

Decolonising science

C. K. Raju

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Preliminaries

- ▶ Was part of Multiversity efforts to decolonise education for a decade.

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- ▶ Our focus was on curriculum, not fees

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- ▶ Why? Because fees were traditionally low or absent.

Example 1: Nalanda university



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- ▶ Was an institution of the highest quality: students came from all over the world, including China.

Example 2: Education in India

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- ▶ e.g. stock caricature of decolonisation
- ▶ “Don’t reject everything Western”
- ▶ Decolonisation means **critical rejection**.



LETTER

ben@thesunday.com

Be critical and choose what is best

This refers to "East, west, what's best" (Comment by E. John, Aug '11), which termed a whole group of critics an emotional and communal, by giving a totally distorted account of the difficulties at the deconstruction conference. The consensus at the conference was that, unlike the 'critical' rejection of the west that is the west, though some really appreciate our rejection of the west that is a critical one, and choose what is best.

For example, our legal system copies the west. As Stud Fung further pointed out, judges are required to be trained in British law, and need not know even the Malayan constitution. The demand to correct such anomalies is neither emotional nor communal, this is a clear case where applying the west hurts our interests. As the US history strategist Huntington bluntly said, applying the west hurts the colonised former ruler western rule.

At the conference, I suggested concrete reforms to the western maths and science curriculum, because that results in practical advantages for us. In fact, I suggested we should teach calculus without limits. This makes maths easy, so more maths students can do advanced maths, while maths students can solve harder problems.

This has many practical benefits. For example, it is easier personally understand the complex mathematics of risk, that would help them avoid wrong decisions.

items, like those which led to the sub-prime crisis. I also proposed we teach better science using functional/differential equations, and pointing to its practical advantages over Newton's "law", for quantum computing, knowledge, space flight, and galactic structure. We should adjust both these proposals evenly because they work better.

But even more the mathematics. How do we implement the new curriculum in our schools and universities? Because solutions have assumed that most people remain mathematically and scientifically illiterate. So, we are forced to only use simple maths.

"Our papers" are all trained in the western tradition, and our method of teaching equates it to the west without modification, so our papers are wholly dependent on the west. It is a major conflict of interest for those to admit the western method is inferior. We have no procedure, such as public debate, to assess transparency, and "our papers" typically take decisions behind-the-scenes. The result will make it difficult for us to do what is good for us.

Now, if every innovation needs western approval, that systematically gives the west the first choice to grab that innovation and its benefits. The way a former member of the Royal Society twice tried to grab credit for slow recognition to use functional/differential equations, the second now, after he had been explicitly informed about it (Please see the latest acknowledgment of my work at <http://www.ams.org/chronicles/2008/08/members/math.pdf>, second page, and the finding of a prior paper same against him at <http://www.sciencemag.org/cgi/content/full/306/5698/1207>, 1208th-fig.1 case 1).

However, there is an even deeper problem. The western bias in Florida's "law" (mentioned in my earlier letter) comes just because Christian theology got mixed with mathematics in the west. People astonished by this claim are usually unaware that the very word mathematics derived from "mathema", a term imbued with deep religious meaning and related to the soul and its past lives by Pythagoras in his famous dialogue with the slave boy in Plato's *Menon*.

Although early Christians had similar beliefs about the soul, the post-Enlightenment rational the belief, and banned philosophy such as Proclus, calling them heretics (which allowed killing them) because they used the use of mathematics to reject the Christian doctrine of creation.

So, we can see how mathematics got into the dead-center of the vicious religious war waged against "pagans" begun in the fourth century. The next religious war, the Crusades against the Muslims, failed in Earth beyond Spain, and the check booked for money to convert Muslims who did not accept the Christian religion, and could not be converted by force, and "pagans" (Satanic Muslims) accepted money (gold, silver, copper) and his scholars advocated a Christian theology of reason. To convert them, Mathematics was now accepted back by the church, but discov-

ered from "soul", and used only as a tool to teach reason. I can explain some of this in "The Religion Roots of Mathematics" (Theory, Culture and Society, 2006) available from <http://dx.doi.org/10.1080/14732160601105919>. Religion-roots-of-math-TCS.pdf and my book Cultural Foundations of Mathematics (Pearson, 2007).

The western claim to ownership of rationality is incorrect, as further explained in my article for the *Journal of Management*, in *Journal of Social Issues*, 2007, available from <http://www.ccsenet.org/journal/index.php/management/article/view/1011> and page 6 for the beginning of my book on rationality, logic and Jesus.

Current western formal mathematics developed out of that post-Creation best of reason. The view of math-as-proof-for-permission is irrelevant for any practical application of maths, such as teaching a man to the moon, all of which require maths-acquisition.

So rejecting formalism will not hurt the practical applications of maths at all. To the contrary, it makes maths easy, and enhances the ability of students to apply it to more complex practical problems.

However, the west is deeply invested into that form that metaphysics which involves anti-Creation and anti-Biblical, anti-Moses etc. bias.

This is formalism assumes that metaphysical proofs are more trustworthy than empirical proofs, contrary to all Indian philosophies.

(i) For example, the western philosophy for creation, mistakenly assumed that logic is universal, though Aristotle and Jain logic are different, like quantum logic. (See my article "Logic" in the Springer Encyclopaedia of Philosophy, Science, 2008, available from <http://dx.doi.org/10.1007/s10992-008-9111-1>).

(ii) Though formal maths can, in principle, begin from any postulates, students are taught only those postulates of arithmetic laid down by western mathematicians.

Those are incompatible with Islamic beliefs about eternity and computer arithmetic, which latter declined in western. (See details in my paper (in Science and Culture, 2011) on "Formal mathematics vs based metaphysics" at <http://dx.doi.org/10.1007/s12146-011-9111-1>).

The religion bias in present-day maths makes it teach a non-rationalist in a secular society, like India, and a Muslim country which do not permit a pro-Christian bias. So, its rejection will be immediately changed across schools and universities.

The change I suggested is better also from a purely practical perspective. Thus, the correct position is the exact opposite of what John stated: namely, that we want to change the educational system for our pragmatic benefit, and to discuss and analyse western maths and science. Now that the position has been clarified, I hope John will join us in our endeavor.

E. K. Raja
Visiting Professor
School of Mathematical Sciences
Universiti Sains Malaysia



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- ▶ whether deliberately or due to ignorance
- ▶ is one of the 23 ways of losing an argument.

Western education

Of the church, by the church, for the church

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Preliminaries

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- ▶ to try to win the Crusades by other means
- ▶ Western universities were fully controlled by the church till the 20th c.
- ▶ Hence, Western education, **by design**, produces an indoctrinated and enslaved missionary mind subservient to church/Western authority.

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- ▶ Google “Education and counter-revolution”.)

Colonial education

To offset military weakness

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- ▶ (First Western universities were set up in India immediately after the revolt of 1857.)

- ▶ We require a fundamentally different design for education

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- ▶ which aims to free the mind

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Colonial education

For science?

- ▶ While the aim was control,
- ▶ the rhetoric emphasized science.
- ▶ This is still widely believed: that Western education is needed for science and technology.

- ▶ Hence, to decolonise education we must first decolonise math and science.

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- ▶ Hence, to decolonise education we must first decolonise math and science.
- ▶ Not just pedagogy, but also content.
- ▶ This was my focus in the Multiversity efforts to decolonise the curriculum.

Introduction

- ▶ Can math and science be decolonised?

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- ▶ Full details (with references) posted at <http://ckraju.net/papers/uct-panel-decolonising-science-ckr-summary.pdf>

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- ▶ have been tried out
- ▶ and are now being taught as regular school/university courses in India.

Gist of summary

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The paradox

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- ▶ Western (formal) math (as taught in schools and universities) is **anti-empirical**.
 - ▶ E.g. a geometric point is declared to be invisible (cannot also infer its existence from empirical data).
 - ▶ Everything in formal math (from $1+1=2$) requires a metaphysics of infinity.
- ▶ Hence, Whitehead and Russell took 378 pages to prove $1+1 = 2$.

•56'101. $\vdash: R \in \check{\Delta} \equiv . D'R, (\check{C}'R \in 1)$

Dem.

$\vdash . \bullet 55'16 . \bullet 11'11'341 . \supset$

$\vdash: (\exists x, y) . R = x \downarrow y \equiv: (\exists x, y) . D'R = t'x . (\check{C}'R = t'y :$

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(1)

$\vdash . (1) . \bullet 56'1 . \supset \vdash . \text{Prop}$

•56'102. $\vdash: \check{\Delta} = \check{D}'\check{C}'1 \cap \check{C}'\check{C}'1$

Dem.

$\vdash . \bullet 56'101 . \bullet 37'106 . \supset$

$\vdash: R \in \check{\Delta} \equiv . R \in \check{D}'\check{C}'1 . R \in \check{C}'\check{C}'1 .$

[•22'33] $\equiv . R \in \check{D}'\check{C}'1 \cap \check{C}'\check{C}'1 : \supset \vdash . \text{Prop}$

•56'103. $\vdash: R \in \check{\Delta} . \supset . \check{\eta} \uparrow R$

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[•33'24] $\supset . \check{\eta} \uparrow R : \supset \vdash . \text{Prop}$

•56'104. $\vdash: R \in 0 . \equiv . R = \check{\Lambda}$ [(•56'03)]

•56'11. $\vdash: R \in 2 . \equiv . (\exists x, y) . x \neq y . R = x \downarrow y$ [(•20'3 . (•56'02)]

•56'111. $\vdash: R \in 2 . \equiv . D'R, (\check{C}'R \in 1) . D'R \cap (\check{C}'R = \check{\Lambda})$

Dem.

$\vdash . \bullet 51'231 . \bullet 55'16 . \supset$

$\vdash: x \neq y . R = x \downarrow y \equiv . t'x \cap t'y = \check{\Lambda} . D'R = t'x . (\check{C}'R = t'y .$

[•13'193] $\equiv . D'R \cap (\check{C}'R = \check{\Lambda}) . D'R = t'x . (\check{C}'R = t'y$ (1)

$\vdash . (1) . \bullet 56'11 . \bullet 11'11'341 . \supset$

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•56'112. $\vdash: R \in 2 . \equiv . D'R, (\check{C}'R \in 1) . \check{C}'R \in 2$

Dem.

$\vdash . \bullet 56'111 . \bullet 54'43 . \supset$

$\vdash: R \in 2 . \equiv . D'R, (\check{C}'R \in 1) . D'R \cup (\check{C}'R \in 2) .$

[•33'16] $\equiv . D'R, (\check{C}'R \in 1) . \check{C}'R \in 2 : \supset \vdash . \text{Prop}$

•56'113. $\vdash: 2_r = \check{2} \cap \check{C}'\check{C}'2$

Dem.

$\vdash . \bullet 56'112'101 . \supset \vdash: R \in 2_r \equiv . R \in \check{2} . \check{C}'R \in 2 .$

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- ▶ Claims of universality mere ideological posturing.
- ▶ Most people understand $1+1=2$ empirically

Resolving the paradox

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- ▶ discard formal math
- ▶ and revert to **normal** math
- ▶ which admits the empirical (including empirical proofs)
- ▶ and prevailed for thousands of years before the birth of formal math.

Common errors

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- ▶ But an invisible geometric point is metaphysics (fantasy). No direct way to know about points.
- ▶ This con-trick forces rejection of commonsense (“emperor’s new clothes”)
- ▶ and acceptance of authority, as the sole source of knowledge.

King's invisible new clothes

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science

C. K. Raju

Preliminaries



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Advantages of decolonised math

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A doubt

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- ▶ A computer **cannot** handle the metaphysics of infinity (formal reals).
- ▶ All engineering and scientific applications involve **approximate calculations**, not “eternal truth”.
- ▶ Teach what works: normal math, not ideology.

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- ▶ West added the metaphysics of formal math
- ▶ a redundant ideological wrapper.
- ▶ Mystery geometry imported from Egypt, since Plato
- ▶ was twisted (“reinterpreted”) to suit post-Crusade rational theology.

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- ▶ but the particular metaphysics of **infinity** in formal math which is NOT universal, but
- ▶ is tied to church dogmas about **eternity**.
- ▶ **Eliminating these superstitions results in a better science.**

The Blackhouse Collective invites you to a conversation with

PROFESSOR C.K. RAJU

"Every conquest is, in the first instance, a conquest of knowledge"



WESTERN SUPERSTITION PACKAGED AS SCIENCE: DECOLONIZING MATHS & SCIENCE

Due to the colonial experience, all ideas, philosophies and theories - generally all systems of learning and knowing in the education curriculum - have a Eurocentric historical and cultural base.

As such, subjects like Mathematics and Science are usually assumed to be inherently European. Afrikan contributions to these subjects remain excluded.

Join us in conversation with Professor C.K. Raju as we explore the origins Maths and Science under the theme:

"Western Superstition Packaged As Science: Decolonizing Maths & Science".

DATE: SUNDAY, 22 JANUARY 2017

TIME: 11.30 FOR 12.00

**VENUE: BLACKHOUSE COLLECTIVE, 10493 DR MATSEKE DRIVE
DOBSONVILLE, EXT.3, SOWETO**

For more information please contact Sista Nehanda on 078 243 8830 or via email blackhousecollective1@gmail.com

**"THE MOST POTENT WEAPON IN THE HANDS OF
THE OPPRESSOR IS THE MIND OF THE OPPRESSED"**
- BANTU BIKO



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SOWETO**

Summary

How to decolonise science

- ▶ 1. Decolonise the method of validating science:

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Summary

How to decolonise science

- ▶ 1. Decolonise the method of validating science:
 - ▶ Use refutability NOT reputability
 - ▶ Judge valid science by experiment, not publication in “reputable” journals.

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How to decolonise science

- ▶ 1. Decolonise the method of validating science:
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 - ▶ and the associated dogmas (“universal laws of nature” etc.).

- ▶ 3. Eliminate the bad metaphysics of (formal) math:
 - ▶ Bad metaphysics creeps into science through formal math.

1. Decolonise the method of validating science

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- ▶ (All systems of Indian philosophy accept the empirically manifest as the first means of proof.)
- ▶ In India, experimental method was applied also to religious beliefs, such as the soul.

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- ▶ Recorded in the *Dīgha Nikāya* (= *Long discourses of the Buddha*).

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- ▶ (Popper wrote, "your arguments are strong, I will reply." but died!)
- ▶ So, those arguments stand, but finer points not needed for present debate.
- ▶ Hence, I am willing to pragmatically accept his (actually Poincaré's) weaker criterion of **refutability**.

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- ▶ than blacks who were declared inferior.

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- ▶ “Peer” review done by reviewers **secretly** appointed by editors.
- ▶ Secrecy and blind trust in the West/Whites is **NOT** science.
- ▶ (Actually secretive pre-censorship just a church method of thought control designed to preserve bad dogmas.)

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- ▶ was published by the *Conversation* last year.
- ▶ It went viral (17K hits), and was then censored.
- ▶ (Still survives in some locations online: Google “math and censorship” for details.)


- ▶ If there was some error in the article, the *Conversation* should have pointed it out.

¹“Black thoughts matter: decolonized math, academic censorship. . .”, *Journal of Black Studies* **48**(3) April 2017, pp. 256-278.  

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- ▶ Article now published in full in a peer-reviewed academic journal.¹

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- ▶ Present panel would have been impossible in the days of apartheid.

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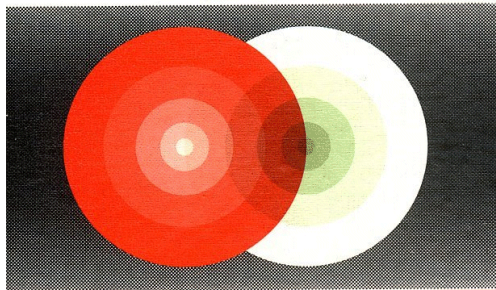
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- ▶ The second time after he was personally informed.

Time: Towards a Consistent Theory

by

C. K. Raju

Kluwer Academic Publishers



Fundamental Theories of Physics

- ▶ The book published by Kluwer/Springer in 1994.

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- ▶ A second book published by Sage, 2003.

The Eleven Pictures of Time

*The Physics, Philosophy, and
Politics of Time Beliefs*



C. K. Raju

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- ▶ and also named the idea as “Atiyah’s hypothesis”

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- ▶ Won't publish your remarks about a conceptual error in the term “Atiyah's hypothesis”. Won't even remove that error. [“Reputation is more important than truth.”]

Letters to the Editor

Retarded Differential Equations and Quantum Mechanics

G. W. Johnson and I wish to draw attention to the work of C. K. Raju that is related to some of the ideas discussed by Sir Michael Atiyah in his talk “The Nature of Space”, which we reported on in the June/July 2006 issue of the *Notices*. Ideas suggesting a link between retarded differential equations and quantum mechanics were put forward some years ago by Raju, and we, along with Atiyah, believe they deserve attention. Interested readers are encouraged to read, in particular, the following papers written by Raju:

1. *Time: Towards a Consistent Theory*, Kluwer Academic, Dordrecht, 1994 (Fundamental Theories of Physics, vol. 65), ch. 5b “Electromagnetic time” (pp. 116–122), and ch. 6b “Quantum mechanical time” (pp. 161–189).
2. *The Eleven Pictures of Time*, Sage, 2003, pp. 298–302.
3. “The electrodynamic 2-body problem and the origin of quantum mechanics”, *Foundations of Physics*, **34**, (June 2004), 937–962.

—Mark E. Walker
University of Nebraska
mwalker5@math.unl.edu

(Received December 29, 2006)

Moral of the story

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Moral of the story

- ▶ Reputation a poor guide.
- ▶ Editors of the most widely-read journal in math cannot be trusted.
- ▶ Nor can the most reputed mathematicians.

- ▶ To decolonise, we must first reject this Western hegemony over academics.

2. Correct the false history and bad philosophy of science

- ▶ The rhetorical justification for colonial education was

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- ▶ that it was needed for science.
- ▶ A key argument here was the Western creation myth:
- ▶ that (“modern”) science is a Western creation.

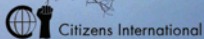
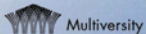
- ▶ First began with Greeks,

- ▶ First began with Greeks,
- ▶ and then developed after the renaissance (actually Crusades).

- ▶ This thesis of the Western origin of science is completely false.

Is Science Western in Origin?

C K Raju



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- ▶ “Euclid” (math) and “Claudius Ptolemy” (astronomy)
- ▶ and “Copernican” and “Newtonian” revolution.
- ▶ (Copernicus copied from Ibn Shatir of Damascus, Newton got calculus from India).

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- ▶ So, the church tried to acquire that knowledge.
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- ▶ and was mass translated to Latin starting 1125 CE.

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- ▶ How to learn from the books of the religious enemy? That too during a religious war?
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- ▶ hence a Christian inheritance.

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- ▶ when Europeans (e.g. Copernicus, Mercator, Tycho Brahe, Kepler) trembled to acknowledge their “heretical” sources.

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- ▶ to glorify themselves.

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- ▶ All the “evidence” comes from stray remarks in excessively late texts (from 1000-1800 years later)
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- ▶ Exactly like saying that a present-day text in aerodynamics in English, from London, is a carbon copy of an ancient African text.

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- ▶ so a 16th c. text attributed to Archimedes reflects 16th c. knowledge

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- ▶ (See, e.g. video of my MIT talk or video: "A tale of two calendars".)

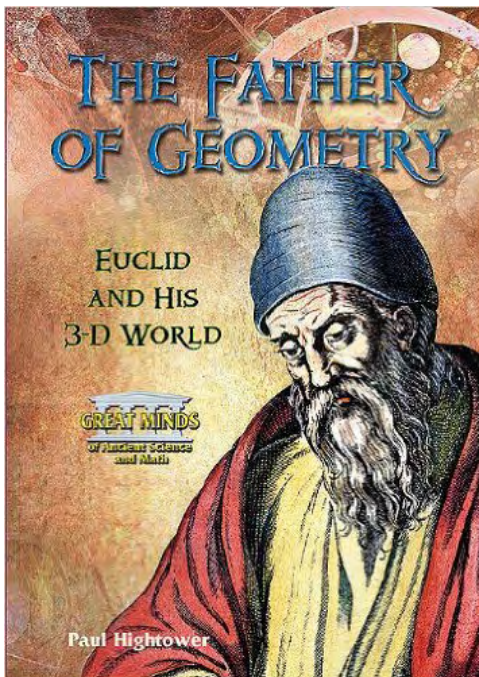
3: Decolonise the philosophy of math

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- ▶ used by Indian school texts
- ▶ to motivate the teaching of anti-empirical (formal) math.
- ▶ All Indian school math texts show an image of Euclid, and depict him a white man.



Decolonising
science

C. K. Raju

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- ▶ This caused considerable outrage.

Euclid and Jesus



C. K. Raju



Multiversity



Citizens International

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- ▶ (Show me better evidence and I will change my opinion.)

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- ▶ Changing the author and her time, changes the understanding of the *Elements*.

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- ▶ That involves a notion of the soul cursed by the church in the 6th c.

- ▶ It is clearly a book in the (“Platonic”/“Neoplatonic”) tradition of Egyptian mystery geometry
- ▶ which links geometry to the soul as in Plato’s Meno.
- ▶ That involves a notion of the soul cursed by the church in the 6th c.
- ▶ Hence, the “author of the Elements”, Hypatia, was raped on the altar of a church and then lynched most brutally.

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- ▶ **It does NOT contain a single pure deductive proof from its first proposition to the last**
- ▶ as was finally admitted at the beginning of the 20th c.
- ▶ So, for centuries (since 1125 CE), the book was wrongly interpreted by ALL Western scholars.

- ▶ To decolonise: don't let the West ever forget this foolish mistake it made for centuries

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- ▶ Keep reminding them of the worthlessness of their authoritative truth.

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- ▶ Formal math started with attempts to “correct” “Euclid” and do what “he” “intended” to do:
- ▶ both Hilbert and Russell wrote (separate) tracts on the Foundations of Geometry.

- ▶ Principle: Any nonsense theory can be saved

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- ▶ That is why refutability is important, and one must reject reputability.

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- ▶ What difference does it make now to the present-day philosophy of formal math?

- ▶ It tells us that **deductive proofs are terribly fallible.**

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- ▶ Invalid deductive proofs were mistaken for valid deductive proofs for centuries, unanimously by ALL Western scholars.
- ▶ Empirical proofs are fallible, but not so fallible:
- ▶ easier to deceive the mind than the senses.

- ▶ Philosophy of formal math just naively assumed that deductive proofs are infallible.

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- ▶ Failure of the myth of Euclid is a strong counter-argument.

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- ▶ Adelard of Bath was the first to translate the Elements from Arabic to Latin around 1125 CE (almost the same time as Gerhard of Cremona).
- ▶ He was a Crusading spy who travelled in Muslim lands disguised as a Muslim student.

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- ▶ to have reason as my guide,
- ▶ while you are dazzled by the show of authority and led by a halter.
- ▶ For what is authority to be called, but a halter?
- ▶ As the brute beasts, indeed, are led by the halter, and have no idea by what they are led or why, but only follow the rope that holds them”

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- ▶ This way the church retained authority while boasting reason.
- ▶ FYI: **Any nonsense proposition whatsoever can be proved by deductive reasoning applied to metaphysics.**

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- ▶ A deductive proved theorem, which starts from faulty assumptions, will result in a false conclusion.
- ▶ Indian Lokayat (people's philosophers) hence rejected deductive inference as a poor guide to truth.

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- ▶ To convince his girlfriend, at night a man makes a wolf's footprints on the ground
- ▶ from the gate of the city to its central square.
- ▶ In the morning, a crowd assembles and wise people infer that a wolf was around.
- ▶ The man laughs: see how deceptive inference can be?

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- ▶ 1. All animals have two horns.
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- ▶ 3. Therefore, a rabbit has two horns.
- ▶ This is a valid example of logical reasoning, but the conclusion is false.

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- ▶ We know that the starting point is false: there are animals who don't have two horns, for instance, a rabbit.
- ▶ But there is no way to know this in anti-empirical formal math,
- ▶ just as there is no way to know way school students can know the properties of an invisible geometric point.
- ▶ Since formal math starts with a metaphysics of infinity (set theory) which assumptions cannot be empirically tested.

Concrete examples: calculus and Newtonian
physics

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- ▶ Both propositions are false.

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- ▶ Formal real numbers involve a metaphysics of infinity.
- ▶ No one can write down even a single formal real number such as $\sqrt{2}$ **exactly**,
- ▶ because it involves a non-repeating, non-terminating (infinite) series.

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- ▶ to calculate precise trigonometric values.
- ▶ Developed over a thousand year period.

श्रेष्ठं नाम वरिष्ठानां हिमाद्रिर्वेदभावनः ।
तपनो भानुसूक्तज्ञो मध्यमं विद्धि दोहनम् ॥
धिगाज्यो नाशनं कष्टं छन्नभोगाशयाम्बिका ।
म्रिगाहारो नरेशोऽयं वीरो रणजयोत्सुकः ॥

...

छायालयो गजो नीलो निर्मलो नास्ति सत्कुले ।
रात्रौ दर्पणमभ्राङ्गं नागस्तुङ्गनखो बली ॥
धीरो युवा कथालोलः पूज्यो नारीजनैर्भगः ।
कन्यागारे नागवल्ली देवो विश्वस्थली भृगुः ॥
तत्परादिकलान्तास्तु महाज्या माधवोदिताः ।
स्वस्वपूर्वविशुद्धे तु शिष्टास्तत्खण्डमौर्विकाः ॥ २.९.५ ॥

Table: Mādhava's sine values

No.	Kaṭapayādi	kalā (')	vikalā('')	tatparā('''')
1	श्रेष्ठं नाम वरिष्ठानां	224	50	22
2	हिमाद्रिर्वेदभावनः	448	42	58
3	तपनो भानुसूक्तज्ञो	670	40	16
4	मध्यमं विद्धि दोहनम्	889	45	15
...
21	धीरो युवा कथालोलः	3371	41	29
22	पूज्यो नारीजनैर्भगः	3408	20	11
23	कन्यागारे नागवल्ली	3430	23	11
24	देवो विश्वस्थली भृगुः	3437	44	48

Accuracy of Madhava's sine values

Table: Accuracy of Mādhava's sine table.

No.	Mādhava's sine value	Difference
1	0.0654031452	0.0000000160
2	0.1305262297	0.0000000375
3	0.1950903240	0.0000000020
4	0.2588190035	-0.0000000416
...
...
21	0.9807852980	0.0000000176
22	0.9914448967	0.0000000353
23	0.9978589819	0.0000000587
24	1.0000000000	0.0000000000

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- ▶ So, this was the biggest scientific challenge in Europe
- ▶ and one for which European governments offered large rewards from 1530 to 1760 CE.

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- ▶ (Such theft followed by self-glorification a cultural characteristic of the West.)
- ▶ Eventually, calculus was credited to Newton and Leibniz, on the doctrine of Christian discovery.

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- ▶ Today done on a computer, which **cannot** use formal real numbers.
- ▶ Uses floating point numbers, for which even the associative law for addition fails.

Sum of infinite geometric series

- ▶ Sum of infinite geometric series Given by 15th c. Nīlakanṭha in his commentary on *Āryabhaṭīya* (Ganita 22)

एवं यस्तुल्यच्छेदपरभागपरम्पराया अनन्ताया अपि संयोगः
तस्यानन्तानामपि कल्प्यमानस्य योगस्याद्यावयविनः
परम्परांशच्छेदादेकोनच्छेदांशसाम्यं सर्वत्रापि समानमेव ।

which may be translated:⁷⁵

The sum of an infinite [*anantya*] series, whose later terms (after the first) are got by dividing the preceding one by the same divisor everywhere, is equal to the first term divided by one less than the common divisor.

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- ▶ which naturally led to unexpressed fractions (rational functions)
- ▶ which formally constitute a non-Archimedean field
- ▶ (which has infinitely large and infinitesimally small numbers)
- ▶ analogue of limits obtained by discarding infinitesimals.

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- ▶ such as the “Leibniz” series for π .
- ▶ Descartes declared it beyond the human mind to carry out an infinite sum (he thought of summing it physically).

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- ▶ As made clear by "McTaggart's" paradox
- ▶ which steals the arguments of 9th c. Śrīharṣa's *Khaṇḍanakhaṇḍakhādyā*.

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- ▶ “absolute, true and mathematical time, flows on without regard to anything external”
- ▶ Four adjectives to emphasize that time is metaphysical.

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- ▶ But this changes Newton's laws of motion.

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- ▶ Minimum change is my retarded gravitation theory (RGT) not General Relativity Theory (GRT).

Retarded Gravitation Theory

- ▶ We seek an expression for the 4-force F in the simple form

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$$F = aX + bV$$

- ▶ where a , b , are Lorentz invariants
- ▶ X = retarded 4-position
- ▶ V = retarded 4-velocity
- ▶ of “attracting” body (“attracted” body at origin).

- ▶ A simple calculation shows that the 4-force

$$F = -\frac{kc^3}{(X.V)^3}X + \frac{kc^3}{(X.V)^3} \frac{(X.U)}{(V.U)}V.$$

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- ▶ $k = Gm_1m_2$, m_1 , m_2 = rest masses,
- ▶ c = speed of light,

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- ▶ $k = Gm_1m_2$, $m_1, m_2 =$ rest masses,
- ▶ $c =$ speed of light,
- ▶ X, V as before,

- ▶ A simple calculation shows that the 4-force

$$F = -\frac{kc^3}{(X.V)^3}X + \frac{kc^3}{(X.V)^3} \frac{(X.U)}{(V.U)}V.$$

- ▶ $k = Gm_1m_2$, m_1 , m_2 = rest masses,
- ▶ c = speed of light,
- ▶ X , V as before,
- ▶ U = 4 velocity of “attracted” particle.

- ▶ In the non-relativistic approximation

$$F \approx \frac{Gm_1m_2}{r^2} \left(\frac{X}{r} + \frac{V}{c} \right),$$

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- ▶ Lorentz covariance needed to measure time. A Lorentz covariant force cannot be purely position dependent.

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- ▶ This effect observed. Called NASA flyby anomaly.

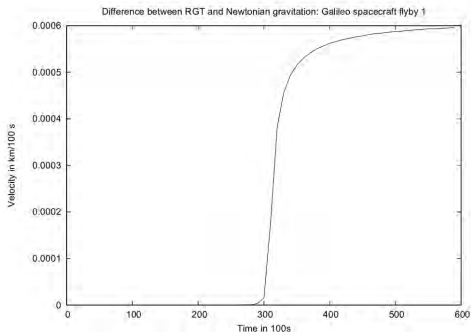


Figure: Galileo. The difference in the velocity between the solutions obtained using the new velocity-dependent RGT force and the Newtonian force, for the first flyby of the Galileo spacecraft. The x -axis is time (in units of 100 s) and the y -axis is difference of (scalar) velocity in units of km per 100 s.

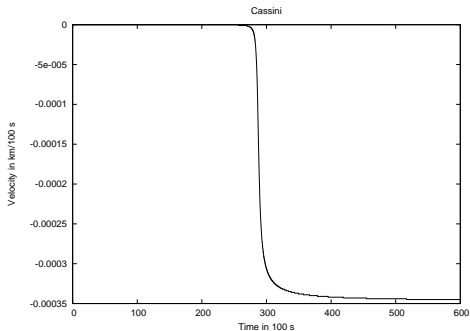


Figure: Cassini. The difference in the velocity between the solutions obtained using the new velocity-dependent RGT force and the Newtonian force for the earth flyby of the Cassini spacecraft. Same units as before. The calculated change in velocity is -3.4 mm/s compared to the reported change of -2 mm/s.

Further tests

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- ▶ one co-rotating with earth, and the other counter-rotating.

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- ▶ for the galaxy (ours and others)

Galactic rotation curves

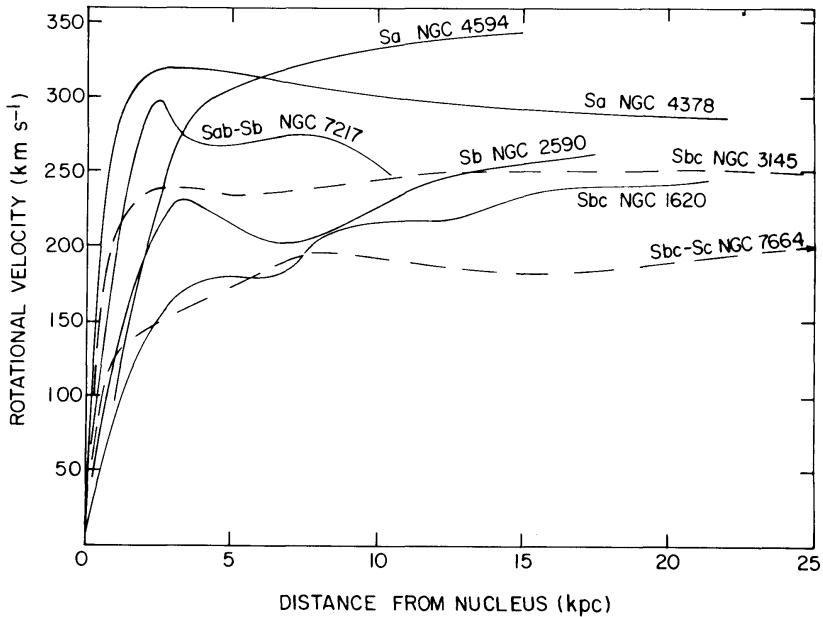
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- ▶ But in spiral galaxies v_r **increases** with r
- ▶ then becomes **approximately constant**.



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- ▶ Typical piling on of hypotheses.

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- ▶ The universe is vast, only a tiny part is open to our observation.
- ▶ At best we can build fallible models.


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²Aquinas, *Summa Theologica*, first part of the second part, 91, 1 


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