Mathematical Past

The Development of the Foundations of Mathematical Analysis from Euler to Riemann. By I. Grattan-Guinness. Pp. xiii+186. (MIT: London and Cambridge, Massachusetts, February 1971.) £4.65.

THE place of history in mathematical education is controversial, and opinions differ widely. There is always a movement among students—with which, it would seem, the publishers of this work sympathize strongly—to demand a more historical treatment of their mathematics. This applies particularly to the elements of analysis which they tend to find difficult and resent having to learn anyway. My former colleague, Dr S. R. Tims, who was an outstandingly brilliant teacher of this subject, always used to claim that it was a mistake to teach the history of it, as students could find plenty of errors for themselves without putting ideas into their heads! I certainly look forward to confronting students with this book and seeing whether they really feel that it is more interesting (or even easier) than taking the subject straight.

The book places the development of nineteenth century analytical ideas in the context of the problems, starting with the vibrating string, in which they arose. Not surprisingly the central character of the book is Cauchy, whom the author effectively portrays in a not altogether amiable light. There is a deal of useful background information which enables the uninitiated reader to follow a lot of contemporary infighting which could otherwise be unappreciated. Perhaps the most important historical point made is that Cauchy had benefited (without a hint of direct acknowledgment) from a study of the writings of Bolzano. This assertion shows up neatly the nature of the difference between mathematical and historical proof, but clearly Dr Grattan-Guinness has made out a highly plausible case which could not be questioned by anybody less deeply immersed in the sources.

The author has clearly benefited from much recent historical work but it is perhaps a pity that by confining himself to a historical period, rather than being guided by the mathematical ideas, he is prevented from discussing the work of Abraham Robinson on non-standard analysis. Robinson's justification of the use of infinitesimals will certainly have to be taken into account in the definitive treatment of the ideas under discussion here, and yet this account, when it is eventually produced, will have again to go over a lot of the ground covered in this volume.

In spite of the claims on the dust cover the book appears to be intended by the author primarily for the benefit of his fellow historians. The historian's mastery of, and need to identify, his sources (as demonstrated by the copious footnotes) is to some extent at variance with providing a narrative which is easy to read. I wonder if the author has fallen stylistically between two stools. The presentation of the mathematical arguments (even when all allowances are made for the need to convey the flavour of past errors) seems somewhat uncomfortable for students of mathematics, and it is not clear that it will be found more helpful in putting the technical ideas across to possible historical readers with comparatively slight mathematical backgrounds.

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Statistical Physics

Statistical Physics. By F. Mandl. Pp. xiii+379. (Wiley: London and New York, July 1971.) £2.75.

Statistical Physics. By A. Isihara. Pp. xv+439. (Academic: New York and London, June 1971.) $18.50; £8.65.

ALTHOUGH the two books reviewed here have the same title, they belong to two completely different worlds: Mandl's book is written for undergraduates and is clearly a textbook, while Isihara's book is clearly a reference book, even though the publishers in their blurb suggest that it might be adopted as the required text for certain advanced courses. Mandl's book covers both thermodynamics and statistical mechanics, while Isihara's book deals only with statistical mechanics; Mandl's book has a restricted coverage, while Isihara seems to include just about everything; finally, Mandl's book is cheap by present-day standards—and, I feel, excellent value for money—while Isihara's book is rather expensive and not such good value for money.

Mandl's book is a volume in the Manchester Physics Series which provides a set of textbooks for undergraduate degree courses in physics. In common with many modern books on the subject, statistical mechanics and thermodynamics are developed at the same time. This makes it necessary to stick to basic principles and to a restricted number of applications. One can hardly quarrel with the choice of material: I found in this book practically all the topics which I would like my own undergraduate pupils to know. As one has come to expect from the author, the book is carefully written and all steps are carefully and clearly presented. I shall certainly recommend this book to my pupils and see to it that it will be in my college library.

Mandl's book starts with the first two laws of thermodynamics, followed by a chapter on paramagnetism, including a section on negative temperatures. A second chapter on the second law includes a section on the third law, and is followed by a chapter on simple thermodynamic systems, and one on specific heats of solids. The next chapter is devoted to the perfect classical gas. A chapter on phase equilibria follows, and the book is concluded with chapters on perfect quantal gases, black body radiation, and systems with variable particle numbers. There are plenty of problems and hints for solving them. As every reviewer should find at least one point of disagreement, I shall mention the fact that the discussion of the relation between spin and statistics for composite particles is not quite correct and does not pay proper attention to the complications of the situation.

I cannot be so laudatory about Isihara's book. He has made important contributions to the subject, and many parts of the book are based on his research. This has as an important result that the book is foremost a research monograph, rather than a textbook. While I shall be glad to have it on my own bookshelves, I would not have bought it, as the contents to a very large extent can be found in research papers in the scientific literature—and more or less in the same form as they are presented here. I feel that the only people who will benefit from the book are those research workers who will themselves work in the fields covered by the author. In my opinion, the author would have produced a better textbook by restricting its scope and covering some topics in more depth and breadth: there are 132 sections in just over 400 pages, which means that the average length of a section is a mere three pages. The fifteen chapters in the book cover, respectively, kinetic theory, including elementary transport theory, principles of statistical mechanics, including ergodic and H-theorems, partition functions, including fluctuations, ideal bosons and fermions, including a very brief discussion of parastatistics and the de Haas–van Alphen effect, the linked cluster expansion, distribution functions, including hypernetted, Percus–Yevick, and Born–Green theories, Brownian motion, lattice statistics, including "melting" of DNA, phenomena near the critical temperature, including a one-page discussion of critical exponents, propagator methods for partition functions, propagator methods for distribution functions, transport phenomena in degenerate systems, including the Kondo effect, irreversibility and transport coefficients, including the master equation, second quantization, including spin and statistics, and Green functions, including superconductivity. As a result of the breakneck speed, the reader gets lost: to mention one instance, the author mentions that Fermi