metrics nor solutions of congruences modulo prime powers has previously been aired properly in the text, the reader not already familiar with $\mathbf{Q}_p$ will be left clueless to what exactly p-adic numbers are.

Such a wide-ranging text requires a good index but, unfortunately, the given one is quite inadequate. Many, or even most, items sprinkled all over the text are absent from the index. Thus there is one single entry for W, namely 'well-ordering', none for Y, and only two items for Z, namely 'zero' and 'zeta-function', so it is hopeless trying to find out from the index if an item is covered in the text or not, and much frustration trying to locate it even when it is there. There is an accompanying Author Index, with entries of over two hundred mathematicians, from Abel and Ackermann to Zemalo and Zorn, who had contributed to topics in the book; however, only the years of their birth and death, together with the prestigious honours they had received in their lifetimes, are given in their entries, and not the page numbers for their contributions. I thought 'continuous fraction' was a misprint for 'continued fraction', but it seems to be the author's choice, because the proof-reading for this lengthy text with wide-ranging topics is meticulous.

The author writes with much enthusiasm trying to explain what has been achieved by mathematicians. *Gazette* readers will be pleased to find that he has chosen to present T. Estermann's proof [2] of the irrationality of $N^{1/k}$, which is based on the well ordering of the natural numbers. Notwithstanding the criticisms, it has to be said that many students will find that there is plenty to learn from this well-written book, which would also be a useful reference text had there been a properly compiled index.

References

1. Manindra Agrawal, Neeraj Kayal and Nitin Saxena, "PRIMES is in P", *Annals of Mathematics* **160** (2004) pp. 781-793.

2. T. Estermann, 'The irrationality of $\sqrt{2}$, *Math. Gaz*. **59** (1975) p. 110.

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A first course in group theory by Bijan Davvaz, pp. 291, £44.99 (hard), also available as e-book, ISBN 978-9-81166-364-2, Springer Verlag (2021)

There have been several recent introductory books on group theory. This one, by an Iranian professor, takes a relatively traditional view, using the definition-theorem-proof structure and with not a great deal of informal explanation, though there are helpful, if brief, introductions to most sections as well as nuggets of historical background. It makes a point of using geometrical diagrams, in full colour, to help cement concepts, and in fact chapter 2, 'Symmetries of shapes', illustrates the standard affine transformations, without going any further than GCSE in content if not in notational sophistication. Chapter 1, called 'Preliminaries Notions' [*sic*], covers a miscellany: sets, functions, number theory, simple combinatorics. Groups are introduced in Chapter 3, starting with the usual axioms (closure being a property of a binary operation), and this is followed by chapters on cyclic groups and permutation groups. There is an 'optional' chapter on groups of arithmetic functions, then the main flow continues with matrix groups, cosets and Lagrange's Theorem, and normal and quotient ('factor') groups as far as Cauchy's Theorem. Chapter 10 is called 'Some special groups' and includes commutators, derived subgroups and maximal subgroups; and the final chapter is on homomorphisms as far as Cayley's Theorem and characteristic subgroups. Each chapter contains several sets of exercises and at the end some 'Worked-Out Problems' and supplementary exercises. No answers are provided. There is a substantial bibliography and a competent index. Proofs throughout are adequately full.

My first impression was that the book might suit a first course in group theory for those with fairly limited background knowledge, provided they were competent at coping with sophisticated notation and in reading proofs. There are various things in the book that I like very much, such as diagrams that use 'string art' to show how the element 5 generates $\mathbb{Z}_{12}$ and how cycle notation works, and the diagrams illustrating the three isomorphism theorems are also very helpful, but I think opportunities have been missed to illustrate dihedral groups, and transformations in 3D in a more ambitious way. Unfortunately there are rather a lot of other problems. As can be inferred from the section titles already quoted, the English used is not always idiomatic. Definite and indefinite articles are often omitted; more worryingly, the logical structure of assertions and questions is sometimes misleading. For instance, on page 89 we read 'In other words, the integer a is a unit modulo n, meaning that $ab \equiv 1 \pmod{n}$ for some integer b', when what is meant is, presumably, 'In other words, the integer a is a unit modulo n if (and only if) $ab \equiv 1 \pmod{n}$ for some integer b'. There are other similar examples, while quite a few of the exercise questions contain typos or ambiguities. The order of the material is not always helpful (examples should always come immediately after definitions, and there should be more of them) and is sometimes simply wrong; there are unhelpful elisions between relations and sets or functions; and there is unexplained notation. Further, the author introduces a large number of concepts at an early stage, so that, for example, we meet semigroups and monoids before groups (in a section described as 'optional', but the results in it are used later on, as is some of the vocabulary) and torsion is defined as early as Chapter 4, although it is not used later. This seems to me a recipe for information overload. Add a significant number of typos, and the impression is of a book which could have been a lot more useful with more careful proofreading and subediting. Learners with the limited background knowledge that the first chapters envisage will find the going tougher than need be, although the book might serve as a useful reference resource for the more experienced.

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A course in complex analysis by Saeed Zakeri, pp. 428, £50 (hard), ISBN 978-0-691-20758-2, Princeton University Press (2021)

This book is a second-level course in complex analysis for beginning graduate students. It presupposes some background knowledge in analysis and topology, but not much in the way of functional analysis or measure theory. Throughout, the author emphasises geometrical and topological aspects of the subject but does not neglect more computational function theoretic concerns. The book is superbly produced on good quality paper with wide margins and excellent use of colour in the many helpful diagrams. Each of the 13 chapters culminates in a very satisfactory highlight, without being overwhelming in detail or complexity.

The first 7 chapters establish the groundwork and cover the rudiments of complex analysis (essentially a rapid review of an introductory course), the general homology form