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Chemistry in Pasteur's Quadrant

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CSIRO (www.csiro.au) is the largest of the publicly funded Australian research agencies. It is focussed on research that benefits Australia by improving the environment, health, and the economy. The success of CSIRO depends on a deep understanding of the fundamental scientific disciplines. Chemistry has been a strength since 1927, when the focus was on animal health. As the Australian economy has grown, the focus of the chemistry done by CSIRO has changed to reflect the needs of the nation.

Chemists working in the current CSIRO Molecular and Health Technologies, a division of 320 people, and its many CSIRO Division antecedents[1] have an impressive record of work that contributes both to advancement of knowledge and to producing value to the Australian economy and society. It is useful to differentiate CSIRO research from that of the universities and companies. Stokes[2] has characterized research of this type, that is research that advances knowledge and provides economic outcomes, as belonging in Pasteur's quadrant, in contrast to work in the Bohr quadrant, that seeks advancement of knowledge alone, and in the Edison quadrant, that seeks utility alone. This approach in this CSIRO division has, for example, produced the mineral floatation process used extensively in the mining industry, the first influenza drug 'Relenza', the polymer banknote technology which is used in Australia and 32 other countries, the insecticide 'Cycloprothrin', the Focus Night and Day contact lens, Elast-Eon, Novosorb, and seen the establishment of many new technology-based companies.

The papers in this issue of the *Australian Journal of Chemistry*, which marks the transition of CSIRO Molecular Science and CSIRO Health Sciences and Nutrition to the new division of CSIRO Molecular and Health Technologies, shows that this tradition of excellence in science combined with a strong commitment to utility is thriving.

Considine, Drummond, and Dixon,[3] continuing the long CSIRO contribution to surface and colloid chemistry, have used atomic force microscopy to measure the force of interaction between pairs of silica colloids in aqueous inorganic and natural organic electrolyte solutions. The paper shows that some adhesion can occur in natural organic matter solutions and will contribute to the understanding of the interaction between silica surfaces in complex aqueous solutions.

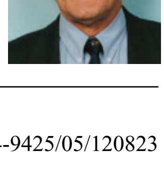
Research into optically variable devices embedded into polymers was an integral part of the polymer banknote technology. Evans and Such[4] review recent trends in photochromism including their own work on the attachment of oligomers to dyes. Photochromic dyes are used in opthalmic lenses and have the potential to be used in three-dimensional data storage devices. Research on modifying the switching speed of a dye in a polymer matrix is particularly relevant to the latter application. It is typical of CSIRO research that technology platforms are developed which can have multiple application. Evans makes use of technologies to control molecular weight distribution in polymers, an area developed over many years in CSIRO reaching back to Rizzardo and Solomon.

Sweigers and Wild[5] report results that suggest that some low molecular weight tertiary phosphine polymers are helically coiled and hence can form single-handed conformers. This is unusual behaviour and the authors explore the chain length dependence of this behaviour.

One of the most successful CSIRO areas of research in the polymer domain has been based on biostable polymer implants. This technology is now in AorTech Biomaterials and the paper by Mudumba, Padsalgikar, and Littler[6] describes the development of analytical techniques to measure small molecule leaching from the Elast-Eon polymers, a key issue for human-implantable polymers.

Greg Simpson joined the CSIRO Division of Applied Organic Chemistry in 1983. He is currently Deputy Chief of CSIRO Molecular and Health Technologies. During his time in CSIRO Greg has worked in a range of technology areas in research, commercialization, and management roles. He is currently President of the Royal Australian Chemical Institute and directs the CSIRO Secure Australia program.

Tom Spurling joined the CSIRO Division of Applied Chemistry in 1969 and retired from the Organization in 2003. He was Chief of the Divisions of Chemicals and Polymers and Molecular Science from 1989 until 1999 when he went to Indonesia to manage a World Bank project. He is now a Professor in the Australian Centre for Emerging Technologies and Society at Swinburne University and CEO of CRC Wood Innovations.



Greg and Tom share an interest in the future of the Australian Chemical Industry and the Richmond Football Club.

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Strong mathematical and computational capabilities have characterized the CSIRO chemical tradition. Polley, Burden, and Winkler[7] show how this can be made into a useful product with their development of the *MolSAR* package to predict the ADMET (absorption, distribution, metabolism, excretion, toxicity) properties of drug leads. They have modelled intestinal absorption data using several types of molecular descriptors and Bayesian neural networks to produce excellent predictions.

The great challenge of synthetic chemistry is to learn how to synthesize and manufacture any new substance of scientific and practical interest, using compact synthetic schemes with high product selectivity in an energy-efficient and environmentally friendly way.[8] The papers by Liepa, Nguyen, and Saubern,[9] Johnson and Turner,[10] Ali and Winzenberg,[11] and Savage and Wernert[12] illustrate how CSIRO is continuing to meet this challenge. There is a particular focus on heterocyclic chemistry in CSIRO, and Australia generally, in the production of chemical diversity.

Liepa, Nguyen, and Saubern[9] have enhanced the range of thiochromones available for development as biologically active agents by their discovery of an alternative synthesis pathway to a variety of 4-oxothiochromenes and related compounds. The novel compounds from this work are being screened for crop protection activities at the DuPont Stine–Haskell research center Laboratory in Delaware, USA. A further contribution by Liepa, this time co-authored by Adhikari, Jones, and Nearn,[13] describes an alternate synthesis of *N*-substituted methylene lactams as fungicidal agents. Fallon, Francis, Johansson, Liepa, and Woodgate[14] report on the regioselective formation of some fused thiatriazines by an unusual use of chlorosulfonylchloroformamidines as 1,3-dielectriphiles.

Johnson and Turner[10] have developed a short, efficient synthesis of 1,4,6,2-oxathiazaphosphorines. These molecules are prone to ring opening and thus are limited in their use as building blocks for compounds containing the six-membered ring system. They are, however, useful for the preparation of a wide variety of substituted phosphorus molecules.

Savage and Wernert[12] continue the theme of nitrile oxide cycloaddition which has been developed here and at the Australian National University over the last decade. This paper highlights the use of benzotriazole as a steric auxiliary to enhance the range of cycloaddition chemistry.

Ali and Winzenberg[11] have similarly explored annulation chemistry to prepare a range of potential biologically active materials based on a substituted 3,4-dihydropyridin-2(1*H*)-one motif.

All biologically active compounds have to be screened for activity in the laboratory and eventually tested in the field. For most areas CSIRO needs to collaborate with an industrial partner or a hospital. This is not the case for wood treatments where the CSIRO–New Zealand joint venture ENSIS has its own testing facilities. Carr, Duggan, Humphrey, Platts, and Tyndall[15] have used these facilities to show that environmentally benign boron compounds are both effective fungicides and can be made leach-resistant.

Biological methods are increasingly used to expand the synthetic methodology available to chemistry. Rasmussen, Henderson, Chowdury, Straffon, Dumsday, Coulter, and Zachariou[16] report the biological oxidation of cineole and other terpenes using microbes isolated using the Evolver technology.

It is with the understanding of biological systems at the molecular level that chemistry will make major contributions. Hendry, McCall, and Lockett[17] describe the molecular engineering of hammerhead ribozymes to develop precise catalysts as RNA cleavage agents. Precise RNA cleavage offers potential in the development of human therapeutics.

We commented at the beginning of this foreword on the excellence of chemistry producing useful outcomes—we also note here that these outcomes depend critically on partnerships. The authors of the papers in this edition come from partners in universities, industry, other research institutions, and from Cooperative Research Centres.

This issue of the *Australian Journal of Chemistry* shows the wisdom of Pasteur's words:[18]

> *There does not exist a category of science to which one can give the name applied science. There are science and the applications of science, bound together as the fruit of the tree which bears it.*

References

[1] T. H. Spurling, *Chem. Aust.* **1997**, Oct, 12.

[2] D. E. Stokes, *Pasteur's Quadrant: Basic Science and Technological Innovation* **1997** (Brookings Institution Press: Washington, DC).

[3] R. F. Considine, C. J. Drummond, D. R. Dixon, *Aust. J. Chem.* **2005**, *58*, 837. doi:10.1071/CH05154

[4] R. A. Evans, G. K. Such, *Aust. J. Chem.* **2005**, *58*, 825. doi:10.1071/CH05049

[5] G. F. Swiegers, S. B. Wild, *Aust. J. Chem.* **2005**, *58*, 831. doi:10.1071/CH05253

[6] R. Mudumba, A. D. Padsalgikar, S. W. Littler, *Aust. J. Chem.* **2005**, *58*, 845. doi:10.1071/CH05240

[7] M. J. Polley, F. R. Burden, D. A. Winkler, *Aust. J. Chem.* **2005**, *58*, 859. doi:10.1071/CH05202

[8] National Research Council of the National Academies, *Beyond the Molecular Frontier (Challenges for Chemistry and Chemical Engineering)* **2003** (National Academies Press: Washington, DC). www.nap.edu/books/0309084776/html/

[9] A. J. Liepa, O. Nguyen, S. Saubern, *Aust. J. Chem.* **2005**, *58*, 864. doi:10.1071/CH05205

[10] W. M. Johnson, K. A. Turner, *Aust. J. Chem.* **2005**, *58*, 834. doi:10.1071/CH05190

[11] A. A. Ali, K. N. Winzenberg, *Aust. J. Chem.* **2005**, *58*, 870. doi:10.1071/CH05188

[12] G. P. Savage, G. T. Wernert, *Aust. J. Chem.* **2005**, *58*, 877. doi:10.1071/CH05189

[13] R. Adhikari, D. A. Jones, A. J. Liepa, R. H. Nearn, *Aust. J. Chem.* **2005**, *58*, 882. doi:10.1071/CH05286

[14] G. D. Fallon, C. L. Francis, K. Johansson, A. J. Liepa, R. C. J. Woodgate, *Aust. J. Chem.* **2005**, *58*, 891. doi:10.1071/CH05070

[15] J. M. Carr, P. J. Duggan, D. G. Humphrey, J. A. Platts, E. M. Tyndall, *Aust. J. Chem.* **2005**, *58*, 901. doi:10.1071/CH05226

[16] J. M. Rasmussen, K. A. Henderson, M. J. Straffon, G. J. Dumsday, J. Coulter, M. Zachariou, *Aust. J. Chem.* **2005**, *58*, 912. doi:10.1071/CH05204

[17] P. Hendry, M. J. McCall, T. J. Lockett, *Aust. J. Chem.* **2005**, *58*, 851. doi:10.1071/CH05196

[18] L. Pasteur, *Rev. Sci. France* **1871**.