the computational and experimental techniques used in studying molecular interactions.

PHILIP C. H. MITCHELL
University of Reading, UK

Advanced Practical Inorganic and Metalorganic Chemistry

R. J. Errington
Blackie Academic and Professional, 1997
xii + 288 pages. Soft cover £24.99
ISBN 0-7514-0225-7

This eminently readable book has been written to bridge the cultural gap for students moving from carrying out synthetic chemistry in a teaching environment to performing preparative chemistry in a research environment. The emphasis is on the handling of air-sensitive compounds, although methods for the characterization of compounds are covered briefly in later chapters.

Important preliminaries for the new research student, such as searching and keeping up to date with the chemical literature, and the maintenance and content of laboratory notebooks, are prominently featured in the introductory chapter.

The use of Schlenk lines, glove boxes and high-vacuum lines is comprehensively covered. For example, in the chapter devoted to Schlenk techniques we are taken through a discussion of aspects of the design and setting up of an inert-gas/vacuum manifold, to considerations of the inert-gas supply and purification columns, and finally to a description of filtration techniques using Schlenk apparatus.

Having considered the apparatus to be used in our experiments the author then moves on to discuss the solvents and reagents which might be employed. There is much useful information collected here on the purification and drying of solvents (including the design and maintenance of solvent stills). The section on reagents is by its very nature somewhat general. Nevertheless the author provides a host of useful ideas for carrying out halogenation, ligand metathesis, alkylation, oxidation, reduction and deprotonation reactions.

By this stage we are ready to carry out a reaction! Focusing on air-sensitive materials, the author discusses techniques for the measurement of quantities of reagent and their introduction to the reaction vessel, and for heating and mixing the reaction mixture. Subsequently of course the products must be worked up, isolated and purified and the ways in which this can be achieved are quite thoroughly described. There is also a useful discussion at this point of the long-term storage of sensitive materials in ampoules. The growing importance of the reactions of solids is recognized by the author and discussed here in two short chapters.

Characterization of products now follows, the emphasis being on the preparation of samples for measurement, rather than the theory of particular techniques, as is appropriate to the general thrust of the text.

Special techniques such as microwave heating, metal vapour synthesis and sonication are treated briefly in the penultimate chapter and the book concludes with short descriptions of preparative methods for selected compounds, which largely reflect the author's own research interests.

In conclusion, the text is lucid and is supplemented by many clear line drawings of apparatus. The book will be of interest to anyone embarking on a career in preparative chemistry and should also provide more experienced researchers with new ideas on how to carry out their synthetic studies.

DEREK A. TOCHER
University College London

Edward Frankland: Chemistry, Controversy and Conspiracy in Victorian England

C. A. Russell
Cambridge University Press, Cambridge, 1996
xx + 535 pages. £65.00, 110.00
ISBN 0-521-49636-5

All cultures need their heroes, and organometallic chemistry has an excellent one in Edward Frankland. In the past he has been undersung but, with this scholarly researched and referenced biography by Colin Russell, Frankland should now receive the recognition he deserves.

He was born in Churchtown, near Lancaster, in 1825, the illegitimate son of Edward Gorst Jr and Margaret Frankland, who was a servant in the home of Edward Gorst Sr, a prominent lawyer in Preston. Soon afterwards, his mother married William Helm, and Frankland lived in Lancaster with his stepfather and mother, who took in lodgers for a living. He never gave interviews, and though his own recollections were published in 1901 as *Sketches from the Life of Sir Edward Frankland,* this was rapidly withdrawn before reappearing in an expurgated edition. The secret of his origins was suppressed, and this may have influenced the fact that neither the Royal Society nor the Chemical Society published an obituary when he died in 1899.

Colin Russell and his wife Shirley very fortunately came across a collection of several thousand documents in the hands of Frankland's descendants. Microfilm copies of these papers have been deposited in the Open University Library, and it is largely on these papers that the present book is based.

After a rudimentary education at eight different schools, Frankland was apprenticed for six years to a pharmacist's shop in Lancaster; then in 1845, on recommendation of a medical friend, he moved to London to be assistant in analytical chemistry to Lyon Playfair of the Geological Survey. Here he met Kolbe, who was to be a life-long friend. He attended Playfair's

lectures at Putney College, passing with credit the only chemistry examination which he ever sat.

In 1847 Frankland spent three months with Kolbe in Bunsen's laboratory in Marburg, where in 1849 he became the first Englishman to obtain a Ph.D. He then had a series of appointments, some of which he held simultaneously: Professor at Putney College (1850), the first Professor of Chemistry at Owen's College (later the University of Manchester) (1851–1857), Lecturer at the Royal Indian Military College (1959–1861), at the Royal Institution (1863–1865) and finally Hofmann's successor (1865–1885) at the Royal College of Chemistry (later to become Imperial College).

Frankland's entry into organometallic chemistry came in 1848 in his attempts to isolate organic radicals, by reactions such as that of potassium with ethyl iodide to give potassium iodide and the ethyl radical. With current knowledge of atomic weights it is clear that his 'ethyl' was in fact butane:

$$2EtI + 2K \rightarrow 2KI + EtEt$$

These reactions were often violent if not explosive, and to moderate the reactivity he moved instead to zinc. He heated methyl iodide in a sealed tube with zinc, and obtained a compound which reacted violently with water giving a greenish-blue flame. He had obtained dimethylzinc:

$$2MeI + 2Zn \rightarrow ZnI_2 + Me_2Zn$$

Under similar conditions, tin reacted with ethyl iodide to give diethyltin diodide:

$$2EtI + Sn \rightarrow Et_2SnI_2$$

Though Zeise had prepared the platinum–ethylene complex $K^+ [C_2H_4PtCl_3]^-$ in 1827, and Bunsen had obtained from potassium acetate and As_2O_3 a series of cacodyls such as $Me_2AsAsMe_2$ and Me_2AsCl in the 1840s, Frankland was the first to recognize that there existed whole series of compounds to be found, which he set out to investigate systematically. He coined the name 'organometallic', and can rightfully be recognized as the father of the subject. He contributed to the chemistry of the organic derivatives of mercury, boron, silicon, lead, arsenic, antimony, and bismuth. His organozinc and organomercury compounds were used for the alkylation of other Main-Group metals and the organozincs were used in organic synthesis for the alkylation of what we would now call electrophilic centres in organic molecules, right up to 1900, when Grignard's organomagnesium compounds were found to be easier to make and to handle. He survived explosions with his alkali metals, fires with his organozinc compounds and the habit of tasting all his products, including the organomercury and organolead compounds.

It was this work which led Frankland in 1852 to advance the concept that elements have a specific binding power or 'valency', and in 1866 he introduced the word 'bond' into chemical nomenclature. His *Lecture Notes for Students*, published in 1866, popularized these concepts and established him as one of the great chemical communicators of the 19th century.

Amongst all this, Frankland was involved extensively in consultancy, particularly in water analysis, and he submitted monthly official analyses of London's water supply and sat on the Royal Commission on River Pollution. He served as President of the Chemical Society (1871–1873) and as the first President of the Institute of Chemistry (1877–1880). He was elected a Fellow of the Royal Society in 1853 and was awarded its Bakerian Lectureship, the Royal Medal and the Copley Medal. He acted as its Foreign Secretary but never as President, probably because of the Royal Society's horror of 'trade', with which he was too closely associated because of his consultancies. He was knighted in 1897.

Russell argues that Frankland's illegitimacy gave him a sense of insecurity which drove him throughout his life to advance himself socially, financially and professionally. It made him accept multiple appointments, undertake consultancies, and to be manipulative rather than following established procedure, and was both his strength and his weakness.

This a fascinating book of social history and of the history of chemistry in roughly equal parts, and should be required reading for all contemporary organometallic chemists.

A. G. DAVIES
University College London