Anthony Lo Bello: Origins of Mathematical Words, Johns Hopkins University Press, 2013. ISBN:978-1-4214-1098-2, USD 51.95, 350+xv pp.

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We are entertained, rather than surprised, by occasional reports that document the ignorance, provincialism, and cultural poverty found in Americans selected at random. But even one-half percent of 300 million is a large number, and those of us who have profited from time spent in that great transatlantic republic know that millions of its citizens are far from typical. Anthony Lo Bello is one of those other Americans. He profited from a fine liberal education at Kenyon College in Ohio, and went on to graduate studies at Yale. He studied Mathematics under Kakutani, and along the way added a mastery of Arabic to his grasp of Latin and Greek. He now works as Professor of Mathematics at Allegheny College in north-western Pennsylvania. His main scholarly work concerns the late mediaeval period, particularly the transmission of mathematical knowledge and skill from the Islamic world to the Christian world.

Alfonso VI of Leon captured Toledo in 1085. The libraries, the best in Europe, were not pillaged, and the Muslim and Jewish scholars were not expelled. This provided a unique opportunity, and Gerard of Cremona was one of those who exploited the situation, and made Latin translations of the material. In particular, he translated the text of Euclid as given in Arabic, with commentary, by Abu'l Abbas al-Fadl ibn Hatim al-Nayrizi (Arabic:النيريزي, Latin: Anaritius, 865?-922?) who worked in Baghdad. Lo Bello has published annotated translations to English of al-Nayrizi's work, and of Gerard's translation, and of the subsequent commentary of St Albert the Great[2, 3], the patron saint of natural scientists (among other accomplishments).

In 2008, Trevor Lipscombe of Johns Hopkins University Press invited Lo Bello to write 'a discursive etymological dictionary of mathematical words whose origins are in Greek, Latin, or Arabic'. This was an inspired idea, because it gave Lo Bello scope to share with a wider public some of the contents of his well-stocked mind, in a way that is hardly possible using any other format.

The entries range in length from a few words to an extended essay, reminiscent of the pronouncements one heard at high tables in days gone by. Facts mingle with opinions. An opinion, arrived at after a thorough examination of any relevant facts, is better called a *judgement.* Lo Bello is opinionated, but he has put in the work.

The essays are highly entertaining, delightful, surprising, enlightening, provocative, and amusing. A few are impassioned rants — *American spelling*, 3pp; *Mathematics*, 8pp; *cant*, 5pp; *(teaching) evaluation*, 5pp — and others are concise, and well-written summaries — *Timaeus*, 13pp; *Philosophy*, 5pp; *Cartesian*, 7pp; *algebra*, 3pp; *Euclid*, 2pp; *calendar mathematics*, 4pp; and *Archimedes*, 5pp. I noted many interesting details, and found some accounts thoroughly illuminating. For instance, I had not realized that the grand scheme of the Elements — building up to the regular solids in Book XIII — was (according to Proclus) inspired by the 'Physics' expounded in the Timaeus dialogue, which sees four of these solids as the reality behind all matter.

He has a bibliography of 39 items, mostly linguistic; just five are mathematics books (three of them are curve dictionaries), but he also quotes many other sources in the text. The book is laced with well-chosen quotations from writers ancient and modern, some given at length. Q. H. Flaccus gets pride of place, and I was touched by the line about the great poet's visit to Athens to study Mathematics (and other matters),

> *Atque inter silvas Academi quarere verum.*
> (and seek truth among the Academy's groves.)

This could serve as a motto for us all. Occasionally, there is mathematical content, and Lo Bello writes with some authority about Probability and Statistics.

He rages against the decline in the quality of liberal education. In the entry *innovation,* (pp 179-82) he quotes, in full, a final 'honors' examination paper for mathematics majors set in his *alma mater* in the sixties, and says: "If this examination were given today, after fifty years of innovation, there would be no honors mathematics graduates

in the United States." Under *Euclid*, he notes that in addition to his translation of Heiberg's definitive text of Euclid, Sir Thomas Heath published his own edition in Greek of Book I for students of mathematics who could read Greek. Lo Bello says that such students are 'a type of scholar that does not exist anymore'. I feel that he is unduly pessimistic.

Universal education tends to disappoint the hopes of the reformers, as did the BBC, Radio Éireann, the gaelic revival, the great radio orchestras, and the national theatres. The worthy blogs of Fields' medallists, the Ted Talks, and Project Maths may fare no better. Gresham's Law operates across the whole spectrum of value. Most people decide by the time they reach adolescence that they no longer need to learn whatever is on offer, and thereafter learn on a self-motivated basis. It happens that they learn things, because they become interested, that they were told, but did not hear, many years before. This is nothing new. The fact is that Lo Bello was an exceptional student, even in his day. It is better to look on the bright side, as did Max Dehn. When asked whether he had been frustrated by the paucity of serious mathematics students at Black Mountain, he said: "Not at all. In fact, I have been very fortunate. In my sixty years of teaching I have had at least fifteen real students". My own experience of observing students gives me ground for hope that a positive proportion of them have the makings of real scholars. When I was at Brown, a respectable number of students took up Greek every year, and a few studied Akkadian. It is still possible to study the languages and classics of the ancient world in many US colleges and universities, and people do. I have been heartened to meet people more than thirty years younger than me who can read cuneiform tablets or hieroglyphic inscriptions as I would read the daily newspaper. The scholars are few, but it does not matter. They are probably more numerous than ever.

Lo Bello admits that *vox populi* is the voice of God, yet rails against its lack of culture. He has strong and exact views about the proper way to coin new words and he frequently mocks the efforts of those who coined our mathematical vocabulary, condemning various words as 'macaronic', 'comical', 'low', 'a sign of illiteracy', or 'pleonastic'. Right at the start, in the preface and again in the entry for *a-,an-,in-,im-,un-*, he lays down the law about the proper way to go about inventing new words. The main idea is that we usually build on roots

that are Greek, Latin, or Teutonic, and we should not combine prefixes or suffixes from one source with words from another.

For example, *normalization* is 'macaronic'; all attempts at the plural of *Latus rectum* apart from the correct *latera recta* are 'comical'; *sector* and *subgroup* are 'mistakes'; *septagon* is *'vox nullius'*, a 'learnèd mistake'; *subset* and *superset* are 'low', as are *subharmonic* and *superharmonic* (they 'should be hypoharmonic and hyperharmonic'); *tautochrone* was 'coined by someone who did not know what he was doing' and 'should be isochrone'. *multifoil, cinquefoil, quatrefoil*, etc show 'inconsistency of language'.

Occasionally, he gives the thumbs up: *ethnomathematics* is 'correctly formed'. Once, he exhibits actual enthusiasm: Napier's 1614 word *logarithm* was a 'happy' choice.

In wider discourse, beyond mathematics, he rails against *droid* and *software*: 'uncultured'; *cosmetology*: 'contemptible'; *automobile, homosexual, neuroscience, sociopath*, and *television*: 'absurdities'; *virtual*: 'hideous computer lingo' *professor emerita*: 'comical to those who know Latin'; *triangulate*: 'misused. Two respectable meanings are now swallowed up and lost in new vernacular'; *the virgule (/)*: 'is poor style and should never be used'.

In all this, I have sympathy with Lo Bello, when he says that 'our ears are assaulted with the most ugly concoctions and constructions.' But he swims against the current. Under *glottochronology*, he quotes the two 'main theorems' of the subject: (1) With k=0.217, and t in millennia, $N(t) = N(0) \exp(-kt)$, where $N(0)$ is the number of words in a basic list at time 0, and $N(t)$ is the number of these words still present at time t. (Thus a language loses about one-fifth of its basic words per millennium.)
(2) If languages L_1 and L_2, derived from a common root share M words in the basic list $N(0)$, then the time now is

$$T = -2.30 \ln \left(\frac{M}{N_0} \right).$$

I suppose that he is being ironical in giving the constants to three significant figures, and perhaps also in referring to these hypotheses as theorems. But the fact is clear: languages change, and they do so at uneven rates, but always rather rapidly. Lo Bello remarks that the spelling *mirror* came about 'a millennium ago, in an age careless of detail'. It is precisely at times of conflict and mayhem that language mutates most rapidly. We live now in such an age. England lost

control of English two centuries ago. In the exuberance of the melting-pot, the American language adopted new patterns of word-formation, and now America has lost control of American. Besicovitch said to Hayman[1, p38]: "Fifty million Englishmen speak English you speak. Five hundred million persons speak English I speak." Today, half the human population speak broken English, and they break it a little more every day. We just have to live with that.

Lo Bello makes an interesting point, in a rant about the poor quality of English prose written by American academics. He attributes it to the fact that English-speaking people do not trouble to study foreign languages because the language is used in books intended for a universal audience (replacing Latin). It would be interesting to check how many great writers were monoglot.

Lo Bello is not unreasonable, and says that he does not intend "to exhibit the kind of inflexible behaviour criticized by Voltaire" in a passage quoted from his *Lettres anglaises* that was aimed at mathematicians:

> *...animé...par cette inflexibilité d'esprit que donne d'ordinaire l'étude opiniâtre des science de calcul.*
>
>   (gripped by the inflexibility of spirit that results from the mulish study of methods of calculation.)

He does not presume to cavil at terms adopted by Newton, the Bernoullis, Leibniz, Euler, or Gauss, "from whose authority no appeal is possible", but I fear it too late to complain about the practice of using the title *references* for a bibliography, or to criticise the use of citations in the form [LoB], instead of [2].

He is quite correct to rail at the barbarous use of $\aleph$ or $\And$ for N, and Λ for A. He labels these, and the construct *numb3rs* as "illiterate fontese". It is a pity that he could not overcome his distaste for the *spellings* TeX and LaTeX to a sufficient extent to allow him to make use of Knuth's peerless system for typesetting mathematics. Indeed, not only the mathematical formulas, but even the quoted Arabic words and phrases are poorly typeset. There is no excuse these days for printing such things as $1 + \frac{1}{4} + 1/9 + 1/16 + \cdots$ instead of $1 + \frac{1}{4} + \frac{1}{9} + \frac{1}{16} + \cdots$.

For me, these facts take nothing from the interest in the etymology of our mathematical language, and I derived great pleasure and much

instruction from Lo Bello's account. For instance, it was a delight to realize that a *test* was a pot and a *text* a woven thing; that *transitive (transitivus)* goes back to Priscian of Caesarea (about 500 AD,), who also gave us *numeral (numeralis)*; that the Incas had the parabolic spiral; that the ovals of Cassini are the plane sections of a torus; and how to construct the trisectrix of Maclaurin. There is a small essay about renaissance architecture under the heading *vault.* The entry under *numerals* is a mine of information. Best of all, the steps by which a word mutates in form and meaning are just fascinating. For instance, the Greek word ἄλογος, meaning *irrational*, also has the literal meaning *lacking word*, so Islamic translators used أصمّ (ʾasamm), meaning *deaf*, and this became Latin *surdus*, giving us the English *surd* and *absurd.*

The book is full of such nuggets. Every library should have a copy, and it would make a fine gift, if someone you love loves words.

References

[1] W.K. Hayman. My Life and Functions. ISBN 978-1-326-03224-1. Logic Press. Kilcock. 2014.

[2] A. Lo Bello. Book I of Euclid's Elements of Geometry (3-volume set). ISBN 0-391-04197-5. Brill. Boston. 2003.

[3] A. Lo Bello. The Commentary of al-Nayrizi on Books II-IV of Euclid's Elements of Geometry. ISBN 9789004173897. Brill. Boston. 2009

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