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Book review

Multiple Bonds and Low Coordination in Phosphorus Chemistry, M. Regitz and O.J. Scherer (Editors), G. Thieme Verlag, Stuttgart, 1990, 496 pages. DM 468. ISBN 3-13-752201-3.

The past 15 years have seen remarkable developments in the chemistry of phosphorus compounds containing double or triple bonds to other main group elements. The editors should be congratulated on bringing together, in a single volume, a collection of authoritative reviews of some of the most exciting aspects of contemporary organo-phosphorus chemistry. It is particularly appropriate that the book is dedicated to Professor Karl Dimroth, who was a pioneer in the early developments of compounds containing phosphorus–carbon multiple bonds.

The text consists of six sections; A. Historical Introduction, B. Bonding Properties of Low Coordinated Phosphorus Compounds, C. Phosphorus compounds with coordination number 1, D. Phosphorus compounds with coordination number 2, E. Phosphorus compounds with coordination number 3 and F. Survey of ^{31}P NMR data. A brief introduction by the editors gives an historical summary of the steady erosion of the so called “double bond rule” in the face of experimental evidence for the existence of many classes of organophosphorus compounds containing multiple bonds involving $p\pi$ – $p\pi$ orbital overlap. W. Schoeller presents a thoughtful and informative review of bonding and reactivity aspects of low coordinated phosphorus compounds, concentrating particularly on π -bond strengths, molecular orbital calculations, structural consequences, and patterns of reactivity of compounds containing P=C, P=N, P=P and P=Si bonds.

A substantial section (94 pages) on phosphorus compounds with coordination number 1 contains lucid accounts of phosphinidenes (RP) (Mathey; Huttner and Lang), phospho-alkynes $\text{RC}\equiv\text{P}$ (Regitz, Binger), and phosphorus nitride and polyphosphorus units (Scherer). As expected, from authors who are themselves major contributors to their respective fields, these sections are exemplary both in their coverage and insight. Particularly noteworthy topics covered include: (i) the synthetic potential of the RP fragment and its ligating properties towards transition metals, (ii) the wide range of ‘alkyne-like’ behaviour of the phospho-alkynes, exemplified by [2 + 1], [2 + 2], [3 + 2] and [4 + 2] cyclo-addition reactions, and their use as ligands in organotransition metal chemistry to afford phosphorus analogues of the better known, cyclobutadiene, cyclopentadienyl, allyl, etc., transition metal complexes, and (iii) ligating properties of P_1 , P_2 , P_3 , P_4 , P_5 and P_6 units.

The very wide range of compounds with coordination number 2 that are now known, is evidenced by the sections on phosphonium cations, (Sanchez, Mazières, Lamandé and Wolf), 2-phosphoallylic cations, (Schmidpeter), phosphinylidene boranes, (Bickelhaupt), phospho-alkenes and allenes (Appel), λ^3 -phosphinines and their aza and phospho derivatives (Märkl), heterophospholes (Schmidpeter and Karaghiosoff), silylene, germylene and stannylene iminophosphines (Niecke),

diphosphenes (Yoshifuji), phosphinylidene phosphoranes and sulfuranes (Schmidpeter) and oxo, thio and selenoxophosphines (Quin and Szewczyk). This section (237 pages) contains a wealth of information, including tables of data, showing clearly the exciting developments in these trivalent organophosphorus compounds and their transition metal complexes. In particular the contributions of Appel, Schmidpeter, Niecke, Märkl, and Yoshifuji discuss chemistry that would have seemed fanciful two decades ago.

The chemistry of novel unsaturated organophosphorus compounds, is not however confined to trivalent compounds, and bismethylenephosphoranes (Appel), methylene(imine, oxo, thioxo and selenoxo)phosphoranes (Heydt), bis(iminio)phosphoranes and their oxo, thioxo and selenoxo derivatives (Niecke and Gudat), phosphinylidene methylene(imino)phosphoranes (Yoshifuji), and dioxo and dithioxophosphoranes (Meisel), λ^5 -phosphaalkynes and nitrilophosphoranes (Majoral), are discussed fully by expert practitioners in the field. The volume concludes with a useful survey of ^{31}P NMR data for these classes of compounds (Karaghiosoff).

The quality of production of the book is excellent, and the chapters represent a timely account of exciting and unexpected aspects of low coordination chemistry, while offering tempting glimpses of possible future developments. It is highly recommended reading for all organometallic chemists, and all libraries should have a copy on their shelves. The high price however may limit the number of copies owned by individuals.

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