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Swaraj in Education

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Con-all-ism

Colonialism (or con-all-ism) involved con-tricks which fooled the colonised for centuries. They have not understood those con-tricks even till today. Even less have they understood the various systems used to *perpetuate* those con-tricks and accompanying superstitions. Colonial education was one such system. It was brought to us by godmen of the church: for Western education was hundred percent church education when it first came to India in a big way in 1857. Unlike ordinary con-tricksters, the church has vast resources, and a demonstrated expertise in propagating and preserving all sorts of fantastic superstitions for centuries. Church education was designed to produce insular missionaries, stuffed with those fantastic myths. Colonial education was a slight redesign to produce slaves of the empire not the church; it taught faith in the West, not the church. (West and church are closely interlinked: the very concept of the West, as defined for example by Toynbee,[1] or me,[2] or as used in US military strategy after the Cold War,[3] involves the church in an essential way.)

Church education taught faith by instilling ignorance. This carried over to colonial education: though colonial education supposedly came for the sake of science, the vast majority of the colonially miseducated are scientifically illiterate. This is by design, for the ignorant have no knowledge of their own to decide any issue; for everything they must perforce proceed on trust. Whom should they trust? Where church education taught faith in the church, and distrust of everything else, colonial education taught faith in Western authorities, and distrust in anything non-Western. This is apparent from the attitudes of the colonially educated. It is not just a "craze for phoren", they decide the validity even of a scientific theory by faith, by reputability, not refutability: if it is published in a "reputable" (Western) scientific journal, or comes from a "reputed" (Western) institution, it must be true.

This childhood indoctrination through colonial education ("trust only the West") leads to the widespread superstition that everything Western is superior and must be aped. This superstition is manifest in the comic behavour of the colonially educated, in feeling superior by wearing suits and ties in the Delhi summer, or speaking Hindi with a British accent. Even our system of governance apes the West. Though the system has so manifestly failed—all three organs of it, the legislature, the judiciary, and the executive—mere facts do not shake the faith of the colonised intelligentsia. They will never critique the rotten Western system, or seek to correct it, but will always blame Indians (or Africans, or south Americans) instead. This apologetics of shifting the blame is another stock clerical trick used to preserve all sorts of fantastic beliefs.

Those superstitions implanted by colonial education are preserved in various other ways. For example, today if people are ignorant of something, they google for information, and google takes them to Wikipedia, blindly trusted by millions. Wikipedia uses the same church technique, namely, it enforces

1 Arnold J. Toynbee, *A Study of History*, abridgement in 2 vols. By D.C. Somervell, Oxford University Press, 1957.
2 C. K. Raju, *The Eleven Pictures of Time*, Sage, 2003, glossary, p. 499.
3 Samuel P. Huntington, *The Clash of Civilizations and the Remaking of World Order*, Viking, New Delhi, 1997.

the use of secondary sources, and declares that only Western secondary sources are "reliable". This leads to the preservation of all sorts of nonsense, especially in history.

Another stock church method to preserve foolish beliefs is to disable criticism. The simple technique is to just denounce and attack the critic. The church denounced critics as heretics, atheists etc. and then killed or exiled them, and thereby evaded any substantive engagement with the critique. Likewise, any critic of the West is today denounced by the Western or colonised intelligentsia, Inquisition fashion, as a Hindu fanatic, and the substance of the critique evaded. For example, Witzel from Harvard, a confirmed ally of the church, denounced me in this manner, but had no answer when asked what evidence he had for my religious beliefs. The professional scientist or university academic whose career depends on marks of Western approval (impact parameter, citation index etc.) cannot be expected to break this taboo against a critique of the West, so similar to the taboo against a critique of the church.

From all this, it is manifest that decolonising education, or swaraj in education, is a difficult task. In my experience, persuading the colonised intellgentsia to set aside their superstitions, especially about mathematics and science, is much more difficult than persuading astrologers of their superstitions. This enterprise is rendered even more difficult by the fact that the colonised intelligentsia are in a position of social authority, and colonial education teaches blind distrust of critics of the West. Nevertheless, let us examine those Western and colonial superstitions.

The creation myth of science

An important myth used to claim Western superiority was the creation myth of science—that science was created in the West, first by early Greeks, then in post-renaissance Europe. That creation myth was used by Macaulay to declare the West as vastly superior, and to bring in colonial education. In nearly two centuries since Macaulay, the colonially educated intelligentsia did not once cross-check the evidence for that creation story of science, any more than the faithful will cross-check the Biblical creation myth. On the contrary if that myth is challenged, and evidence demanded for it, the colonised intelligentsia get as annoyed as the church faithful and start hurling abuses at the critic, as above.

In *Ending Academic Imperialism*,[4] I advocated that as a first step towards decolonisation of education we must expose the fraud involved in the Western creation story of science. It is one thing to do so through booklets.[5] But individual books cannot match the reach of the education system. Hence, this Western fraud should be exposed by designing and teaching an alternative course in the history and philosophy of science.

Such an alternative course, on the history and philosophy of science, different from any existing course, in any university, was indeed designed, after some debates[6] and an international workshop.[7] I taught it at the AlBukhary International University, Malaysia,[8] a few times, and the students responded very positively to the course.[9] Exposing the Western creation story of science, especially to poor students, a majority of them Muslim, was viewed as a great political threat in the West, and the university was

4 C. K. Raju, *Ending academic imperialism*, Multiversity and Citizens International, Penang, 2011. http://multiworldindia.org/wp-content/uploads/2010/05/ckr-Tehran-talk-on-academic-imperialism.pdf. Video at http://www.youtube.com/watch?v=zdvgH4gByfk.

5 C. K. Raju, *Is Science Western in Origin?* Multiversity, Daanish Books, 2009. Reprint, Other India Bookstore, 2014.

6 http://ckraju.net/usm/PSc-minutes.html.

7 http://ckraju.net/blog/?p=73.

8 http://ckraju.net/blog/?p=89. The formal curricula and lectures for the two courses are posted at http://ckraju.net/hps-aiu and http://ckraju.net/hps2-aiu/ .

9 See the video of the students of the HPS course interviewed by Claude Alvares. A short (2.5 min) version is at http://youtu.be/ozQRBNk2alg. The full video is at https://www.youtube.com/watch?v=eCoLlle9ANA.

abruptly shut down by applying pressure at the highest level of government.

Why have Indian universities never had courses on the history and philosophy of science? Clearly this is taboo for even a bad course risks an inquisitive mind who might expose the tricks used to bring in and maintain colonial education. When I first raised the demand for university courses in history and philosophy of science, 15 years ago, I predicted that as and when we get people for such courses they will be co-opted Western-approved third-raters with little or no knowledge of science. We can see the beginnings of this process today.

One question which weighed on the minds of students of the course was this: if we change the creation story of science, will that affect the practice of science? Isn't it true that science works? The simple answer to this question is: yes, changing the creation story will change the practice of science. The new science works better. Since science is based on math, let us begin with math.

The creation myth of math

Philosophy often rests on history: so a bad history leads to bad philosophy. The creation story of science and math is the primary basis of the philosophy with which math is taught today in schools and university. I have commented on this extensively,[10] but since the colonial intelligentsia are mathematically and scientifically illiterate, most of them may not understand those comments. Further, the mere thought of doing something contrary to the West paralyses them into inaction, which inaction maintains *status quo*. Therefore, the myths about math prevail despite being exposed.

Therefore, let me use a simple and concrete example to illustrate how philosophy is decided by myth. Recall the remarks of science minister Harsh Vardhan at the Indian Science Congress, last year (2015), concerning the "Pythagorean theorem". Many colonised minds hated it because it attacked their belief that the West is superior in every way. However, it is undeniable that the "Pythagorean theorem" is stated in the sulba sutra-s[11] which precede "Pythagoras". Nevertheless, the science spokesperson of CPM, Prabir Purkayastha,[12] defended one Western superstition by appealing to another: he repeated the Western claim that irrespective of chronological precedence, the theorem must be credited to Pythagoras, since he had a proof of the proposition. He went on to explain at great length the importance of proof above a mere formula.

In a rejoinder,[13] I pointed out that Pythagoras, who supposedly had a golden thigh, is obviously myth. I asked what is the evidence (meaning primary historical evidence) for the existence of Pythagoras? I asked what is the evidence that "Pythagoras" had a proof of the proposition today known as "Pythagorean theorem". If so, what is that proof?

Expectedly, neither Purkayastha nor anyone else has answers to these questions about the historicity of Pythagoras or any details about the supposed Pythagoras' purported proof. The sad fact is that Western myths that the colonially educated have swallowed on blind faith do not withstand the slightest critical

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10 C. K. Raju, *Cultural Foundations of Mathematics*, Pearson Longman, 2007. For more recent popular accounts, see .g. C. K. Raju, "Decolonising math and science education". *Ghadar Jari Hai* **8**(3), 2014, pp. 5-12. http://www.ghadar.in/gjh_html/?q=content/decolonising-math-and-science-education. Video at http://www.vikasinterventions.in/sites/default/files/conference-proceedings/sessions/SESSION_05_CHAIR_RUMESH_CHANDER/C%20K%20RAJU_PAPER.mp4. For a quick account, see "Decolonising maths education", *The Hindu*, 24 October 2014, http://www.thehindu.com/opinion/op-ed/decolonising-maths-education/article6528274.ece?homepage=true, or the full article at http://ckraju.net/press/2014/Response-to-Glover-Teach-religiously-neutral-math.html.

11 E.g., Baudhayana, 1.9, 1.12.

12 *Ganashakti* http://ganashakti.com/english/comments/details/156

13 C. K. Raju, "The Pythagorean controversy", *Frontier Weekly*, **47** (34) 1-7 Mar 2015. http://www.frontierweekly.com/articles/vol-47/47-34/47-34-The%20Pythagorean%20Controversy.html.

scrutiny. It is curious how even Marxists are trying to pass off as history these silly Western superstitions spread by church education. It is also ironical in the extreme, for Macaulay clearly identified church education as the cheapest counter-revolutionary measure[14] to exorcise the spectre which was then haunting Europe, and that education did, in fact, derail the revolutions in several countries.[15] It is no coincidence that colonial education came to India in a big way in 1857. Colonial education has created that strange oxymoron: counter-revolutionary Marxists.

Purkayastha should at least have learnt that Western creation story of science properly! There is, in fact, no dearth of proofs of the "Pythagorean theorem" in Indian tradition. Indeed, I have been pointing out those proofs for the last two decades.[16] So, it is factually wrong to claim that Pythagoras had a proof while there was no such proof in Indian tradition. (Instilling ignorance of indigenous knowledge, the better to demonize it, is yet another stock trick used by church education, and copied in colonial education. As another example, few colonially educated can tell their date of birth on the scientific Indian calendar, closely tied to Indian culture. Though they swear by scientific temper, the fact is that they use *only* the unscientific Gregorian calendar, not the scientific Indian one. Though they similarly swear by secularism, the fact is that the two secular Indian festivals are defined only on that Christian calendar used to define the Nicene creed.[17]) Anyway, now that the fact of Indian proofs of the "Pythagorean theorem" is on the table, what is the basis of Pythagoras' claim to that proposition?

An important but little-understood aspect of the Western creation myth of math, the aspect which Purkayastha missed, is the claim that Pythagoras had a *special* sort of proof (not just any proof). Thus, the Western creation story of math claims that "real" mathematics and geometry were created by the early Greeks who were the first to use pure *deductive* proofs.[18] The proofs of the "Pythagorean theorem" in Indian tradition are all classified as *empirical* proofs for while they do involve inference or deduction, they also involve empirical elements such as drawing a figure on a palm leaf, cutting it, and moving the figures about in space.[19] It is an essential aspect of the Western creation story that the myth of Pythagoras and the myth that he had a proof be supplemented by the further myth that Pythagoras had a purely *deductive* proof of the theorem.

Since we have no information about Pythagoras or what sort of proof he had, how do we know this to be true? Without any knowledge of the the proof how can we say it was a purely deductive proof? A hallmark of actively preserved myths is that if one asks for evidence for one myth, one is supplied only with further myths, never the evidence. Ask what was the proof of the "Pythagoras theorem" and you will be told the story of "Euclid" and his *Elements*. However, "Euclid", declared the father of "real" mathematics, is just another myth.[20] To demonstrate that "Euclid" is myth, I have offered a challenge prize of Rs two lakh for serious evidence about "Euclid". This is double the prize offered by Kovoor to astrologers! To reiterate, evidence means evidence from primary historical sources, and not evidence from tertiary sources such as Wikipedia or our NCERT school texts.

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14 C. K. Raju, "Education as counter-revolution" online comment in *Frontier Weekly*, edited and republished as an article "Education and Church: Decolonising the hard sciences" in *Frontier Weekly* **46**(7) 25-31 Aug 2013. Available online at http://ckraju.net/papers/Education-and-counter-revolution.pdf.

15 C. K. Raju, "Ideology and scientific temper", talk at 38th ISSA, Vishakhapatnam, in Proc.

16 E.g. C. K. Raju, "Mathematics and Culture", in *History, Culture and Truth: Essays Presented to D. P. Chattopadhyaya*, Daya Krishna and K. Satchidananda Murthy (eds), Kalki Prakash, New Delhi, 1999, 179–193. Reprinted in *Philosophy of Mathematics Education* **11**. http://ckraju.net/papers/Mathematics-and-culture.pdf.

17 "A tale of two calendars", in *Multicultural knowledge and the university*, ed. Claude Alvares, Multiversity, 2014, pp. 112-119. Video at https://www.youtube.com/watch?v=MvpuC7Dg4e0.

18 W. W. Rouse Ball, *A Short Account of the History of Mathematics*, Dover, New York, 1960, pp. 1–2.

19 C. K. Raju, "Computers, Mathematics Education, and the Alternative Epistemology of the Calculus in the YuktiBhâsâ", *Philosophy East and West*, **51**:3 (2001) pp. 325–362. http://ckraju.net/papers/Hawaii.pdf.

20 C. K. Raju, *Euclid and Jesus*, Multiversity, 2012. An earlier account is in "Towards Equity in Math Education 1. Good-Bye Euclid!", *Bharatiya Samajik Chintan* **7 (**4) (2009) pp. 255–264, http://ckraju.net/papers/MathEducation1Euclid.pdf.

Mention that there was no "Euclid", and there is no dearth of indoctrinated minds like Rohit Dhankar who will say,[21] "so what if Euclid did not exist (and so what if we wrongly taught that for centuries), we have the book". Since the ignorant colonised mind only learns to go by myths which it does not cross-check, it just jumps from one myth to another. Hence, it confounds the fact of the actual book with just some myths about it.

Thus, it is just a further myth that the *Elements* is a book about deductive proof. In actual fact, its very first proposition uses an empirical proof.[22] People like Dhankar, though they masquerade as school teachers of math, never read or understood even that elementary first proposition of the *Elements*, either as students or as school teachers.

An empirical proof, exactly like the Indian proofs of the "Pythagorean theorem", which involves moving a figure about in space, to *see* the equality of two figures, is again used in the 4th proposition (side-angle-side theorem) of the *Elements*, essential to the rest of the book, and used to prove the "Pythagorean theorem" in it. Thus, the proof of the "Pythagorean theorem" in the *Elements* is NOT a fundamentally different proof from the proof available in Indian tradition, it is just more prolix and confusing.

Indeed, there was no purely deductive proof of the "Pythagorean theorem" prior to the 20th c. To reiterate, it is a *complete falsehood, a fraud,* that the *Element*s has some special kind of (deductive) proof of the "Pythagorean theorem". Church dominated Westerners foolishly believed the myth over facts for 8 centuries, from 1125 CE when the *Elements* first came to Europe, until the turn of the 20th c. when Russell and Hilbert acknowledged the fact of empirical proofs in the *Elements*. The overpowering influence of the myth is clear from the fact that these two still tried to save the myth of the purported intentions of the supposed Euclid in their respective tracts on the foundations of geometry. Even more foolishly, colonised Indian minds ape that Western foolishness today. Our school texts now teach Hilbert's approach which changes the 4th proposition from a theorem to a postulate. But our older social scientists have not even updated their stories, and are still stuck with the 19th c. story about mathematics and science.

But why are deductive proofs important? Pythagoras is credited with the theorem on grounds of yet another myth. The further myth is that deductive proofs are *superior* to empirical proofs of the sort universally accepted in Indian tradition or used in scientific experiment. Our present-day teaching of mathematics is entirely premised on the belief in the superiority of deductive proofs.

But is it a valid premise? Commonsense tells us it is not. Most students study mathematics for its practical applications to science and engineering, and commerce. These latter disciplines are empirical in nature, and accept empirical proofs. So, there can be no loss in accepting empirical proofs in mathematics intended for practical applications. So, commonsense tells us that we should accept empirical proofs in mathematics.

However, remember that church education designed to produce good missionaries taught them to distrust commonsense, and trust only church authority. Likewise, the colonially educated learn to distrust commonsense, especially when contrary to Western myth and authority. They are as little able to apply commonsense, as a missionary of the church is able to apply commonsense to the myth of virgin birth.

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21 Personal communication.

22 C. K. Raju, *Cultural Foundations of Mathematics*, Pearson Longman, 2007, chp. 1, "Euclid and Hilbert".

Passing off something as superior when it is contrary to commonsense is obviously a con-trick. The West is notorious for its claims of superiority: before colonialism, racists believed the color of the skin established superiority, and before that they said Christians are superior, and so on. Should we believe any of that, contrary to commonsense, just because many authoritative Western philosophers, like Kant, foolishly supported racism? Likewise, there is no reason to believe in the superiority of deductive proof, just because many authoritative Western philosophers said so.

Note how this reliance on Western philosophy simultaneously involves a total disregard for Indian philosophy. In India while both empirical and deductive proofs were widely accepted, deductive proofs were declared as inferior by the Lokayata: they correctly argued that something proved deductively from false assumptions is false. Thus, a Lokayata man went about at night with a pair of wolf's paws, with which he made marks on the ground. He pointed out: looking at these marks wise men will wrongly deduce that a wolf was around.

The Lokayata further argued that, particularly in the metaphysical domain, it is easy to make false assumptions, so deductive proofs do NOT lead to true knowledge. Recall that the formal mathematics taught in our schools and universities today is hundred percent metaphysics: even the simplest thing like 2+2=4 is not permitted to be established empirically. It is declared erroneous, on formal mathematics underlying school teaching, to try to establish 2+2=4 by pointing to two apples and two apples to make four apples, for that is an "inferior" empirical proof, hence unacceptable on the premise that deductive proofs are "superior". To establish 2+2=4 within formal mathematics one must use Peano's axioms or set theory. That brings in the metaphysics of infinity. Those who are ignorant of those axioms (most people), and the related metaphysics of infinity (most of the rest), cannot judge whether a formal mathematical theorem is valid knowledge. Nevertheless, after colonialism, even our best philosophers came to believe that 2+2=4 is certain truth. (The metaphysics of infinity in Peano's axioms is most easily demonstrated using the fact that computers can never do Peano arithmetic.[23])

Because the axioms of a formal mathematical theory are arbitrary, nothing particular is achieved by proving something as a formal mathematical theorem. What was the point of Hilbert's claim to prove the Pythagorean theorem deductively by postulating something equivalent (SAS)? Indeed, by choosing appropriate axioms, ANY proposition whatsoever, no matter how silly, can be proved as a formal mathematical theorem, for instance the proposition that "God (the one with a capital G) has two horns". That is, even if there was a Pythagoras, who had a purely deductive proof of the theorem, that would be of little value, because empirical proofs, such as those used in science, lead to knowledge which is surer than that obtained from mere deductive proofs.

Further, contrary to Western superstitions, deductive proofs are *more* fallible than empirical proofs for another reason: one cannot easily decide the *validity* of a deductive proof. For example, the first proposition in the *Elements* uses an empirical proof, but this was declared to be a valid deductive proof by all Western scholars for 8 centuries. Granted that empirical proofs are fallible, but they are rarely as *persistently* fallible as deductive proofs. Today, formal mathematicians are too intellectually challenged to decide whether the computer-generated proof of the 4-color theorem is a valid deductive proof. The situation will only get worse in the future with ever more complex machine generated deductive proofs the validity of which no human mind can decide.

There are many other fundamental issues: there is no certainty even about the nature of the logic used

23 For an example C program see the paper "Computers, mathematics education..." cited above. Though the program refers to technology which is a bit dated, the same thing applies today for 2 billion + 2 billion with a Java program.

for deductive proofs, whether Buddhist *catuskoti*, or Jain *syadavada* or quantum logic or any other among the infinity of possible logics. Even a valid deductive proof is at best a truth relative to a vast infinity of possible permutations and combinations of axioms and logic. Not at all comparable to the relative certainty which comes from even a fallible empirical proof.

Thus, it is a complete falsehood, entirely contrary to commonsense, that deductive proofs are superior to empirical proofs. However, this falsehood is widespread, and it is taught to school children today as a compulsory part of their childhood indoctrination. What it does is to teach a cultural bias, for it puts down all Indian systems of philosophy as inferior on the grounds that they accept empirical proofs, as does Islam and science. Metaphysical formal mathematics is declared "superior" to science.

When a falsehood, especially such an obvious one, is so widespread, one can be sure there is a deep vested interest behind it. The vested interest in this case is that of the church and its Crusading theology. Most people are unaware that, during the Crusades, Aquinas and his schoolmen changed Christianity from a (purported) doctrine of love to a (purported) doctrine of reason. On this theology, reason was declared superior to facts, on the grounds that reason bound God who was free to create the facts of his choice. This creation story is the basis of the ridiculous belief that deductive proofs are superior to empirical proofs.

I have explained elsewhere[24] the vested interests behind the change in church theology during the Crusades. This Christian theology of reason was adapted from the earlier Islamic theology of reason (*aql-i-kalam*, which connected to Neoplatonism or Egyptian mysteries). Without going into those details, the point here is that the Crusading church glorified reason, and declared it to be universal and infallible. The church adopted reason since Muslims accepted only reason, and the church, then, hoped to fill its coffers by using reason to convert rich Muslims who could not be converted by force. Since there is nothing about reason in earlier Christian tradition, the church claimed ownership of reason through myths like those of Aristotle[25] and Euclid. Those who call themselves rationalists need to explain how their own stand on reason differs from that of the church. Did they ever point out that Euclid is myth? Do they accept it now?

If one rejects all the bunkum church myths and mumbo jumbo about reason, and deductive proofs, what remains? Obviously, one may continue to use two-valued logic for inference in *many* everyday situations, for that logic existed long before the church screwed up matters. In India, many people such as the Naiyayikas used two-valued logic for inference. However, the use of that logic (or any other logic) can be validly justified only on empirical grounds. (That means that two-valued logic will probably not hold at the microphysical level, where one can expect instead a temporal logic corresponding to a structure of time.[26] It also means that the notion of logic, intertwined with the notion of time, gets entangled with the notion of identity, as in natural language.[27])

To summarise, one must reject the premise underlying present-day math teaching that deductive proofs are superior to empirical proofs. They are actually inferior because something proved deductively is only as sure as the axioms, and metaphysical axioms cannot be trusted. Indeed, unlike empirical proofs,

24 C. K. Raju, "The Religious Roots of Mathematics", *Theory, Culture & Society* **23**(1–2) Jan-March 2006, Spl. Issue ed. Mike Featherstone, Couze Venn, Ryan Bishop, and John Phillips, pp. 95–97. Also, "Benedict's Maledicts", Zmag, https://zcomm.org/znetarticle/benedicts-maledicts-by-c-k-raju/ Check also http://ckraju.net/papers/Benedicts-Maledicts-by-c-k-rjau.pdf. Reprinted in *Indian Journal of Secularism*, **10**(3) (2006) pp. 79-90.

25 For an explanation of why the Aristotelean syllogism is myth, see the article on "Logic" in the Springer Encyclopedia of Non-Western Science, Technology, and Medicine, posted at http://ckraju.net/papers/Nonwestern-logic.pdf.

26 C. K. Raju, *Time: Towards a Consistent Theory*, Kluwer Academic, Dordrecht, 1994, chp. 6B "Quantum mechanical time".

27 C. K. Raju, *The Eleven Pictures of Time*, Sage, 2003.

any nonsense can be deductively proved by just assuming something equivalent. One often cannot decide the validity of deductive proofs, so that deductive proofs are more fallible than empirical proofs.

Therefore, mathematics (and its teaching) must be fundamentally changed. This is an example of how correcting history changes philosophy and entails reforms in the math today globalised by colonialism.

Ganita as decolonised mathematics

How should mathematics (and its teaching) be changed? The first step is to recognize that, contrary to another common myth, mathematics is *not* universal. For example, Indian *ganita* used empirical proofs, prohibited by formal math. Mathematics is, at best, *normatively* universal; relying on the same false myth that deductive proofs are "superior", *ganita* and other non-Western ways of understanding mathematics were declared inferior, and "not mathematics", as "land surveying" not geometry. Once we understand that this basic premise is faulty, then we need to decide *which* mathematics is actually better. This decision must be based on something more solid than the vanity and pomposity of racist Western historians and philosophers.

The choice is not very difficult. The Western metaphysics of formal math adds nothing of practical value to math. We can reject all of it. Historically speaking most math taught in schools today (arithmetic, algebra, trigonometry, calculus, probability) developed in India for its practical value, and was transmitted to the West also for its practical value. There it acquired a coating of metaphysics. Rejecting that metaphysics, therefore, retains all the practical value of math.

Again, for example, from what was argued above, what we need to do is real geometry, not imitate some church metaphysics which the West mixed up with Egyptian spiritual geometry in reinterpreting the *Elements* attributed to Euclid. The *ganita* of the *sulba sutra* has a great conceptual advantage over "Euclidean" geometry, for the sulba (rope, string) can be used to measure curved lines, as even Egyptian "rope stretchers" did. Measuring a curved line is impossible with the ritualistic compass box today used to teach geometry in schools.[28] That leaves children permanently confused about elementary geometric notions such as angle.[29] The *sulba* also leads to a conceptually correct definition of angle, as the length of a curved line, unlike the "something between two straight lines" definition used by NCERT texts.

Once we recognize the generality of the proposition that a bad history results in bad philosophy, then corrected history impacts various other aspects of mathematics. Thus, for example, on the creation myth of calculus, the calculus was invented by Newton (and Leibniz) who successfully applied it to science. Therefore,[30] we teach calculus today as it was (wrongly) understood in the West.

This argument is often disguised as a philosophical argument and presented by saying "limits are needed to make calculus rigorous". This claim of "rigor" is exactly the earlier claim of superiority. The "limits" in question are metaphysical limits, for the metaphysical existence of which metaphysical formal real numbers are needed. Formal real numbers need formal set theory, which brings in the metaphysics of infinity in a big way. The claim of "rigor" hides the claim that all this nonsense

28 C. K. Raju, "Towards Equity in Math Education 2. The Indian Rope Trick" *Bharatiya Samajik Chintan* **7** (4) (2009) pp. 265–269. http://ckraju.net/papers/MathEducation2RopeTrick.pdf.

29 This confusion extends even to scholars. See, for example, the article on the "Pythagorean controversy" cited earlier.

30 See the minutes of conversation with a formal mathematician: http://ckraju.net/issa/conversation-draft-minutes.html.

metaphysics is “superior” (because it is linked to nonsense church dogmas of reason, and its theology of eternity).

A change in the history of calculus, therefore implies also a change in the teaching and practice of calculus. Now, apart from the myths of Euclid and Pythagoras, I long ago busted that Western creation myth of calculus.[31] I first initiated a project with INSA and PHISPC in 1998 to establish that calculus developed in India and to find out exactly how it was transmitted to Europe. Contrary to some earlier attempts to locate the origin of the calculus in Bhaskara II or in the infinite series found in Kerala, I established that calculus developed in India with the 5th c. Aryabhata's numerical calculation of sine values by solving difference equations using what is today called “Euler's” method. Refinements of Aryabhata's method of recursive computation later developed into the infinite series of his followers in Kerala. Some key new points have emerged, such as the use of non-Archimedean arithmetic to obtain limits by order counting.

Recall that Europeans were arithmetically challenged when Indian arithmetic first went to Europe in the 10th c.; hence the foolish mistake made by the infallible pope Sylvester II in constructing an abacus for “Arabic numerals”. In the 16th c. backward Europeans had barely understood the basics of the decimal system. Hence, the more sophisticated aspects of the Indian calculus were beyond them, and were misunderstood for centuries by Westerners starting with Descartes and Newton.[32] Descartes foolishly declared that the ratios of curved and straight lines were beyond the human mind. (He meant that the infinite series for π could not be summed.) Newton wrongly thought the problem could be solved by his confused fluxions.

So, we have to decide whether we should teach calculus as *ganita,* the way it developed in India, for its practical value, or its inferior understanding as formal mathematics, the way it was misunderstood in the West, together with oodles of metaphysics.

To reiterate, the metaphysics of formal math has NIL practical value (apart from glorifying the West). This is equally true of the calculus. Thus, today, to send a rocket to Mars we still use (slight improvements to) Aryabhata's method of numerically solving differential equations. Indeed, this is true for all practical applications which involve the use of computers. As pointed out earlier, computers cannot even manage Peano arithmetic: they obviously cannot manage formal real numbers. Even a single formal real number cannot be represented on a computer. Accordingly, if we teach calculus for its practical value, we should teach it as *ganita*, not as formal mathematics.

Unfortunately, the Western tendency to constantly falsify history dogs the matter even here. Just as calculus was plagiarised and misunderstood by Westerners, the calculus transmission thesis was plagiarised and misunderstood by the likes of George Joseph and Dennis Almeida who serially plagiarised my thesis right from the year 2000. Because these people are neither mathematicians nor historians familiar with primary sources, they are both mathematically and historically challenged, and have misunderstood my thesis, and produced an inferior copy. They slyly think calculus transmission is matter of glorifying the so-called Kerala school (actually the Aryabhata school in Kerala). Further, our

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31 C. K. Raju, *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.

32 See, for example, my MIT talk: Calculus: the real story. abstract, video, presentation, blog. Or see, C. K Raju, “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. Draft at http://ckraju.net/papers/Eternity-and-infinity.pdf.

ignorant journalists with their deep respect for the West, and distrust of Indians naturally tend to go along with anything coming from the West.

This is also in accord with the doctrine of Christian discovery, that only Christians can make discoveries. This vicious doctrine is at the heart of some of the more blatant manipulations of history to glorify Christians, as in Vasco da Gama's purported discovery of India, or Columbus' "discovery" of America, or Cook's "discovery" of Australia. The guiding principle for these historical manipulations is that non-Christians are sub-human and don't matter. This doctrine of Christian discovery has been confirmed by the US legal system, stating that the earlier inhabitants of the Americas lost their right to the land, upon being "discovered" by Christians. Where the pope encouraged such theft, as the epitome of morality, and the US legal system approved it, Western universities have extended it to intellectual theft: the permission to serially plagiarise my work has been granted by the Exeter and Manchester ethics committees, and Princeton University Press, through various devious tricks. It shows incidentally what kind of open fraud the Western history of science continues to be.

However, it is impossible to explain the proposed changes in teaching of math to the colonially miseducated. Because of colonial education most people are ignorant of the calculus, and most of the rest are ignorant of its philosophy. The handful who are left are usually coopted. There is no way to open the eyes of those educated into Western superstitions, since, apart from being ignorant, they foolishly trust only those who have fooled and exploited them: they have been taught from childhood to revere Newton, and look down on Indians. It seems they will die with their foolish superstitions, about mathematics and science, and future generations will howl with laughter.

I should add that going back to *ganita* is not just a theoretical recommendation. Actual pedagogical experiments have been performed and reported.[33] The decolonised course on calculus as practical *ganita* ("calculus without limits"), built around the way calculus developed in India, has now been successfully tried on 8 groups in 5 universities in 3 countries. Some sophistication is needed to deal with the systematic but context dependent discarding or zeroing of small quantities. This is articulated by my philosophy of zeroism[34] similar to the realistic philosophy of *sunyavada*. That denies as erroneous various idealistic notions, such as the notion of a point.

Finally, it should be clearly pointed out that all this is being done solely for practical reasons, and not on the grounds that calculus, for instance, developed in India. Practical reasons are far more universal than the church metaphysics underlying formal mathematics.

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33 "Teaching mathematics with a different philosophy. Part 1: Formal mathematics as biased metaphysics." *Science and Culture* **77** (7-8) (2011) pp. 274–279. http://www.scienceandculture-isna.org/July-aug-2011/03%20C%20K%20Raju.pdf, arxiv:1312.2099. Part 2: Calculus without limits", *Science and Culture* **77** (7-8) (2011) pp. 280–85. http://www.scienceandculture-isna.org/July-aug-2011/04%20C%20K%20Raju2.pdf. arxiv:1312.2100. Also, "Calculus without limits: report of an experiment", Proc. 2nd People's Education Congress, http://ckraju.net/papers/calculus-without-limits-paper-2pce.pdf.

34 For a quick account, see "Probability in Ancient India", chp. 37 in *Handbook of the Philosophy of Science*, vol 7. *Philosophy of Statistics*, ed, Dov M. Gabbay, Paul Thagard and John Woods. Elsevier, 2011, pp. 1175-1196. http://www.ckraju.net/papers/Probability-in-Ancient-India.pdf. Also, "Zeroism", article to appear in the Springer Encyclopedia of Non-Western science, technology and medicine, 2016. Or, "Zeroism and calculus without limits", 4th Nalanda Dialogue, http://ckraju.net/papers/Zeroism-and-calculus-without-limits.pdf.

Decolonised physics

The Western conceptual misunderstanding of calculus also affects the applications of calculus to physics.

Thus, Newton believed in the Western superstition that mathematics contains eternal truths, hence must be perfect. (Recall that the belief in the eternal truths of mathematics comes from Egyptian spiritual mathematics as elucidated by Plato or Neoplatonists like Proclus. That mathematics was about arousing the soul, about using reason to direct the mind inwards on the same principles as that of yogic meditation. It was believed that mathematics is especially suited for this, since it contains eternal truths which arouse the eternal soul. The *Elements* was actually a religious book about this spiritual mathematics. However, that book was reinterpreted in support of church theology of reason, where reason became just a means to persuade others. The church cursed the Egyptian or "pagan" notion of soul, similar to the Indian notion of *atman*, because of its underlying belief in equity.[35] Thus, mathematics became disconnected from the soul.) Though the church transformed mathematics, the belief in the eternal truths of mathematics just persisted in the bastardised mathematics of the church, and gave rise to the Western superstition that mathematics must be perfect. As Bishop Berkeley put it, in his arguments against Newton: "It is said, that the minutest Errors are not to be neglected in Mathematics". (Why not? If mathematics is done for its practical value, minute errors obviously do not matter.)

It was in this search for an imagined perfection that Newton made time metaphysical and his physics hence failed.[36] Since Newtonian physics and Newtonian gravitation come as a package deal, it is necessary to modify Newtonian gravitation. If this is done with the above understanding it minimally results in a new theory of gravity, called retarded gravitation theory, which uses functional differential equations.[37] There are many other corrections, such as a correction to Maxwell's equations to solve the problems of infinities with radiation damping.[38] There is also the issue of differentiating discontinuities, as in shocks in real fluids like air or water, or shocks in general relativity.[39]

Basically, these issues arise since the calculus was not properly understood by physicists. Functional differential equations arise just as coupled ordinary and partial differential equations,[40] but were not understood or used because of difficulties with the calculus,[41] which make it very hard to tackle this coupling in the older way of doing calculus.

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35 C. K. Raju, "The curse on 'cyclic' time", *The Eleven Pictures of Time*, Sage, 2003, chp. 2.

36 For the argument that Newtonian physics failed because of a conceptual error about time, see C. K. Raju, *Time: Towards a Consistent Theory*, Kluwer Academic, 1994.

37 C. K. Raju, "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.

38 C. K. Raju, "Functional differential equations. 3: Radiative damping" *Physics Education* (India), **30**(3), July-Sep 2014, Article 8. http://www.physedu.in/uploads/publication/15/263/7.-Functional-differential-equations.pdf.

39 C. K. Raju, "Distributional matter tensors in relativity", *Proceedings of the Fifth Marcel Grossman meeting on General Relativity*, D. Blair and M. J. Buckingham (ed), R. Ruffini (series ed.), World Scientific, Singapore, 1989, pp. 421–23. arxiv: 0804.1998.

40 C. K. Raju, "Functional differential equations 2: The classical hydrogen atom", *Physics Education* (India), 29(3), July-Sep 2013, Article 2. http://physedu.in/uploads/publication/11/201/29.3.2FDEs-in-physics-part-2.pdf.

41 C. K. Raju, Functional differential equations.1: a new paradigm in physics", *Physics Education* (India), 29(3), July-Sep 2013, Article 1. http://physedu.in/uploads/publication/11/200/29.3.1FDEs-in-physics-part-1.pdf.

As such, together with the new way of teaching calculus, we need to teach physics in a new way using functional differential equations. This has many other advantages, since it escapes from other traps of church theology.[42]

Statistics for social scientists

Another decolonised course which was framed but not actually tried out concerns statistics. Not only calculus, but also probability developed in India.[43] Not only calculus but also probability was misunderstood in the West. The clear sign of that is that there is not even a good definition of probability today.

Probability is metaphysically regarded as the limit of relative frequency as the number of trials becomes infinite. As this definition suggests, we can never find out what the probability of an event is for we would have to wait for an infinite amount of time. For practical purposes this does not matter: it suffices to know relative frequency, since that provides a good practical estimate of the probability.

However, there is a further problem. The attempt to apply limits is obviously an attempt to imitate the metaphysical techniques of the calculus. However, limits, even in the inferior way of the Western calculus, do not apply to probability. The best one can say about the "law of large numbers", based on the measure-theoretic understanding of probability, is that probability is the probabilistic limit (limit in measure) of relative frequency. This is obviously circular.

Thus, defining probability as measure confounds issues. Further, bringing in the Lebesgue measure and integral involves a whole lot of metaphysical complexities which are thoroughly useless from a practical perspective. This is particularly irritating for social scientists who would like to make use of the quantification of risk without all those complexities. It creates the grounds for the large scale manipulation of statistics by the pharmaceuticals and hospitals industry.

The course on statistics for social science was designed with this in mind. It should help people to understand how they are being fooled. It is also planned to use open source computer software, PPSS, instead of SPSS. However, this course has yet to be tried out in actual pedagogical experiments.

Conclusions

The colonial education system, deriving from church education, implanted ignorance and superstitions. It indoctrinates young minds. Hence it is essential to change it. Some key superstitions of the colonised mind concern mathematics and science. Hence, it is important to change that teaching.

Decolonisation involves getting rid of various Western superstitions. This process is as difficult as unindoctrinating missionaries, because the colonised mind is ignorant of the mathematics and science it believes in, and has been taught to trust only the West and to distrust everyone else. Hence, it proceeds on blind faith in the West, and distrusts critics. The best way would be to abandon the colonised mind, and focus on the next generation. However, even this is rendered difficult by the fact

42 "Functional Differential Equations. 5: Time travel and life, Physics Education (India) 31(4) Oct-Dec, 2015. http://www.physedu.in/uploads/publication/21/344/1.-Functional-differential-equations-5-Time-travel-and-life.pdf.

43 "Probability in Ancient India", chp. 37 in *Handbook of the Philosophy of Science*, vol 7. *Philosophy of Statistics*, ed, Dov M. Gabbay, Paul Thagard and John Woods. Elsevier, 2011, pp. 1175-1196. http://www.ckraju.net/papers/Probability-in-Ancient-India.pdf.

that colonised minds are today in positions of social authority.

To begin with one must expose the falsehoods in the creation myths of math and science. To this end, an alternative course in the history and philosophy of science has been formulated and successfully taught. The difficulty is to bring it into the curriculum in widespread use.

The present-day bad philosophy of (formal) math is closely linked to its false Western history. In actual fact, formalist metaphysics has nil practical value; it was only an add-on to imported math of practical value. Abandoning that metaphysics preserves the practical value of math. Doing so has the advantage that it makes math very easy, and thus enables students to solve harder problems. In practical terms, this means that we should teach geometry using the *sulba* and not the compass box. We should teach calculus the way it developed with Aryabhata as the numerical solution of differential equations. This alternative course too has been formulated and taught successfully. This also involves a new mathematical philosophy called zeroism.

The confused Western metaphysics of math led to bad science, and was responsible for the failure of Newtonian physics. Correcting that conceptual misunderstanding also leads to a better "decolonised" physics which should be taught. Difficulties with the calculus led to the neglect of the coupling between the ordinary and partial differential equations of physics which leads to functional differential equations and a paradigm shift in physics.

Probability, too, originated in India. Its present-day understanding as measure is faulty and enormously complicated. This allows statistics to be easily manipulated especially in its applications to medicine and social science. To offset that, a new course on statistics for social science, using zeroism and open-source software has been formulated but not yet tried out.