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Book Reviews

General biochemistry by J. H. Weil, Wiley Eastern Ltd, 4853/24, Ansari Road, Daryaganj, New Delhi 110 002, 1990, pp. 515, Rs 150.

The subject of biochemistry has grown in the last three decades. It has become difficult for any author of a textbook to make a comprehensive textbook and keep it within a reasonable size. The new textbooks are well over 1000 pages. The attractive illustrations in colour and good printing increase the value and cost of these books. It has now become necessary to ask "what to omit" if biochemistry has to be presented as a subsidiary course in general biology teaching. A moderate size textbook, not omitting essentials, is therefore required. In the experience of the reviewer, this book by the French author, Weil, fills this purpose as no other recent publication can.

The subject is divided into eight chapters. amino acids, peptides, proteins, structures and important properties; enzymes and enzyme catalysis; bioenergetics; structure of metabolism of carbohydrates; structure and metabolism of lipids; structure and metabolism of nucleic acids; metabolism of nitrogen compounds; and regulation of cellular metabolism. The treatment was on chemical basis of reactions and structures of virtually all important compounds are given including some not common in such books (*e.g.*, penicillin, cobamide coenzyme). The reactions are schematically presented, marking out in squares or circles the portion or groups that undergo changes, making it easy for the reader to comprehend. Effectively these are cost-effective substitutes for the expensive colour illustrations. The book is written in simple style and easy to follow and does not suffer from any difficulties due to translation from the original French.

A good feature of the book is the information on the developments of regulation of cellular metabolism. Under this, regulation of protein synthesis and gene expression are succinctly covered as well as the active regulation of enzymes. Some methods commonly used (*e.g.*, gel retardation) are also included. A weakness is the meagre coverage of receptors, growth factors and signal transfer which have become active fields.

Some comments on printing deficiencies which may be corrected in future are: p.30, Figs 1–7 poor reproduction; p.31 caption—tertiary structure of proteins inappropriate; p.182—energy....stored by the cells in the form of ATP?—conceptually unacceptable; p. 84. Ca instead of CA.

The reviewer finds the book of excellent scientific value, moderately priced and worthy of possession by students of biochemistry.

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Why we nap by Claudio Stampi, Birkhauser Verlag AG, P.O. Box 133, CH–4010 Basel, Switzerland, 1992, pp.280, SFr 168.

The present volume represents some of the contributions made at a Workshop on Polyphasic and Ultrashort Sleep-Wake Patterns held in Castello di Gargonza (Italy) in May 1988 under the auspices of the Commission of the European Communities. The themes discussed in this volume are of interest not only to a category of people caled "sleep scientists", chronobiologists, sleep disorders physicians but also to physiologists, psychobiologists, psychiatrists, paramedics, shift-workers, and their managers and mission control specialists. Even though the book is a trifle too obviously addressed to professionals, to syndicate, union, and government leaders, some chapters do focus on the theoretical, biological, chronobiological, medical aspects, with special emphasis on the human performance aspects of polyphasic and ultrashort sleep strategies.

The title of the book is somewhat misleading since it is not just about the afternoon 'siesta' but about the recurrent alternation between states of alertness, which is experienced throughout 24 hours by most, it not all, living animals and—not mentioned any where in this book—plants.

This book is mostly about ultrashort sleep and multiple daytime naps indulged in, among other lesser mortals, Leonardo da Vinci, Napoleon, Salvador Dali, Thomas Edison and Winston Churchill. It is almost common knowledge that newborn babies take about 2-hourly cat naps and wake up often only to feed and cry a bit. There is much impressive data in animal literature that there are ultradian bouts of rest: activity cycles impressively shown by Menno Gerkema for voles which last over 2.5 h each. It has been known for a long time that there are a variety of rhythms especially in mammals whose periods range from a few minutes to 5–6 hours which have no overt and obvious relationship to the environment. It is also unlikely that a common mechanism underlies ultradian rhythms and circadian rhythms even though there is some evidence that the two may be coupled to each other in a weak manner.

Ultradian cycles of rest–activity (sleep–wake) of 2.5 h for humans has been reported as early as in 1920 by J. S. Szymanski and cycles of about 90 minutes by N. Kleitman in 1961. Such short polyphasic sleep–wake cycles are now believed to occur in humans only in infancy, pathological conditions or I nacroleptic patients (chapters 15 and 16 in this volume). There is an interesting chapter of the personal experience of an eclectic artist (a playwright and actor) Gian Carlo Sbragia who tried to sleep for 15 minutes every 4 hours, as Leonardo da Vinci is supposed to have done. He writes "my excitement lasted for about 5–6 months, at which time I started to have a few doubts. It is true that I could read more, that I could paint and play music, but I reached a point where it was just not possible to have enough activities to fill the 22 5 hours day after day. My house was silent, my children did not pay attention on (sic) me, nobody did. I was suffering from loneliness: this was the truth". Most of the chapters of the book make the point that, if need be, adult humans may adapt without major difficulties to some sort of polyphasic behaviour. Even so it is clear that at least for humans, polyphasic sleep–wake, under normal societal conditions, is *not* preferable to monophasic sleep. In fact, humans studied for sleep–wake conditions under prolonged social isolation (in many laboratories abroad and at the Madurai-Kamaraj University) show in all cases only monophasic sleep episodes during conditions of freeruns. This is an interesting book, which, in spite of being the outcome of a workshop, cogently relates apparently diverse phenomena as ultradian rhythms, circadian rhythms, polyphasic and monophasic sleep–wake patterns in human infants, sleep disorders, nacroleptic patients and 'sleep' in animals.

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Supercomputers by V. Rajaraman, Wiley Eastern Limited, 4835/24, Ansari Road, Daryaganj, New Delhi 110 002, 1992, pp. 106, Rs 50.

The first book that I read about computers (some two decades ago) was by V. Rajaraman. It was a masterly introduction to Fortran programming which we used extensively as students at the Indian Statistical Institute. I remember consulting the book to write programs to compute statistics as wonderfully esoteric as Shepherd's corrections, Gini's mean differences and Tukey's additivity tests. But what I remember most of all was that Rajaraman's book contained the answer to practically every doubt that we had on Fortran. More people must have learnt Fortran (and learnt it well) from Rajaraman's books than from all these new computer institutes in Bangalore put together.

It is therefore a special pleasure to read another book by V. Rajaraman. This is a small book (I remember editions of his early books to be rather large) with just over a 100 pages in which Rajaraman tries to explain what is a 'supercomputer'. Now Rajaraman doesn't really like the word 'supercomputer' (he would rather say 'high performance computer') but since one of the objectives of the book is to educate (the word is being bandied around full-throatedly without quite knowing what it means) no other word would obviously do. This trifling detail is in any case of little consequence as the reader will discover once he gets his teeth into the book.

The reader will be delighted to find that the good old professor is still in top form. One flies past the introduction at super speed as Rajaraman defines supercomputers, says that we need them especially in numerical simulation and then explains how these computers achieve their neckbreaking speed (essentially by exploiting temporal and data parallelism).

The second chapter, with the rather daunting title: 'Architecture of vector supercomputers', however appears a trifle intimidating. Rajaraman realises this, so he asks his illustrators to get to work. And he works very hard himself explaining every concept and expression threadbare. And when you discover that 'pipeline processing' is equivalent to four teachers evaluating one answer script together, it is time to wipe the sweat off the brow. Actually such is Rajaraman's felicity that he probably doesn't need to use these fearful expressions. But since the rest of the world says 'vector processing' he probably has no choice in the matter.

Rajaraman continues the good work in the third and fourth chapters (third chapter: 'Computing with vector supercomputers', fourth chapter: Parallel computers) once again explaining concepts painstakingly and emerges with flying colours. There are more tables, illustrations and flow charts; and a notable feature of the discussions is the way Rajaraman switches effortlessly between what one may call 'hardware' and 'software' concepts (the bugbear of many smaller computer professionals). At the end of it all one is suitably educated and even awed. Supercomputers are indeed wondrous and multi-splendoured. Surely Seymour Cray is wrong! How can "computer designers be (mere) glorified plumbers"?

We now come to the fifth chapter titled 'Available high performance computers'. And it is here that one is disappointed with Rajaraman for the first time. The chapter begins with a description of the Cray series of supercomputers. Fair enough, perhaps, especially when you consider that Cray is to supercomputers what Cadbury is to chocolates. Similarly, it is no surprise to find Convex and Alliant listed among the shared memory architecture. But why does Flosolver of the National Aerospace Laboratories find absolutely no mention? In 1992, when the book appeared, Flosolver was most definitely 'available'. So if it still doesn't figure in the list, it must be presumably because it is not 'high performance'. Let us therefore look at Rajaraman's own criteria for high performance ("a very good method is to collect a reasonable variety from the time..." page 86) and, in all fairness, see where Flosolver stands–especially in relation to other computers which meet Rajaraman's approval!!

But since such a comparison is likely to take some time (it might actually take a *lot of time* given the reluctance of Indian R&D establishments making parallel computers to agree to take part in a common race) let us move over to the last chapter ('Application of supercomputers') and marvel at all the wonderful things we will be able to do with supercomputers: simulate motor car crashes (rather than lose legends like Ayrton Senna), model the earth for potential oil wells (without messing around with detonators), make the most memorable animation movies like 'Who Framed Roger Rabbit' or 'Aladdin' (although most viewers might still opt for 'Gone with the Wind' or 'Doctor Zhivago'), do weather forecasting (Flosolver was the first non-Cray computer to run the T-80 weather code in India in reasonable time) or do computational chemistry (and perhaps discover a new drug to counter AIDS).

Supercomputers therefore have the potential to really change the quality of life and make this world a happier place to live in. And if they were so far cloaked behind the misty smoke screen of hype and jargon it was only because its sellers wanted it to be that way. We must therefore thank Rajaraman for unveiling the many secrets of supercomputers and doing it so lucidly and engagingly. About three decades after he wrote his first book on computers, Rajaraman returns to remind us that he is still one of the best in the business.

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Physics and technology of heterojunction devices by D. Vernon Morgan and Robin H. Williams, Peter Peregrinus Ltd, Michael Faraday House, Six Hills Way, Stevenage, Herts SG1 2AY, UK, 1991, pp. 309, £ 49.

The concept of heterostructures in semiconductor devices is not new. Shockley first patented the idea in 1951 while Gubanov wrote a theoretical paper in the same year. By 1962 Ge–GaAs heterostructures had been realized. The idea of heterojunction semiconductor lasers was mooted in 1963 and realized by 1965 with the advent of multibin liquid phase epitaxy (LPE). With improvements in epitaxial technologies, now such devices are widely used involving several heterojunctions. In this context, the present book is timely. Earlier, a few books (Milnes and Feucht, 1972; Sharma and Purohit, 1974) have reviewed heterojunction physics but by now they are dated. There have been several reviews in journals but a compilation of this kind is very welcome at this time.

Semiconductor heterojunction is an ideal interface between two semiconductors. Although the LPE technique does not produce such abrupt interface, later developments of metal-organic chemical vapor deposition (MOCVD) and more recently of molecular beam epitaxy (MBE) and its many variants now allow nearly ideal heterojunctions. It is now possible to grow monolayer with crystal perfection unparalleled by any other growth technique. One can also grow layers with built-in strain allowing band gap tailoring. These flexibilities have resulted in tremendous growth of heterostructure devices meeting stringent requirements. The advancement of technology has also allowed discovery of new physical phenomena involving low-dimensional electron gas, tunneling, ballistic motion, etc. This book is a compilation of reviews by experts in the field of the physics and technology of heterojunction devices.

I have gone through some of the chapters in detail and others in brief. The opening chapter on the physics of heterostructures is excellently written giving full information on different types of junctions as also the physics of band alignment determination of band offsets. The influence of strain is also discussed thoroughly. Another important chapter is on the simulation of heterojunction devices. This subject is usually not given its due importance and I am glad that detailed techniques as well as results are discussed. The chapter on characterization techniques is well written but only considers electrical methods. Some important optical techniques such as photoluminescene, Raman spectroscopy and X-ray diffraction have not even been mentioned. There are full chapters on different types of devices such as resonant tunneling structures, heterostructure bipolar transistors, lasers, high-electron mobility transistors, etc., which are written by experts. Full details of the design of the structures and performance achieved are given. Pseudomorphic HEMT devices are also included. The chapter on novel heterojunction devices is very interesting but many of the ideas are not futuristic any more. It is a sign of the rapid growth of the subject. However, one important aspect of the subject of heterostructures, *i e.*, epitaxy technology itself does not find sufficient importance in this book. This can be considered a shortcoming of this monograph by some but that is a vast subject by itself and a number of treatises are now available on epitaxy.

Overall it is a well-written, comprehensive and timely book. The manuscript has been prepared meticulously. A good deal of experimental data is provided and a large number of figures are used for illustrating the subject. It will be very useful for research institutions as well as senior students taking up work in the area of advanced devices.

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Santilli's isotopies of contemporary algebras, geometries and relativities by J. D. Kadeisvili. Hadronic Press, Inc., 131, Palm Harbor, Fl 34684, USA, 1992, pp. 310, Price not mentioned.

Kadisvili in this monograph presents a systematic review of the work of Santilli on 'Algebras, groups and geometries'. It contains fifteen sections and five appendices dealing with a lucid exposition of Santilli's isotopic relativities and isotopic generalization of fields, vector spaces, transformations, Lie algebras, Hamiltonian mechanics, Lie symmetries and symplectic, affine and Riemannian geometries. It espouses a generalization of conventional relativities to nonlinear, nonlocal, non-Lagrangian and non-Hamiltonian systems by introducing exterior and interior dynamical systems. The analysis neatly brings out the inapplicability of local differential topology (Zeemann topology), canonical formulation of Hamiltonian mechanics, the symplectic geometry of Abraham and Marsden (which is based on local differential character!), affine geometry and Riemann geometry, the Galilei, Lorentz and Poincaré symmetries to name a few. To lift the conventional formulation to nonlinear and nonlocal structure, the author heavily draws on the existence of an isounit $\hat{1}$ which is nowhere null in the considered region of local variables.

In Section 6, the author deals with Lie-isotopic theory and iso-associative algebras. It is claimed that the conventional Cartan's classification of Lie algebras still holds good here except one gets a nonlinear and nonlocal representation for such algebras. In Section 7, Santilli's direct universality of Birkhoffian mechanics for local differential systems is reviewed and the Hamilton–Santilli mechanics as a special case of Birkhoff–Santilli mechanics in which the general Birkhoff terms are replaced by canonical ones is elucidated.

The author has taken special care to construct infinitely possible isotopes $\hat{M}(X,\hat{g},F)$ corresponding to linear and local transformations on a metric space $\hat{M}(X, g, F)$ which are 'isolinear' and isolocal. This section (8) also deals with connected Lie–Santilli group G_o (m) in particular the Lorentz group $\hat{0}(3,1)$.

The properties of symplectic manifold, affine and Riemann are suitably atuned to deal with the noncanonical and nonlinear formulations. The integrability condition is formulated for the isosymplectic geometry by suitably constructing the two-form which is closed and exact. The covariant isovector field on the cotangent manifold $\hat{T}$ *M($\hat{R}$), the exterior calculus are also deftly dealt with. Generalisation of Einstein's gravitation to isogravitation and genogravitation are discussed respectively through a systematic development of isoaffine, isoRiemannian geometries and geoaffine and geoRiemannian geometries. The modification of curvature as well as the torsion, the Bianchi identities, Freud identity, etc., are neatly developed.

Judging from the spectrum of topics covered in the monograph, there is much left uncovered. The topics discussed have limits up to 'the contact interaction', *e.g.*, in Lie theory, except displaying possible $\hat{0}(3)$ structure, no attempt is made regarding the general structure of the Cartan's family. There is hardly any space left to discuss the representation theory except appendix E which mentions something of genoparticles. Similarly, the differential geometry discussion has not got a raw deal. The bundle structure is just discussed to deal with the situation.

Normally, for ordinary Lie algebras one can have nonlinear realisations and there are infinitely large family of nonlinear representations for such algebras. But then one wonders as to why one should take so much pain to develop the iso-Lie theory? One can call it by any 'name'.

On the whole, the author has done a splendid job in making Roger Santilli's work reachable to a wider audience of theoretical physicists and mathematicians.

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Some aspects of Brownian motion, Part I by Marc Yor, Birkhauser Verlag AG, P.O. Box 133, CH-4010 Basel, Switzerland, 1992, pp. 148, SFr 34.

This book is a masterful account of the computation of laws of several important functionals of Brownian motion. It is largely based on author's own contribution to this field over the last decade. It consists of nine chapters.

Chapter 1 deals with the Gaussian space associated with the Brownian motion. Let $(B_t, t \geq 0)$ be a one-dimensional Brownian motion. Then the associated Guassian space Γ(B) is defined by

$$\Gamma(B) := \left\{ B^f := \int_0^\infty f(s)dB_s, \, f \in L^2(\mathbb{R}_+) \right\}.$$

The Hilbert space isomorphism $B^f \leftrightarrow f$ between $\Gamma(B)$ and $L^2(\mathbb{R}_+)$ given by

$$E[(B^f)^2] = \int_0^\infty f^2(t)dt$$

plays the central role in deriving the various results. In particular, it is shown that the Gaussian space generated by Brownian bridge coincides with the Gaussian space generated by the following Brownian motion:

$$B_t := B_t - \int_0^t \frac{Bs}{s} ds, t \geq 0.$$

This in turn characterizes the natural filtration of the Brownian bridge. It is also proved that the transformation which generates the above Brownian motion from the original one is strongly mixing. It also deals with the harmonic functions of Brownian motion.

Chapter 2 consists of the derivation of the laws of certain quadratic functionals of Brownian motion. In particular, some variants of Levy's formula for the stochastic area of Brownian motion are obtained. The method consists of using Girsanov's transformation to change the probability measure. With respect to the new measure the quadratic functional disappears. Thus, one needs to compute only the mean and covariance of a Gaussian variable. Thus, the Girsanov transformation reduces the complexity of the problem. At the end of this chapter, Bessel process is studied and its infinite divisibility established.

Chapters 3 and 4 are devoted to the study of local times of various processes. The local time of Brownian motion $\{l_t^a, a \in \mathbb{R}, t \geq 0\}$ is defined by the formula

$$\int_0^t f(B_s)d_s = \int_{-\infty}^\infty f(a)l_t^a da$$

for $f: \mathbb{R} \to \mathbb{R}$ bounded and continuous.

The above formula transfers the integration in time to integration in space. Based on this transfer principle the Ray-Knight theorems show that there exist certain stopping times T such that $\{l_T, a \in \mathbb{R}\}$ is a strong Markov process, the law of which can be described in terms of Bessel processes. Thus the Markov property in time gets translated to in space. Using essentially the same ideas, the corresponding results for the local times of square of Bessel processes, Bessel bridges, etc., are derived. The Ray-Knight theorems are also generalized for local times taken at an independent exponential time.

Chapter 5 deals with the winding number $\{\theta_t\}$ of planar Brownian motion $\{Z_t\}$. An explicit formula for the characteristic function of θ_t is obtained in terms of the modified Bessel functions. From the explicit formula it becomes more apparent why the winding tendency increases when Z_t is either too close or too far away from the origin. The technique employed to obtain the formula highlights the close relationship between the Bessel processes and θ_t. An identity in law of the winding number of the complex Brownian bridge is also obtained. Finally the asymptotic behaviour of θ_t is studied.

Chapter 6 deals with the exponential functionals of Brownian motion. The study of these functionals comes from mathematical finance. Using the knowledge of Bessel processes already developed in earlier chapters, the laws of the exponential functionals of Brownian motion with drift are obtained explicitly. The expectations are also computed in terms of gamma functions.

It was established in Chapter 5 that if θ_t is the winding number of the planar Brownian motion around the origin, then

$$\frac{2\theta_t}{\log t} \to C_1 \text{ in law}$$

where C_1 is a Cauchy distribution with parameter 1. In Chapter 7 this result is first generalized for the winding number $(\theta_t^1, \theta_t^2, \ldots, \theta_t^n)$ of planar Brownian motion around n points. The asymptotic law, however, becomes much complicated. It, in particular, involves Cauchy distributions and local times of reflecting Brownian motion. This chapter also includes some results on the asymptotic behaviour of the winding number of Brownian motion in $\mathbb{R}^3$.

Chapters 8 and 9 are devoted to the extension of Levy's arc-sine law to more general processes. Levy has proved the following: let

$$A^+ := \int_0^1 I\{B_t > 0\} dt$$

and

$$g := \sup\{t < 1: B_t = 0\}.$$

Then A^+ and g are arc-sine distributed. This is known in the literature as Levy's arc-sine law. In these chapters analogous results are derived for symmetrized Bessel processes, Walsh Brownian motion, singularly perturbed reflecting Brownian motion, etc.

A salient feature of this book is that it employs standard techniques in Probability Theory to derive several deep results involving Brownian motion and related processes. On several occasions it provides intuitive reasoning behind the results before providing rigorous proofs. It would be very useful to researchers working in probability and stochastic processes.

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