How mistakes are made

Leslie E. Orgel

Accuracy in Molecular Processes: Its Control and Relevance to Living Systems. Edited by T. B. L. Kirkwood, R. F. Rosenberger and D. J. Galas. *Chapman & Hall: 1986. Pp. 398. £48.50, $110.*

THE frequency of errors in the transmission of DNA sequence information from one generation to the next can be as low as one per 10^8–10^{10} bases copied. Transcription and translation have substantially higher error rates, but are still far more chemospecific than comparable non-enzymatic processes. The measurement of error rates, the study of the enzymatic mechanisms that maintain them at low levels and the investigation of the cumulative effect of errors on the health of the organisms that harbour them have become the subject matter of a subspeciality of biochemistry. This subspeciality is the subject of the present multi-author volume. The "accuracy" of methylation, restriction, splicing and other post-synthetic modifications of proteins and nucleic acids is not discussed.

The empirical data on the accuracy of DNA replication, and the classic mechanism of error correction by exonuclease activity during replication are discussed in a chapter by Goodman and Branscomb. The role of DNA repair in maintaining the integrity of the genetic material is covered by Sedgwick. The accuracy of RNA synthesis is discussed by Anderson and Menninger.

Protein synthesis is dealt with in three chapters. Fersht covers the charging of tRNA and deals in detail with editing pathways that remove "incorrect" amino acids hydrolytically from charged tRNAs. Buckingham and Grosjean review the literature on the accuracy of mRNA–tRNA recognition and show that recognition depends on many factors beyond the complementary pairing between codon and anticodon triplets. Kurland and Gallant deal with the role of the ribosome in controlling the accuracy of protein synthesis.

In addition to these empirically based reviews, there are other, mainly theoretical contributions on such topics as the kinetic cost of accuracy (Ehrenberg, Kurland and Blomberg), selection for optimal accuracy (Kirkwood and Holliday) and the effects of errors on the integrity of genetic information transfer (Rosenberger and Kirkwood). A chapter on probabilistic thinking about enzyme kinetics by J. Ninio provides a number of qualitative insights that are not readily derived from the differential equations of traditional chemical kinetics.

This volume is a valuable addition to the literature of biochemistry because it brings together reviews of all of the important aspects of the "accuracy" problem. It is not always easy going — the introductory material is highly compressed and requires very careful reading, as do many of the more theoretical sections. But the determined reader will be rewarded with an excellent overview of an important but little-known area of biology. □

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Solar systems

A.K. Turner

Physics, Technology and Use of Photovoltaics. By R.J. Van Overstraeten and R.P. Mertens. *Adam Hilger:1986. Pp. 278. £35, $70.*

THE potential of photovoltaic solar-energy conversion as a renewable energy source is widely recognized. Photovoltaic power is already finding remote-site application in telecommunications, navigation aids and water pumping, for example, predominantly using crystalline silicon-cell technology. Calculators and watches with amorphous silicon and cadmium telluride solar cells are also now common. Surprisingly, there are few good general texts on the subject, which makes Van Overstraeten and Mertens's contribution all the more valuable.

The book begins with a comprehensive account of the background to the physics of solar cells, made particularly interesting by the inclusion of a thorough description of the mechanisms which can account for loss of solar-cell efficiency. The theory is also developed separately for monocrystalline and polycrystalline silicon, amorphous silicon, gallium arsenide and other thin-film photovoltaic cells.

The method of manufacturing crystalline silicon photovoltaic modules is covered in great detail, from silicon purification and crystal growth, through cell fabrication, to the assembly of finished modules. In contrast, the section on thin-film technology is rather brief, with only a limited discussion of the various options. On the practical side, there are sections on measurement of the efficiency of light conversion of cells and modules, and their ability to withstand different environmental conditions, on cell interconnection in modules and on important factors in the design of photovoltaic systems for particular applications.

The book concludes with a summary of existing applications of photovoltaic systems which serves well to demonstrate the current dominance of crystalline silicon. This may well justify the authors' rather scant treatment of the emerging, potentially cheap, thin-film technologies such as amorphous silicon, cadmium telluride and copper indium diselenide cells which have yet to find large-scale commercial use beyond consumer applications.

Well written and logically structured, the book is easy to follow, and provides both a good text for the student and a useful reference work for the researcher. It describes the physics, technology and uses of photovoltaics for an audience anxiously awaiting a breakthrough in the availability of a low-cost, renewable energy source — we must hope that we don't have to wait too long. □

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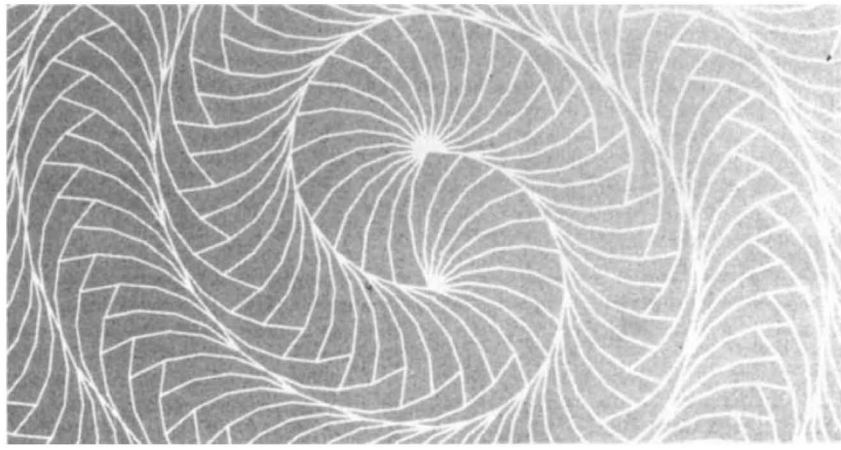

Singular construction — monohedral tiling (in which the tiles are all of the same shape) arranged into the semblance of a spiral; the prototile also admits many other, similar arrangements. The picture is reproduced from Tilings and Patterns, *an unusual and happy marriage of mathematics and aesthetics written by Branko Grünbaum and G. C. Shephard and published by W. H. Freeman. The book will be reviewed in a future issue of* Nature.