A Wealth of Numbers

Reviewed by Andy R. Magid

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Benjamin Wardhaugh

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When it comes to mathematical exposition, we mathematicians are diligent consumers. We buy non-textbook monographs, read *Notices* articles, and attend departmental colloquia, generally independent of whether the exposition is high quality (*Notices*), mixed (monographs), or low (most colloquia). Perhaps we are motivated by the hope that ideas and methods from other fields will inspire our work in our own specialty, or perhaps we feel the duty to be informed about the world of research mathematics in general. In any event, we devote time and effort to consuming mathematical exposition. Fortunately, some mathematicians are diligent producers of mathematical exposition, although the hard work of producing exposition is usually not rewarded as well, or even at all, compared to original research or earning funding for original research. The mathematical world would probably be better off if we were all better citizens in this regard, say, by accepting *Mathematical Reviews* assignments, but it's also true that there is some art to exposition, and not everyone who does it does it artfully. Those who do it well earn, if not the rewards their employers could offer, the respect of their fellow mathematicians who, after all, set the standards for what qualifies as excellent exposition.

When it comes to mathematical exposition for the nonmathematical public, however, mathematicians are at best interested bystanders. Popularizations of mathematics, like other publishing ventures, succeed or fail in the marketplace through coincidences of taste, timeliness, advertising, and fate—which may or may not have anything

to do with the quality, or even correctness, of their mathematical content. For example, consider the Amazon Best Sellers rankings of the following: Constance Reid's excellent *From Zero to Infinity* is number 907,624, only slightly better than Marilyn vos Savant's execrable *The World's Most Famous Math Problem*, number 966,319, while Lancelot Hogben's venerable (first published in 1937) and valuable *Mathematics for the Million* substantially outranks both at 153,398. For further comparison, John Allen Paulos's 1980s classic *Innumeracy* ranks 16,221 (all ranks observed 16 November 2012). This highly unrepresentative sample of mathematics books for the general reader currently available consists of books this reviewer happened to read, either as a general reader himself before becoming a mathematician or, for the later ones, out of curiosity when the books became newsworthy (Paulos) or notorious (vos Savant). I suspect most mathematicians have similarly limited exposure to popular mathematics books. "Limited" includes limited in time: while I wouldn't be surprised if my American coevals among the mathematical community are familiar with Reid, maybe even Hogben, our millennial successors probably aren't, and neither would be our prewar predecessors. For all any of us know, the general public is being offered, and buying, mathematical exposition that is erroneous in content, logically opaque, and gracelessly written.

Fortunately, Benjamin Wardhaugh has had the happy idea to anthologize selections of writings about mathematics for the general reader. Wardhaugh, a postdoctoral fellow at All Souls College specializing in the history of mathematics, assembled his selections ranging widely over topics (from Mathematical Tricks to Fiction and Humor) and time (1481 to 2004). With approximately one hundred excerpts, each with a brief introduction, comprising eleven chapters, each of which also has a short introduction, in some 370 pages, including index, the selections are necessarily brief. Nonetheless, Wardhaugh has certainly collected a representative sample of how people write when they are writing in English about mathematics for readers whose formal mathematics education

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is only assumed to be “school-level”. As such, this book belongs in every university library or similar places where mathematicians and others who are curious about the quality of mathematical popularizations can dip into it.

Here are some samples of the range of topics and times: from *A Path-way to Knowledge* by John Tapp, London, 1621, instructions about how to reduce fractions, presented as a dialogue between a teacher, Theodore, and a pupil, Junius; from *Sir Isaac Newton’s Philosophy Explained for the Use of Ladies* by Francesco Algarotti, London, 1739, a description of Kepler’s second law; from *Geometry without Axioms* by Thomas Perronet Thompson, 1833, an eccentric discussion of how to present Euclidean geometry without axioms or postulates, especially the fifth; from *Algebra for the Practical Man* by J. E. Thompson, London, 1931, the cookbook procedures for solving a cubic equation; and from the science fiction novel *Blue Mars* by Kim Stanley Robinson, London, 1996, a description of a twenty-third century physicist as viewed by an (extremely superannuated) scientist from our own era.

But the reader should be cautioned that the representative nature of this anthology means that it is definitely not a “greatest hits” collection. Wardhaugh warns his readers in the first paragraph of his preface that his collection is designed to answer the questions, “How did ordinary people think about mathematics in the past? How did they write about it? How did they learn and teach it?” And although he does later call his selections “a rambling garden of delights” (a point of view to which this reviewer will take exception), it is a fact that Wardhaugh has alerted us that this book is a sourcebook of historical mathematical popularization, not an invitation-to-mathematics collection for the general reader.

Unfortunately, the copywriters who prepared the cover blurbs for the volume failed to get the message. They write, “A treasure-house of popular mathematics, *A Wealth of Numbers* will provide many hours of fun and learning to anyone who loves math or science.” No, it won’t. Some examples:

From the selection *Napier’s Rules* by Alan Clive Gardner, 1956 [Gardner is discussing a spherical triangle with angles $A = 90^\circ, B, C$ and opposite sides a, b, c]: “Draw a circle and divide it into five sectors ([figure indicated]). Starting from the right angle, which is indicated by a heavy line [drawn center to 12 o’clock], give each sector the name of one part of the triangle, naming the parts in order round the circle. The two parts next to the right angle are named normally [clockwise b, c], but the other three parts are replaced by their complements [clockwise $90^\circ - B, 90^\circ - A, 90^\circ - C$].

“Two Rules must be memorized in connection with the Circular Parts. They are as follows:

- (1) Sine Middle Part = Product of Cosines of Opposite Parts.
- (2) Sine Middle Part = Product of Tangents of Adjacent Parts.”

Examples follow. There is no further discussion of why these rules might be true.

From the selection *Making a Star Clock* by Roy Worvill, 1974 [this selection is about constructing a device to measure the angle the line containing Dubne and Merak (unnamed in the selection) makes with the celestial parallel through Polaris. Worvill has instructed his readers to assemble materials (cardboard and a paper fastener) and tools (compasses, scissors, and knife) and to cut the cardboard into two 8-inch squares]: “On the other cardboard square draw...five concentric circles ...the largest one of radius four inches and the others, proceeding inwards, of three and a half inches, three inches, two and a half inches and two inches. Draw a diameter in the outer circle and mark off angles of thirty degrees so that there are twelve spaces or sectors. On the outer circle these are marked with two-hourly divisions from twelve o’clock to midnight throughout the twenty-four hours, although of course the nocturnal can only be used when it is dark enough to see the stars.”

The selection continues in this vein, including instructions for use.

From the selection *Turtle Fun* by Serafim Gascoigne, 1985 [The first two paragraphs of the selection, in their entirety]: “The world of micro-computers is forever changing. There is always something new to learn and find out. How can you keep up? Will you be able to program the computers of the future? And what about ‘intelligent machines’ and robots, especially the LOGO turtle?

“This book will help you to keep up with events by introducing you to a very powerful control language of the future, called LOGO. LOGO has in fact been developed by computer scientists working in a new science called Artificial Intelligence. LOGO has been written for young programmers. It comes from another language called LISP, which is one of the main languages used to control ‘intelligent’ computers and robots. Using such commands as STARTROBOT or REPEAT [FORWARD 50 LEFT 120] for example, you can either drive a small mechanical device called the floor turtle or control the screen turtle, a movable cursor on your TV screen. You can also teach the turtle your own commands, called ‘procedures’, which can include graphics text and sound.”

The historical value of these examples is obvious. The common thread of these selections, of course, is their lack of mathematical content, at least as far as mathematicians would be concerned.

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There are also selections from Euler, Polya, van der Waerden, Sylvester, Feynman, and others, with real mathematical content. But even in those the selections are so brief that mathematics must be interrupted midconcept. This well serves the purpose of a historical sourcebook, although "anyone who loves math or science" lured by the cover copywriter's blurb into looking at this book for "many hours of learning and fun," may well be disappointed.

Does this matter? Readers lured into buying a book by false advertising can always return it and get their money back. More generally, should mathematicians care about books on popular mathematics sold to the general public? I think so.

Consider the greatest years for popular support for mathematics (and science) in the United States, arguably from the Sputnik launch to the Mansfield Amendment. That was also the era of two colossal achievements in the area of mathematical popularization: Martin Gardner's *Scientific American* column "Mathematical Games", and James R. Newman's anthology *The World of Mathematics*, published in 1956. To quote Wikipedia, the latter is "a four volume library on the literature of mathematics from A'h-mos the Scribe to Albert Einstein, presented with commentaries and notes,...[it] covers many branches of mathematics and represents a 15-year effort by Newman to collect what he felt were the most important essays in the field...from a biography of Srinivasa Ramanujan by Newman to Bertrand Russell's Definition of Number. [*The World of Mathematics*] is often praised as suitable for any level of mathematical skill." It is still available new (Amazon rank 553,586).

Whether America's choice to generously support mathematical research in those years—unparalleled, I believe, before or since—was encouraged by Gardner and Newman or whether the popularity of Gardner and Newman was an artifact of the prestige with which America held its mathematical community in those years is open for debate. But we could certainly use figures like them now, making by example the public case for mathematics in the intellectual life of all Americans. Benjamin Wardhaugh's anthology is a useful tool for historians of mathematics, professional and amateur, who would like to know what forms mathematical popularization has taken. But the mathematical community could also use an updated *The World of Mathematics*, presenting the public with an anthology of the best writing about the best mathematics. It would certainly deliver the insight and entertainment the cover blurb of *A Wealth of Numbers* falsely promises. Who knows, it might even inspire a resurgence of the liberal funding of mathematics we once knew.