

the book. Projection operators are reserved for a later chapter on the representation of symmetry-adapted linear combinations, while the two concluding chapters treat vibrational spectroscopy and transition metal complexes. The most obvious comparison to be made is with Davidson's rather less ambitious but handy *Group Theory for Chemists* dating from 1991. Carter's book goes into considerably more depth than does Davidson's and is intellectually more satisfying; it also offers a more structured approach. It goes a long way towards its stated aim of bringing out the meaning and chemical significance carried by the mathematics of group theory without overdoing the mathematics itself. There are various appealing features, notably the adoption of a tabular method of reducing representations, as well as the use of group-subgroup relationships for dealing with infinite-order groups. Illustrations are bound to be important in any account of symmetry; the new book is not over-generous but the figures it does include are pertinent and workmanlike, while not inspired.

For all its virtues, the text is not without weaknesses. In places, the author's effort to be more rigorous has been at the expense of making the problem appear more difficult than it need be. For example, the burden of theory tends to mask the relative simplicity of working out the symmetries of vibrational modes. Similarly, the problem of combining the spin and orbital parts of a d^2 system to make the symmetry of the term arising from the e_g^2 configuration conform to the Pauli principle lacks context; in this particular connection, too, I cannot but regret the absence of any direct product tables in which antisymmetrised products are denoted. As a practising vibrational spectroscopist I found myself a little disappointed by the vibrational spectroscopy chapter. No effort is made to explain normal, internal or symmetry coordinates, and, although the normal modes of vibration of some simple molecules are portrayed in an appendix, there is no indication of how these might be derived. I am surprised that room has not been found for the symmetry-characterisation of bond-stretching modes; this, rather than the full vibrational characterisation, must be one of the most commonly applied criteria for appraising molecular symmetry. As a teaching primer the book would benefit from answers to the well conceived problems that appear at the end of each chapter, and from having some sort of bibliography making contact, say, with more rigorous treatments as well as literature highlighting the *other* side of chemical problems to which group theory is applicable (e.g. Ebsworth, Rankin and Cradock's book, *Structural Methods in Inorganic Chemistry*).

While falling short of my notional ideal, then, the book has much to commend it, and certainly deserves a place on the list of recommended reading for second- and third-year chemistry undergraduates; others for

whom group theory has so far proved elusive are likely no less to profit from it.

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Pf 50022-328X(98)00614-7

Application of Transition Metal Catalysts in Organic Synthesis, L. Brandsma, S.F. Vasilevsky and H.D. Verkruisje, Springer Verlag, Berlin, 1997, pp. 335 + xix, DM 198, US\$ 128, ISBN 3-540-62831-2

Anyone who has used the series of books written by Brandsma and collaborators will be very pleased to learn of the publication of a new volume which carries on the good work of this author. However, before extolling the virtues of this book I must make some critical comment on its rather general and misleading title. In the preface of the work, the authors note that their intention had been to cover a broader field of transition metal chemistry but that they felt that that was too ambitious a goal. Given the style of the book, I would agree with this decision, but feel that a more specific and informative title could and should have been used.

However, this is really my only criticism of what is an exceptionally useful manual, the primary function of which is to provide clear reproducible experimental procedures for carrying out copper-, palladium-, and nickel-catalysed coupling reactions. Ch. 1 starts with methods for the preparation of catalysts, ligands and reagents and, like the rest of the book, pays attention to detail. The section on Grignards includes critical evaluation of methods used and a discussion of commonly encountered problems that would be of considerable use to any synthetic chemistry group. Ch. 2 provides a summary of methods for the preparation of halogen-containing compounds and, given the synthetic importance of this group of compounds, this section is particularly welcome. Chs. 3, 4 and 5 cover various coupling reactions of alkynes, including aminoalkylation, oxidative dimerisation and diyne preparation. Ch. 6 is a very good chapter on copper-catalysed coupling of alkoxides with aryl and vinyl halides and the section on aromatic substitution methods is particularly informative. Ch. 7 describes copper-catalysed C-C bond formation including halide displacement, ring-opening of epoxides, and allylic and propargylic substitution reactions. Chs. 8 and 9 describe nickel catalysed iodo-dechlorination of sp^2 halides and cyanation of sp^2 halides and triflates, respectively. Ch. 10 covers coupling of sp^2 halides with acetylenes. This is a large and extremely informative section with numerous tables and

critical evaluation of available methods. The final chapter describes nickel- and palladium-catalysed cross-coupling with organometallics and, perhaps unsurprisingly, this is the largest chapter. This is a difficult subject to cover, given the huge number of examples that now exist, but the majority of general methods are discussed, including couplings with organolithium, magnesium, aluminium, boron, and tin reagents. At the end of this chapter there are 11 tables of examples. There are then several indexes including reaction types, experimental procedures and subjects, all of which greatly assist searching the book.

The work is very useful, primarily because the authors have carried out most, if not all, of the experiments

themselves and the procedures are therefore very detailed and have been carried out on a preparatively useful scale (50–100 mmol). The presentation is of the very highest standard and the work will provide an outstanding practical manual for those interested in the area. I strongly recommend this book, which should be an integral part of any library or personal collection.

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PII S0022-328X(98)00618-4