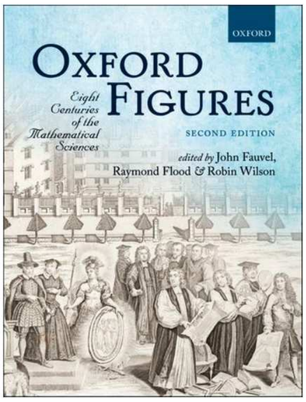
Book Reviews

Oxford Figures

John Fauvel, Raymond Flood and Robin Wilson, Editors
Oxford University Press, 2013, ISBN 978-0-19-968197-6

In 2013, Oxford University opened its new Mathematical Institute. As part of the celebration, OUP published a new edition of its 2000 publication *Oxford Figures: Eight Centuries of the Mathematical Sciences*, an intellectual and social history of the 800-year-old mathematical community. This new edition adds a foreword from Marcus du Sautoy and a survey of recent developments by Peter Neumann. The editors (Fauvel died in 2001) are three distinguished mathematicians who are also accomplished historians of mathematics. The five Parts, covering the Medieval and Renaissance periods, the 17th Century, the 18th Century, the Victorian Era and the 20th Century, are divided into several chapters, each written by a specialist in the area.



There is a persistent English myth that you go to Oxford to study Arts, and to Cambridge to study Sciences. As far as the mathematical sciences are concerned, the real history suggests that this is somewhat unfair, firstly because of the long mathematical tradition of Oxford and secondly because of the strong nexus between the two ancient universities, including the frequent interactions of professors and students.

Right from its founding in the 12th Century as a centre of Medieval scholarship in the tradition of Christian Neoplatonism, mathematics played a leading rôle at Oxford. An early Chancellor, the philosopher Robert Grosseteste, and his colleague Roger Bacon, proclaimed the impossibility of understanding natural philosophy without knowledge of geometry. Oxford in the 13th Century was dominated by the Aristotelian influence of Merton College, prominently Thomas Bradwardine who went beyond Greek geometry to try to quantify intensities of light, heat, sound, hardness and density as well as, less effectively, certitude, charity and grace.

A characteristic of Oxford mathematics, in fact of English mathematics in general, is periods of intense activity followed by longer periods of relative quiescence. This is what appears to have happened in the 250 years from the mid 14th to the late 16th centuries. The revival was sparked by the great textbook writer Robert Recorde and the brilliant but eccentric Thomas Harriot and later by the founding of the Savilian Chairs of Geometry and Astronomy, and the Sedleian Chair of Natural Philosophy, which persist to the present day. Even though they suggest a division into pure, applied and mixed mathematics, the titles meant little, since each chair has been held at various times by distinguished scholars who worked in all three areas. Some of the more distinguished scholars who held the chairs include John Wallis, Henry Briggs, David Gregory and Christopher Wren.

English mathematics in the late 17th Century was dominated by Isaac Newton. Of course his name is associated with Cambridge, but the 'Newtonians' also flourished at Oxford, including the Savilian Professor of Geometry and later Astronomer Royal, Edmond Halley.

Another characteristic hiatus ensued until the mid 19th Century which saw the rise of the geometer Charles Hinton, the logician, algebraist and superb populariser Charles Dodgson (Lewis Carroll). Later in 19th Century came the number theorist Henry J. S. Smith, another Savilian Professor of Geometry, and then the formidable James Joseph Sylvester.

Before World War 2, 20th Century Oxford mathematics was dominated by G. H. Hardy, equally at home in Cambridge. After the war a brilliant stream of mathematicians carried the torch, including Henry Whitehead, E. C. Titchmarsh, Graham Higman, Alan Turing, Roger Penrose, Michael Atiyah, Ben Green and Peter Neumann. Mary Cartwright and Dorothy Wrinch were two early women mathematicians whose careers included spells at both Oxford and Cambridge.

But this book is not just a catalogue of famous names and dates. The contributors succinctly explain the practitioners' mathematics in context, at least of those prior to the 20th Century, as well as the social, religious and political milieus in which they worked. We learn about life at Oxford apart from mathematical discovery, including a glimpse at student life through the ages, the textbooks and instruments they used and the examination systems they suffered.

It was Chaucer who provided the definitive image of the ideal academic in his portrayal of the Clerk of Oxenford. The final line has become a cliché, but it is illuminating to quote the whole verse:

> Of studie took he most sure and most hede.
> Noght o word spak he more than was need,
> And that was seyd in form and reverence,
> And short and quick, and ful of hy sentence.
> Souninge in moral vertu was his speche,
> And gladly wolde he lerne, and gladly teche.

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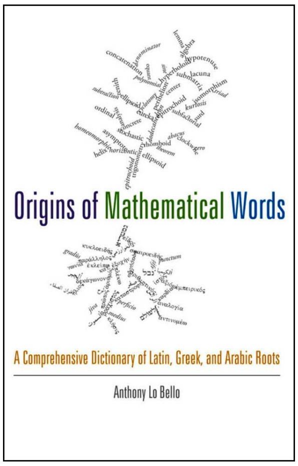
Origins of Mathematical Words: A Comprehensive Dictionary of Latin, Greek and Arabic Roots

Anthony lo Bello
The John Hopkins University Press, 2013, ISBN 978-1-42-141098-2
Also available for Kindle



All mathematicians are, or at least should be, concerned with the precise meaning(s) of mathematical words (and symbols) and almost every mathematician we know exhibits at least a passing interest in their etymology; their derivation, when and where they originated, perhaps by whom they were first coined, and their subsequent evolution in usage and meaning. If you entertain such curiosity, then this book is almost surely for you.

As one of us (JMB) knows first-hand, writing a dictionary [2] or like book [3] is a daunting task: be it highly successful [4] or less so [1].

After a somewhat provocative preface, the book settles into a dictionary-style format, with entries largely restricted to those mathematical terms with a root(s) traceable to one of the three languages listed in the subtitle: Greek, Latin or Arabic. In many, but not all, cases entries offer a precise mathematical definition together with details of the terms etymology; its origin, perhaps when and by whom it was first coined and something of its subsequent evolution. However, first and foremost it is what the subtitle proclaims: 'a comprehensive dictionary [giving the derivation of amenable words from] Latin, Greek and Arabic roots', thus typical entries are:

> **entire** This adjective came into English from the Latin *integer*, which means *whole*, through the mediation of the French *entier*.
>
> **pseudosphere** This modern word is correctly compounded of the prefix *ψενδο-*, *false*, and the noun *σφαρα*, *a sphere*. The *pseudospere* is the surface of revolution produced by revolving a tractrix about its asymptote. It acquired the name because it is a surface of constant *negative* curvature.

It is also a book with a mission; wherever possible to eschew the use of Dr Johnson's *low* words (concoctions that are 'frequently acronyms or *macaronic* concatenations, the infallible sign of defective education' [from the preface]). Examples being:

> **CW complex** The use of letters to name mathematical objects is to be deplored. If the letters ever had a meaning, they are forgotten in the next generation.'

We do observe that pre-emptive naming has a fine tradition. Banach called his complete normed linear spaces 'B-spaces' and Fréchet called his metric extensions 'F-spaces'. They just begged to end up called after their inventors. Nonetheless we have opted to have no BS-spaces in our joint corpus.

> **nonagon** This is an absurd word used by the unlearned for *enneagon, q.v.* It is the same sort of concoction as *septagon, q.v.*

'By their unnatural ugliness and comical pomposity, such words betray themselves to the reader, be his intelligence ever so limited' [from the preface].

The author, however, grudgingly concedes that 'immemorial custom' condones the use of certain low words; two examples being *unequal* and

> **binomial** The prefix *bi-* is a Latin abbreviation of the adverb *bis*, *twice*. It should therefore be prefixed only to Latin words or words of Latin origin. The Greek noun νόμος means *rule* or *law*. Some claim that the word is legitimate because the second component is from the Latin *nomen*, *name*, with the adjectival ending *-alis* added, but this is unlikely, for then how does one explain the absence of the second *n*? What happened was that the Latin adjectival ending *-alis* was illiterately appended to the Greek noun, and the word became legitimate through its adoption by Newton, from whose authority there is no appeal.

This image comes from a Kindle screen capture and gives a fine flavour of the volume. When such an exception might be acceptable is largely left for the reader to decide. The current reviewers take an even less prescriptive approach to mathematical nomenclature; better an ugly universal term than competing elegant synonyms.

Thinly peppered throughout, one encounters small lapses in proof reading and cross checking, as the entry for *nonagon* betrays; the cited entry for *enneagon* is nowhere to be found. However, this should not come as a surprise, when [2] was made into software (see http://www.mathresources.com) nearly twenty years ago, the process uncovered more than 50 such dangling links (despite many seemingly careful readings by all involved in the original project).

Sadly the publishing industry has not yet quite mastered the 'new' technology. *Were this book* available online as a single file in searchable form it would be an informative and valuable resource. (Actually, it has a *Kindle* version, and is also available as a large set of alphabetic and other files in *Project Muse* http://muse.jhu.edu/books/9781421410999 for which you may have institutional access.)

There is, nonetheless, also a place for it on the shelf of a research mathematician and especially anyone teaching higher mathematics; certainly it is a must for any university/mathematics library.

References

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[2] Borowski, E.J. and Borwein, J.M. (1989). *Dictionary of Mathematics*. Collins, Glasgow. Second revised edition (2002) (12th printing).

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[4] Borwein, J.M. (2009). The Princeton Companion to Mathematics. Feature *SIAM Review* **51,** 790-794

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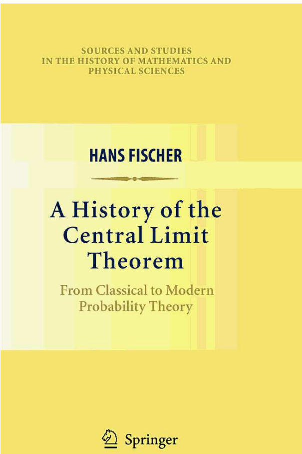
A History of the Central Limit Theorem: From Classical to Modern Probability Theory

Hans Fischer
Springer, 2011, ISBN 978-0-387-87856-0

At the outset, Hans Fischer points out that the phrase 'central limit theorem' is often used broadly to refer to a group of results in probability. There are many central limit theorems. However, it is convenient to talk about 'the central limit theorem' provided that we understand the limitation of this phrase.



The central limit theorem is one of the classical results in mathematics. It has attracted the attention of celebrated scholars such as de Moivre, Laplace, Cauchy, Bienaymé Chebyshev, Lyapunov, Bernstein, Kolmogorov, Feller and many others. Over a long period of time, mathematicians have devoted their energies to extending and refining the theory pertaining to this result. It is not surprising that many of these scholars made contributions to both approximation theory and the study of limit theorems in probability. The books by Gnedenko and Kolmogorov (1968), Araujo and Giné (1980), Hall (1982) and Petrov (1995) provide evidence of these theoretical developments. The central limit theorem is the basis for many methods in applied statistics that are concerned about inferences from large samples. The result has made its way into the curricula in university subjects in statistics in psychology and business, and now appears in the Australian senior mathematics curriculum for schools.

The central limit theorem has a well-deserved place in the history of ideas. Adams (2009) recognised this when he published the first edition of his work in 1974. Fischer's history of the central limit theorem deals mainly on developments between 1810 and 1935. To discuss the history of a technical mathematical result necessarily involves some technical mathematics. Fischer has done a fine job in balancing the mathematics and historical discussion.

One particular feature of this book that I enjoyed is that Fischer occasionally provides short discussion and pointers to the literature on topics that I did not expect to see. His discussion of the log-normal distribution is one example (pp. 133–134). The work certainly makes you aware of the importance of being able to read in several languages to appreciate historical aspects of mathematics.

There are numerous black-and-white photographs scattered throughout the book. The book is well bound and, as one would hope, has an extensive bibliography. I am proud to say that the bibliography lists the works of several Australian scholars, particularly Professor Eugene Seneta.

Most statistics subjects at university, and the corresponding text books, pay little attention to the history of the subject. Perhaps this is common for subjects that are developing rapidly. Fischer's work would be a useful reference for many subjects on probability and statistics at university. It may inspire a lecturer or student to find out more about the history of probability. Perhaps a graduate student writing a thesis might be motivated to add an historical chapter. I recommend Fischer's scholarly history of the central limit theorem for any university library.

What would be other fruitful topics for research in the history of mathematical ideas?

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