

BOOKS

lity to infer performance of a large group of missiles fired in haste and anger from tests of a far smaller number of rockets that have been tuned, primed and launched at leisure. Even if one could make such inferences, problems of measurement, pushed nearly to the limits of modern instrumentation, remain. The politically engaged, of whatever persuasion, will find in this chapter infuriating ideas as well as a wealth of material to support their own points of view.

MacKenzie has done many strategic analysts a tremendous service by compiling an enormous set of unclassified data, derived from open sources, and using that information to arrive at realistic values for the accuracy and range of most Soviet and American missiles, from the Atlas D of 1958 to the Trident D5 of 1990. He has carefully compared relative figures given freely by many sources, extracted a "best fit" from slightly differing data and then sought out the few accurate and absolute values that have ever slipped into the open to calibrate the entire data set. Appendix 1 may be the most valuable resource in this extraordinarily useful book.

PETER D. ZIMMERMAN
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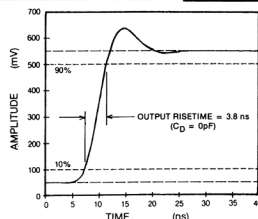
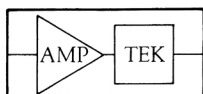
Wave Mechanics Applied to Semiconductor Heterostructures

G r ald Bastard

Halsted (Wiley), New York,
1991 [1988]. 357 pp. \$44.95 pb
ISBN 2-86883-092-7

It is often said that the behavior of electrons in semiconductor quantum wells provides one of the clearest venues for observing quantum mechanical phenomena in their simplest textbook form. Nowhere else can one "see" those particle-in-a-box energy levels as clearly as in the interband absorption spectrum of a quantum well or in the beautiful transmission resonance of a double-barrier diode seen in the current-voltage trace on an oscilloscope. However, the analyses of these systems found in textbooks do not take one very far, and the necessity to go beyond the simple plane-wave model soon becomes apparent. This book by G r ald Bastard of l'Ecole Normale Sup rieure in Paris is designed to help the researcher and the advanced student take this step.

The book was first published in



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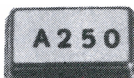
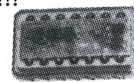
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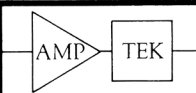
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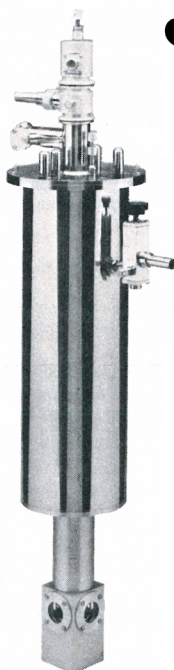


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1988. However, at that time the book was difficult to obtain from its French publisher, and it was expensive, about \$70 for a paperback. It is therefore pleasing that *Wave Mechanics* is now being distributed more widely at a price that makes it more accessible to students and those of us who might want a copy for our own bookshelves.

Because of the nature of the book that Bastard has chosen to write, the material is not dated, despite the

delay between the publication of the French and US editions. The book concentrates on basic concepts and may therefore outline the plethora of collections of review articles that characterize this still fast-moving field. Bastard makes no attempt to be comprehensive; he leaves it to others to cover applications. *Quantum Semiconductor Structures*, by Claude Weisbuch and Borge Vinter (Academic, San Diego, Calif., 1991) has a broader

but shallower scope, and could serve well as a complement for coverage of applications and fabrication and analytical techniques.

Bastard is especially well qualified to teach these basic concepts of semiconductor wave mechanics. His own research has been wide ranging, and he has been at the forefront of many of the important developments in the field, including the application of the Kane model to quantum-well band structures, the elucidation of the nature of the electronic states of excitons, impurities, modulation-doped structures, coupled wells, Stark ladders and recently spin-flip scattering in quantum wells. Bastard's particular style of theoretical research, which stresses the use of analytical models rather than more detailed computationally intensive methods, has lent itself to the writing of this book. This approach has given him a highly developed intuitive sense, which he shares with the reader.

Thus Bastard clearly explains the path from the simple one-band plane-wave model, to the Ben Daniel-Duke refinement, to two- and three-band models, and then to the multiband Kane model. He follows a systematic approach in setting up the analytical apparatus for the book's topics, which include impurity states, modulation-doped structures, electron scattering, optical properties and external field effects. The assumptions, approximations and limitations are clearly spelled out, and the basic formulas are derived. In what I think are particularly interesting sections, notably in the appendixes to each chapter, the author gives examples or extensions of the developed material. An example is the estimation of the effect of the lack of inversion symmetry in III-V quantum wells, a feature that is unrecognized by many, including many theorists.

There are a few deficiencies, which hopefully can be corrected in future editions. The lack of an index is frustrating; there are more than a few typographical errors; the breadth of topics could be increased. Let us encourage Bastard to produce a second edition, one that might include the additional material found in his recent chapter (written with J. A. Brum and R. Ferreira) in Volume 44 of Ehrenreich and Turnbull's *Solid State Physics* series (Academic, 1991).

The claim in the preface that the book is intended for undergraduate as well as graduate students should be taken with caution. Unless the students have had two years of solid-state physics, much time will be required to bring them up to speed on

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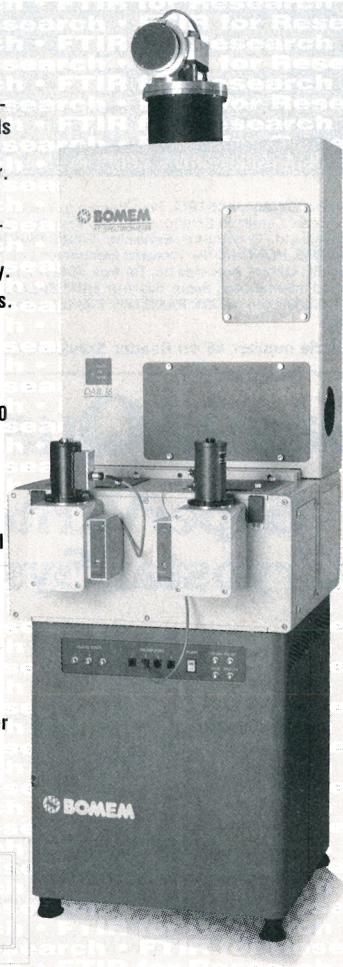
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the ordinary, bulk-semiconductor varieties of such topics as the multiband Kane model, the theory of excitons and Coulombic impurities, Poisson's equation, Boltzmann's transport equation and magnetic Landau levels. On the other hand, for advanced graduate students and researchers in the field this is a unique book that will be used and referred to often.

JOEL SCHULMAN
Hughes Research Laboratories

P., Cambridge, Mass., 1991. 468 pp. \$24.95 hc ISBN 0-262-23158-1

Optoelectronics for Environmental Science. *Ettore Majorana International Science 54.* S. Martellucci, A. N. Chester, eds. Plenum, New York, 1991. 293 pp. \$79.50 hc ISBN 0-306-43806-2. *Compilation*

Solar Collectors, Energy Storage and Materials. *Solar Heat Technologies: Fundamentals and Applications 5.*

F. de Winter, ed. MIT P., Cambridge, Mass., 1990. 1082 pp. \$85.00 hc ISBN 0-262-04104-9. *Compilation*

The Earth As Transformed by Human Action: Global and Regional Changes in the Biosphere over the Past 300 Years. B. L. Turner, W. C. Clark, R. W. Kates, J. F. Richards, J. T. Mathews, W. B. Meyer, eds. Cambridge U.P., New York, 1991. 713 pp. \$100.00 hc ISBN 0-521-36357-8. *Compilation*

NEW BOOKS

Cosmology and Relativity

After the First Three Minutes. *AIP Conference Proceedings 222.* Proc. Conf., College Park, Maryland, October 1990. S. S. Holt, C. L. Bennett, V. Trimble, eds. AIP, New York, 1991. 626 pp. \$75.00 hc ISBN 0-88318-828-7

Conceptual Problems of Quantum Gravity. *Einstein Studies 2.* A. Ashtekar, J. Stachel, eds. Birkhäuser, Boston, 1991. 602 pp. \$99.00 hc ISBN 0-8176-3443-6. *Compilation*

Cosmology and Particle Physics. D. Lindley, E. W. Kolb, D. N. Schramm, eds. AAPT, College Park, Maryland, 1991. 172 pp. \$16.00 pb ISBN 0-971853-42-3. *Reprints*

The Detection of Gravitational Waves. D. G. Blair, ed. Cambridge U.P., New York, 1991. 480 pp. \$135.00 hc ISBN 0-521-35278-9. *Compilation*

General Relativity and Relativistic Astrophysics. *Texts in Monographs in Physics.* N. Straumann. Springer-Verlag, New York, 1991. 460 pp. \$39.00 pb ISBN 0-387-53743-0

An Introduction to General Relativity. *London Mathematical Society Student Texts 5.* L. P. Hughston, K. P. Tod. Cambridge U.P., New York, 1991. 183 pp. \$49.50 hc ISBN 0-521-32705-9. *Monograph*

Energy and Environment

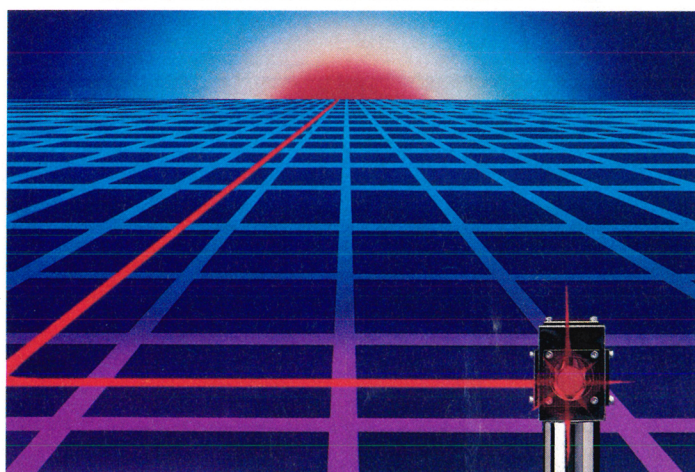
Anthropogenic Climatic Change. M. Budyko, Y. A. Izrael (translated from Russian by the authors). Arizona U.P., Tucson, Ariz., 1991 [1987]. 485 pp. \$60.00 hc ISBN 0-8165-1122-5

Chemistry of Atmospheres. Second edition. R. P. Wayne. Clarendon (Oxford), New York, 1991 [1985]. 446 pp. \$85.00 hc ISBN 0-19-855574-1

Energy and the Environment in the 21st Century. J. W. Tester, D. O. Wood, N. A. Ferrari, eds. MIT P., Cambridge, Mass., 1991. 990 pp. \$50.00 hc ISBN 0-262-20078-3. *Compilation*

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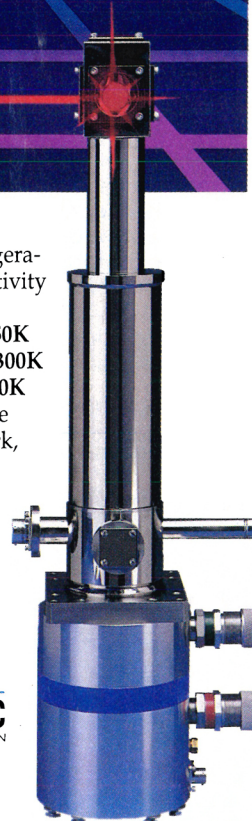
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