A tool of elegance and great power for physicists . . .

Peter McClintock

Green's Functions and Condensed Matter. By G. Rickayzen. Pp.357. ISBN 0-12-587950-4. (Academic: 1980.) £22.80, $55. *Many-Particle Physics.* By G.D. Mahan. Pp.1,003. ISBN 0-306-40411-7. (Plenum: 1981.) $85, £53.55.

WHEN George Green, miller and part-time theoretical physicist, died in 1841 at the early age of 47 the *Nottingham Review* commented regretfully that ". . . had his life been prolonged, he might have stood eminently high as a mathematician". Little did they realize. During his brief but remarkably productive twelve-year spell of scientific activity, starting with *An Essay on the Application of Mathematical Analysis to the Theories of Electricity and Magnetism* (published privately in 1828), Green had introduced the concept of electric potential, had carried out work of fundamental importance in wave theory and hydrodynamics and had laid the foundations for modern theories of elasticity. Notwithstanding this substantial contribution, however, and despite his acknowledged influence on both Stokes and Kelvin, Green's memory remained relatively obscure until more than a century after his death, when R.P. Feynman took up some of the techniques introduced by Green, and developed them for application to nuclear physics and the theory of elementary particles. The use of Green's function methods has subsequently spread through the rest of physics including, particularly, solid state physics.

Thus it has come about that no physicist in the 1980s can remain indifferent to Green's functions. For those who love them including, probably, the majority of theorists, Green's functions constitute a tool of elegance and great power, indispensable in some areas of physics, which can with advantage be applied to almost any problem with which they may be confronted. Others regard them with profound suspicion. They feel that devotees frequently employ Green's function techniques for their own sake, for the sheer joy of using them, and often at the expense of physical insights which can more readily be gained through simpler approaches. Their mistrust probably relates, at least in part, to a lack of understanding. The publication of two new advanced textbooks on the subject, each aimed at filling what has been an unfortunate lacuna in the literature, is therefore to be applauded.

The similarities between G. Rickayzen's *Green's Functions and Condensed Matter* and G.D. Mahan's *Many-Particle Physics* are greater than their differences. Both books are aimed at advanced graduate students, or academic staff, and both assume a good prior knowledge of quantum mechanics at the level provided, say, by the classic texts of Schiff or Landau and Lifshitz. They are both most definitely books of physics, as opposed to mathematics, each consisting very largely of an account of how Green's function and Feynman diagram techniques can be applied in practice to a selection of topics in solid state physics. Both books cover, for example, phonons, the Coulomb gas, electron–phonon interactions, transport theory, linear response, superconductivity and liquid helium (which by tradition is treated as solid state physics). Both provide, for each chapter, references to the original literature (Mahan's being the more extensive) and a set of problems, without solutions. In each case, the standard of production is high. The most obvious difference between the two books lies in their respective lengths: Rickayzen's has 357 pages in total whereas Mahan's, with 1,003, is almost three times as long. Much of this difference can be accounted for in terms of Mahan's detailed treatment of certain topics — for example, optical properties or polarons — which Rickayzen either omits or treats less fully; but, to a considerable extent, it also relates to their very different styles of presentation.

Mahan's stated objective was

> . . . to take standard subjects . . . and to summarize what is generally known. All the steps are retained in the derivation, so that the answers are obtained by starting from the beginning and working through to the end.

This latter feature is quite unusual in advanced texts, which commonly leave the reader to fill in a lot of the intermediate steps for himself, and it is a reflection of Mahan's declared intention of producing a book which graduate students will be able to use on their own, if necessary, in the absence of a formally taught course. It will also be a considerable help and encouragement to the less theoretically biased readers at all ages and stages. Mahan writes in a style which is relaxed without being imprecise, and which often displays refreshing candour as, for example, in relation to the ground state properties of quantum fluids where he comments that, unusually, ". . . the Green's function method gives awful results".

Rickayzen's book, which starts disarmingly with the truism that "Anyone who has used the Coulomb potential due to a point charge has used a Green's function", is by contrast a model of brevity and succintness. The most immediate benefit lies in the remarkable range of topics which he has managed to treat at a useful level in the space available: in addition to the items mentioned above, the book also includes chapters on magnetism, disordered systems and critical behaviour. The relatively condensed presentation should be well suited to the graduate student in theoretical physics at whom the book is primarily aimed, particularly if used to support and supplement the material provided in a formal course of lectures on the subject.

Each of these books is excellent in its own way. They should be a real help both in educating the next generation of solid state theorists and also in rendering "Greenery" just a little bit less daunting to those professional physicists who have not yet fully come to terms with the power and utility of these techniques. □

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. . . and another for molecular biologists

Ueli Schibler

Genetic Engineering 1. Edited by Robert Williamson. Pp.168. ISBN 0-12-270301-4. (Academic: 1981.) £9.80, $24.

GENETIC engineering has not turned dull molecular biologists into imaginative ones. There is, however, little doubt that both could profit immensely from this elegant and powerful technique. This is enough justification for a new series entitled *Genetic Engineering.* According to the editor, the purpose of the new periodical is to rapidly publish comprehensive reviews about different aspects of recombinant DNA technology. This first issue addresses a very heterogeneous readership, including students, experienced researchers and physicians. It brings together a rather technical article about cDNA cloning, an article about prenatal diagnosis of abnormal haemoglobin genes and a review on transcription of cloned genes in different experimental systems.

J. E. Williams provides a meticulous account of every aspect of the applicability and feasibility of cDNA cloning, and evaluates most of the tricks used in the enzymatic construction of recombinant molecules containing cDNA and their propagation in bacterial host cells. Particularly helpful are the discussions of mRNA complexity and the size of a cDNA library. Using this information one can easily calculate how many bacterial colonies should be screened to obtain, with a certain probability, an mRNA sequence of a given abundance. It is a pity that Williams did not include a short protocol