Light on lasers — and a lot of it

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Lasers. By Anthony E. Siegman. *University Science Books, 20 Edgehill Road, Mill Valley, California 94941, USA/Oxford University Press, UK: 1986. Pp.1,283. $58, £60.*

In 1971, in *An Introduction to Lasers and Masers* (published by McGraw-Hill), A.E. Siegman described lasers and masers in the context of electronic amplifiers; the main differences of these devices from earlier ones such as transistors and tunnel diodes is that the amplification is through interaction between electric (and magnetic) fields and the internal resonances of atoms and molecules. The subject was described very successfully in terms of the semi-classical concepts of the electron oscillator model, providing a textbook suitable for first-year graduates either in physics or electrical engineering.

Since 1971 the subject has continued to proliferate and we now have the present, very impressive volume, which runs to 1,283 pages compared to the 520 pages of its predecessor. An important reason for alluding to the previous book is that although Siegman now goes into the subject at considerably greater depth, and over a much wider range, his approach remains the same: "to remove much of the quantum mystique from quantum electronics"; the classical electron oscillator results are converted to quantum mechanical results for real atomic transitions.

Siegman's prescription is, where necessary, to replace the total number density of the classical oscillator by the population difference density of the actual atomic transitions involved; the linewidth is interpreted as that associated with the atomic transition, and the radiative damping time with the atomic transition lifetime (or the inverse of the quantum mechanical transition rate). A normal rate equation analysis then follows. In the quantum case the population difference becomes a function of time, which means the rate equation limit fails for strong enough applied signals and leads to Rabi flopping behaviour. The nonlinear polarization equation has to be solved together with a time dependent population equation. The general subject of coherent transient phenomena is also dealt with (towards the end of the book), by allusion to the Bloch vector equations for magnetic dipole transitions.

As the author points out, there is a large amount of material here. But it is conveniently divided into sections that can be used at all levels from introductory graduate work to an advanced text for practising laser engineers and research workers. As may have been anticipated by those attending laser Summer Schools over the years, there are excellent chapters devoted to such topics as optical resonators, Q-switching, mode locking and injection locking, which are a complete guide to the current state of research. Other areas are well referenced for further reading. Where necessary, laser systems are described in detail to illustrate physical principles, but no attempt is made to be encyclopaedic in this regard. Since the author comes from Stanford University one is tempted to ask, what about the free electron laser? It doesn't get a mention!

This is an excellent book, and a very good buy at $50 (if less so at £60). The only quibble I have is that, once one breaks the 1,000-page barrier, is it really worth all the effort to avoid what is the most elegant and logical description of some of the coherence phenomena — namely the density matrix model? After all, to quote the author's own comparison with the understanding of solid state devices as adequate in terms of a "classical" description of electrons and holes; this does not, for example, explain what tunnelling means in tunnel diodes. However, I do agree that we don't need to hear, *ad nauseam*, about perturbation theory. □

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Talk of nucleotides

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Gnomic: A Dictionary of Genetic Codes. By Edward N. Trifonov and Volker Brendel. *Balaban Publishers/International Science Services, POB 2039, Rehovot, Israel: 1986. Pp.272. Hbk $80; pbk $60.*

In *Gnomic*, Trifonov and Brendel seek to help us understand the "language" of nucleic acid sequences. Their tome of sequence "gnomology" (knowledge of oligonucleotide meaning) suggests several questions: Who could use it? Is it up to date? Is it, as intended, a complete pangenetic dictionary?

The authors have assembled about 800 "words" of pithy meaning in genetic sequences; in their lexicon, each oligonucleotide-word is accompanied by note of its biological meaning or function, with appropriate references. Such an aid for bench scientists studying promoters, operators, protein-binding sites and so on could soon find service since the huge second-generation sequence banks are on the horizon. However, the book is biased and incomplete. The first main section, "Gnomic Dictionary", does not give authors' names or dates of publication of the papers concerned, and some journals are favoured over others: *Science* is cited only eight times, the last reference being from 1983 when that weekly was starting to publish more molecular biology; *Nature* is listed six times more often. Next comes the "Context Index", revealing in which published sequences each of the 1,024 possible pentanucleotides has been found. Many of these pentamers are absent in our biological system if we can believe the data here; AAGCG, AAGGC, ACGCC, ACGTT, AGACG, AGATT, AGCAC and over 50 others apparently do not exist, but this is more than likely a reflection of the prematurity of the text.

The third major section, "Keyword Index", shows entries for intron, goat and beta-globin, but none for exon, sheep (or beef) and alpha-globin. *Gnomic* could not be up to date, because the number of sequences published nearly doubles every year and there is no end in sight. But the authors indicate a workbase of only six million letters, and their already obsolete sample thus averages probably about one nucleotide per extant species. The book is also incomplete through neglect of references; the 400 papers screened are simply too few! Indeed, Trifonov and Brendel are excessively auto-referential and ignore pertinent analyses by other groups in their discussions of the "Morphology of Gnomic" (by which they mean preferential use of certain words in composing a genetic text). Finally, the appendices are hampered by unclear explanations and outdated data. Appendix IV, "Codon Usage Tables", is just a jovial blank page with a reference.

This book requires extensive rethinking and updating before it can appeal to researchers and students. For example, the present double reference system is unnecessarily cumbersome; full citations with standard journal abbreviations could appear in the "Gnomic Dictionary". And, of course, the references could be put in alphabetical order by author name, becoming an author index (missing at present) and slightly humanizing the book's contents.

Trifonov and Brendel are right in encouraging us to do more comparative analysis and interpretations on the sequence information available, but bench sequencing will probably continue to dominate because of our preoccupation with biotechnology (*nostra culpa*). Still, as the authors envisage, there *could* be a trend towards making "gnomic a most intensively studied language and most intriguing reading". □

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