Decolonising mathematics: how and why it makes science better (and enables students to solve harder problems)

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Abstract[1]

Mathematics is not universal. Traditional normal mathematics accepted *both* empirical proofs and reasoning, as does science, but formal mathematics prohibits the empirical. Prohibiting the empirical is obviously disadvantageous for applications of mathematics to science, but colonial education anyway replaced normal by formal math, declaring the latter to be superior without any critical examination, and globalised it.

Given the growing worldwide agitations to decolonise the university,[2] such *a critical examination* today *by the colonised* is essential to decide which math is really better for science, and which math ought to be taught. However, any such critical re-examination is blocked (by the West which may lose its dominance, and by formal mathematicians subordinate to it who may lose their jobs). I explain the arguments in my censored article[3] (censored after it went viral):that to decolonise mathematics one must first stand up to its false history (myths) *and* bad Western philosophy (superstitions).

Regarding history, Euclid is a concocted myth: in a decade no one accepted my challenge prize for serious (primary) evidence for "Euclid". Experts know there is none, while there is ample counter-evidence.[4] Western scholars collectively failed to notice, for centuries, that there isn't even a single valid deductive proof in the book *Elements,* which "Euclid" supposedly authored. The false myths of an early Greek origin of "superior" Western math serve to hide the church connection: the undeniable fact is that the book *Elements* was used as a text by the church for centuries, and therefore its purported origins and interpretation both had to be theologically correct. Formal

1 Since the ideas involved are novel, an extended summary is posted at http://ckraju.net/papers/palestine-extended-summary.pdf.

2 Claude Alvares and Shad Saleem Faruqi, *Decolonising the University*, Penerbit Universiti Sains Malaysia and Citizens International, 2012. For an example of the related decolonisation debate in Malaysia, since 2011, see "Decolonisiation: Conversations in the Sun", archived clips posted at http://ckraju.net/blog/?p=61. The more recent events in South Africa relate to the well-known movement "Rhodes must fall" and its fallout.

3 CKR, "To decolonise math stand up to its false history and bad philosophy." The most accurate version of the censored article is on my blog at http://ckraju.net/blog/?p=117. It was reproduced by many others worldwide most of whom also later took it down, but survives in some other locations, where the editors took an independent stand, such as The Wire, https://thewire.in/75896/to-decolonise-maths-stand-up-to-its-false-history/. See, also, CKR, "Mathematics and Censorship", on Kafila, https://kafila.online/2017/06/25/mathematics-and-censorship-c-k-raju/ and CKR, "Black Thoughts Matter: Decolonized Math, Academic Censorship, and the "Pythagorean" Proposition", *Journal of Black Studies*, **48**(3) pp. 256-278. . The censored article is also due to appear in *Rhodes Must Fall in Oxford*.

4 CKR,, *Euclid and Jesus: How and why the church changed mathematics and Christianity across two religious wars*, Multiversity, Penang, 2012.

mathematics actually began at the turn of the 20th c. CE, with the attempts by Hilbert and Russell to "save the story" of "Euclid" by wrongly imagining that the mythical Euclid intended deductive proofs, and trying to rewrite the book to fulfil that purported intention. They naively and uncritically assumed that formal (anti-empirical, metaphysical, deductive) mathematical proofs are superior.

Actually, formal mathematical proofs are inferior to the proofs of normal mathematics. Everyone agrees that empirical proofs are fallible, but deductive proofs are *more* fallible: hence formal mathematical theorems are unreliable knowledge. (1) An invalid deductive proof may be mistaken for a valid one (as happened for centuries with the *Elements*), and any doubt about a complex formal proof can only be settled inductively or by authority which is unreliable. (2) Formal mathematical proofs naïvely assume 2-valued logic (as in church rational theology[5]) which logic is neither culturally universal (e.g. Buddhist logic[6]) nor empirically certain (e.g. quantum logic[7]). (3) A formal mathematical theorem need have *no relation to valid knowledge* since any nonsense proposition whatsoever can be trivially proved as a formal mathematical theorem from suitable postulates. If the postulates are tested empirically such a test has to be inductive.

In actual fact, the postulates of formal math are decided by Western authority, not empirical tests. Empirical tests are impossible since most present-day formal mathematics, such as the calculus needed for physics, is based on a metaphysics of infinity (set theory, real numbers, limits) subtly allied to church dogmas of eternity.[8] This metaphysics is irrelevant for the practical value of calculus: to send a man to the moon we use numerical computations performed with floating point numbers on computers (which cannot represent even a single formal "real" number).[9] But it has political value, for through formal mathematics, a religiously biased metaphysics[10] creeps into science. A prime example is the claim that Stephen Hawking's singularity theory has proved the truth of creation in particular and Judeo-Christian theology in general.[11] Eliminating this bad metaphysics of formal math by reverting to calculus as normal math (the way it originated, using non-Archimedean arithmetic[12]) provides a better way to handle infinities (discontinuities, singularities, renormalization) in physics[13] without entailing such false and bombastic claims.

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5 CKR, "The Religious Roots of Mathematics", *Theory, Culture & Society* **23** Jan-March 2006, Special Issue ed. Mike Featherstone, Couze Venn, Ryan Bishop, and John Phillips, pp. 95–97.

6 CKR,, "Logic", article for *Encyclopedia of Non-Western Science, Technology and Medicine*, Springer, 2008, 2014, 2016. pp. 2564–2570. http://ckraju.net/papers/Nonwestern-logic.pdf.

7 CKR, "Quantum mechanical time", chp. 6b, in: CKR, *Time: Towards a Consistent Theory*, Kluwer Academic, Dordrecht, 1994. Fundamental Theories of Physics, vol. 65.

8 CKR, "Eternity and Infinity: the Western misunderstanding of Indian mathematics and its consequences for science today." *American Philosophical Association Newsletter on Asian and Asian American Philosophers and Philosophies* **14**(2) (2015) pp. 27–33. http://ckraju.net/papers/Eternity-and-infinity-Pages-from-APA.pdf.

9 CKR, "Computers, Mathematics Education, and the Alternative Epistemology of the Calculus in the YuktiBhāsā", *Philosophy East and West*, **51**:3 (2001) pp. 325–362.

10 CKR, "Teaching Mathematics with a Different Philosophy. 1: Formal mathematics as biased metaphysics". *Science and Culture* **77** (2011) pp. 275–80. http://www.scienceandculture-isna.org/July-aug-2011/03%20C%20K%20Raju.pdf. arxiv:1312.2099.

11 The bottom line of the serious book by Hawking is that "the actual point of creation, the singularity, is outside the scope of presently known laws of physics". S. W. Hawking and G. F. R. Ellis, *The large scale structure of space-time*, Cambridge University Press, 1973. The claim that "physics has established the truth of Judeo-Christian theology", using Penrose-Hawking singularities, was made e.g. by F. J. Tipler (*Physics of Immortality*, Macmillan, 1995, preface) who boasts of several publications in *Nature*. For a full discussion, see CKR, *The Eleven Pictures of Time* (Sage, 2003)

12 CKR, "Calculus", in: *Encyclopedia of Non-Western Science, Technology and Medicine*, Springer, 2016. pp. 1010–1015. http://ckraju.net/papers/Springer/ckr-Springer-encyclopedia-calculus-1-final.pdf. "Calculus transmission", pp. 1016–1022. http://ckraju.net/papers/Springer/ckr-Springer-encyclopedia-calculus-2-final.pdf

13 CKR, "On the Square of x^{-n} *J. Phys. A: Math. Gen.* **16** (1983) pp. 3739–53. Also, "Distributional Matter Tensors in Relativity." In: *Proceedings of the Fifth Marcel Grossman Meeting on General Relativity*, Perth, 1988, ed. D. Blair and M. J. Buckingham , R. Ruffini (series ed.), World Scientific, Singapore, 1989, pp. 421–23. arxiv:0804:1998.

The case of the calculus, essential for science, requires further examination. Calculus originated in India, and was stolen by Jesuits in the sixteenth century, and later falsely credited to Newton and Leibniz in the usual Western way.[14] In fact, for centuries, Europeans *failed to understand* the imported calculus (e.g. Newton's confused "fluxions"), the way they earlier took centuries to understand the elementary arithmetic algorithms they imported to replace their own primitive Greek and Roman arithmetic, which lacked even fractions.

On the Western (Platonic) superstition that mathematics involves eternal truths (and hence arouses the eternal soul[15]), and must hence be exact, Europeans (e.g. Descartes, Galileo) declared it impossible to exactly sum infinite series, such as the Indian series for π today wrongly called "Leibniz series".[16] Newton thought that the way to make calculus "perfect" was to make time metaphysical. It was this *conceptual error,* not any experiment, which led to the failure of Newtonian physics and its replacement by special relativity, created by Poincaré, but wrongly credited to Einstein.[17] On this understanding, before rushing in to general relativity, as Einstein did,[18] one *must* first modify Newtonian gravitation to make it consistent with special relativity. This was done only recently in my Lorentz covariant retarded gravitation theory (RGT)[19] which can be empirically tested through the effect of earth's rotation on nearby spacecraft[20] and satellites.[21]

The complex metaphysics of infinity underlying formal mathematics is what makes every simple thing in mathematics difficult, as in Russell's[22] complicated 378 page proof of 1+1=2. Today, calculus is taught using the redundant metaphysics of limits and formal real numbers. But, the original Indian understanding of calculus as a method of numerically solving differential equations,[23] together with non-Archimedean arithmetic and the philosophy of zeroism[24] makes calculus easy enough to teach in five days.[25] This ease enables students to solve harder problems such as elliptic integrals required for the first science experiment with the simple pendulum.[26]

Two actual courses on decolonised math—decolonised calculus, in university, and string geometry, in schools—are available and have been tested. It is time that the colonised decided the aim of teaching mathematics: whether to teach blind imitation of the West or to teach practical value.

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14 CKR,, *Cultural Foundations of Mathematics: the nature of mathematical proof and the transmission of calculus from India to Europe in the 16th c. CE*, Pearson Longman, 2007.

15 E.g. Plato, *Meno*. trans. B. Jowett. (Search for the second occurrence of soul in the online version at http://classics.mit.edu/Plato/meno.html, which has the story of Socrates and the slave boy's innate knowledge of geometry.)

16 *Cultural Foundations of Mathematics*, cited above.

17 CKR, *Time: Towards a Consistent Theory*, Kluwer Academic, Dordrecht, 1994. Fundamental Theories of Physics, vol. 65. chp. 2, 3a, 3b.

18 Jagdish Mehra, *Einstein, Hilbert and the theory of gravitation,* D. Reidel, 1974.

19 CKR, "Retarded gravitation theory" in: Waldyr Rodrigues Jr, Richard Kerner, Gentil O. Pires, and Carlos Pinheiro (ed.), *Sixth International School on Field Theory and Gravitation*, American Institute of Physics, New York, 2012, pp. 260–276. http://ckraju.net/papers/retarded_gravitation_theory-rio.pdf.

20 CKR, "Functional Differential Equations. 4: Retarded gravitation", *Physics Education* (India) **31**(2) April-June, 2015, http://www.physedu.in/uploads/publication/19/309/1-Functional-differential-equations-4-Retarded-gravitation-(2).pdf.

21 CKR, *Functional Differential Equations: a new mathematical paradigm in physics* (to appear). Appendix: The two-satellite experiment: http://ckraju.net/papers/RGT-experiment-article.pdf.

22 A. N. Whitehead and Bertrand Russell, *Principia Mathematica*, Cambridge University Press, 2nd ed. 1927 (reprint 1963).

23 *Cultural Foundations of Mathematics*, cited above.

24 CKR, "Zeroism", in: *Encyclopedia of Non-Western Science, Technology and Medicine*, Springer, 2016, pp. 4604–4610. http://ckraju.net/papers/Springer/zeroism-springer-f.pdf.

25 CKR, "Teaching Mathematics with a Different Philosophy. 2: Calculus without limits". *Science and Culture*, **77** (2011) pp. 281–86. . arxiv:1312.2100.

26 Suvrat Raju, "The pendulum project", http://ckraju.net/11picsoftime/pendulum.pdf. Also, CKR, "Time: What is it That it can be Measured", *Science & Education*, **15**(6) (2006) pp. 537–551. http://ckraju.net/papers/ckr_pendu_2.pdf.