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Book Reviews

Harmonic analysis and hypergroups, by K. A. Ross *et al.*, Birkhauser Verlag AG, Klosterberg 23, CH-4010 Basel, Switzerland, 1998, pp. 256, sFr 178.

The book under review contains the proceedings of the International Conference on Harmonic Analysis held at the University of Delhi in the winter of 1995. An underlying theme of the conference was hypergroups. The theory of hypergroups was developed around 1970 independently by Charles Dunkl, Robert Jewett and Rene Spector and has been found useful in fields as diverse as special functions, differential equations, probability theory, representation theory and quantum groups. Contributors to this volume include such distinguished mathematicians as Henry Helson, Kenneth Ross, Alan Schwartz, Donald Sarason and V. S. Sunder.

Reviewing a conference proceedings is not always an easy job. Any such proceedings will certainly have something interesting and useful to an expert in the field. But a general reader browsing through such a volume may find it quite disappointing. There are exceptions to this general rule and the present volume is one such. Apart from several interesting articles which an expert will surely enjoy, this book also contains articles of expository nature introducing the concept of hypergroups to a general reader. The articles 'Hypergroups and signed hypergroups' by K. A. Ross and 'Three lectures on hypergroups' by A. L. Schwartz are of this kind.

These articles introduce the notion of hypergroups and describe the basic results in the field. The article by A. L. Schwartz discusses quite a number of examples of hypergroups and concludes with several research questions. Unfortunately, most of the fundamental results are presented without any proofs. However, this article has an extensive bibliography so that any interested reader can find suitable references. Another interesting article by K. Trimeche discusses some examples of hypergroups in detail and then proceeds to study the continuous wavelet transform on hypergroups. Another article by M-O. Gebuhrer discusses Fourier Series and multiplier theorems on compact commutative hypergroups. The article by V. S. Sunder and N. J. Wildberger introduces and studies the notion of actions of finite hypergroups and several examples are discussed in detail.

Besides the articles mentioned above, all of them dealing with various aspects of hypergroups, there are also articles on other topics in harmonic analysis such as de Branges modules (S. Agarwal and D. Singh), Multipliers of de Branges–Rovnyak spaces (B. A. Lotto and D. Sarason), Disintegration of measures (H. Helson), Orthogonal polynomials (R. Szwarc), Positive definite functions (M. E. Walter) and others. The article by N. J. Wildberger on 'Characters, bi-modules and representations in Lie group harmonic analysis', which is a bit philosophical in nature, discusses the role of characters of commutative hypergroups in the representation theory of Lie groups. The author puts forth an approach to the representation theory which is similar in spirit to the original approach of Frobenius using characters.

We would like to conclude this review with some remarks. Every article of this book which deals with hypergroups invariably defines them elaborately with all the axioms. This repetition could have been easily avoided with no extra effort on the part of the editors. Probably, the editors could have written an introduction giving the definition and discussing the basic examples of hypergroups. Despite these remarks, this is a good source book for anyone interested in hypergroups.

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Groups and geometries edited by Lino di Martino *et al.*, Birkhauser Verlag AG, Klosterberg 23, CH-4010 Basel, Switzerland, 1998, pp. 280, sFr. 128.

This book contains expanded versions of many of the talks given at a conference on groups and geometries held at Siena, Italy, on September 1–7, 1996. Most of the group-theoretic and geometric issues discussed here are related to the study of finite simple groups.

Except for the groups obtained as the set of all even permutations on finite sets of size at least five, and twenty-six specific and still quite enigmatic finite groups, all finite simple groups are *expected* to be among sections (i.e. quotients of subgroups) of finite groups of Lie type.

Finite groups of Lie type appear as the fixed-point sets of certain endomorphisms of simple algebraic groups over algebraically closed fields of positive characteristic defined by Chevalley in his seminal Tohoku paper.[1] A finite irreducible root system is built into Chevalley's definition of each of these groups. Thus, the structure as well as the representation theory of the algebraic group defined by a finite root system and of the finite groups of Lie type contained in it are closely related to those of the Coxeter group and of the complex semi-simple Lie algebra associated with the root system.

After many years of work (and the work of Veld Kempf on polar spaces), Tits discovered a deep connection between simple algebraic groups and certain combinatorial objects he (and Bourbaki) defined called 'buildings'. They include objects equivalent to finite-dimensional projective spaces and polar spaces. A building is an ordered pair consisting of a regular simplicial complex of finite rank and a family of thin subcomplexes of maximal rank called 'apartments' satisfying certain conditions (see Brown[2]). Here, 'thin' means: Each simplex of codimension 1 is in precisely two maximal simplices. Spherical buildings are those whose apartments are finite Coxeter complexes. The sublattice of the subgroup lattice of a finite group of Lie type, consisting of all subgroups containing the normalizer of a Sylow subgroup for the defining prime, is the lattice of all simplicies of a typical example of a spherical building. Later, Tits also gave a definition of a building (the one used in Ronan[3]) which makes it 'look like a metric space with the metric taking values in a Coxeter group'.

Tits' magnificient classification[4] of spherical buildings of rank at least 3, apart from putting the fundamental theorem of projective geometry[5] and the classification of polarities of projective spaces[5] in broader context, also provides geometric objects whose groups of automorphisms and the centralizers in them of certain outer automorphisms account for all finite groups of Lie type.

More precisely, a finite group of Lie type which is not on a certain explicit list is a section of the group of all order-preserving bijections of the partially ordered set of all flags of simplicies of an appropriate finite building. Further, each of the exceptions is a section of the group of all order-preserving bijections of the partially ordered set, as above, for an appropriate finite building which commutes with a fixed-order-reversing bijection.[4]

The volume under review contains articles by mathematicians actively pursuing several issues related to the above, with emphasis on recent results and open problems. Here are some samples:

(i) a paper by Aschbacher and Smith on their progress on the so-called 'quasi thin' case which is one of the unpublished parts of the classification of finite simple groups; by Seitz on the study of the maximal subgroups of exceptional type, and by Guralnick and Hoffman on the first cohomology of simple groups;

(ii) papers on building (by Shult) on building-like geometries for sporadic simple groups (by Bueekenhout, Dehon and Leemans), and some geometric questions (by Cooperstein on ovoids in $Q^+(10, q)$ and the Lie incidence geometry $E_{6,1}(q)$);

(iii) on extensions of some classes of geometries (by Ivanov and by Van Bon and Cuypers);

(iv) Zara's paper on a generalization of the concept of reflection groups; Shaley's paper on the study of subgroups of profinite groups using ideas of fractal geometry and Kac–Moody algebras; and a survey article by Thas on embeddings of geometries in finite projective spaces.

This volume succeeds eminently in the stated objective of providing a 'stimulating collection of themes for a broad range of algebraists and geometers' and is very much in the spirit of title of the Birkhauser series 'Trends in Mathematics'.

Students of finite simple groups and finite geometries should find this collection very useful in educating themselves about the current thinking in their subject.

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Mathematics of the 19th century edited by A. N. Kolmogorov and A. P. Yushekevich, Birkhauser Verlag AG, Klosterberg 23, CH-4010 Basel, Switzerland, 1998, pp. 368, sFr. 128.

Mathematics is a strange discipline created by man. As and when it evolves, it completely sheds out its earlier garb and adopts a new manifestation. It is a sculpture presented to connosieurs who applaud its serene beauty. But beginning with a raw stone how the metamorphism to a divine art takes place in the hands of a sculptor is normally an unrevealed story. When we go through an astoundingly beautiful theory, we overlook the fact that such a theory is the culmination of pioneering works of a gallery of mathematicians. The current volume under review helps, to some extent, to bridge this gap in our understanding the course of development in the lore of mathematics.

The pinnacle of a culture is always reflected in its achievements in mathematics. The history of human civilization amply substantiates this view. However, 19th century had witnessed an unprecedented upsurge in the development of mathematical thinking and it had played a crucial role in the advancement of mathematics. Indeed, the works of Gauss, Weierstrass, Cauchy, Dedekind, Cantor, Hilbert, Poincare and a host of such eminent mathematicians did firmly lay the logical foundation for a deeper understanding of mathematical concepts.

The book under review is the third volume in a 3-volume series on 'Mathematics of the 19th century', edited by A. N. Kolmogorov and A. P. Yushkevich and is a translation of the Russian edition. This volume is devoted to a presentation of development in best approximations, differential equations, calculus of variations and finite differences during the 19th century. The whole book is divided into four huge essays, each on different topic written by different people.

The first essay 'Function theory according Chebyshev' is an attempt to present, as lucidly as possible, the developments in the theory of best approximations during the 19th century. A deep theorem of Weierstrass asserts that a continuous function on a compact interval can be uniformly approximated by polynomials. But the central question in best approximations by polynomials is to find the polynomial of a fixed degree which is 'closest' to the given function. Chebyshev proved that

$$\inf_{f\in\mathcal{P}_n}\max_{x\in[-h,h]}|f(x)| = \frac{h^n}{2^{n-1}},$$

where $\mathcal{P}_n$ is the set of all polynomials of degree n and this infimum is achieved by the Chebyshev polynomial $T_n(x)$ defined by

$$T_n(x) = \frac{1}{2^{n-1}}\cos\left(n\cos^{-1}x\right).$$

Chebyshev used continued fractions to arrive at this result. He systematically developed these ideas and used them successfully to get polynomials of 'minimal deviation from zero' in other metrics like integral metrics. As a consequence we see the birth of a rich theory of orthogonal polynomials.

Bernstein, armed with the findings of Chebyshev and Petersburg school, set himself to the task of finding the error in best approximations. If

$$E_n(f) = \inf_{p\in\mathcal{P}_n} \sup_{x\in[-1,1]} |f(x) - p(x)|,$$

Bernstein proved that

$$\frac{\sqrt{2}-1}{4(2n-1)} < E_{2n}(|x|) < \frac{2}{n(2n+1)}.$$

The second essay is on ordinary differential equations. The question of existence and uniqueness of solution to initial value problem

$$\frac{dy}{dx} = f(x,y), \quad y(x_0) = y_0$$

was first raised by Cauchy. He used the method of successive approximation developed by Euler and studied the convergence of sequence of approximation. He also developed the method of majorization and successfully employed it in studying the problem of existence of power series solutions to IVP. His work was continued by Lipschitz, Picard, Peano and Osgood. On the other hand, integrating the given differential equation to obtain solutions in elementary transcendental functions occupied the final few decades of the 19th century. Notable contributions were made by Riccati, Liouville and Bernoulli. Their works led Sophus Lie to his famous classification of all differential equations using groups of finite continuous transformations, later came to be known as Lie groups. He also gave methods of integrating these classified differential equations.

The general theory of linear differential equations took its shape through the researches of a gallery of mathematicians like Christoffel, Hesse, Brisson, Gregory, Boole, Heavyside, Sturm, Liouville and Steklov. In the same period, Bessel introduced his famous 'Bessel function' in an attempt to find solutions to certain differential equations. Gauss' study of hypergeometric series and analytic theory of differential equations by others unified special functions with differential equations. The work of Poincare led to the theory of automorphic forms. He also investigated qualitative theory of differential equations and gave a classification of singularities exhibited by integral curves in phase plane. This in turn led Liapunov to his stability theory of differential equations.

We see the contributions made to calculus of variations during 19th century in the third part of the book. It began as an independent discipline in the work of Euler in the middle of 18th century and later was put on solid ground by Lagrange. The simplest problem in this discipline is to find the extremum of the functional

$$J = \int_{x_0}^{x_1} f(x, y, y')dx$$

under the boundary condition $y(x_0) = y_0$, $y'(x_0) = y_1$. Many of the problems in partial differential equations can be transformed to a problem in calculus of variations. The famous divergence theorem of Gauss transforming a volume integral into a surface integral was extremely useful in solving many problems.

Around 1830, Hamilton, based on the results of Lagrange, who first wrote the partial differential equations of mechanics in variational form, introduced canonical equations of dynamics. Jacobi perfected it and also developed a method of integrating these equations. The whole theory is popularly known as Hamilton–Jacobi theory in mechanics. Earlier, Legendre found a certain set of equations for weak extremum of a functional, but left some questions unanswered. This gap was filled by Jacobi who developed the method of variation of parameters and successfully used it to solve differential equations.

The second half of the 19th century witnessed a tremendous upsurge in the advancement of calculus of variations. Weierstrass took the lead and changed the entire style of work by attracting the attention of mathematicians to a clarification of its foundations. He introduced parametric definition of curves thereby enlarging the class of curves among which an extremum can be sought. David Hilbert proved his 'independence theorem' and established the connection between Euler's and Hamilton–Jacobi equations.

An important class of problems in calculus of variations is the so-called isoperimetric problem. This began with the work of Euler who established the 'law of duality'. Weierstrass also proved this independently and included it in his 1877 lectures. At the end of 19th century and the beginning of 20th century the whole discipline took a different shape in the works of Volterra, Frechet and Gateaux for whom we owe the present formulation of calculus of variation.

The final section of the book is devoted to the development of calculus of finite differences. Along with the formulation of differential equations to describe many physical phenomenon, a need for integrating them was equally felt. Since it was impossible to find solutions of many equations in closed form, people began to think of the possibility of obtaining numerical solutions to them. Newton was the first to think in this direction. The work of Lagrange on interpolating polynomials is noteworthy. The question of having interpolating series was addressed by Laplace, Amphere, Frobenus, Hermite, Poisson, Legendre and Ostrogradaski. Finite difference equations were also introduced in place of original differential equation and methods for solving these difference equations were developed.

The whole book unfolds before you the strange story of evolution of independent disciplines among which there is an inherent cohesion. It takes you to a saga of folklore of mathematics which is totally absent in what we study now. The book is recommended to all those who would like to know the historical perspective of the present-day mathematics.

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Proceedings of the International Congress of Mathematicians, Vols I and II, edited by S. D. Chatterji, Birkhauser Verlag AG, Klosterberg 23, CH-4010 Basel, Switzerland, 1998, pp. 1676, sFr. 98.

The twenty-second International Congress of Mathematicians was held at Zurich, Switzerland, for the third time, during August 3–11, 1994. The proceedings of the Congress have been brought out in two volumes (over 1,600 pages) and includes invited addresses and works of award winners on a variety of topics. It also includes a historical account with details of opening and closing ceremonies along with a list of 2,476 participants from 92 countries.

The scientific programme begins with the works of award winners, invited addresses at the plenary sessions and details of lectures at 19 section meeting on logic, algebra, number theory, geometry, topology, algebraic geometry, Liegroups and representations, real and complex analysis, operator algebra and functional analysis, probability and statistics, partial differential equations, ordinary differential equations and dynamical systems, mathematical physics, combinatorics, mathematical aspects of computer science, numerical analysis and scientific computing, applications of mathematics in the sciences, teaching and popularization of mathematics and history of mathematics.

The proceedings contain a brief account of the works of four Fields Medalists—J. Bourgain, P-L. Lions, J-C. Yoccoz and E. Zelmanov—along with the Rolf Nevanlinna prize winner A. Wigderson. Fourteen plenary lectures and 135 section lectures are included. The lectures deal with several different and diverse topics of mathematics and lack uniformity in emphasis and presentation since the articles range from elementary to advanced levels and do not conform to any pattern. The proceedings is no doubt a good collection of articles on several active branches of mathematics, giving a wide coverage of what is going on in several fields.

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Elements of the representation theory of Jacobi group by R. Berndt and R. Schmidt, Birkhauser Verlag AG, Klosterberg 23, CH-4010 Basel, Switzerland, 1998, pp. 232, sFr 88.

The theory of modular forms, which are certain special kind of functions on the upper half-plane, is one of the most important parts of number theory. Initially, this theory was studied more from the function theory point of view, but slowly more and more group-theoretic considerations were brought to bear on it. Indeed, the theory of Hecke operators or the theory of new forms owes essentially to group-theoretic considerations.

From the perspective of group theory, modular forms on the Poincare upper half-plane are certain functions on $\Gamma\backslash GL_2(\mathbf{R})$ on which both $SO(2)$ and the center of the universal enveloping algebra of $GL_2(\mathbf{R})$ operate via characters, and which have "moderate growth at infinity". (Here Γ is a certain subgroup of $GL_2(\mathbf{Z})$ of finite index.)

Much of the classical theory, once recast in the group-theoretic language, becomes available to much more general groups, the so-called reductive groups, of which Gl_n and Sp_n are examples. This generalised viewpoint has been very useful to view under the same umbrella, the classical theory of modular forms as well as the theory of Hilbert and Siegel modular forms.

Jacobi modular forms have made their appearance in many different contexts. The more important of these are in the theory of theta functions, or as coefficients in the 'q'-expansion of Siegel modular forms. These are certain functions on $\mathbf{H} \times \mathbf{C}$ where $\mathbf{H}$ is the Poincare upper half-plane. The group which underlies the Jacobi modular form is the Jacobi group which is a semi-direct product of SL_2 and the Heisenberg group (which is a 2-step, 3-dimensional, nilpotent Lie group). The Jacobi group is *not* reductive, and some of the considerations available for general reductive groups are not available here.

The theory of Jacobi forms was exposed and streamlined in the book of Eichler and Zagier *The theory of Jacobi forms*. The book of Eichler and Zagier besides laying the foundations of the theory, contained many original results including the relationship of Jacobi modular forms to modular forms of half integral weight and to Siegel modular forms. The initial impetus to that work came from what is called the, 'Saito–Kurokawa conjecture' which gives a 'lifting' from modular forms to Siegel modular forms. This lifting is constructed via Jacobi modular forms which acts as an anchor.

The book of Eichler and Zagier, though modern in perspective, still did not emphasize the representations of the Jacobi group on which the center of the Heisenberg group operates non-trivially. It is a simple consequence of Mackey's work that these representations are in bijective correspondence with the representations of the metaplectic group which is a 2-fold cover of SL_2. The corresponding global theorem gives the bijection between Jacobi modular forms and modular forms of half integral weight mentioned earlier.

The book presumes almost nothing, and develops the whole theory from scratch. It has detailed chapters on Hecke algebras and Whittaker models.

As some inaccuracies, I might point out that the book (on page 25) claims that there is a unique central extension of SL_2 which is not true; the proofs of theorems 2.6.1 and 2.6.2 are not correct.

To conclude, the book, with much valuable information not to be found elsewhere, will surely serve as a reference work for the emerging theory of Jacobi modular forms.

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Modern group analysis VI edited by N. H. Ibragimov and F. M. Mahomed, New Age International (P) Limited, Publishers, 4835/24, Ansari Road, Darya Ganj, New Delhi 110 002, 1997, pp. 409, Rs 575.

The proceedings under review is the outcome of the International Conference on Modern Group Analysis, held at the University of Witwatersrand, Johannesburg, South Africa. It contains articles by top experts in the field and range from classical Lie symmetries to modern approximate symmetries.

Lie group theoretical method is a well-known procedure to obtain special class of solutions/or reduction of the order of the equations. In particular, Lie infinitesimal invariant transformation is quite simple, yet a powerful method to achieve the above objectives. Many mathematical models which appear in mathematics, physics and mechanics are mostly nonlinear by construction. It is often very difficult to obtain even simple and physically important solutions. But, Lie symmetry analysis is often applicable to any complicated problem and can get useful solutions through this approach. So, the primary aim is to find the underlying invariances in the given model. Some of them are related to the underlying geometry of the model and the remaining are not connected to geometry in a simple manner. The geometrical symmetries can be recognised from the structure of the equation itself without invoking any group-theoretical methods. But these types of symmetries form only a subclass among the invariant group. Hence, we need to follow some systematic procedure to obtain all the symmetries of a given system, from which one can obtain a large family of solutions. Lie symmetry analysis simply says that a Lie one-parameter transformation group leaves the given differential equation invariant under the transformation of all independent and dependent variables. Once the invariant transformation is known, then it is an easy task, at least in continuous equations, to get the exact solutions or reduce the order of the equations. At this stage, sufficient caution should be taken not to have an impression that the classical Lie symmetry approach can give all the invariants. Hence, modern group methods have emerged in recent time. Multifaceted developments have taken place in developing the original idea of Lie on invariant transformations. This proceedings concerns with these new developments. For example, if the given equation depends on a small parameter, then we should look for approximate symmetries and invariant groups. On similar line to classical theory, infinitesimal criterion for invariants of approximate groups has been introduced. Here, the determining equations are linear partial differential equations with a small parameter. Furthermore, functions defining transformations have perturbation parameter as an additional variable. Using the language of Jet space this theory can be brought to a nicer form and perturbation parameter eliminated.

But this is not the end of the story. Additional invariant solutions and reductions can be obtained from non-Lie point symmetries. The first in this class is the non-local symmetry which involves integrals of dependent variables in transformations. Through this approach one can obtain new class symmetries. Another source of new (non-Lie) reductions is possible through conditional symmetry. Here we have to impose an additional differential constraint. But the price to be paid for this new reductions is that we have to solve nonlinear overdetermined systems. The other names given for this method are direct reduction and non-classical symmetries. All the methods described above are quite simple but the calculations are very tedious. Lie's method demands huge number of algebraic manipulations in order to find the symmetries of a differential equation. In recent years, this difficulty has been resolved by the introduction of many mathematical softwares–Mathematica, REDUCE, Macsyma, etc.–to calculate symmetries using symbolic manipulations.

It is obvious to see that considerable pains have been taken to present in this proceedings every aspect of symmetry approach described above and examine it with respect to a variety of physical problems and modern mathematics. The theme covers many branches including continuum mechanics, fluid mechanics, wave phenomena, relativity, quantum mechanics, etc. Models from abstract dynamical systems, differential equations in Colombeau algebras, Bäcklund and Darboux transformations, singular manifold method have also been discussed. Symmetry analysis using Mathematica package has been presented in detail. Renormalisation group and symmetries have been exploited in connection with relativity and quantum mechanics. In these articles, the authors try to present a systematic procedure to compute renorm group and symmetries. Symmetries and exact solutions have also been obtained for submodel of barochromic gas motions, for some non-Newtonian fluids, for an interfacial solitary wave, Boltzmann equation and models in continuum mechanics. Linearization of Monge–Ampére equations has also been derived. Using the theory of differential resultant, algebraic and differential condition on the coefficients of the differential equations has been found for the existence of solutions. A detailed presentation on Bäcklund transformation for vaccum Einstein equation and Loewner transformation in gas dynamics has been given. Invariants of higher-order differential equations, linear, quasi and nonlinear partial differential equations have been obtained. Equivalence transformations and their extensions are presented.

In short, the proceedings is a valuable source to researchers who are working/intend to take up this modern group analysis approach to obtain exact solutions/or for reduction procedure in a variety of physical problems of interest.

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The invisible computer by Donald A. Norman, The MIT Press, 55 Hayward Street, Cambridge, Mass. 02142, 1998, pp. 302, $25.

There are two very well-known stories about the 'invisible man'. The science fiction by H. G. Wells describes a man who actually becomes invisible. The 'detective' story by G. K. Chesterton, on the contrary, describes a man who was so much a part of the everyday scene that no one really noticed him. This is exactly what should happen with the computers, argues Prof. Donald Norman, the author of the book under review.

The cover of the book has an ingeniously designed, translucent jacket, with the words 'The' and 'Computer' printed in dark, bold letters on the jacket itself, and the word 'Invisible' on the cover in a slightly lighter shade, making the word 'invisible' itself invisible at the first sight! This touch of making a point humorously, delightfully and strongly is a hallmark of Prof. Norman and is seen all through the book. The somewhat lengthy subtitle of the book sums up the divergent yet connected topics very nicely: "Why good products can fail, the personal computer is so complex, and information appliances are the solution".

Over the last decade or so, the number of people using personal computers (PCs) has increased tremendously. What is more, the demand for computers has kept on growing at a faster rate. The fact that PCs have become faster, more versatile and more importantly, more and more inexpensive over the years has further increased their popularity. So far, so good. However, in contrast to almost all the other technologies, the PCs have become more complex and more difficult to use. Notice the contrast with almost any other product used in everyday life—be it the fountain pen, the tape recorder or the car. All these have become simpler to use than what they were a few decades ago. On the other hand, the PCs, and in particular the software, as Dr. Norman points out, has become more complex and much more difficult to use. He has coined a very appropriate phrase for it: "Creeping featurism"—a symptom of the dreaded disease "featuritis". Thus, for example, the 1992 version of the popular word processing package Microsoft Word offered 311 different commands for the user! As if this was not enough, the 1997 version offered 1033 commands! Who needs all this complexity?

Unfortunately, as pointed out by Prof. Norman, this is an almost inevitable consequence of the present, "all purpose" nature of the PC on the one hand, and the marketing and commercialization aspect on the other. Today's word processor is designed such that the same package is used for all the word-processing tasks—a child writing to his friend or a scientist writing a technical monograph in her specialty subject. In the process of making one package do all the things, one cannot avoid making it more complex.

The second and even more alarming cause is the force of the marketplace. Make no mistake—the primary goal of all the commercial software developers is to make more and more money by selling more and more copies of the product; the convenience of the user is way down on the list of priorities. When there are many competing products that seem equally good in doing the job, how does one aggressively advertise the supremacy of one's own product? By pointing out the fact that many more features than the competition have been included. Thus start the wars, which can only escalate over time, making each product full of a lot of unnecessary options.

This tendency has attained really frightening proportions when it comes to hardware. Each of the computer vendors tries to outshout the other by claiming superiority on account of RAM, DRAM, MIPS, FLOPS, SPECS and whatnot. Even the experts, called in to review competing products, fall prey to the attraction of the benchmarks—and start giving importance to what is measurable than measuring what is important (a criticism more familiar in the context of citation scores and impact factors)! It is not as if the limitations of such criteria are not known. The experts are well aware of how poorly do the indices reflect the suitability of the computers to carry out the tasks at hand. One of the measures of the speed of the PC, or, to be more precise, of the CPU or the processor, is MIPS—million instructions per second: a higher MIPS rating means a faster processor. Very soon, however, MIPS was taken to be an acronym for "meaningless indicator of processor speed".

What, if any, is the way out of this sorry state of affairs? The major point, forcefully and convincingly made by Prof. Norman is in favor of a shift of emphasis from the technology to the user and the task (in line with the recognition of single-most important factor common to the majority of car accidents—the 'nut behind the wheel who drives the car'). Thus, nobody really wants to use a word processor or for that matter the computer; what they want to do is to write a short letter (or draw a graph, or tally the accounts, etc.). So, according to the author, we should move towards small, simple-to-use, special-purpose appliances, designed for carrying out a specific task, rather than continuing to build and market general-purpose, ever-more-powerful PCs. In fact, the importance of his suggestions is already evident from the growing popularity of digital diaries, personal digital assistants and other such 'downscaled' and simplified avatars of the PC.

This is the major theme of the book, and it covers a wide range of its facets in eleven attractively titled chapters. The author has drawn on his rich and extensive experience ("from the hallowed halls of bickering academia" to the "harried frenzy of industry") to take us through the many steps of product development—research, production, marketing, user support, etc. The many anecdotes about the history of technological products (e.g. Edison being a brilliant inventor but a very poor marketing strategist) make the book extremely entertaining. There are many serious thoughts and tips too, for making the computer, the software packages and in general any of the high-tech products far more useful to the user and the consumer.

In summary, this is a most enjoyable book about radically redesigning the computers to make them far more user-friendly and efficient, and can be read profitably by students of science, engineering, design, management as well as by general readers.

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Thermodynamics by C. P. Arora, Tata McGraw-Hill Publishing Company Limited, 7, West Patel Nagar, New Delhi 110 008, 1998, pp. 762, Rs. 275.

Teaching thermodynamics at the undergraduate level or writing an appropriate textbook is always a challenging task, as it appears to be a subject which the students often find difficulty in comprehending fully. The usual approach to problem solving as applied to some other basic engineering subjects (such as mechanics) may not be easily applicable in thermodynamics. A possible reason for this is the involvement of a number of variables (such as temperature, pressure, internal energy, entropy, enthalpy, and so on), and perhaps the concept of the second law which most students get introduced to for the first time. Certain concepts such as reversible, irreversible, quasi-equilibrium, inequality relations, etc. can be very confusing to a student who is more used to definite relations imposed by the laws of mechanics. Hence, while writing a thermodynamics textbook, one has to introduce the different topics in an appropriate sequence, and maintain continuity at the same time. The presentation should cover enough depth and breadth in the subject so that the student obtains a clear understanding of the fundamental principles, and at the same time generates interest in some of the common applications of thermodynamics. This textbook by Prof. C. P. Arora is well written and seems to take care of some of the above issues. The design and structure of this text, however, is very similar to some popular textbooks on thermodynamics such as the one by G. Van Wylen and R. Sonntag. But that is understandable since the success of such textbooks is bound to influence future authors.

In this book, the topics have been sequenced in a proper manner, generally. For the benefit of an engineer, the subject has been introduced with practical examples (Chapter 1) instead of making it very abstract. The student is first introduced to those thermodynamics variables which can be easily measured (such as pressure, temperature and specific volume) in Chapter 3. Properties involving more advanced concepts, such as enthalpy and entropy, have been introduced after describing the first and second laws, respectively. However, I feel that the topic of real gas has been treated too elaborately in Chapter 3 which is likely to confuse the beginner. Perhaps, the concept of real gas could be mentioned briefly and qualitatively in Chapter 3, and the details could be covered in more detail later in Chapter 11 (along with thermodynamics property relations). Apart from that, the various topics such as first law, second law, cycles, availability and irreversibility, property relations, non-reacting mixtures, etc. have been sequenced in a conventional manner as in many established thermodynamics textbooks.

The introduction of heat-transfer concepts in Chapter 4 seems to be out of place, in my opinion. While the concept of heat, its units, and its relation to work are necessary to be introduced before the first law is established, any details regarding heat-transfer fundamentals need not be in the scope of a thermodynamics textbook. Firstly, the details presented about heat transfer are very sketchy and incomplete, and may confuse the reader. Secondly, heat transfer is essentially a non-equilibrium process which always requires a temperature difference, whereas the present textbook is supposed to be dealing with equilibrium thermodynamics. Equilibrium thermodynamics is concerned only with the quantity of heat, while the subject of heat transfer is concerned with the mode of heat transfer, its rate, and temperature distribution.

The theory on vapour cycles in Chapter 8 seems adequate, but the number of problems at the end of the chapter is very few, especially when one realizes that this chapter lays the foundation of practical thermodynamic systems. Solving problems involving power and refrigeration cycles is generally popular among students as it teaches them design concepts in thermodynamics. Hence, a bigger set of problems addressing a wide range of issues regarding power and refrigeration cycles is desired. A table for refrigerant R-134a should also be included, considering that it is a refrigerant of the future.

On the whole, it is a well-written textbook on thermodynamics at the undergraduate level. Typographical and grammatical mistakes are very few (a notable one being in equation 3.32 on page 89). The author may use some of the above suggestions to improve the manuscript in a future edition.

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Elements of physics, Volumes I and II, by D. Chattopadhyay and P. C. Rakshit, New Age International (P) Limited, 4835/24, Ansari Road, Daryaganj, New Delhi 110 002, 1997, pp. 506, Rs. 165.

It is a pleasure to come across a good textbook, this time for classes XI and XII students, who are at an impressionable age and hence need proper foundation. The West Bengal Council for Higher Secondary Education decided some years ago to restrict the number of pages of the textbooks for classes XI and XII, so that the students are not burdened literally and figuratively with the enormous volume of their books. The present books were written according to these guidelines, covering the syllabus in a limited number of pages. The Council's decision and the attempt by the authors to meet the challenge are both to be commended.

The two authors are indeed highly qualified researchers and teachers working at the Institute of Radio Physics and Electronics, University of Calcutta, a very renowned institution. Both have Ph.D.s, have more than two decades of research experience, have published several research papers and are currently at the level of professors. On looking at the credentials of the authors, the reviewer had initially a serious worry that the story would be repeated of the unfortunate episode of the NCERT's effort some years ago to revise the physics textbook at roughly the same level. The authors of that episode were all very distinguished researchers. They assumed the students to be at their research level and wrote a book which presented the elementary concepts in physics from the most advanced top-down point of view. For example, the laws of mechanics were deduced from the general principles of invariance and conservation, temperature from the zeroth law of thermodynamics, electrical and magnetic fields from gauge invariance and so on. Such a book might be useful for advanced researchers to get an axiomatic and unified view, but resulted in a virtual revolt by the students and the teachers of classes XI and XII. At that level, physics is best taught with all its links with day-to-day life. The historical evolution of the ideas, including the successive refinements of these ideas, gets accepted immediately. This is indeed the time-tested traditional way of teaching the subject at the school level. The scholarship of the authors should reveal itself in the precision and clarity of presentation, with occasional flashes of insight or peep into the current thinking on the older subjects. The great mathematician Felix Klein, who titled his famous treatise *Elementary geometry from an advanced point of view*, cautioned the readers that the book is meant for advanced students to look at the basis and foundations of geometry, from angles like Euclidean, cartesian, projective, affine, and non-euclidean geometry and so on. The students have to be advanced students and the subject material is the foundation of the topic of geometry. The title of the book should not mislead anyone to assume that the book is meant for the general students learning the rudiments of the subject.

The present textbook set is written in a more traditional acceptable way, avoiding the pitfalls of over-zealous attempts to exhibit the superiority of the authors. Volume I covers the four topics of mechanics, general properties of matter, heat, vibrations and waves. Volume II deals with optics, magnetism, electrostatics, current electricity and modern physics. The text covers the syllabus in a uniform way. The topics are treated in a simple language with a number of diagrams and illustrations, some of the traditional type and some from the modern advanced world. The idea is to make the subject intelligible and interesting to the students. Numerous problems have been worked out to train the students into the applications of the principles and the formulae developed in the text. Short-answer questions, long-answer exercises, and analytical and numerical problems are given. It appears from the references given that many of the questions and problems have been chosen from the recent examination papers. Thus the requirement of both the average and the meritorious students have been kept in mind. For the more intelligent students, several harder problems, sometimes marked with asterisks, are included, which will help the students to prepare for the more demanding competitive examinations. The use of the fine print for the worked examples, questions and problems adds to the visual clarity of presentation. It is therefore not surprising that the two volumes have been well received and have gone to the second edition.

The occasion of the second edition has obviously been used to eliminate the slips or errors, which might have remained undetected in the first edition. Very few typographical slips remain. Indeed with some effort one could notice a few in Volume I, like 'radio' for 'ratio' on p. 153, 'density of specific gravity' instead of 'density and specific gravity' on p. 204 or 'oule' instead of 'Joule' on p. 342. It was not Arago who was the first to measure the velocity of sound in air in 1829 (p. 482). The 'guinea' should be mentioned as a coin in the Guinea and the feather experiment on p. 148 to avoid the word being mistaken for the bird and its feather. The publishers have indicated on page ii of Volume II that the first edition was printed in 1992 and the second edition in October 1997, but this information is missing in Volume I. Perhaps better care was taken of the second volume. This is reinforced by the fact that Volume I has the question paper of 1991 Physics first paper of the West Bengal Higher Secondary examination. Volume II has the question papers of the Physics second paper of the examinations for the years 1991, 1992, 1993 and 1994.

A few more improvements could have been considered while revising Volume I. Scalar and vector products of two vectors are mentioned on p. 14 and the example of work as a scalar product of two vectors, force and displacement, is mentioned in p. 101. The representation of angular motions as (axial) vectors is mentioned on p. 126 and the torque is called a vector on p. 82 without citing them as examples of vector products. The authors have felt the need to retain for the benefit of the students the older CGS, FPS and MKS systems of units besides the introduction of the SI System of Units (p. 4). In this spirit, they could have added a note on the units for measuring sound intensity in Chapter 4, especially p. 486 dealing with vibrations and waves. Similarly, in the spirit of adding bits of advanced thinking, they could have added a paragraph on safety siphons on p. 222, but then there are limitations to the material which can be covered within a fixed number of pages.

The authors have closely followed the syllabus prescribed by the West Bengal Council for Higher Secondary Education. However, repeating the numbering of the chapters 1, 2, 3... for each topic like mechanics, properties of matter, heat... is somewhat clumsy. Each topic could have been given a Part number I, II, III, etc. Then an improved method of numbering of the chapters could have been easily considered. The policy of exactly following the syllabus has also the disadvantage that a short account of 'Transformers' is not given. It would have greatly widened the knowledge of the students in connection with alternating currents. If something is to be deleted, the reference to 'cold fusion' could be removed.

The authors have also given short accounts of the pioneers associated with the subject. This bit of history adds spice to the book and is welcome. However, these are not uniformly given for every chapter or with photographic sketches in every case. Short accounts with the pictures of the savants could have been provided for each chapter. A suggested pattern could be Galileo, Newton (mechanics and work in optics), Aristotle, Leonardo da Vinci (mechanics and painting), Watt, Coriolis (rotational forces), Kepler (also geometrical optics), Hooke, Pascal, Archimedes, Toricelli, Kelvin, Harrison (chronometer), Hope, Boyle, Rumford (calorimetry), Black, Van der Waals, Joule, Boltzman, Fourier, Rayleigh, Huygens, Young (optics and elasticity), Helmholtz and C. V. Raman for the various chapters of Volume I. For Volume II, the pattern could be Roemer (eclipse and velocity of light), Fermat (least time principle and mathematics), Foucault (velocity of light and Foucault pendulum), Snell, Gauss (lenses, magnetism and mathematics), M. N. Saha, Bunsen, Abbe (microscopes), P. Curie, Maxwell (electromagnetism and kinetic theory of gases), P. Weiss, Gilbert, B. Franklin, Poisson, Coulomb, Van de Graaf, Volta, Ampere, Ohm, Faraday (numerous areas), Oersted, Henry, Tesla, J. J. Thomson & Roentgen, O. W. Richardson, Einstein, N. Bohr, M. Curie & H. Becquerel, O. Hahn and W. Schockley.

The authors have used the conventional older examples and the recent developments to illustrate the principles. The Magdeburg Hemisphere experiment and the Tantulus' cup are given as well as zero gravity situations in orbiting satellites. The background of the authors in research and teaching is stamped at numerous places. A few examples of these are the discussions when they explain why a goods train is moved back a little before moving forward, why it is easier to pull a roller than to push it, how a roll of carpet unrolls on the floor, why there is more dew on the ground than on the leaves in winter, what happens to a candle light in an orbiting artificial satellite, why distant sounds are heard more distinctly in night than during daytime, why air bubbles are put in glass paper weights, why metallic lead is chosen as the reference for thermo-power measurements and so on. These linkages between general principles and practical observations give charm to the study of a subject like physics.

On the whole, the authors have written a fine textbook at the XI–XII standard level. Their labor of love has not gone in vain.

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Stochastic analysis, control, optimization and applications edited by W. M. McEneaney *et al.*, Birkhauser Verlag AG, Klosterberg 23, CH-4010 Basel, Switzerland, 1998, pp. 674, sFr. 118.

It has been a pleasure for me to get the opportunity to review this book. Prof. Wendell Fleming has been something of a patriarch to stochastic control theory. Most stochastic control theorists of my generation and later, when they try to trace the antecedents of the paradigms and techniques they routinely use, find that many of these have roots in the early pioneering work of Prof. Fleming. Those fortunate enough to have met him, howsoever briefly, have fond memories of his warm personality. The book under review is a small gesture of respect by his many followers and friends to honour him on the occasion of his 70th birthday.

Prof. Fleming started out his mathematical career in calculus of variations and geometric measure theory. He soon moved to the then fledgeling field of stochastic control theory and helped lay down its foundations. Among his many early contributions is a rigorous treatment of the associated Hamilton–Jacobi–Bellman equation. He went on to make many more important contributions to the field over the following decades. My own favourite is his treatment of the control under partial observations, where, in a joint paper with E. Paradoux, he developed the notion of wide-sense admissible controls, pushing the relaxation procedure for controls introduced by his mentor, the legendary L. C. Young, to new levels of abstraction. He also made important early contributions to the allied area of differential games.

In recent years, his focus has been on the celebrated logarithmic transformation and its control implications. (The most familiar avatar of this transformation for applied mathematicians is the Cole–Hopf transformation linking Burgers equation with the heat equation.) This connects the forward Kolmogorov equation of a diffusion process with a Hamilton–Jacobi–Bellman equation corresponding to an associated control problem, giving it a variational interpretation. Among the most significant developments in this has been a novel approach to large deviations theory, stretching it well beyond its conventional confines, and to risk-sensitive control and its interplay with differential games. Prof. Fleming has contributed significantly to both these areas.

In addition to these, he has written important texts which are classics of the subject. His book with Rishel, perhaps the first text on the subject, has trained generation of stochastic control theorists. His recent book on viscosity solutions with Mete Soner is doing likewise with the next generation.

The volume under review, comprising 37 articles by many leading researchers in the field, reflects the breadth and depth of Prof. Fleming's interests. It opens with a short write-up about Prof. Fleming's contributions, written with much warmth by his friend and colleague Prof. Harold Kushner, another leader in the field. The book is neatly organized into four parts. The first is on 'Large deviations, risk sensitive and H_∞ control'. It has nine papers on these topics, many by his former students and collaborators, such as Nisio, Basar, Dupuis, Wentzell, Hernandez–Lerma, to mention a few. The second section is on 'Partial differential equations and viscosity solutions'. It has 10 articles, by Souganidis, Pardoux, Ishii, among others, covering various regularity issues in the theory of Hamilton–Jacobi-type equations. The third part is on 'Stochastic control, filtering and estimation'. This has 11 papers on these topics by Kushner, Ocone, Krener, Pasik–Duncan, among others. The final section is on 'Mathematical finance and other applications', with seven papers by Bensoussan, Rishel, Kumar, among others. The 'applications' cover option pricing, portfolio management, manufacturing and wireless networks.

This is a very substantial collection of articles, written by some of the leading workers in the field. It gives a panoramic perspective of where the field is and where it is headed. That most of this can be traced back to Prof. Fleming's work is just a further testimony to the breadth of his contributions. It is a fitting tribute to the man.

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