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BOOK REVIEWS

Mathematics and physics by Yu. I. Manin. Birkhauser-Verlag, P.O. Box 34, CH-4010 Basel, Switzerland, 1981, pp. xii + 99, S.Fr. 22.

The university teaching of undergraduate mathematics consists mainly of classical mathematics and its applications—the part of mathematics based on pre-twentieth century and in large part on pre-Cantorian ideas and methods. Not much importance, or perhaps no importance, is given to the studies in the foundations or inquiry into the nature of mathematics. Similarly, in the teaching of physics, though the physics is taught in the language of mathematics, the student is invariably taught to pass from the formulas directly to their physical meaning omitting the mathematical abstraction. As a result, from their earliest student days mathematicians and physicists are taught to think differently. However, any inquiry into the nature of physics or mathematics encounters the problem of understanding the relationship between these two sciences. This problem is not new, the physicists have always felt strongly the need for mathematics in the development of physics, though they also recognize that in the presentation of physical ideas to the inquiring non-physicist it might be necessary to translate the content of the mathematics into ordinary language. A great deal of the work in modern physics and related subjects is really mathematics in so far as it is concerned with abstract structures. It is sometimes difficult to draw a line between mathematics and physics. Some ' mathematics ' does fall into the category that it can be called ' physics ' and ' physicists ' sometimes are ' mathematicians' no matter how they are classified on the payroll.

The book *Mathematics and physics*, from a Soviet Mathematician, Yu. I. Manin making a new attempt to understand the philosophical problem of relationship between mathematics and physics is very welcome addition in the series publications of ' Progress in Physics ' edited by A. Jaffe and D. Ruelle. The translators of the book, which originally appeared in Russian, Ann and Neal Koblitz have done a very good job of translating an abstract material.

As the book is coming from a mathematician the first and longest chapter of the book gives a bird's eye view of the mathematics. Starting with the simplest mathematical operations of arithmetical computations Yu. I. Manin shows how mathematical reasoning enters into the physical interpretations. Then the reader is led to the understanding of the mathematical truth connected with the development of two major conceptions : set-theoretic mathematics and the mathematics of formal languages. The notions of topological linear spaces, nonlinearity and curvature are related to abstractions in quantum mechanics and field theory. The ' novelties ' like ' Catastrophes ', ' Supersymmetries ' and ' Solitons ' are not forgotten.

The wide knowledge and the humorous style of the author becomes apparent when the chapter on the physical quantities, the fundamental constants of physics, the physical laws and their relationship to the group theoretic approach to dimensional analysis ends with the example on finding the heights of the mountains in terms of fundamental constants.

The more philosophical problems of the observer-observed dualism observable and unobservable, space and time, action and symmetry are dealt in the last three chapters. The author concludes with a remarkable discovery that the deepest ideas of number theory, a mathematical discipline which is highly developed and possesses amazing beauty, reveal a far-reaching resemblance to the ideas of modern theoretical physics.

Writing in his own style with his own subjective views on the subject, Yu. I. Manin impresses very successfully on his readers the oneness of the cultural elements of physics and mathematics. In ninetynine pages the author has managed to cover in a lucid way a wide range of abstractions from both physics and mathematics, which leaves the reader awed at the unification of the though tprocesses in these two sciences. Mathematicians, physicists, students and any outside readers trying to understand the cultural elements of mathematics and physics will enjoy this book and will be aroused to ' thinking about ' mathematics and its association with physical abstractions.

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Elementary classical physics (Second Edition) by Richard T. Weidner and Robert L. Sells. Allyn and Bacon Inc., Vol. 1, pp. xvi + 1–450, £ 8.95 ; Vol. 2, pp. xix + 451–830, £ 8.95.

Any textbook which goes into a second edition must be considered successful and if, in addition a fourth printing is ordered, the virtues of the book must be numerous. The two volumes belong to this category. Their level would be covering the material read by our students in the B.Sc. physics classes, though some items would be taught a little earlier. While one may argue about the balance among the different topics covered, there is no doubt that it is very well prepared as a textbook for the students and the teacher.

Broadly speaking, the first volume covers mechanics including waves and vibrations, kinetic theory of matter and thermodynamics. The second volume concerns itself with electricity, magnetism, electromagnetic fields and optics. As indicated in the title, quantum or relativistic phenomena are not discussed. However, as appropriate to a modern text, elements of newer developments are imperceptibly introduced (but not analysed or discussed) so that the student builds up an awareness. Thus chapters on mechanical and thermal properties of matter discuss phenomena whose explanation would require non-classical ideas, which the student will learn later. Examples from atomic and nuclear physics are given in various places to introduce this awareness.

Numerous worked examples are provided. Each chapter ends with a summary of the principal results. A reasonable number of problems are given in each chapter and answers to odd numbered questions are given. The S.I. units are used, though some consideration is given to pounds and feet still used commonly in the U.S.A. A large number of drawings and figures are used to aid the discussion. The use of two-colour printing helps to highlight some items. Over and above all these are the clear explanations of almost every item mentioned. These two volumes have been a pleasure to read from cover to cover.

In a textbook there is always a competition between the overall size which has to be kept small and the material which has to be comprehensive. Each author strikes an appropriate balance. The same is true of these two volumes. Perhaps just an extra page explaining the concepts of positive and negative charges would have been of great value to a student. The intelligent student often wonders why electri-charges obeying inverse square law come in positive or negative varieties, while gravic tational forces also obeying inverse square law is always attractive and never repulsive. Similarly an extra page explaining the relationship between geometrical optics and wave optics could have been provided. Again in discussing the mechanical properties of liquids, viscosity has been left out. These are, however, minor matters compared to the totality of the good writing.

The book bears mute evidence of the scholarship of the authors and of the vigorous test of the material by generations of students. Many more students in India would be attracted to physics, if we had such good textbooks.

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E. S. R. GOPAL

Elementary modern physics (Third Edition) by R. T. Weidner and R. L Sells. Allyn and Bacon Inc. (International Students' Paperback), 1980, pp. x + 484, £ 8.95.

This book, first published in 1960, has come to a third edition, which is now reprinted as a paperback students' edition. It will require considerable courage to review such book, because the reviewer runs the risk of being on the docks ! One should perhaps take the view that a listing of the contents, a study of the style of writing and a mention of the tricks of the trade, which make the book so attractive to students, would enable other authors to strive for this excellence.

First let me take the clarity and precision of writing which have been tested by students over two decades. The fact that the book has grown out of the actual teaching work ensures a straight clearance from other users. One would be hard put to improve the explanations, though in a few places Indian students would not possess the required background. The treatment is concerned with the basic principles and their elementary applications, but at a rigorous level with reasonable mathematical details. Instead of trying to cover everything in modern physics in a sketchy way, the authors concentrate on a limited number of fundamental principles which are treated in depth. Thus anyone who studies the book carefully and works out all the problems would be assured a very good grasp of the basic principles and a high competence in applying them to a variety of stituations.

The contents of the book are fairly conventional. The principles of the special theory of relativity, the start of the quantum theory and the concepts of matter waves are given in the first five chapters. The next two chapters deal with atomic structure, followed by molecular and solid-state physics. The next chapter is a little unusual, dealing with quantum phenomena and devices like the band phenomena of solids, superconductivity and lasers. Two chapters follow on nuclear structure and nuclear reactions. The last chapter, the twelfth one, discusses elementary particle physics. The material is quite up-to-date. Quark interactions and ideas of the unification of the fundamental forces are for instance mentioned. In natural radioactivity, one has discussions of the applications to cosmological problems. Also, by avoiding the restrictions imposed by the historical growth of the subject, one is able to condense the treatment in some places. For instance, de Broglie waves are introduced before discussing the structure of atoms and molecules, which avoids a duplication of the discussion without and with wave mechanical ideas. This, however, does not mean that the surprise and wounder of new ibeas are thrown away. The student gets captivating photographs of the leadidg actors, Einstein, Planck, Bohr, and others, at the beginuing of each chapter with brief historical sketches.

This brings me to a number of other important features of the book. The book has a number of worked examples within the text and a good collectiod of problems at the end of each chapter. The questions are also graded in levels of difficulty.

Short answers are provided at the end of the book. Indeed one notices that the problems have been nicely framed to extend the range of the applications considered in the main text. Each chapter has a brief summary, reproducing the main results. The printing is skillfully done in two colours. Each chapter has a number of figures and the figure captions are printed in the margin space, which is ample enough for the student to make additional notes if needed. Numerical values, examples and problems are widely distributed, giving a feel for the magnitudes of the phenomena.

If the review reads like an unqualified praise, it is really meant to be so. This is one of the excellent introductions to modern physics. It has been a pleasure to read the book. It is strongly recommended.

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The Einstein myth and the Ives papers edited by Richard Hazelett and Dean Turner. The Devin-Adair Company, Old Greenwich, Connecticut, 1979, pp. 313, $ 22.50.

From time to time some persons, mostly non-professional physicists, developed a passionate desire to disprove Einstein and some of his contributions in physics. In fact, there are books written on physics without Einstein.

Dr. Herbert Eugene Ives was an outstanding engineer and has made valuable contributions of great applications such as blackout lighting and other inventions made for the defence of the United States. However, he developed a passionate desire to demolish some of the pillars on which Einstein's special and general theory of relativity are constructed; for example, Ives' attempt to prove evidence for the absolute space and time.

This book contains a collection of articles by Ives and a few others trying to find difficulties and paradoxes, connected with the special and general theories of relativity such as Clock paradox, length contraction and time dilatation, Doppler effect, revision of the Lorentz transformations, concept of photons, cosmic background radiation and ether drift, etc. While these contain passionate arguments, they have not been accepted by the community of physicists and the special theory still stands as a rock. The general theory of relativity has found remarkable support from observation involving large scale structure of the universe although it is admitted that under extreme conditions where the quantum effects become important, general theory relativity must be modified. In this respect, Einstein himself admitted on page 123 his famous book *Meaning of Relativity*.

I do not know whether this book could be recommended to the general audience. Nevertheless, it should find a place in libraries where it will serve for reference purpose, for persons seeking different kinds of views on special and general theory of relativities.

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The golden cloak by Rudy Ydur. Lumeli Press, San Carlos, California, U.S.A., 1979, pp. 70, $ 3.95.

Many times, in this short book, it is mentioned that a description is not an explanation. When the author describes what great scientists have commented on the laws or rather the development of the laws of nature, he appears learned and well-informed. Yet when he tries to offer his own explanation of some phenomena of nature, he reveals his own lack of understanding.

The book begins with an interesting fable—then comes to the phenomenon of relativity in nature and how the concept of ether as a medium was discarded by Einstein when he formulated his special theory. The author wants to invent a substitute and calls it 'light-filled space'. He seems to be ignorant of the concept of particles and fields. It is now well accepted that fields which mediate in various kinds of forces fill space. Thus fields have taken the role of ether. In fact, ether is being reincarnated as 'quantum ether'.

His remarks on general relativity again shows that he is not a professional scientist. He seems to be a layman trying to offer *ad hoc* explanations. The claim on the back cover that the author suggests a practical solution to several difficulties in science is hollow.

The language is good and clear—perhaps the only redeeming feature of the book. The most sensible sentence of the book is the last one 'perhaps it is time to take a new look at nature'. This will remain always true. This is what Newton, Einstein, quantum physicists, Darwin and others did. And we have to continue doing this.

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Electron and pion interactions with nuclei at intermediate energies edited by W. Bertozzi, S. Costa and C. Schaerf. Harwood Academic Publishers, P.O.-Box 786, Cooper Station, New York 10003, 1980, pp. xii + 703, $ 55.

This volume is the proceedings of the international school on 'Electron and pion interactions with nuclei'. The lectures are delivered by well known specialists currently engaged in active research. The contents of most of the papers, broadly speaking, are a brief review of the earlier history and the detailed discussions of the recent developments taking place in their area of specialization. The book gives a quick glance at the current problems of interest to an expert working in this topic of nuclear physics.

The electron interaction with nuclei is of electromagnetic origin. Because of the point particle nature of electron and of our clear understanding of the electromagnetic interactions, electron is the cleanest probe to study strong interaction properties of a nuclear system. In the case of pions, same is not true due to its additional strong interaction properties and finite size. Different nuclear properties are studied using different energies of the incident electrons. The contents of the book can thus be divided into the following three main parts depending on the electron beam energy. The first part can be defined by the electron beam energy less than the nuclear separation energy. The problems discussed in this part are : determination of the charge density distributions of nuclei, low-lying sprectra and transition densities of nuclei. The related theoretical formalism involves core polarization and meson exchange contributions to nuclear magnetism, relativistic effects in charge and magnetic scattering of electrons. The second electron energy range is between nucleon separation and pion thereshold energies. The papers included in this category cover the properties of giant nuclear resonances, the single particle and single hole states and their properties. Considerable amount of related theoretical work is also discussed. The large momentum transfer electron scattering cross-section is most sensitive to magnetization density of the unpaired nucleons in oddnuclei, while the structure of interior orbitals requires the knowledge of the form factors over several maxima. Some talks emphasize the measurement of transverse form factors which are very powerful tool to study the correlations in nuclear ground states.

In the third range of beam energies above pion threshold, the book has many contributions touching upon the following new aspects of the intermediate energy nuclear physics. Parity violation in electron scattering due to the interference between neutral weak current interaction and electro-magnetic forces, the isobar configuration in nuclei, the nuclear short distance interaction, exchange currents, nucleon form factors, and dispersion, recoil and relativistic corrections, are the topics which attracted the attention of large number of speakers. The large energy-momentum transfer region which is used to observe the nucleon internal structure inside a nucleus and nucleon excitation bound in a nucleus, found an encouraging response in some talks. The deep inelastic electron scattering structure functions of nuclei are shown to follow the scaling properties, The lectures on pion interactions brought out the major results related to the role of delta-isobar formation and propagation in nuclei, and the short range pair correlations in nuclear states. With the use of pion and keon beams a large amount of work is carried out on the baryonic internal excitation in nuclear environment. The theories developed the necessary modifications of the unperturbed barionic excitation spectrum due to the presence of other nucleons. The phenomenon of the isobaric resonance fluorescence scattering of pions is discussed. Some talks are devoted to photo-nuclear reactions. In the low-energy region, as is well known, the information obtained is related to the giant resonances, their decay, direct knock out and meson exchange currents. In the high-energy photon region, the threshold pion production, pion nucleus interactions and delta excitation peak are discussed. All the information obtained from using the electron, mion, pion, keon and photon beams on nuclear targets is correlated to each other. Their mutual consistency confirms the semi-phenomenological ideas theoretically introduced in the analysis of the experimental data.

The book also contains the results and status reports from various laboratories together with a discussion of the importance of hundred per cent duty cycle accelerators.

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Sets : **naive, axiomatic and applied** by D. van Dalen, H. C. Doets and H. de Swart. Pergamon Press, Oxford, 1978, pp. xvii + 339.

The first chapter of the book, titled ' Naive Set Theory ', occupies 149 pages. One is happy to note that no ludicrous examples of sets have been given, unlike what is a common practice in elementary books. The sets of natural numbers, integers, rational numbers and real numbers are cited as examples of sets on page 1. A description of the ' naive ' set operations in Sections 2 to 7 is followed by a definition of an ordered pair a la Kuratowski-Wiener-Hausdorff in Section 8, and cartesian products and equivalence relations in Sections 9 and 10. Next, the integers are ' constructed ' from the natural numbers, and the rational numbers from the cartesian product of the natural numbers and the non-zero integers. This is immediately followed in Section 12 by the Cantorian construction of real numbers as equivalence classes of sequences of nested intervals of rationals. A sequence of intervals $\{ [a_n, b_n] \}$ (using the more common bracket notation, instead of the notation $\langle a_n, b_n \rangle$ of the authors) is called a *chain* if for all $n \in N$, $a_n \leq a_{n+1} \leq b_{n+1} \leq b_n$, *and* for all n, $b_n - a_n \leq 2^{-n}$, where a_n, b_n are all rational numbers. Thus, " the ' speed of convergence ' of the chain has been fixed. This is not necessary, but some condition on convergence has to be given, and this one happens to be rather simple ". This may give the beginning student the impression that a different condition of convergence (for example, $b_n - a_n \leq 3^{-n}$) would give the *same* equivalence classes of chains. Also, the definition of the sum and the product of two equivalent classes of chains–which is left to the reader–would turn out to be a little harder, since the term—wise sum of two chains may not be a chain and so one will have to prove the existence of a chain equivalent to the term-wise sum. (Two chains $\{ [a_n, b_n] \}$, $\{ [c_n, d_n] \}$ are *equivalent* if $b_n \geq c_n$ and $d_n \geq a_n$, *i.e.*, if the intervals overlap term by term.) It would perhaps make the definition of sum and product easier if the condition 'for every $\epsilon > 0$, there is an n such that $b_n - a_n < \epsilon$ ' was used in place of the condition '$b_n - a_n \leq 2^{-n}$'. Admittedly, the latter is more 'constructive'. (A similar approach has been used by Errett Bishop in his *Foundations of constructive analysis*, McGraw-Hill, 1967, where a sequence $\{x_n\}$ of rationals is called *regular* if $| x_m - x_n | \leq m^{-1} + n^{-1}$, two regular sequences $\{x_n\}$ and $\{y_n\}$ are said to be *equal* if $| x_n - y_n | \leq 2 n^{-1}$, and *effectively*, a real number turns out to be an equivalence class of regular sequences.) The Cantorian construction of the reals is followed by the Dedekindean one, and the job of constructing the reals in terms of Cauchy sequences is entrusted to the reader as an exercise.

In the next section (13), interestingly, a function is reviewed as a set of ordered pairs satisfying the usual condition, and even a sequence is re-defined as a function from the natural numbers to any arbitrary set. There is a good subsection on substructures and isomorphisms, and a number of exercises of category–theoretic flavour are given.

Section 14 defines 'order' and proves the 'Principle of transfinite induction' for a well-ordered set (Theorem 14·10) : if $\langle X, R \rangle$ is a well-ordered set and ϕ a property of elements of X, then $\forall x \in X [\forall y \in X [y R x \rightarrow \phi(y)] \rightarrow \phi(x)] \rightarrow \forall x \in X [\phi(x)]$. It is next shown (Theorem 14.11) that this principle for $\langle N, < \rangle$ is 'equivalent' to the Principle of Mathematical Induction, N denoting the set of natural numbers. However, there seems to be some confusion at this point. Using the *naive* principle of Mathematical Induction, the authors prove that $\langle N, < \rangle$ is a well-ordered set and then appeal to the abovementioned Theorem 4.10 to conclude in one part of Theorem 4.11 that the Principle of Transfinite Induction holds for $\langle N, < \rangle$. In the other part of Theorem 4.11, they show that tne Principle of Mathematical Induction for $\langle N, < \rangle$ follows from the Principle of Transfinite Induction, and comment after the end of the proof that 'the reader may wish to provide a *direct* (my emphasis) proof of the Principle of Transfinite Induction from the Principle of Mathematical Induction'. What is meant by a *direct* proof here? Do the authors mean : without involving the notion of well-orderedness of $\langle N, < \rangle$, *i.e.*, showing simply the '$\forall x \in X [\forall y \in X [y Rx \rightarrow \phi(y)] \rightarrow \phi(x)] \rightarrow \forall x \in X [\phi(x)]$' part of the proposition, without using the assumption that $\langle X, R \rangle$ is a well-ordered set in Theorem 14.10 ?

Section 15 is on cardinality. One is a little surprised at the appellation 'Cantor–Bernstein Theorem' in place of the more common 'Schröder–Bernstein Theorem'. An informal arithmetic of cardinal numbers follows. The next section gives first an 'intuitive' definition of a *finite* set as a set that is equivalent to some initial segment of the naturals, but soon this is followed by an 'absolute' definition of an *infinite* set (a la Dedekind). Theorem 16.8 states that a set V is Dedekind-infinite iff some subset of V is equivalent to N. In the proof of the 'only if' part of this theorem, however, the authors use the intuitive notion of repeating an operation 'k times':

$$g(k) = \underbrace{f(\cdots f(a)\cdots)}_{k \text{ times}}$$

It seems to me that a better approach would be as follows (of course, it is not 'naive'): since V is Dedekind infinite, there exists a proper subset, say, W equivalent to V, i.e., there exists a one-to-one and onto function $f: V \rightarrow W$ and an $a \in V$ such that $a \notin W$. Now consider the family F of all subsets U of V such that $a \in U$ and U is f-closed. Then one could 'easily' show that the set $\cap F$ is equivalent to N.

The next section (17) on denumerable sets springs a pleasant surprise: Ramsey's theorem is stated and proved. This is naturally followed by a section on uncountable sets, and another one on paradoxes. Only Russell's paradox is described, the 'Naive Comprehension Principle' is pointed out as the culprit, and several remedies mentioned. The Zermelo-Fraenkel (ZF) axioms of set theory are given next (Section 20), the notion of a *generalized successor function* is introduced ($x^+ = x \cup \{x\}$) and a *successor set* defined as one which is closed under the successor function and contains the empty set. The *Axiom of Infinity* (INF) is introduced as an assertion of the existence of a successor set. (There is a remark after this which appears to be wrong : 'The axioms preceding INF happened to be such that exactly one set fulfilled the requirements.') Finally, the natural numbers are re-viewed as *the* smallest successor set Ω. The last section (21) of the first chapter introduces the Peano Axioms of Arithmetic and shows quickly that on making the identification of N with ω and O with ϕ, the Peano Axioms are provable in ZF. This section ends with the Recursion Theorem and an important observation that ZF yields an arithmetic of natural numbers much more powerful than Peano's relating this to a consequence of Gödel's Theorem.

The second chapter, 'Axiomatic Set Theory', occupies 87 pages, and contains a development of some aspects of axiomatic set theory which is rather more detailed than what is commonly found in introductory textbooks on set theory. There is a very good discussion of the Axiom of Choice, of the Continuum Hypothesis, and of their various equivalent formulations. In the section on Models, the possibility of a circular reasoning involved in defining models for an axiomatic set thoery, such as ZF, *in terms of sets*, is pointed out, but not elaborated. This, it seems to me, is indeed a weak point of Model Theory when applied to an Axiomatic Set Theory. Of course, in the Appendix at the end of the book, the authors do give a discussion of the concept of *property*, contrasting it with the concept of *set*, which sheds some light on this problem of interpretation. (Incidentally, I could not find the term 'interpretation' listed in the Index.) Perhaps, Mirimanoff's paradox could have been mentioned in this chapter.

The last chapter of the book, titled 'Applications', occupies 84 pages, and contains material on Filters, Boolean Algebra, Order Types, Inductive Definitions, Applications of the Axiom of Choice, the Borel Hierarchy, Trees, and the Axiom of Determinateness, I do not know in what sense these topics could be called ' Applications of Set Theory '. Of course, one could argue that, in a way, *all* mathematics is an application of set theory—or perhaps in these modern times one should say, of category theory. In the section on Boolean Algebra, the proof of Stone's Representation Theorem is left as an exercise to the student, though some hints are given.

Finally, a comment on the production features of the book. The publisher notes that ' in order to make this volume available as economically and as rapidly as possible, the author's typescript has been reproduced in its original form '. Apart from the ' typographical limitations ' of this method, another drawback is that errors are more likely to escape notice in a typescript than in printed matter. For instance, a page numbered 106a and 106b appears between pages 106 and 107. In the preface, on page xi, a sentence has perhaps been skipped in the third paragraph (' we will stick to the set theoretical universe cosist (*sic*) of ') and a sentence from the next paragraph has been partly repeated here. On page xvi in the introduction, in the last line there is a reference to chapter II, Section 15, which is non-existent.

To end, the book under review is a welcome addition to the already rather large collection of books on set theory, because of its different emphasis, inclusion of certain advanced topics, and novelty of treatment of some topics. Its value as a textbook would be enhanced if hints for solution of some of the difficult exercises are provided.

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Differential geometry—an integrated approach by Nirmala Prakash. Tata McGraw-Hill, New Delhi, 1981, pp. xvi + 414, Rs. 57·00.

In recent years many textbooks on differential geometry have appeared making the job of the instructors a little easy, so that they may pick and choose as they wish and give varied courses in differential geometry. The book under review is one more addition to the list of existing books, this time written by an Indian mathematician.

The first impression one gets of the book and its contents is that the text is bulky with a poor geometrical content. The author's taste is for the formalities of calculations as opposed to the genuine geometric questions, as is evidenced by the fact that the results of advanced calculus, linear and multilinear algebra are everywhere dense in the book.

The organization of the material seems to be haphazard. For purposes of the present review, it appears suitable to organize the material into three units—the first unit consisting of local properties of curves and surfaces, the second of global properties of surfaces, and the third of modern material like manifolds, differential forms, etc.

The first four chapters, chapter 7 and some parts of chapter 9 provide a very short course on local properties of curves and surfaces, which roughly includes Frenet-formulae for curves, the fundamental existence theorem for space curves, theorema Egregium and the fundamental existence theorem of Gauss-Bonnet for surfaces. These together run to as many as 200 pages. The same material is covered in any existing standard book in about 50 pages.

This part of the book is written in a chatty style which sometimes blurs the precision that is needed in mathematical writing. The author's excessive concern for minor details has resulted in elevating the routine to a position of central importance. A beginner is likely to get lost in the deluge of trivialities and miss the essential ideas.

The theorems of classical global surface theory which have a great geometric appeal and which lie at the very foundations of the subject must have a central place in any introductory book on differential geometry. The literature is so vast on this subject that it poses many problems as to what one has to include in a textbook. It is here that the author has to display his pedagogical skill in choosing the right material which will give a real sense of what differential geometry is about and arrange them properly so that it interests a beginner. The reviewer feels that it is precisely here that the author has failed. Gauss-Bonnet theorem for compact oriented two dimensional manifold and Hopf-Rinow theorem on complete surfaces are the only two theorems which find a place in this book.

The part dealing with global properties of surfaces is written in a relentless definition-theorem-proof style with almost complete absence of motivation. It is difficult for a beginner to understand and appreciate the full significance of the theorems with the sort of topological preliminaries that is sketched in the book. In fact, proof of Gauss-Bonnet theorem is incomplete.

A notable omission is the global theory of curves. Flenchel's theorem, Fary-Milnor theorem, Four-Vertex theorem and 'Umlaufsatz' theorem have been stated without proof.

In studying modern text in mathematics, a reader has to sustain a long march-past by an army of definitions before coming to the real object of study. So is the case with this book where it treats the modern topics, but with a difference—the captain has no hold on any of his soldiers, some of whom are mutilated, some are dumb, and some are in rags, but none of them walks erect. Instead of witnessing this disdainful march-past in every detail, the reviewer preferred to take a flight over the battle field to have a bird's eye view !

Riemannian manifold and Riemannian connection are defined, the fundamental theorem on Riemannian geometry is proved, Torsion and curvature tensors are introduced, Bianchi identity is established but nothing worthwhile and interesting in geometry is met with.

The most notable omission is the theorem on the existence of Riemannian metric on a manifold. The author seems to avoid all results which involve some delicate topological arguments. There is a chapter on Lie groups. There is no pedagogical or mathematical justification for including this chapter in the book. In fact, it is loosely connected with the rest of the book.

Concepts are often used before they are defined (if defined at all)—for example, the tangent space to a manifold. There are many mathematical errors, some of which, of course, are attributable to carelessness. For example, the set $V_n(Z)$ of all integral n-tuples appearing on page 201 is a Z-module and not a vector space over Z and on the same page it is mentioned that $V_n(Z)$ is a vector space over the field of real numbers, which is absurd. On page 149, the set $\Lambda^q(R^n)$ of alternating $\mathscr{F}(R^n)$-multilinear maps from $x(R^n) \times x(R^n) \times \cdots \times x(R^n)$ to $\mathscr{F}(R^n)$ is mentioned to be a vector space but it is an $\mathscr{F}(R^n)$-module. On page 196, the author asserts that the functors $\Lambda^q(M)$—the set of all alternating $C^\infty(M)$-multilinear maps and $\Omega^p(M)$—the set of all alternating R-multilinear maps are the same, obviously not realizing that it needs some more work to establish an isomorphism between these functors. The algebraist's functor $\otimes^k V$ is also introduced, but its relationship with other functors is not even mentioned. All these omissions seem all the more significant in a book which purports to teach the subject in an integrated fashion. Even within the declared limitations, the author has not done a good job.

Even in my rather sporadic reading, I found here and there some typographical errors and some sentences which do not read decently. Despite the publisher's claim that this will become a ' useful under-graduate and post-graduate text ' the book does not seem to the reviewer to have the character of a text.

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Experimental organic chemistry (Vols. 1 and 2) by P. R. Singh, D. S. Gupta and K. S. Bajpai. Tata McGraw-Hill Publishing Co. Ltd., New Delhi, 1980, Vol. 1, pp. vii + 267, Rs. 27·00 ; Vol. 2, pp. xix + 337, Rs. 27·00.

The authors set out their objective in the preparation of these two volumes on experimental organic chemistry as the instruction of the student in the basic laboratory techniques covering qualitative and quantitative aspects with simultaneous exposure to the underlying physical principles. The reviewer feels that the authors have succeeded well in their effort. There is adequate coverage of the essential principles of chromatography and spectroscopic aids, while the mechanistic background to the various reactions and preparations are presented succinctly. The other useful features which the students, even at research level will highly value are the exhaustive group frequency data and illustrative spectra covering UV, IR and NMR, tables of physico-chemical data of typical and common organic compounds, exercises and problems at the end of each chapter, informative appendices, bibliography and author-*cum*-subject index. These two volumes represent a commendable effort on the part of the authors. They are well produced with clear diagrams and neat structures and with very few obvious printing errors. The volumes are recommended without hesitation to students and teachers in university colleges and medical and technological institutions and organic chemists working in analytical, testing and other industrial laboratories.

The following errors may be corrected in future editions:

Vol. 1, page 22, line 3 from bottom: length of the pole tube (polarimeter tube).

Vol. 1, page 81, line 3 from bottom : Anhydrous calcium (drierite) calcium sulphate).

Vol. 1, page 114, Figs. 6.17 and 6.18. The headings have to be reversed.

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The third language—Recurrent problems of translation into English—by Alan Duff. Pergamon Institute of English, Oxford, Pergamon Press, 1981, pp. 138, £ 5.95.

Carpentry is better learnt from an experienced carpenter rather than from a dendrologist (a scientist specialising in trees). Likewise, the finer aspects of translation are better learnt from an experienced translator rather than from a mere linguist.

Alan Duff has a long experience in translating from French, Serbo-Croat and Hungarian, and in editing translations. From his rich experience he has some interesting things to say to practising translators using English as the target language.

From examples taken from thousands of pages of translation (p. 126), the author analyses how translators get trapped in a ' third language ', *i.e.*, clumsy English, under the stupefying effect of the original writing. From the hundreds of examples given by the author, I shall reproduce only one example to show how a ' close ' translation has to be sometimes edited and re-edited to make it readable (pp. 116-117).

The original text in French :

Si la lecture est enseignée aux petits enfants dès l'aube de leur scolarité, cela ne veut pas dire que l'effort soit facile, cela veut dire simplement que son apprentissage est fondamenal et constitute un préalable à l'acquisition des autres contenus scolaires. Il faut donc tout faire et tout prèvoir pour minimiser les problèmes et les pièges et il faut, en tout cas, ne pas créer gratuitement des difficultés supplémentaires à l'enfant. (from a UNESCO document).

'Close' translation (by Alan Duff) :

If reading is taught to small children from the very dawn of their schooling this does not mean to say that the effort is easy, it means simply that its learning is fundamental and constitutes a preliminary to the acquisition of other school subjects. One must therefore do everything and foresee everything in order to minimize the problems and the traps, and one must, at all events, not gratuitously create additional difficulties for the child.

Edited 'readable' version (by Alan Duff) :

Although children are taught to read from their earliest schooldays, this does not mean that reading is an effortless task for them, but simply that it is a fundamental precondition for mastering other disciplines. Every precaution must therefore be taken to reduce the child's problems and help him avoid the pitfalls and on no account should he be burdened arbitrarily with extra difficulties.

Alan Duff is aware that it is often difficult to pinpoint what it is in a translation that 'sounds wrong'. While suggesting some ways of avoiding gross errors, the author has ample commisseration for the practitioners of the difficult craft. "The translator is a traveller, moving constantly back and forth from one world to another, and, like all travellers, he is exposed to fatigue, 'jet-lag', and confusion at having to switch perpetually from one reality to another......" (p. 121).

Every translator has a great responsibility to continuously improve his knowledge of the source language, his writing skill in the target language and his general knowledge—the desired goal being to produce translations that should not read like a translation at all. Nevertheless, it might be wise, as suggested by Alan Duff (p. 126), to put up the following notice outside our offices :

Please do not shoot the translator
He is doing his best.

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