Polar Covalence; by R.T. Sanderson (Emeritus Professor, Arizona State University, Tempe, Arizona), Academic Press 1983 New York, xii + 240 pp. $19.50.

Here is a book about bonding in inorganic and organic compounds which hardly mentions wavefunctions, orbitals, or energy levels and is without the balloon-like pictures which commonly fill such books. Professor Sanderson develops the approach of his earlier books, considering that the most important properties of atoms are the electronegativity (given to three decimal places on a scale with $F = 4.000$) the non-polar covalent radius and the homonuclear covalent bond energy. When two atoms having different electronegativities combine, their electronegativities adjust to some intermediate value. Since the atomic parameters on which the theory depends are not directly measurable for all atoms, heavy reliance has to be placed on interpolation and what the author calls "numerous intuitive judgements", based on the assumption that these idealised quantities vary smoothly across the Periodic Table. Unexpectedly weak bonds, e.g. in difluorine, are accommodated by postulating a bond weakening effect associated with the presence of lone pairs. Professor Sanderson goes on to calculate the covalent and ionic contributions to the energies of bonds in more than 1000 compounds. The range of his applications is astonishing: he deals with hydrocarbons, organic halides, organic compounds containing oxygen, sulphur and nitrogen, organometallic compounds, free radicals, inorganic molecules (halides and oxides) and non-molecular solids.

The chapter on organometallic compounds is short, and discussion is confined to alkyl and phenyl derivatives of Main Group elements, together with a number of organometal halides. The approach developed in the rest of the book gives values for the energies of metal—carbon bonds which differ from those derived experimentally, using the usual assumption that bond energies within organic groups attached to metals are the same as those in the parent hydrocarbons. The discrepancies are greater for metal alkyls or aryls than for organometal halides. It is not at present clear what new understanding the theory of polar covalence gives in organometallic chemistry.

The thinking of inorganic chemists is informed by comparisons of the properties of one element with those of its neighbours in the Periodic Table. In his book, which follows through the quantitative consequences of such comparisons, we find interesting and convincing insights into the nature of chemical bonding. Whether the approach given here as a whole is more satisfying than that of most present-day textbooks is less clear. In order to accommodate the experimental measurements a large number of empirical adjustments must be made to hypothetical atomic properties, so that we lose the simplicity which at first seems attractive. The book does however remind us that we can describe chemical bonds in more ways than one, and that from a different point of view we may well see something new.

School of Chemistry and Molecular Sciences,
University of Sussex, Brighton BN1 9QJ (Great Britain)

J.D. SMITH