On the practical side

P.V.E. McClintock

Experimental Physics: Modern Methods. By R.A. Dunlap. *Oxford University Press: 1988. Pp. 377. $49. To be published in Britain in April, £45.*

PHYSICS is *a fortiori* an experimental subject. Take away the experiments and one is left with mathematics; and the mathematics, however beautiful, may not necessarily relate to the real universe that physicists endeavour to describe. That is why all undergraduate students of physics, even aspiring theorists, are at some stage expected to undertake laboratory experiments.

Organizers of laboratory classes encounter a number of problems. Commonly, because of the expense of providing multiple sets of each experiment, the students in a class will be working on a whole range of different experiments at any moment, rather than all doing the same one. Thus a parallel lecture course is inherently difficult to relate to the laboratory work. Reference to a necessarily wide range of standard texts is useful (and also of some value in familiarizing students with libraries), but this is often inconvenient, and sometimes even unhelpful, because the required text may very well not be available when it is needed.

It would be of immense value, therefore, to be able to recommend students to buy their own copies of a single book containing relevant information about most of the experimental work they will undertake. R.A. Dunlap's *Experimental Physics* is largely intended to be such a book. It owes its origins to a full-year junior-level course in experimental physics at Dalhousie University, Nova Scotia; the level is broadly comparable with a second-year undergraduate course in Britain. The 14 chapters cover a huge range, but concentrate particularly on topics in solid-state physics, optics and nuclear physics. The text is designed to act as a complete introduction for students majoring in physics and also as a "reference work for technicians throughout a professional career".

How far has Professor Dunlap succeeded in these aims? On the plus side, the book provides a clear and friendly exposition of many experimental topics — semiconductors, electronics, signal processing, thermometry, cryogenics and magnetism — some of which have been introduced relatively recently to the undergraduate laboratory. There are helpful references to standard texts relating to each of the chapters, for students who are interested or who require more detailed information. Of course, in a book of this kind almost every reader will be able to identify his or her own list of 'missing' topics: for example, there is not much discussion of experiments in thermodynamics or critical phenomena, or of the use of bridges for electrical measurements. The quality of production is mostly good, although a few of the diagrams strike me as crude and certainly fall far below the usual standards one associates with Oxford University Press.

One must seriously question the longevity being claimed for the book. Digging out the equivalent text in use during my own undergraduate days (B.L. Worsnop's and H.T. Flint's admirable *Advanced Practical Physics for Students*, 9th edn, Methuen, 1957), I was struck by how much of the landscape of experimental physics has been transformed during the intervening period; in fact, that book must already have seemed dated to the point of quaintness a decade or more ago. In this context, to say that *Experimental Physics* will be suitable for use throughout a professional career must surely be construed as publisher's hyperbole. Nonetheless, this first edition of Professor Dunlap's book is much to be welcomed. It should provide valuable reading and support for large numbers of physics students, over the next several years at least. □

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Simply . . . optics

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Optics. By K.D. Möller. *University Science Books, 20 Edgehill Road, Mill Valley, California 94941/Oxford University Press, UK:1988. Pp.644. $48, £35.*
Optics, 2nd edn. By F.G. Smith and J.H. Thomson. *Wiley:1988. Pp.320. Hbk £36.50, $73; pbk £11.95, $23.90.*
Optics, 3rd edn. By W.T. Welford. *Oxford University Press: 1988. Pp.155. Hbk £17.50, $39.95; pbk £8.95, $14.95.*

IF YOU have sweated blood and tears in writing an undergraduate textbook on optics, why agonize over the choice of title? Better surely to follow some illustrious predecessors and simply call it *Optics*. That is what each of the authors of the books reviewed here has done, one (Möller) in a brand new book, the other two in new editions of volumes originally published in the 1970s. In doing so, they must invite comparison with other new editions with exactly the same title and a similar intended audience, such as those by Hecht (Addison-Wesley) and Klein and Furtak (Wiley). And presumably the Pedrotti brothers would wish their new undergraduate textbook to be ranked in the same company, even though they have been rather verbose in their title, *Introduction to Optics* (Prentice-Hall).

Looking at the three books side by side, one is immediately struck by the differences in style and format, which are reflected in their relative prices. So in fairness to the authors, readers of this review should remind themselves of the prices shown above before going further.

Möller is a well-produced, larger-format book with colour plates, and even a rainbow hologram. The others are both part of standard series of physics textbooks (Welford from the Oxford Physics Series, Smith and Thomson from the Manchester Physics Series), and they are constrained in size, style and lavishness by the necessary uniformity of the series. All three aim to cover a wide syllabus in undergraduate optics, although with a number-of-pages ratio of 1:2:4 (Welford: Smith and Thomson:Möller) the same breadth and depth cannot be maintained in all of them. Welford acknowledges the brevity with which he covers some topics, and suggests that his book might correspond to a first-term university course. The other authors see theirs as supersets of an undergraduate syllabus in optics, and invite the lecturer to select a course from among the topics included.

Hooray! In geometrical optics, all three books employ the cartesian sign convention for distances, which is used by every self-respecting optical designer (whereas, oddly enough, the three competitors mentioned earlier use schoolboy style conventions). All deal with Fermat's principle, but Möller states it only in Fermat's original form of minimum path, rather than as the correct stationary path. This lends force to his use of Feynman's lifeguard analogy, which is certainly memorable, but it provides little insight into the physics underlying Fermat's principle. This is no mere pedantry: in many straightforward cases, rays do follow maximum paths.

Möller spends some time dealing with the matrix approach to paraxial ray-tracing, whereas this is not covered by the other two books. I personally find little to commend the matrix approach — in my experience it is rarely used by professionals in geometrical optics — but I acknowledge that it is a popular topic in optics textbooks (for example in Klein and Furtak). The Smith–Helmholtz–Lagrange optical invariant is surely an important item in geometrical optics; I could not find it dealt with by either Möller, or Smith and Thomson. Understandably at this level, none of the authors gives a long account of aberrations, but Welford's is particularly brief.

On the subject of diffraction theory,