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BOOK REVIEWS

Alice in Quantumland *An allegory of quantum physics* by Robert Gilmore, Sigma Press, Wilmslow, England, 1994 (paperback edition reprinted in India By Affiliated East-West Press, New Delhi, 1995, ISBN 81-85938-31-8; pp. x + 208; price not stated).

The Editor had done duty - sent in her/his reminder. The best way to wonder how to begin writing the review was the way to the coffee kiosk. My ears perk up, in well- or ill-bred but best canine fashion, when I overhear "Alice", "quantum" or words to that effect from what seemed like an animated conversation between two young people, clearly brother and older sister from their sibling resemblance, walking side-by-side just ahead of me. I turn up the volume on my hearing-aid/mini tape-recorder, hasten and begin to follow at a discrete but hearing-aid distance.

They were engaged in needling each other, one mock-formally addressing the other by name, polysyllabic, strange-sounding names really, nothing like "Sonya" or "Kenneth".

The Young Lady: What'ch've you got there, Mr. Sameehana?

S: Couldn't help being curious about what you fellows are up to in phys and maths ever since I copped out into the bio stream, Miss Vibhavaree [flaunts a paperback]. Got it from the libe. Leafed through it. The line-drawn pictures are very engaging. Seems worth reading too.

V: Oh! *Alice in Quantumland*. Confess to having read it. There are others like it too, like the ones listed in Further Reading. You know I don't suffer from tintinnabulation (look it up in the dictionary) but that title rings a bell. Must have come across it somewhere. Westerners seem to have only "Alice" as their *puraana* to fall back upon when they want to be allegorical in their fantasies and "Faust" when they want to get kickbacks from Mr. "D" of the Netherworld as a *quid pro quo* for souls sold.

Ah, yes! That was the title of a chapter in David Layzer's "*Cosmogenesis*" [Cosmogenesis – *The growth of order in the universe* – by David Layzer. Oxford University Press, Oxford, 1990 (paperback edition 1991)]. You know, Alice has a knack for getting into long boring conversations with all and sundry 'achievers' just because she is such a dear, 'curious/innocent' plasticine doll in the hands of writers with an urge to 'explain' the 'achievements' of all those wierdos. Maybe, one of these days she will be listening to a fellow called Plato, so fond of holding dialogues with captive audiences on how to govern a republic without televised debates, voicemail eavesdropping [I felt a little hot under the collar hearing *that*], booth capturing, anticipation of kickbacks, drug cartels, ultras and whatnot. On another day, maybe, she will meet that fellow with the double-hyphenated triple name (a new fashion) Fermat–Wiles–Pythagoras. She has yet to meet a man with a scholarly stoop called Keynes and discuss with him which is better— demand – or supply-side control. But I bet it will be a very long time before she tries to understand an old, saintly man named Paanini (coming from somewhere near the Khyber Pass) because, I hear, he was in the habit of always speaking rather cryptically in what he called "threads", four thousand of them!

S: You mean "Alice" is just a contrivance for presenting complicated things in a popular way?

V: Looks so. In *Cosmogenesis*, she gets to know what the staples of popular presentations of Quantum Mechanics are from Zeno (You know Zeno? And his tortoise who can never get 'there'?). You will know what I mean by 'staples' if you read books like the one you have just borrowed, things like: why spectra have lines, the photoelectric effect and interference, leading to

Messrs. Classical and Quantum Mechanic acQUAINTing Alice with the flora and fauna of the Quantum World under the unblinking gaze of the unsmiling Cheshire Cat.

what used to be called the Wave-Particle 'duality' (not the fashion nowadays), amplitudes and their squares which tell what you're *likely* to find, the Uncertainty Principle, the Exclusion Principle [Thought crossing my dirty mind on hearing that: "Turn over dear, so I can get into bed"],

Alice entering the Quantum World.....

..... and falling down, helplessly, into a singularity, watched by spin-up and spin-down electrons.

states and superposition of states. 'Locality' and 'Non', 'Complementarity' of position-momentum or energy-time of 'particles', two-photons-and-crossed-polarizers (a thing that comes out of one slit showing something called 'polarization' at right angles to that carried by the thing that came out of the other, even though either of those 'two' things had no way of cross-checking *before* being found out what mischief each had been up to), the grisly 'thought experiment' with a live/dead cat, Schrödinger's pet pet, Virtual Reality (things and *anti*-things that come out of *no*-thing), Many-many Worlds, getting out from under by tunneling, just like a mole, a pinch of chemistry and a dash of nuclear reactions, some paired names given to a desire to be conserved in numbers or to a desire to be 'condensed' — Fermi-Dirac and Bose-Einstein, and so on. Nothing much of magnetic interactions. Those and 'spin-glasses' seem to be non-staples. But all wonder whether we, who harbour an apparatus capable of harbouring something called 'knowledge' and a wily ability to plan experiments and draw 'conclusions', can imagine ourselves to be 'observers', 'outside it', at all.

S: *I was waiting for your "Whew!". Whew for you. Turning over the pages, I can see* Gilmore has covered all those 'staples', as you call them. Good. But.....

V: Sorry to interrupt you. Gilmore has done a bit more. As Alice is conducted alternately by Messrs. Classical and Quantum Mechanic, distant cousins, on a guided tour of the Theme Park of Quantum Physics to meet its strange flora and fauna. Quantum Mechanic leads her eventually, to a tent in the Phun Phair.....

We had, by now, reached the coffee kiosk. She buys an ice-cream cone but the boy, in his late 'teens, wants a grownup's coffee with his sandwich. That's good - I can eavesdrop some more - if

only they would continue. Being an immersion eater, I buy a packet of biscuits with my coffee and sit myself on a nearby stone bench.

S: I notice Gilmore can draw rather well. Almost manages to make Alice look like what John Tenniel had pictured her originally for the Rev. Charles Lutwidge Dodgson (known to be the *anti* pen-name of "Lewis Carrol"). It doesn't say anywhere what Gilmore does for a living, teaches physics, I suppose. He makes me think he chose "Alice" ("Alice in Wonderland" as well as "Through the Looking Glass") to be, what he calls, an 'allegory' only because he can draw her so well. He says here (pointing to a page in the Preface) he had a choice: "Pilgrim's Progress", "Gulliver's Travels"... "Pilgrim's Progress" (or regaining "Il Paradiso") too "spiritual" or "theological"? "Gulliver's Travels"? A word-cartoon, too 'straightforward.' "Alice" will fill the bill nicely, don'tchew think? Just about as fantastic as Quantum Mechanics. I have glanced through some parts of the book and I am beginning to wonder if having "Alice" as a contrivance to attract the reader isn't a distraction.

V: What's the word Father is so fond of using? "Pejo..."? "Pejo" something.

S: "Pejorative"?

V: Yes! "Contrivance" is pejorative. You may say having Alice now as an "Onlooker", now as one or the other kind of 'particle' (My! What semantic difficulties these fellows face in trying to say what the behaviour of math functions is telling them!) or now even something that can be hit by a photon, appears 'contrived'. Maybe, "Alice is a 'device'" is better. But Gilmore also uses another 'device': Mr. Quantum Mechanic looks from behind a board and points to writing on it: ".... The central feature of quantum behaviour are the detection of discrete quanta, or particles, and the observation of interference..." or, "...The binding is very strong and, like electrical interaction, is due to the exchange of virtual particles....". They sound portentous, don't they?

S: Yes, I have noticed those "boxes" and "End-of-Chapter Notes". I don't know if you're pointing to them a little out of context but they do sound like some people who have fallen into a habit of speaking with set or cultivated expressions. I will be in a blue funk with such 'serious matters' without quite going some way along on feeling how mathfuncs behave.

V: I was about to say, just as we were reaching this place, that Gilmore goes somewhat further than the 'staples' of some popular presentations. Alice meets little fellows named Quarks, said to 'make up' those "basic particles", three little fellows brightly coloured with "colour charges", carrying 'nessy' playthings that (for want of 'names' or out of plain whimsy) have been termed 'upness', 'downness', 'topness', 'bottomness', 'strangeness', 'charm-ing' (not so 'nessy')... They like to stay glued together, in sets of two or three, inside 'bags'. Funny kind of glue too: if you try to pull the Quarks apart (you have to pull quite hard) the 'gluon' first becomes 'stringy' and then turns gritty, to become 'particulate', one new particle sticking at each parting end. At the time the book was written they were still looking for the 'toppy' Quark. See this Mr. Thom(p)son-like man with the butterfly net [points to a drawing showing a Mr. Thom(p)son look-alike] trying to catch good old 'Toppo"?

S: I am not asking about the actual experimental setup but how can anyone tell that the 'particles exist'?

V: Gilmore does deal with the question. It is done by measuring mass/charge ratios, accounting for creation of entities that leave visible marks, seeing if those are 'stable' enough for their lifetimes to be measured with ever-increasing 'swiftness' of measurement *and* looking for symmetries that may tell you what to expect. If you look at a partly hidden pattern you can make up for your-

self the rest of that pattern. Theory (and your human makeup) make you expect some sort of symmetry, not a 2-D one, like that on a wall paper, but a multi-D one, the multi-ness of 'upness', 'downness', etc. leading you to expect complicated symmetry and many 'particles', some quite 'heavy', requiring costly super-duper smashers.

S: Are you going to bore me any more?

V: I do want to get a couple of things off my chest. Let me get some coffee now. What do you want?

S: [sighs] A cool drink will do nicely.

The immersion eater (of biscuits-in-coffee) also sighs, not liking one cup of the brown swill over another, checks for any innocent-looking bystanders who may end up as virtual smokers and, not finding any (innocent ones, that is), lights a cigarette and resigns himself to nurse *his* second cup as long as possible.

V: Alice is lucky enough to find herself in a neutron 'bag' just when a 'down' Quark changes into an 'up' one and the neutron 'bag' changes into a proton 'bag'. She does see an electron escaping but nearly misses the neutrino. A conversation, something like the following, ensues:

"Particles exchanged under the Weak Interaction are called W".

"What?"

"Not what, just W. Two kinds: W^- and W^+. W^- from 'down' to 'up' catches a neutrino and converts it into an electron".

"Where did the neutrino come from?"

"It came back from tomorrow, just to be present today. The electron goes away because it doesn't like the Strong Interactions inside the 'bag' and the Banker is satisfied with the Charge Account. But a 'new' neutrino formed escapes into the 'now-here' (*not* nowhere)".

In contrast with the macroscopic world, processes are (or are seen to be) symmetric to time reversal in the microscopic or individual-event world. That reminds me, not too relevantly perhaps, of Zeno who "spatializes" time and divides it into infinite this-way or that-way parts. That is why his pet tortoise can never reach from 'here' to 'there'. Father nowadays often quotes someone called Navjyothi Singh [Navjyothi Singh, "Foundations of logic in ancient India - *Linguistics and mathematics*. In Science and Technology in Indian Culture - *A Historical Perspective*, (A. Rahman, ed.), NISTADS, New Delhi, 1984, pp. 79–106]. It seems Indians of Old, engaged in what they called *sphotavaada*, arguing that 'utterance' can only be additive, like time. A temporal series of sound patterns manage to express unitary sense - a succession of utterances (or little explosions - *sphotas*) condenses into 'meaning' or a single understanding (a single *sphota*) - some sort of succession that gets compressed into a 'simultaneity' that expresses meaning. Somewhere there must lie buried an "Arrow of Time' (for a 'brief span', in the human head?). If time can be only additive and not reversible, Zeno's tortoise *can* get from 'here' to 'there'. It may mean that nothing ever 'happens' in the individual-event world. Yet that world supplies the 'material' for the world we perceive with our senses.

S: I don't know whatchew're gabbing on and on about, you big show-off.

V: I'm only trying to say what Father means, I think. But let me finish on a 'dark' note. Alice enters Wonderland by falling through a rabbit hole, trying to follow Mr. Rabbit, always in a hurry. Her adventures are in an 'interior world' where the sun is dull and the skies twilit. In the allegory

that Gilmore attempts, she dozes off in front of a TV set (evidently bored by on of those endless *dhaaraavaahiks*) and the world she enters is 'external' and well-lit, with large buildings where her companions are able to show her how potentials are either deep wells or high walls and 'particles' can be 'observed' to interact in this or that way.

Coffee and cool drink finished, the young people get up, lightly stretch their arms and legs and move off. I leave the biscuity dregs of my coffee, switch off the mini tape-recorder, throw away the stub of my cigarette and rush into the nearby bookshop. As luck would have it, I find a copy of the book. Hoping I would be taken as engaging only in some legitimate browsing, I begin to read some pages earnestly. Yes, it *is* an enjoyable read. ["Alice". Allusions bring a smile to; "The Three Quark [Marx] Brothers" with Italian names,] does look like the 'bottom' quark has a donkey's face [Midsummer Night's.....], "charge of the light brigade" [Crimea]..... But what is this: "..... increasingly more and more intense..."?] I wonder how they produce reprinted editions, by retypesetting? That would explain "Neils" for "Niels" (Bohr), "imortant", "give type of atom", "electrons can move into this hots", etc. Worth buying but, if you wish to get a look at the broad concepts and a feel for the terminology in an engaging way.

I must hurry now, to stare at the monitor and tap out the review on my PC.

[Figures reproduced from the book]

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Topics in polynomials: Extremal problems, inequalities, zeros by G.V. Milovanovic, D.S. Mitrinovic, and Th. M. Rassias, World Scientific Publishing Company Farner Road, P.O. Box 128, Singapore 9128, 1994, xiv + 821 pp, US $ 146. (ISBN 981020499x)

This is undoubtedly a very useful work compiling enormous researches carried out on the subject by many mathematical scientists including each of the three authors, especially by Dragoslav S. Mitrinovic (1908-1995). It presents a systematic survey (with interesting historical notes) of some of the most important (classical as well as recent) results on the analysis of polynomials and their derivatives. Thus, not only does the book include all the relevant fundamental results on the subject with their proofs, it also provides a rather detailed account of the most recent developments concerning extremal properties of polynomials and their derivatives, and properties and characteristics of their zeros.

This 821-page work comprises a total of 7 chapters, which collectively cite some 1200 references, a symbol index of 3 pages, a name index of 16 pages, and a subject index of 19 pages. A brief account of the chapter-wise content of this book is being given below.

Chapter 1 presents a review of the classical results on algebraic polynomials in one and several variables, as well as on trigonometric polynomials. The Fejer Riesz representation of nonnegative trigonometric polynomials, the Lorentz representation of polynomials, basic properties of orthogonal polynomials, the classical orthogonal polynomials, the other polynomial systems (such as the Appell polynomial systems) are discussed here.

Chapter 2 considers polynomials inequalities involving algebraic and trigonometric polynomials. Inequalities satisfied by the zeros, by the moments, by the coefficients, by derivatives, and so on, are presented here.

Chapter 3 discusses the distribution of zeros of algebraic polynomials, including such classical results as the Gauss Lucas Theorem, the Sendov Ilieff Conjecture and related topics, and bounds for the zeros and for their number in a given domain, including the Enestrom Kakeya Theorem and its generalizations.

Chapter 4 presents inequalities associated with trigonometric sums. many classical results (such as the inequalities of Fejer Gronwall Jackson, Young, Rogosinski, and Szego) are included here. The authors also consider various positivity and monotonicity results in this chapter.

Chapter 5 discusses various extremal problems for polynomials. The topics considered here include polynomials with maximal norm and estimates for coefficients, incomplete polynomials and weighted norm inequalities, and inequalities of Nikol'skii type.

Chapter 6 deals with extremal problems of Markov and Bernstein type. Here the authors begin with inequalities of the Markov and Bernstein type, and then discuss extremal problems for restricted polynomial classes and extremal problems in a circle.

Finally, in Chapter 7 the authors present various applications of polynomials. The topics considered in this chapter include least squares approximation with constraints, simultaneous approximation, the Bernstein Conjecture in approximation theory, and applications in computer and geometric design.

This is a well-written book on a widely useful topic. The authors have succeeded in their attempt to present the material in an integrated and self-contained fashion. It is strongly recommended not only to the specialist mathematical scientists, but also to all those researchers in the applied and computational sciences who make frequent use of polynomials as a tool. Of course, libraries will also benefit greatly by including this book in their cherished collection.

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Vibration problems in structures-Practical Guidelines, H. Bachmann et al., Publisher: Birkhauser Year: 1995 Page Nos: 1-231 Price: DM 68

The book titled "Vibration problems in Structures- Practical Guidelines", authored by several experts in the field including Prof. Dr. Hugo Bachmann, is a well written book for practising engineers. It contains 4 chapters dealing essentially with practical guidelines for practising engineers and 10 appendices giving basic & rudimentary concepts of vibrations. Infact, while there are many text books on structural dynamics and vibration problems dealing only with theoretical aspects, a book dealing with such a combination viz, practical guidelines & basic theory in vibration problems is very rare of its kind.

The practical guidelines almost in the form of a ready-to use handbook deal with all types of structures, starting from a simple foot bridge for pedestrians ending with highly statically indeterminate suspension & cable stayed bridges. In addition, it contains useful information on high-diving platforms, spectator galleries, sports & dancing floors, which is not available any where else in the form of a guide book. Besides, the chapters on Machine Foundations, Wind-induced

vibrations & Vibration induced by traffic & construction appear very useful. Information about Structure-borne sound, ground-transmitted vibrations which has been scarce till now has been made available in the book elegantly.

The information in the text has been organized under subtitles like structural criteria, tolerable values, simple design rules, more advanced design rules & finally, remedial measures. Particularly the information about the sound levels & tolerant limits is very useful in the light of the recent awareness on noise pollution affecting the industrial workers' health due to exposure to sound levels beyond tolerable values. Most of the industrial units suffer from noise pollution for lack of information about the same at the time of structural design.

The comprehensive treatment of the theory of the vibrations & particularly that of reinforced concrete is very illuminating. The information about damping mechanism of reinforced concrete structures in uncracked & cracked state deserves appreciation. The appendix G on dynamic forces from rhythmical human body motions like, walking, jumping & hand clapping is extremely useful in the design of structures. To the best of the reviewer's knowledge, that particular information is not commonly available. Of course, the book does not deal with earthquake & impact induced vibrations as well as fatigue problem. However, a chapter on ductility of R.C. structural elements could have been very handy.

The book mentions both serviceability and collapse limit states of structures subjected to vibrations. The book while guiding a practical engineer in practice also helps him to refresh his basic knowledge of vibrations. Such a book is very timely. The organisation and presentation of the information in the book are excellent & easily understandable. The reviewer recommends the book strongly for all the structural engineers both in the practising and in the academic profession.

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Strategies For Mars: A guide to Human Exploration: AAS Science and Technology Series, Vol 86, edited by Carol R. Stoker and Carter Emmart. Published for the American Astronautical Society by Univelt, Inc., P.O Box 28130, San Diego, California 92198, USA, 1996, pp 619, $70.

The title volume is a collection of review articles from leading authorities on various scientific aspects pertaining to the exploration of Mars divided into six sections covering 25 chapters. It covers issues relating to making the case for Mars, getting there and being there. The articles have been written on a general level so that they could be understood by a broad audience. The very relevant questions which everyone asks, like, why go there?, how to reach and live there? and what to do there?, have been considered in detail.

Interest in the red planet Mars is rejuvenated in recent times after a long spell of 20 years following the Viking lander missions. An intense program to survey Mars is being actively pursued, with NASA sending two probes, Mars Global Surveyor and Mars Path Finder, to explore ways for human landing on Mars, perhaps as early as in 2008.

Unlike the Apollo, which was a one-shot mission with a single objective - beating the Soviet Union to the Moon- the mission to Mars has several facets ranging from pure excitement of exploration, to the question of very survival of human race in case a meteorite hits earth and makes life as extinct as dinosaurs. Mars, unlike the Moon, has all the four elements-carbon, hydrogen, nitrogen and oxygen necessary for life. It has a third of earth's gravity and an atmosphere largely of

gaseous carbon dioxide. Going there is not a single shot affair, the idea is to be there, and create conditions for long term survival. Among the other reasons to go to Mars, it is argued that with the 45 years' cold war ending without nuclear Armageddon, the western society now needs a new frontier to be opened. The new frontier will create a strong driver for technological progress that will produce a flood of innovations.

Today the US has all the technology to send humans to Mars. Propulsion options include chemical, nuclear, and ion and magnetoplasmadynamic propulsion devices. Well suited for long range flights, the use of nuclear propulsion was envisaged in the project EMPIRE in 1962. The feasibility of nuclear rockets was demonstrated as early as in late 60s. A detailed proposal for a manned mission to Mars starting somewhere after 1985 was put forth by Von Braun in 1969, but was turned down due to non-technical reasons. Apparently, the biggest hurdle to human exploration of Mars is not the technology but developing the political and popular will to go.

Unlike the Moon, Mars is too far off from the Earth. Depending upon the trajectory chosen, an exploration mission to Mars could involve at least two years of total trip time, not counting the time spent on the Martian surface. During the trip, the crew could be living in a micro-g condition, which is of primary concern to the crew's health. Another cause of concern is the exposure to space radiations. Creation of artificial gravity during the flight has been envisaged, which could simply be achieved by spinning the spacecraft at 6 rpm, which provides about 2/3rd Earth gravity and surprisingly, it may not prove very costly in terms of vehicle mass penalty which could be as low as 10%.

The key issues for Mars exploration are (1) scientific exploration and (2) determining the potential for human habitation of Mars. Mars is one of the most scientifically interesting planet; the scientific activity on Mars may include, determining the relationship between planetary evaluation, climatic change and life, and Mars' suitability for future human settlement. Exploring for early life, if at all it exists is another area of great interest. The field exploration of Mars is proposed to be carried out by specially designed Mars rovers driven by remote controls, robots or humans.

The cost of Mars exploration is not trivial. Although no real estimates can be made, a common notion is that such a venture will cost at least $200 billion above the current NASA budget; while another study indicates it could be as low as about 5 years of current NASA budget ie $70 billion (1993). According to this study it is neither the technology nor the cost but the perception of the costs of such a venture, and the cultural responses to the challenges involved, are the primary factors inhibiting the exploration of Mars.

The issues cited above have been carefully examined in the papers listed in this volume. In fact, it is a highly timely reference book on human exploration of Mars. The articles provide a wealth of factual information. In one instance, however, an inconsistency is observed. As evident on p.16, the main reason to go to Mars and not the Moon which is so much close to Earth, is that "the Moon has no hydrogen, nitrogen or carbon, the three of the four elements most necessary for life". In the very next article written by Harrison Schmidt, however, it is stated, (p.32) "the lunar produced consumables include hydrogen, oxygen, water , nitrogen and carbon compounds and food", which is obviously not true. Overall, the volume is a fine collection of some of the benchmark papers on Mars. It is recommended to the space scientists and research students interested in problems involving Mars. Certainly, it is an excellent addition to any library. As is usual with the AAS publications, the volume is bound in hard cover. The cover painting depicts two astronauts erecting the flag, designed by Thomas Paine, a former NASA Administrator and Martian pioneer, on Mars. In fact, this book is dedicated to the memory of Tom Paine, and to planting his flag on Mars.

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