of its birth. If in mid-Victorian London the Chemical Society could spend traumatic evenings debating whether atoms "really" existed, in France the outlook for naive atomism was to be bleaker still. The strength of positivist dogma in Paris was a major contributor to the atmosphere of atomic scepticism that permeated physical science (organic chemistry almost alone excepted). The final dispersal of this cloud of unknowing was highly important for the development of modern science and has so far escaped a detailed historical analysis. That is why a book of this kind was urgently needed, and was bound to come, sooner or later.

It seems rather odd that discoveries in France itself should have been specially instrumental in establishing "molecular reality". Not that the opposition kept quiet, of course. The debates in the early years of this century were conducted with Gallic intensity, and at the centre of the fray was the hero of this narrative, the physical chemist Jean Perrin. The author's thesis is that Perrin's later "experimental endeavour was aimed at the resolution of the indecision over the atomic-molecular hypothesis as an assumption or possible alternative in any given physical discussion". It was said of him that "he 'sees' atoms—there is no doubt at all—as Saint Thomas saw seraphims".

The first quarter of the book is an informative chapter on the nineteenth century background. There follows an account of Perrin's early years and some of his first experiments. The last two chapters are entitled "The essential debate" and "Denouement". Throughout the book full attention is given to the "internal" scientific issues, such as the enormous intellectual impact of thermodynamics, the growth of colloid chemistry, the molecular implications of the kinetic theory, and (above all) the crucial studies of Brownian motion. There are a few inaccuracies in chemical terminology, but these are minor blemishes.

Full notes, an excellent bibliography and an index make this a useful addition to the growing literature on the history of modern science. C. A. RUSSELL

An Engineer *Manque*

Landscape with Machines: an Autobiography. By L. T. C. Rolt. Pp. xi+230. (Longmans: London, August 1971.) £3.25.

IN L. T. C. Rolt's *Landscape with Machines* we have an absorbing account of how this author grew up into his profession as an engineer and left it to become the popular writer on engineering history that he now is. Brought up in the Cotswolds and appreciative of the expertise that the country craftsmen around him displayed in their daily lives, and seizing every opportunity of enlarging his experience of mechanisms, he soon developed his own skills. Apprenticeship to a Midlands firm of agricultural engineers followed by a spell at the railway works at Stoke-on-Trent set him well on the way to becoming an engineer. At this time, the depressed state of industry, and his own enthusiasms, side-tracked him into becoming part-owner of a garage, the focal point of the Vintage Sports Car Club. Here his ingenuity and versatility had much scope, and he took part in motor racing whenever the opportunity arose, but he was not a very good business man, and, as his fortunes declined, after several abortive jobs, he finally decided to marry, to set up house on a narrow-boat at Banbury, and to begin a career as a writer. Fortunately he proved to have a gift of assimilating concepts and details of engineering matters and restating them in words easy for us to understand, so that his books have been popular, perhaps helped by his nostalgia for a green England in these days of preoccupation with pollution.

If he had been born a hundred years earlier, he might have become a captain of industry, forging ahead by his hard work and ingenuity, and with capital readily available for the man of ideas, in the climate engendered by the scientific revolution of the previous century. Such men — hard working, adventurous, ingenious and enthusiastic, had also to be tough, since "tinkering" was not enough and ideas had to be hammered out by careful and logical thought. Perhaps on this last point our author might have been found wanting. Let us be grateful for another of his interesting knowledgeable volumes.

AUBREY BURSTALL

Structure and Spectra

Symmetry, Orbitals and Spectra. By Milton Orchin and H. H. Jaffe. Pp. xiii+396. Supplement for *Symmetry Orbitals and Spectra: Problems and Answers*. Written with the help of G. Kuehnlenz and R. Ellis. Pp. vii+220. (Wiley Interscience: New York and London, November 1971.) £7.70.

ACCORDING to the preface, the book "is intended to guide the reader through introductory quantum mechanics and molecular orbital theory, the free electron method and the calculation of ultraviolet spectra, symmetry, group theory and its applications, the structure, bonding, and ultraviolet spectra of inorganic and organometallic complexes, selection rules governing the intensities of absorption bands, the fundamentals of infrared spectroscopy, noncomputer methods for Hückel molecular orbital calculations and their applications, and the basic principles of photochemistry and excited state chemistry, including the Woodward-Hoffman rules for the conservation of orbital symmetry in concerted reactions". This quotation serves as a good summary of the topics treated in the first eleven chapters, the last dealing briefly with "methods beyond the Hückel molecular orbital".

It is a pity that the authors decided to try to cover so many topics, at so many levels of sophistication, in a book of less than four hundred pages. The kernel of the book—the introduction to group theory, illustrated by its application to ligand field theory, the spectra of inorganic complexes, and molecular vibrations—is excellent but too condensed. This is a pity because, while this material is available elsewhere, no good general account of it has appeared at this level. As it is, these chapters would be difficult to read for anyone not already familiar with the material. The introduction to ligand field theory, for example, is inadequate and the application of group theory to specific problems, in particular the reduction of reducible representations, is not properly explained. It would also have been nice to see more applications of the technique, for example, to complexes other than octahedral ones (where most of the results can be obtained by simple considerations of symmetry). The disappointing thing is that the authors certainly could have done this because the book is very well written. As it is, the gold is sandwiched between two thick layers of dross (chapters 1–4 and 10–12). The introduction to MO theory in chapter three, for example, presupposes a knowledge of the usual MO picture of organic molecules in terms of hybrid AOs. Anyone who had reached that stage would be fully familiar with the material presented. Chapter four consists of an account of the free electron method and its application to polyenes and aromatic hydrocarbons, followed by a resonance theory account of cross conjugation and of the Brooker deviation in cyanine dyes. Hardly an adequate introduction to organic spectroscopy! Chapter eleven gives an equally inadequate introduction to photochemistry combined with a scrappy and irrelevant account of pericyclic reactions in terms of the conservation of orbital symmetry. The last chapter, probably the worst, offers a wholly inadequate introduction to the SCF method and procedures derived from it.

Even as it is, the central part of the book is very good and if the price were more reasonable it could have been recommended for that alone.

MICHAEL J. S. DEWAR