contaminated Hanford nuclear processing site in the USA without accurate knowledge of the composition of buried material and the contents of vats of highly toxic waste. This would be aided considerably by lightweight, low maintenance and unattended detector systems with sufficient energy resolution. Similarly, miniature detector probes operating at human body temperature have potential uses in a variety of diagnostic medical procedures. It appears that these are still some way off. The ideal detector material has not yet been found, being a compromise between, sometimes conflicting, requirements which include good photon stopping power, a large enough bandgap for low leakage current, and thus noise, but small enough to allow easy ionisation for good resolving power. High purity, large samples are essential.

A review of the state of the art using high purity germanium is succeeded by comprehensive articles on leading candidate materials for advanced detectors, principally mercuric iodide and cadmium telluride. A frank account of the drawbacks and performance of gallium arsenide makes interesting reading, where both the long history and quite rapid recent progress, clearly partly driven by the availability of improved material, become evident. A chapter on 'other materials' surveys the wide variety of semiconductors which have been evaluated as detectors, usually after having been produced for some other commercial purpose.

Many of the materials studied have other applications, especially in rapidly developing commercial areas such as optoelectronics or copying technology. Despite this, many have roots as detectors going back half a century. The concluding summary lists the principal challenges still to be overcome: material hardness, low carrier mobilities and incomplete charge collection due to traps, and manufacturing difficulties, particularly at the purification and crystal growth stage. It is not surprising therefore to find much of the contents dominated by the chemistry and practical techniques of crystal preparation.

The volume is a valuable source of information on a large number of, some very exotic, materials. Summaries of detector performance characterisation and electronic systems make it a neatly self-contained reference work which will find a place in many libraries, although probably on the shelves of only a few individual researchers.

DR G. HULL
(Imperial College, London)

Susceptibility Tensors for Nonlinear Optics (Disk included), in the series *Optics and Optoelectronics*
By S. V. POPOV, YU. P. SVIRKO and N. I. ZHELUDEV

1995, £100·00 (hbk), pp. xiv + 194. Institute of Physics, ISBN 0 7503 0253. Scope: text, table and software. Level: specialist.

The field of nonlinear optics is well established and develops with the use of higher power lasers and faster pulses; hence there is a need to consider higher order nonlinear polarizations and susceptibilitites. However, most books deal with susceptibilities up to third order only and the reduction of the number of tensor elements due to crystal symmetry is not always fully explained although tables of results may be found. This book expounds the required algorithms in Chapter 3 and in addition it is the first to lay out in detail (Chapter 2) how constitutive equations are constructed with inclusion of spatial dispersion, that is, wave-vector dependence of the susceptibilities. The Appendices, which in total are thicker than the main text, tabulate the detailed forms of the susceptibility tensors from second to fourth order ($\chi^{(2)}$ to $\chi^{(4)}$) for all crystal classes; these tables are much more comprehensive than those in existing texts. Chapter 4, 'Implicit Constitutive Equations', covers less conventional material than the rest of the book. In the basic models for nonlinear optics a driving electric field E is equal to nonlinear expression in the polarization P. The tensors $\chi^{(2)}$, $\chi^{(3)}$ etc. are calculated from an expansion of P as an infinite series in powers of E but this can miss some essential physics in strongly nonlinear systems. It is shown here how the nonlinear differential equation for P can be re-expressed exactly as a finite implicit series in terms of tensor products like ξPPP; the forms of the various ξs in different crystal classes are of course given by the tables.

The book includes a software package, TURBO RANK, that can be used to calculate the forms of susceptibility tensors through to sixth order (seventh rank tensor) for all crystal classes. The user inputs the required tensor and crystal class and is able to specify additional symmetries, for example Kleinman symmetry, the requirement that when frequency dispersion is negligible, $\chi^{(n)}$ is symmetric under permutation of all suffices. The output is similar to conventional tables in that it states the linearly independent components and the expressions for the other nonvanishing components in terms of them. The package is easy to install and runs under Windows; we found it easy to learn and to use.

The exposition in the 60 or so pages of main text is clear but concise and the book is not intended as an introduction to nonlinear optics. The text, tables and software taken together are highly recommended as a powerful tool that many research groups in nonlinear optics will find indispensable.

J. OSMAN and D. TILLEY
(Universiti Sains Malaysia)

The Quantum Dot: A Journey into the Future of Microelectronics
By R. TURTON

1995, £11·99 (pbk), pp. x + 211. W. H. Freeman, ISBN 0 7167 4517 8. Scope: review. Level: undergraduate and general.

Imagine some twenty years ago, pencil in hand, you are musing on your predictions for the electronics of the future. How well would you have succeeded? We were then only a short way down the intricacy of integration, with several thousands of transistors emblazoned on each silicon chip. Would the subsequent ten thousand-fold multiplication have seemed sane and reasonable to you? This time Richard Turton sits with his laptop attempting to draw us the same vision, '*A Journey into the Future of Microelectronics*' as he subtitles his book. He has provided an extremely sane and reasonable view into the innards of the devices which purposefully shuffle electrons around, and has peered through the fringes of device research into an uncertain future.

This is a book I thoroughly enjoyed reading, and feel sure would inspire any of my undergraduate students with the intrigue of shepherding electrons around. It is a text devoid of equations, but stuffed with analogies that illuminate; some familiar, such as bath-and-ballcock equivalents to field-effect-transistors, and some I encountered for the first time, such as the electronic states at the band-gap of a semiconductor modelled as the grains of sand in an egg-timer. Richard Turton's first clear aim has been to provide an accessible way to understand modern microelectronics by building up an intuition in the mind of the reader, without recourse to initially distracting mathematics. He clearly succeeds in this, producing as deft an account as any previously, which a capable high-school student can devour and retain as a coherent mental model. This book cannot replace the rigour of a formal textbook, but as a first overview, it covers most of the physical phenomena of both analogue and digital electronics in partnership with brief forays into optoelectronics.

The first half of the book maps out our current technologies, and their microscopic basis linking the two in an instructive way for those insistent on the uselessness of 'pure' research. The haphazard development full of false turns is here condensed into a logical broad arrow of directed improvements. We arrive at the preparation and uses of quantum structures in which different semiconductor materials are grown in nanometer-thick layers to engineer wholly novel properties to their internal electrons. Certain areas are omitted, for instance acoustic charge transport devices, to concentrate on the dominance of switching and memory devices. However the scope of the book is impressive since it starts from the basic electronic structure of crystals and the physical properties of electrical conduction. In the main this breadth succeeds: as long as the reader perseveres they have most of the building blocks to reach the higher arguments and feel they are being carefully steered along a path of understanding. Some minor unexplained jargon creeps in ('native oxide') and some of the concepts such as drift and diffusion currents in p-n junctions rush by a little too quickly, however these are insignificant blemishes. This is a splendid summary of microelectronics for everyone.

Chapter 5 shows how we got where we are now and describes the drive for miniaturisation from the economics of the real world. And hence we finally arrive at our question: What are we going to do next? The issue as often portrayed is the impossibility of continuing what we still do so well—making it all smaller. The problems are on two fronts—the physical difficulty of photocopying designs smaller than the wavelength of light (the deep ultraviolet has $\lambda \sim 0{\cdot}2$ microns), and the breakdown of essential physical approximations as devices pass from the macroscopic to the microscopic world. These arguments are not new and are normally used to justify research into the more esoteric phenomena of solid state physics. However just because they have not proved justified in the past does not mean they will close in on us soon—the generally accepted view is within twenty years. Indeed my own industrial laboratory in the University of Cambridge is committed to answering this question 'What next?'

Richard Turton spends the second span of our attention in showing us a whole range of proposed answers, ranging from the 'Quantum Dot' of the book's title to superconductors, quantum tunnelling, and single electron charging. Much of these lie at the current leading-edge of device research and this provides a fascinating overview of the work of a large group of physicists. Here also he spends more time linking semiconductors and light and describes the holy-grail of all-optical switching. He makes good use of the vocabulary he has previously developed, however, as is typical when so much ground is covered, analogies start to become thinner on the ground. This part of the book induces fascinating questions and ideas to pop into the reader's head and shows the vitality of imagination that is present. What I found lacking was some comparison of these various proposals and a greater analysis of the overall problems faced. In summary, this book provides an enthusiastic and descriptive insight into the micromanipulation of electrons and I heartily recommend it to anyone wanting to find a way into the electronics maze. It may also contain just a hint of the future!

DR J. J. BAUMBERG
(Hitachi Europe Ltd)

Wave Turbulence Under Parametric Excitation: Applications to Magnets, in the series *Nonlinear Dynamics*
Edited by P. K. RASTOGI

1994, DM148·00, sFr148·00 (hbk), pp ix + 195. Springer, ISBN 3 540 57791 2. Scope: Monograph. Level: postgraduate and specialist.

Wave turbulence, involving the nonlinear interaction of many wave modes in a system, is of importance in a wide