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Recensiones

R. E. Moss: Advanced Molecular Quantum Mechanics, p. XVI + 300, London: Chapman and Hall 1973, Price £5.90.

The subtitle of this book, "An Introduction to Relativistic Quantum Mechanics and the Quantum theory of reduction", gives the reader a pretty fair idea of the contents. The author intends it as graduate text for chemists and chemical physicists, the assumed background being that of undergraduate quantum mechanics and mathematics courses for chemists.

In the first three chapters of the book the author deals with the necessary background in non-relativistic quantum mechanics, vector and matrix algebra and classical mechanics. The treatment is brief and is I think intended to summarise and to extend slightly, perhaps, the assumed background knowledge of the reader. In the next three chapters special relativity, the interaction of charged particles with electro-magnetic fields (in a non-quantal way) and the classical theory of electromagnetic fields are discussed. The author then goes on to discuss relativistic wave equations for electrons and the setting up of the Dirac equation and its reduction to non-relativistic form. He discusses also the Breit equation and its reduction and gives one approach to the vexed question of how to introduce the nuclei properly into such a reduced equation. The problem of obtaining spectroscopically useful forms of the equation is then touched on, and after a brief look at the hydrogen atom problem in the various approaches discussed, the book ends with a chapter on the quantum theory of radiation.

The book is, as can be seen, a very ambitious one and it is, I think, a very good one too. There has long been a need for a book of this kind, in the precise area identified by the author in his preface. This book really meets that need at a level which should be attainable by the interested graduate student with the appropriate background. It is by no means an easy book and I think many graduate students with a pure chemistry background may have to work pretty hard at it, but I am sure that they will find it worthwhile to do just that. The book seemed singularly free from misprints and mistakes (though the review copy had pp. 112—129 missing!) it seems well produced and is not (by current standards) excessively expensive, and I think many students will want to possess a copy for themselves. Having said this however, there are a few points about the book which I think are worth further discussion.

The author assumes throughout that the relevant equations of motion for a particle in a field can be derived from a Lagrangian, but a reader who perhaps consults Rohrlich's book on the classical theory of charged particles to supplement his reading of Chapters 4 and 5, will find that this may not necessarily be the case. It is of course true that we cannot proceed in quantum mechanics without a Lagrangian, but it would here perhaps have been helpful to say as an aside that the Lagrangian is only possible on the *assumption* of the Lorentz force and this is an extra assumption.

The reader may also be forgiven for assuming from the author's asides particularly in Chapters 8 and 9 that many of the tricky problems with which the author deals so well, would go away if only he (the reader) could read and understand a book on quantum electrodynamics. I think in this respect the author sells himself short. It would not really help much at all to read a book on quantum electrodynamics in this context, and it would not help at all in the problem of nuclear terms. It seems to me that the treatment of the nuclei in this book is one of the weaker parts in that I think that the student who turns to the given reference in Bethe and Saltpeter, which the author quotes as clarification and partial justification of his stand, will not find much help there. But on the other hand I admit that I know of no other text that deals even remotely with this subject.

I was also a bit disappointed that there was no discussion of the problems of convergence in either the "small components" or the Foldy-Wouthuysen approach to the reduction of the relativistic equations. There is a real problem here, though again I admit no real solution, but it might have been worth pointing it out, particularly in the context of what classes of potentials may definitely not be included, if the reduction is to have any hope of being convergent.

Also in the chapter on the quantum theory of radiation, I think the author avoids the pitfalls of the "sudden" approach to switching on the radiation field, only to be hoist with the reaction matrix at the last minute since he seems to forget in deriving the "golden rule", that the reaction matrix is a function of time, so that his result (13.20) is, to me, not at all obvious.

In an important sense, however, these points are really quibbles, my advice to anyone who is interested in this subject would be to buy this book.

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