language of *BASIC*, which while possessing a great many limitations, continues to be – at the school level – one of the simplest languages to learn. (For the purist, *PASCAL* with its modular structure would probably be the language of choice; there are many who feel that *BASIC* encourages a poor programming style.)

The focus of the book throughout is on numerical experimentation. (A more accurate title for the book might be *Computational Explorations in Mathematics*.) Starting with approaches to compute π, it goes on to explore the Fibonacci sequence, the golden ratio, Pythagorean triples, computations involving large numbers (for symbol manipulation packages this is no problem at all, they routinely churn out 500-digit numbers with barely a hiccup; but not so for a language such as *BASIC*), prime numbers, construction of calendars, biorhythm cycles, construction of tables of logarithms, the game of tic-tac-toe, base conversion (decimal to binary, octal, etc.), writing numbers in word-form (for writing cheques), linear Diophantine equations, the notorious '$3X + 1$' problem. Conway's enigmatic game of 'Life', and finally magic squares. The *BASIC* programs needed to do the investigations are all included.

Each chapter has a well-written preamble that introduces the topic, gives some sense of its history and current status, and places it in a setting; 'Magic Squares' has a particularly nice preamble. Proofs and mathematical analysis are for the most part avoided (though the author has not been able to resist from giving Euclid's proof for the infinitude of primes!); in each case the relevant theorems and formulae are simply presented as facts. Included here and there are puzzles that act as teasers; e.g. the one about bank deposits. In a few places the author poses a provocative question without letting out the answer; for example, he computes the partial sums of the reciprocals of the primes, then wonders whether the sums converge. In such cases he invites the reader to discover the facts by further exploration. In the chapter on Pythagorean triples, the snippet about the 'right-angled triangle in Tamil poetry' is unusual and interesting. And, of course, 'Life' is fascinating.

In a few areas the author could have included a bit more. For instance, in 'Diophantine Equations' he could have considered ways of solving Pell's equation too. In the chapter on 'Tic-tac-toe', he could have taken up the more challenging three-dimensional version of the game known as *QUBIC* (played on a $3 \times 3 \times 3$ cubical frame). In other chapters, themes could have been listed at the end for further exploration; for example, in the chapter on number bases, he could have posed questions like: 'For any positive integer n, let the sum

$$\left[\frac{n}{2}\right]+\left[\frac{n}{4}\right]+\left[\frac{n}{8}\right]+\left[\frac{n}{16}\right]+\ldots$$

be computed; what relationship does the sum bear to n?' Other such questions are readily envisaged.

A few minor errors have crept in. On p. 83 it is stated that Gauss proved the prime number theorem (this is the statement that as $x \to \infty$, the ratio

$$\frac{\text{number of primes between 1 and } x}{x/\ln x}$$

tends to 1). In fact, Gauss only conjectured the result (based on extensive empirical work); its proof came a full century later. On p. 62, following a reference to Fermat's Last Theorem, the statement that 'no one has been able to find a general proof' is contradicted a sentence later by the statement that the theorem was proved by Andrew Wiles in 1994. (The latter is of course the case.) On p. 207, a 4×4 magic square is displayed with Ramanujan's birth date (22, 12, 18, 87) forming the top row; it is described as having been given by Ramanujan himself, but this is doubtful. The magic squares studied by Ramanujan were of a very different kind. But on the whole the book is quite free of errors.

The question to ask is, who will use the book, and in what way? Ideally it could be used in mathematics/computer science clubs, at the middle/high-school level, where ideas for computational projects are often in short supply. With leading questions provided by a well-meaning teacher, a student could be started-off on promising trails. But at some stage the student would have to graduate to analysis and proof, and not be content only with empirical discovery.

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Optical Solitons: Theory and Experiments. Porsezian, K. and Kuriakose, V. C. (eds). Indian Academy of Sciences, Bangalore 560 080. 2001. 1164 pp. Price not mentioned.

The concept of soliton as a nonlinear, localized, solitary wave propagating without change in its properties is known in hydrodynamics since the 19th century. This property arises from the balance between dispersion and nonlinearity. These localized waves are stable against mutual collisions and retain their identities. This particle-like property justifies the name soliton analogous to the names phonon and photon representing vibrational wave quantum and optical wave quantum respectively. The invention of the laser in the 1960s opened up a new area of research known as quantum optics. This discovery stimulated the growth of new research fields such as nonlinear optics and nonlinear spectroscopy. Optics research using lasers comprises holography, optical information processing, optical communication and even optical computation. In particular, the nonlinear optics itself is of considerable interest both for theoreticians as well as for experimentalists because of its potential application in technology related to optical fibre communications. The concept of optical soliton and its potential use in fibre-optics communication of the future is the most important and interesting consequence of nonlinear optics. Indeed, the prospect of possible applications of solitons in telecommunications, pulse compression, optical switching, logic gates, etc. has prompted their experimental studies.

This book comprises articles reprinted from the special issue of *Pramana – Journal of Physics*, (November and December 2001, **57**, nos 5 and 6), devoted to 'Optical Solitons: Theory and Experiments'. Eminent scientists from India and abroad have contributed some rather readable articles discussing overall theoretical models and recent experimental studies of this exciting field of optical solitons. These articles cover a wide range of topics, such as temporal and spatial solitons, nonlinear optical materials, nonlinear Schrödinger equation and its higher order generalization, the concept of dark solitons, etc.

Solitons play a key role for lossless propagation through nonlinear optical fibres.

The editors of this book deserve to be congratulated for organizing the articles in this book appropriately along with a nicely written 'Preface', inspiring anyone to read the contents of the book in detail. The first three articles cover in an excellent and readable manner the fundamental aspects of solitons, including their universality and ubiquitous nature, fibre optics communication and nonlinear optical materials. The remaining fourteen articles are devoted in general to several theoretical aspects of the changing collisions of optical solitons and their connection to logical gate operations is also discussed in an article. Another article discusses the methodology of obtaining the approximate solutions of different nonlinear evolution equations in optics. Completely integrable models of nonlinear optics based on different optical effects are presented in an interesting article along with their detailed analysis. An article discusses exact periodic wave tracing for systems of coupled, nonlinear Schrödinger equation. Another one analyses the concept of up-switching and down-switching between bistable solitons in doubly inhomogeneously doped fibre systems involving lossless as well as lossy couplers. The nonlinear compression of bright and dark solitons in inhomogeneous, nonlinear Schrödinger equation is nicely discussed in another article. Even the concept of spinning solitons in both conservative and dissipative cubic–quintic nonlinear media is adequately discussed in an article. The existence of fully stable spinning solitons in fibres with Kerr nonlinearity and in bulk media featuring a combination of the cubic self-defocusing and quadratic nonlinearities form the subject of another article. This article also considers a system of compiled, nonlinear Schrödinger equations for the fundamental and helical mode solitons to discuss the results of collisions between solitons associated with the two modes from the analytical as well as experimental point of view. The book also contains an article presenting an interesting overview of the soliton-based ultrahigh speed communications and discussion of the recent theoretical and experimental results in this area. Basic concepts of the theory of spatial solitons, including the soliton stability in non-Kerr media and the collisions of solitary waves in nonintegrable media are discussed in another article. The last two articles cover recent experimental developments in the study of optical spatiotemporal solitons and an account of the experimental study of the spatial solitons in nonlinear liquid wave-guides.

In summary, this book brings out clearly the relevance and utility of optical solitons and the related optical devices in optical communications systems in future. Most of the articles are written in a lucid and readable manner. It clearly fulfils its aim of being useful for beginners as well as for specialists and research workers in the area of nonlinear optics and optical communications. It may also be useful to teachers teaching courses on optical solitons and their applications to future optical communication systems.

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Calcium Carbonate – From the Cretaceous Period into the 21st Century. F. Wolfgang Tegethoff *et al.* (eds). Birkäuser Verlag, AG, P.O. Box 133, CH-4010, Basel, Switzerland. 2001. 350 pp. Price: SFr 168/DM 224/Euro 112.

The deceptive simplicity of the formula for calcium carbonate – $CaCO_3$ hides its rich crystal and geochemistry, its importance as a biomaterial and its many uses as a structural material and in industry. From blackboard chalk to pearls, the Taj Mahal and the David, to many toothpaste formulations, calcium carbonate is ubiquitous. It can be unobtrusive and it can be kitsch. Tegethoff's collaborators have examined these many aspects of calcium carbonate in this erudite and fascinating oeuvre.

The first part of the book is on the geochemistry of calcium carbonate by Jacques Geyssant, starting with the formation of the constituent elements in the universe. One learns that in Shergotty, near Gaya, a meteorite fell which contained calcium carbonate and sulphate and is believed to have been chipped-off from the Mars crust. The standard geochemist test for calcite – effervescence with acid – was apparently put to use by Hannibal when he crossed the Alps. He had vinegar poured to soften the limestone so that his elephants would tread more surely. One learns here of formation of limestone and its conversion to marble, the distribution of limestone and marble worldwide, the sources of colour in marble, and the important role of marine organisms such as certain marine algae.

The second part of the book is by Johannes Rohleder and titled 'The Cultural History of Limestone'. This beautifully illustrated part describes the many uses of limestone and marble in art and in buildings over the ages. The illustrations include Egyptian and Mayan pyramids, chalk Champagne cellars in Reims, Palladio's Villa Rotonda and a certain white building on the banks of the Yamuna. We are told of the fluctuating fortunes of marble, and of how there is today, renewed faith in the natural stone as a building material.

The third part of the book, by Johannes Rohleder and Eberhard Huwald, is a regression to the mundane. We are told here of the many uses of chalk and PCC (precipitated calcium carbonate) as a glazing compound, in the rubber industry, as a pigment and as a filler material. In keeping with the comprehensive nature of this book, the authors not only tell us what kind of calcium carbonate is used in which product, but also describe the entire supply chain.

Christian Naydowski, Peter Heβ, Dieter Strauch and Ralph Kuhlmann have shared the writing of the fourth and last part of the book which is on modern industrial, agricultural and environmental uses of calcium carbonate. This versatile material finds its way into a number of plastics formulations, including as a filler and reinforcing agent in thermoplastic, thermosetting, elastomeric, adhesive and sealant formulations. It also finds use as a pigment extender and as a surface-coating material. Most interesting is its use in the treatment of flue gases (for desulphurization) and drinking water, and for the treatment of water bodies whose pH has fallen to unacceptably low levels. One also learns that large quantities of calcium carbonate go into livestock feed.

The book is beautifully illustrated and produced. One complaint that can be made is that many small but nagging errors have crept in during the transla-