact of the research in structural integrity, catalysis, surface properties, in the processing and manufacture of engineering materials, the structure and function of natural and biomimetic materials and the identification and preservation of artefacts that enhance our cultural heritage.

The lecture concluded with a glimpse into future developments, exploring various methods of energy storage and production, including nuclear fusion. The design and construction of impressive future equipment was described, with improvements in detectors that may, for example, be capable of identifying gravitational waves.

The increased intensity of radiation from new machines, with wavelengths optimised, higher time resolution and greater computer power for data processing, will allow dynamic events, down to atomic scale resolution, to be observed and measured at unprecedented rates. This solves previously intractable problems and opens up whole new areas of exploration.

The lecture was sponsored by IOM3, University of Sheffield, SMEA, The Armourers and Brasiers Co, The Ironmongers Co, TWI and NAMTEC. More than 500 people attended.

The lecture can be viewed online at: www.hatfield-memoriallecture.group.shef.ac.uk/wood/.

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