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Peter Lynch: That's Maths III, Logic Press, 2022. ISBN:9781471757525, EUR 13.69*, 282 pp..

REVIEWED BY RICHARD M. ARON

When picking up a new book, the first things that a potential reader may ask are: Is this book for me? Who are the intended readers?

I was sceptical of Peter Lynch's response to these questions which appears in the preface, namely that the book is suitable for any interested person who has studied mathematics at secondary school level, and that it is especially aimed at teachers of mathematics and science at school and university levels. After all, what could I, who have lectured to university students for around half a century, learn from TM III?

I felt that way until I got to page 5, when I read about a certain Dr Muriel Bristol who strongly preferred that milk should precede tea when being served. Although the three-page account left me in the dark about whether and when Dr Bristol took sugar, I did learn that as a consequence of this 1935 episode, the term *statistical significance* became prominent.

Like TM II, this volume has 64 short chapters, each averaging four pages in length. Many of the articles are based on Lynch's fortnightly column in the *Irish Times*, while some come from his blog (thatsmaths.com). References for further study are included at the end of most short chapters; typically, these references are to helpful *Wikipedia* notes, or to accessible texts, or even to *YouTube* videos.

A significant difference in TM III is that one quarter of the chapters (specifically, the last 16 chapters), require more sophistication and knowledge on the part of the reader. Thus, for example, the first of these – Chapter 49 – is about the "elegance of complex analysis". Starting with a picture of Cauchy, in five pages we are led to line integrals, Laurent series, and the Residue Theorem. Of course, nothing is proved, but it is reasonable to think that for many this would be an excellent introduction encouraging further study of complex variables.

Similarly, the three-page sketch about why the sphere and the torus are not homeomorphic, titled "Doughnuts $\neq$ Dumplings", gently leads the reader through an intuitive argument about why the torus cannot be deformed to a sphere, with a strong hint that group theory and algebraic topology hold the answers. (Here, I wished that the heuristic argument had treated the case of space-filling curves on the sphere.)

To me, one of the most fascinating chapters is about the Euler-Borel divergent series

$$\sum_{k=0}^{\infty}(-1)^k k!$$

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to which Euler assigned the value $0.596347562\ldots$. There's a nice justification, which roughly goes:

$$\begin{aligned}\sum_{k=0}^{\infty}(-1)^k k! &= \sum_{k=0}^{\infty}(-1)^k \int_0^{\infty} x^k e^{-x}\,dx \\ &= \sum_{k=0}^{\infty}\int_0^{\infty}(-x)^k e^{-x}\,dx \\ &= \int_0^{\infty}\frac{e^{-x}}{1+x}\,dx \\ &\sim 0.596347562\ldots.\end{aligned}$$

(Surely, only an over-zealous person would question any of the three equalities!). In fact, as suggested by Lynch, I went to *Wikipedia* to learn that Émile Borel had explained the above to Mittag-Leffler, who was not impressed.

There are few book authors, mathematical or otherwise, who sincerely suggest that the reader should *ramble* through its pages, more or less randomly. This is indeed the case here, where readers are encouraged to wander through the book, skipping over sections they find too difficult. General topics appear in one chapter, followed by several chapters on disparate things, only to reappear later on. Thus, for example, Chapter 13 in TM III is called "The Rise and Rise of Women in Mathematics", with "The 'Superior Genius' of Sophie Germain" being Chapter 43. (The contribution by women was already noted in TM I with a short chapter about the first female PhD, Sofia Kovalevskaya, who did her work with Karl Weierstrass.)

By way of conclusion, I return to answer my initial questions: I think that, anyone with even a vague interest and slight background in mathematics, will find many interesting topics in TM III. Given the author's firm but gentle hand, the book will find a very appreciative audience.

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