Electromagnetism

I USED the first edition of *Electricity and Magnetism* by B. I. Bleaney and B. Bleaney (Oxford University: London; hardback £17.50; paperback £9.95) as an undergraduate at Oxford in the fifties and when I came to Sussex in the sixties I bought the second edition. Now there is a third edition, which I have read with a sense of familiarity and which I still like, although I do wonder what sort of future it has for the student audience of the seventies. It is not cheap; but it contains a considerable amount of material likely to be taught in a range of undergraduate physics courses, rather than just one. In some ways this can be seen as a distinct merit; indeed, one wants to encourage students not to insulate one stream of knowledge from another. On the other hand, who would make *Electricity and Magnetism* their a main recommendation for a course on solid-state physics? And for a course on straight electromagnetism, who can overlook the range of cheaper texts which contain all the necessary material? Yet it is undoubtedly a valuable book, and one which in this new edition will continue to be referred to frequently.

The initial chapters on electrostatics and magnetic effects of currents are not greatly changed. They are still, it seems to me, a little dry and mathematical. The uniqueness theorem is no longer given but the section on expansion in special harmonics remains unpruned. The solid-state bias of the book has been strengthened and begins to tell as soon as currents are introduced in chapter 3. (There is a small misprint on page 65, which should read: $\overline{r^2}=2\tau^2$).

Later chapters (11–13) are devoted to free electrons in metals, to the band theory of metals and to superconductivity. The arrangement of this material is greatly improved and the entirely new chapter on superconductivity is a good addition. The chapters on magnetic materials (6), on the various forms of magnetism (14–16) and on magnetic resonance (23) are not very different in this edition. The same is true for dielectrics (10). It is right that the space devoted in the previous editions to thermionic vacuum tubes has been severely cut back, and the progression from semiconductors (17) through solid-state devices (18, 19) to amplifiers and oscillators (20) and other applications is much more satisfactory.

The authors continue to use SI units, bringing in pascals in place of mm Hg, but failing to use joules (p466) in place of m^{-1}. They are not consistent in the use of references; for example, why are Oliver and Sucksmith referenced on p484 but not Henry on p450? Some chapters (for example, 14) are starved of references, although generally the record is good. There are nearly 200 problems, together with numerical answers where appropriate.

A second new book to appear in the past year, *Electric and Magnetic Fields* by Sir Charles Oatley (Cambridge University: Cambridge, London and New York; Hardback £9.75; paperback £3.50), is completely new although it has apparently grown out of a ten-year stint of lecturing at a non-specialist level to undergraduate students of all branches of engineering. The blurb claims that it would also be suitable for physics majors, but I doubt it. Physicists have to cover electricity and magnetism more thoroughly in a main course and do not generally have an introductory course followed by a specialist course. The author has tried to keep mathematics to a minimum but has not always succeeded. For instance, the section on the equivalence of a small plane current loop and a magnetic dipole is stiff with mathematics, whereas the idea of potential is introduced in an unnecessarily loose verbal way. These are perhaps details, but they exemplify an approach which makes me feel uneasy about the development chapters. The ordering and stress seem peculiar, right from page 1. In the very first paragraph of the book we are assured that in wires it is "a reasonable assumption, at low frequencies, that the current is uniformly distributed over the cross-section . . . and concepts such as resistivity present no difficulty". A little further down we learn that the word "field" is to be used "in a general sense to indicate the region of space throughout which the effect which we are studying is appreciable". These statements strike me as questionable. Once the text moves into specific examples and applications, however, I begin to see its strengths.

The sections on induction and the chapters on the Laplace and Poisson equations and on non-linear magnetic materials are particularly valuable. Towards the end of the book, there is a chapter on electromagnetic waves, but this is too short (8 pages). The final chapter on the experimental basis of electromagnetic theory and some applications (such as eddy currents) is good. There are about 50 problems and a number of worked examples.

In conclusion, my own view is that for student audiences with which I am familiar (physicists, with a handful of chemistry and applied science majors), this book does not meet the challenge of Grant and Phillips' *Electromagnetism* (Wiley: London and New York, 1975). **D. S. Betts**

D. S. Betts is Lecturer in Physics at the University of Sussex, UK.

Vector analysis

Vector Analysis: A Physicist's Guide to the Mathematics of Fields in Three Dimensions. By N. Kemmer. Pp. xiv+254. (Cambridge University: Cambridge, London and New York, January 1977.) Hardcover £12; paperback £3.95.

IN the 'ideal university' this might be the right textbook for a physicists' first course on fields. But in most real universities there is not time to spend so long on one topic at this level. Students need to learn about partial differentiation, differential equations and vectors. They must also see how these mathematical tools are used in mechanics, in the description of waves and in thermodynamics. Electromagnetism and hydrodynamics provide the workshops where fields and vector analysis are to be understood, so we add half a dozen lectures to the 'Maths for Physics' course, to establish what the 'del 'operator is, and we let the students get a feel for 'div', 'grad', and 'curl' later, when they need to use them. If there is to be a respectable minimum time spent on pure mathematics then it is hard to give all the tools of applied mathematics the unhurried treatment they may deserve.

Such problems are solved differently in each department, and Edinburgh University's solution has produced this very enjoyable book. As a course text, I would guess it covers about twenty lectures' worth of material, including Gauss' divergence theorem, Stokes' theorem, simple solutions of Poisson's equation and boundary behaviour. But it would be a difficult book to which to refer students from a briefer course on the same topics because its strength lies in the elegant geometrical approach, which Professor Kemmer develops in the first few chapters, to discuss lines, surfaces and volumes in Euclidean space. For a teacher this new notation means he must take the book whole or leave it alone. It could, however, be worth recommending as private reading to those stronger students who might be able to set aside the time to work right through it. The presentation is methodical and very clear, with excellent diagrams. There are large numbers of exercises at each stage and a full set of specimen answers at the back.

David J. Miller

David Miller is Lecturer in Physics at University College, London, UK.