

# In defence of decolonisation of mathematics

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## Summary

Is mathematics universal (hence cannot<sup>1</sup> be decolonised)? No! The purported universality is obviously contradicted by the colonial claim of Western *superiority* (a mutation<sup>2</sup> of the earlier claim of racist superiority) even in mathematics.<sup>3</sup> But decolonisation stands that claim of “Western superiority” on its head.

Roman arithmetic was *inferior*; realizing this, Europeans abandoned it, and repeatedly imported<sup>4</sup> superior Indian arithmetic (“Arabic numerals”) since the 10<sup>th</sup> c. But Indian arithmetic was *different*; it had many features missing in Roman arithmetic: zero, place-value system (hence large numbers), fractions, and negative numbers all of which Europeans hence found difficult to *understand*<sup>5</sup> till the 19<sup>th</sup> c. On “phylogeny is ontogeny”, these difficulties repeat in the current colonial teaching at primary-school level, which is being modified.

Similarly, the calculus originated in India<sup>6</sup> with the 5<sup>th</sup> c. Aryabhata who numerically solved differential equations to obtain precise trigonometric values. Later, the 7<sup>th</sup> c. Brahmagupta’s “unexpressed” (=non-Archimedean) arithmetic of polynomials, and a philosophy of zeroism,<sup>7</sup> was used to sum infinite series.<sup>8</sup> This Indian method of summing infinite series was **not understood**<sup>9</sup> by Europeans when they appropriated calculus from India<sup>10</sup> in the 16<sup>th</sup> c. (to help solve the European navigational problem<sup>11</sup>). The West hence invented axiomatic real numbers (and related axiomatic set theory by the mid-20th c.) to understand calculus in its ethnocentric way.

However, like Peano’s axioms for arithmetic, axiomatic reals add nil practical value, but much difficulty to calculus, so that California recently cancelled calculus.<sup>12</sup> The claim that axiomatic math adds *epistemic* value

- 1 (anon.) ‘Why We Have Nothing to Fear from the Decolonization of Mathematics’, *Nature* 614, no. 7946 (31 January 2023): 8–8, <https://doi.org/10.1038/d41586-023-00240-9>.
- 2 C. K. Raju, “‘Euclid’ Must Fall: The ‘Pythagorean’ ‘Theorem’ and The Rant Of Racist and Civilizational Superiority — Part 1’, *Arumaruka: Journal of Conversational Thinking* 1, no. 1 (2021): 127–55, <https://dx.doi.org/10.4314/ajct.v1i1.6>.
- 3 Raju, C. K. “‘Euclid’ Must Fall: The ‘Pythagorean’ ‘Theorem’ and the Rant of Racist and Civilizational Superiority - Part 2’. *Arumaruka: Journal of Conversational Thinking* 1, no. 2 (2021): 57–105. <https://doi.org/10.4314/ajct.v1i2.5>.
- 4 C. K. Raju, ‘Precolonial Appropriations of Indian Ganita: Epistemic Issues’ (International round table on Indology, IAS, Shimla, 2020), <http://ckraju.net/papers/ckr-indology-abstract.pdf>.
- 5 Augustus de Morgan, *On the Study and Difficulties of Mathematics*, New Ed. (Chicago: Open Court Pub, 1898), xi; Augustus de Morgan, *Elements of Algebra: Preliminary to the Differential Calculus*, 2nd ed. (London: Taylor and Walton, 1837), 70–71. De Morgan failed to understand negative numbers and rejected them saying they were evil, just as Florence in 1299 passed a law against zero!
- 6 C. K. Raju, *Cultural Foundations of Mathematics: The Nature of Mathematical Proof and the Transmission of the Calculus from India to Europe in the 16th c.* CE (Pearson Longman, 2007).
- 7 C. K. Raju, ‘Zeroism’, in *Encyclopedia of Non-Western Science, Technology and Medicine*, ed. Helaine Selin (Springer, 2014), <http://ckraju.net/papers/Springer/zeroism-springer-f.pdf>.
- 8 C. K. Raju, ‘Calculus’, in *Encyclopedia of Non-Western Science, Technology and Medicine*, ed. Helaine Selin (Dordrecht: Springer, 2016), <http://ckraju.net/papers/Springer/ckr-Springer-encyclopedia-calculus-1-final.pdf>; C. K. Raju, ‘Calculus Transmission’, in *Encyclopedia of Non-Western Science, Technology and Medicine*, ed. Helaine Selin (Dordrecht: Springer, 2016), <http://ckraju.net/papers/Springer/ckr-Springer-encyclopedia-calculus-2-final.pdf>.
- 9 C. K. Raju, ‘Marx and Mathematics. 4: The Epistemic Test’, *Frontier Weekly*, 8 September 2020, <https://www.frontierweekly.com/views/sep-20/8-9-20-Marx%20and%20mathematics-4.html>.
- 10 C. K. Raju, ‘Marx and Mathematics. 2: “Discovery” of Calculus’, *Frontier Weekly*, 31 August 2020, <https://www.frontierweekly.com/views/aug-20/31-8-20-Marx%20and%20mathematics-2.html>.
- 11 C. K. Raju, ‘Marx and Mathematics. 3: The European Navigational Problem and the Dissemination of the Indian Calculus in Europe’, *Frontier Weekly*, 4 September 2020, <https://www.frontierweekly.com/views/sep-20/4-9-20-Marx%20and%20mathematics-3.html>.
- 12 C. K. Raju, ‘California, Indian Calculus and the Technology Race. 1: The Indian Origin of Calculus and Its Transmission to Europe’, *Boloji.Com*, 11 December 2021, <https://www.boloji.com/articles/52924/california-indian-calculus>; C. K. Raju, ‘California, Indian Calculus and

is incorrect; axiomatic proofs (“reasoning MINUS facts”) are MORE fallible<sup>13</sup> than proofs in science or Indian ganita (“reasoning PLUS facts”).

The case of probability and statistics<sup>14</sup> is similar.

Hence, there *are* different kinds of math, (1) an earlier normal math which works for **all** current practical applications, such as calculating rocket trajectories, and (2) its axiomatised version, a 20<sup>th</sup> c.<sup>15</sup> formal math which adds difficulty but no practical or epistemic value. So math *can* be decolonised by reverting to the original normal math and rejecting its later-day superfluous coating of axiomatized formal math, globalised by colonialism, which adds *political* value,<sup>16</sup> ONLY for the West. (And, global≠universal.)

Decolonisation makes math easy, and enables students to solve harder problems, as **pedagogically demonstrated** by decolonised courses in calculus<sup>17</sup> taught in 5 universities in 3 countries. Similar decolonised courses have been taught in school geometry and trigonometry.<sup>18</sup> Decolonisation also makes math secular,<sup>19</sup> as particularly important e.g. for France and its Muslim dominated former colonies.

Sadly, the Western response in a quarter century<sup>20</sup> has been *only* to make personal attacks based on deliberate misinformation,<sup>21</sup> or to censor<sup>22</sup> me, or to grossly misrepresent<sup>23</sup> my decolonisation thesis, though such propagandist methods are regarded as sure ways of losing the argument on the classical Indian rules of debate,<sup>24</sup> which regarded the aim of debate as truth, not domination.

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the Technology Race. 2: Don't Cancel the Calculus, Make It Easy!', Boloji.Com, 24 December 2021, <https://www.boloji.com/articles/52950/california-indian-calculus-and>.

13 C. K. Raju, 'Decolonising Mathematics', *AlterNation* 25, no. 2 (2018): 12–43b. <https://doi.org/10.29086/2519-5476/2018/v25n2a2>

14 C. K. Raju, 'Probability in Ancient India', in *Handbook of Philosophy of Statistics*, ed. Paul Thagard Dov M. Gabbay and John Woods, vol. 7, *Handbook of Philosophy of Science* (Elsevier, 2011), 1175–96. <http://ckraju.net/papers/Probability-in-Ancient-India.pdf>.

15 Contrary to the Western myth, there are no axiomatic proofs in the Euclid book, Raju, “Euclid” Must Fall: The “Pythagorean” “Theorem” and the Rant of Racist and Civilizational Superiority - Part 2'. The first axiomatic proofs in geometry were by Hilbert, whose synthetic geometry grossly distorts the “Euclid” book, while Birkhoff’s metric geometry trivialises the “Euclid” book. David Hilbert, *The Foundations of Geometry* (The Open Court Publishing Co., La Salle, 1950); George D Birkhoff, ‘A Set of Postulates for Plane Geometry, Based on Scale and Protractor’, *Annals of Mathematics* 33 (1932): 329–45.

16 C. K. Raju, 'Why (Axiomatic) Math Is Racist', *Medium* (blog), 28 February 2022, [https://medium.com/@c\\_k\\_raj/why-axiomatic-math-is-racist-f1d81d716f13](https://medium.com/@c_k_raj/why-axiomatic-math-is-racist-f1d81d716f13).

17 C. K. Raju, 'Teaching Mathematics with a Different Philosophy. 1: Formal Mathematics as Biased Metaphysics', *Science and Culture* 77, no. 7–8 (2011): 274–79; C. K. Raju, 'Teaching Mathematics with a Different Philosophy. 2: Calculus without Limits', *Science and Culture* 7, no. 7–8 (2011): 280–85.

18 E.g., <http://ckraju.net/geometry/Raju-Ganit-poster.pdf>.

19 C. K. Raju, Euclid and Jesus: How and Why the Church Changed Mathematics and Christianity across Two Religious Wars (Penang: Multiversity and Citizens International, 2012); 'Petition: Teach Religiously Neutral Mathematics', accessed 15 October 2023, <https://www.ipetitions.com/petition/teach-religiously-neutral-mathematics>; C. K. Raju, 'Practical Ganita vs Religious Mathematics', *Medium* (blog), 5 September 2023, [https://medium.com/@c\\_k\\_raj/practical-ganita-vs-religious-mathematics-d908efc0f69f](https://medium.com/@c_k_raj/practical-ganita-vs-religious-mathematics-d908efc0f69f); C. K. Raju, 'The Religious Roots of Mathematics', *Theory, Culture & Society* 23 (March 2006): 95–97. Also, video of public lecture: “Practical ganita vs religious mathematics”, <https://www.youtube.com/watch?v=zTqL9EkENiI>.

20 C. K. Raju, 'Mathematics and Culture"', in *History, Culture and Truth: Essays Presented to D. P. Chattopadhyaya*, ed. Daya Krishna and K. Satchidananda Murthy (New Delhi, 1999), 179–93; C. K. Raju, 'Computers, Mathematics Education, and the Alternative Epistemology of the Calculus in the Yuktibhāṣā', *Philosophy East and West* 51, no. 3 (2001): 325–62, <http://ckraju.net/papers/Hawaii.pdf>.

21 E.g. Witzel from Harvard, 'C. K. Raju's Blog » Blog Archive » Probability in Ancient India: Response to Witzel', <https://ganita.net/probability-in-ancient-india-response-to-witzel/>.

22 C. K. Raju, 'Black Thoughts Matter: Decolonized Math, Academic Censorship, and the “Pythagorean” Proposition', *Journal of Black Studies* 48, no. 3 (2017): 256–78, <https://doi.org/10.1177%2F0021934716688311>; C. K. Raju, 'To Decolonise Maths, Stand up to Its False History and Bad Philosophy', *The Wire*, 2016, <https://thewire.in/history/to-decolonise-maths-stand-up-to-its-false-history>; C. K. Raju, 'To Decolonise Math Stand up to Its False History and Bad Philosophy', in *Rhodes Must Fall: The Struggle to Decolonise the Racist Heart of Empire* (London: Zed Books, 2018), 265–70.

23 E.g. the attack by G. F. R. Ellis and his student in the South African press to prevent me from explaining in the math department of the University of Cape Town my [objections to Stephen Hawking's singularity theory](#). For a brief summary of the attack, see "[The Bantuization polemic](#)" video excerpt of [lecture at Sol Plaatje University, Kimberley](#). For the relevance of singularity theory to decolonisation, see C. K. Raju, 'Decolonising Mathematics: How and Why It Makes Science Better (and Enables Students to Solve Harder Problems)', *Palestine Technical University Research Journal* 6, no. 2 (2018): 1–4. The above abstract was for two invited talks in Palestine which could not be presented since Israel refused a visa. Misrepresentation, too, seems endemic in the West. E.g. [a recent review of decolonisation of math](#) falsely claimed my course on calculus without limits was about teaching software. I did point out to John Armstrong (an author) that he had had grossly misrepresented me by quoting half a sentence from the abstract of my [Decolonising math article](#), “Decolonised calculus teaches calculus as normal math, the way it originated in India as a numerical technique to solve differential equations,” **while omitting the other half of the sentence** “together with non-Archimedean arithmetic (instead of formal ‘real’ numbers) and zeroism (instead of limits) used to sum infinite series”. However, he justified his misrepresentation saying his review had “systematic sampling” (quoting half a sentence) but was “not comprehensive” (not quoting the other half)!

24 Satish Chandra Vidyabhushana, *The Nyaya Sutras of Gotama* (Allahabad: Pāninī Office, 1913), 167 et seq. Book 5, chp. 2.