

THE “PYTHAGOREAN” “THEOREM” AND THE RANT OF RACIST AND CIVILIZATIONAL SUPERIORITY – PART 2

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Abstract

Previously we saw that racist prejudice is supported by false history. The false *history* of the Greek origins of mathematics is reinforced by a bad *philosophy* of mathematics. There is no evidence for the existence of Euclid. The “Euclid” book does not contain a single axiomatic proof, as was exposed over a century ago. Such was never the intention of the actual author. The book was brazenly reinterpreted, since axiomatic proof was a church political requirement, and used in church rational theology adopted during the Crusades, as a counter to Islamic rational theology. Deductive proofs are MORE fallible than inductive or empirical proofs. Even a validly proved mathematical theorem, such as the “Pythagorean” theorem (based on Hilbert’s axioms), is invalid knowledge in the real world. There is no concept of approximate truth in formal mathematics. Nevertheless, the myth of “superior” axiomatic proofs in the “Euclid” book continues to be reiterated by Western historians, and colonial education teaches axiomatic mathematics. Actually, superior practical value comes from the two “Pythagorean” calculations well known to Indian/Egyptian tradition, but unknown to Greeks. The advantage of related decolonized courses in mathematics has been pedagogically demonstrated. But understanding and political will are needed to change colonial/church education.

Keywords: Pythagorean Theorem, racism, civilizational superiority, philosophy, Euclid

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Introduction

To summarise the previous part, we saw that the foundation of racist prejudice is not colour, but a sense of *superiority* based on a false history of science, that all science is the work of early Greeks and then Europeans after the so-called renaissance. This extension of traditional false Christian chauvinist (Orosian) history, to a false history of *science*, was done most brazenly during the Crusades, by indiscriminately attributing the origin of all scientific knowledge in captured Arabic texts to early Greeks, without any evidence (just because the early Greeks were regarded as the sole “friends of Christians”). This enabled that scientific knowledge to be appropriated as a Christian inheritance. Later, the influx of Byzantine Greek texts in the 15th c., and translated Indian texts in the 16th c., was used along with the “Doctrine of Christian Discovery” to appropriate further knowledge to Christian “discoverers”: Copernicus (from Ibn Shatir), and Newton (calculus, from India) being two key cases of such fake discoveries.

Still, later, when the church’s “moral” justification for the slavery of non-Christians collapsed, due to large-scale conversions by blacks, and threatened the lucrative transatlantic slave trade, the continuation of slavery was justified using the Biblical curse of Kam to declare blacks as “inferior” Christians. However, given the huge suspicions, then prevailing, about the church-authorized version of the Bible, a single quote from the Bible was not adequate.

In this situation, the false history of science provided an alternative *secular* justification for the continuation of slavery. This false history was implicitly used, e.g. by the racist philosopher Kant, to deny creativity to Blacks. That is, the belief in Christian superiority *mutated* into the secular belief in White superiority: early Greeks and “post-renaissance” (=post-Crusade) Europeans were still seen as the source of all scientific creativity, as in earlier Christian chauvinist history, but they were now classified as White (instead of “friends of Christians”, and Christians, respectively). This racist history was subsequently promoted by racist historians with further concoctions, that were meant to appropriate Egyptian knowledge to Greeks.

After colonialism and the Aryan race conjecture, racist history faced another obstacle: the colonised were now perceived as being of the same race as the coloniser. Therefore, any sense of *superiority* over the colonized had to be based on something other than the belief in

Whiteness. Accordingly, the sense of White superiority mutated again, into a related claim of civilizational or Western superiority. The core historical falsehoods remained exactly the same, but now Greeks and Europeans were regarded not as part of a *religious* category (“Christians and friends”) or as part of a *racist* category (Whites) but as part of a *civilizational* category: the West. Subsequently, Arnold Toynbee (1957), relinked the claim of Western ‘civilizational superiority’ back to its religious roots, by portraying Western civilization as rooted in Western Christianity, and Samuel Huntington (1997), etc., related Toynbee’s history to current military and political strategy (as used e.g. by Trump).

The lesson for racism is clear: racist prejudices still flourish because attacking colour prejudice alone is *not* enough. To eliminate present-day racist prejudices it is necessary to simultaneously attack *all* these interlinked claims of (religious/White/Western) *superiority*, which reinforce each other. For this, we must attack the common underlying false history of science which is openly spread by colonial education

This follow-up to part 1 (RAJU 2021), will argue that we actually need to go a step further and that the matter is not about a false history alone, we must also tackle a related bad philosophy of mathematics brought by colonial education.

Colonial education, which came as church education to the colonies, still teaches and spreads the related prejudice (e.g. about “Greek” scientific achievements). It does so not only through history, but also unexpectedly through mathematics: a compulsory subject in school. It teaches a special *kind* of “superior” mathematics: formal mathematics. That involves a key trick, which has gone unnoticed: that this false *history* of mathematics and science is cemented with a bad (church) *philosophy* of mathematics.

While people easily understand the idea of false history, most find it hard to understand that false history can be used to impose a bad philosophy of mathematics as done by colonial education. For example, my censored article (RAJU 2016a; 2016b; 2018a) was entitled, “To Decolonize Math Stand up to the False History and bad Philosophy of Mathematics”. While people understood the false history part, they largely ignored the part about a related bad philosophy of mathematics.

In fact, most people believe that there cannot be two different ways of doing mathematics: isn't $1+1 = 2$ they ask. The answer is "NO!", as I have been trying to explain for the last 20 years (RAJU 2001). In formal mathematics, numbers such as 1 and 2 do not have any innate or empirical meaning, because formal mathematics is divorced from the empirical (RAJU 2001)². Accordingly, I gave an example in that paper of how one could have $2+2 = 5$, in formal mathematics.

It was much later that I realized that most people conflate formal mathematics with the kindergarten mathematics they learned. Thus, they are ignorant of this divorce of formal mathematics from the empirical, though this is stated even at the level of the class IX Indian school text.³ The ignorant are forced to trust someone, and colonial education indoctrinates them into the belief in White/Western superiority. Consequently, the colonised trusted their Western oppressors. Like Wikipedia, the colonised *trust* Western sources, and *distrust* any non-Western critique, such as mine. This combination of ignorance and misplaced trust in the oppressor is a simple recipe for perpetual mental slavery, for the enslaved cannot free themselves (due to ignorance) and will not trust anyone who tries to!

While protesting against the censorship of my article (RAJU 2017a), I made fun of Bertrand Russell's 378 page proof of $1+1=2$, pointing out in a cartoon that this immense complexity of formal math added nothing to the practical value of arithmetic in a grocer's shop. Subsequently, I tried to show that the purported epistemological security of formal mathematics was also merely a matter of faith in Western authority. Thus, after the debate at the University of Cape Town,⁴ I asked the participating senior formal mathematician to prove $1+1=2$, in "real" numbers. He could not; he blundered by trying Peano's axioms, which obviously do NOT apply to "real" numbers.

2 See the first line of the abstract of (RAJU 2001), at the link <http://ckraju.net/papers/Hawaii.pdf>: "Formal mathematics being divorced from the empirical..."

3 "However, each statement in the proof has to be established **using only logic**. ... Beware of being deceived by what you see (remember Fig A1.3)!" [Appendix 1, p. 301, emphasis original], NCERT, class IX text, "Proofs in mathematics": <https://ncert.nic.in/textbook.php?iemh1=a1-15>.

4 "Decolonising science" panel discussion, part 1: <https://www.youtube.com/watch?v=ckbzKfRIi6Q>.

More recently, I posed this “Cape Town challenge” to the faculty in Jawaharlal Nehru University,⁵ offering a prize of a million rupees if the answer were submitted in a day, and a reduced prize of a hundred thousand rupees for the answer submitted in a week. No one claimed either prize.

That is, from this position of complete and widespread ignorance of even why $1+1 = 2$ in formal mathematics, and how it differs from the ancient and universal tradition of precolonial (or normal mathematics), the colonised continue to teach formal math. This superstition about the unavoidability of colonial/formal mathematics is anchored on the firm belief in the superiority of the West and the Greeks, and the consequent need to trust and imitate the West (and the Greeks).

As already explained in part 1 of this article, such widespread superstitions are a sure sign of church involvement, for the church rules by means of superstitions, hence the church eagerly spreads them. We explain below how these church superstitions are thrust into mathematics by means of a false history of mathematics. Specifically, talk of the “superior mathematics” done by early Greeks is used to indoctrinate people into a peculiar (and inferior) method of reasoning without facts, politically convenient to the Crusading church,

How False History Connects to Bad Philosophy

The assertion that only the Whites/West did something “superior” in mathematics and science is planted in the minds of children at an early age through the colonial education system, and is then used to misguide people throughout their lives. Since the West is “superior”, everyone else ought to imitate it today. This claim of the “superiority” of Western ethno-mathematics is at the core of mathematics teaching today, and is the reason why mathematics becomes such an obstacle to learning, because of the confused philosophical beliefs underlying Western ethno-mathematics, beliefs which are also at the core of the post-Crusade Christian theology of reason.

5 C. K. Raju, *Statistics for Social Science and Humanities: Should We Teach It Using Normal Math or Formal Math?*, 2020, <https://www.youtube.com/watch?v=A9Og1k-Z5O4>.

However, any public scrutiny or discussion of that false history or the related bad philosophy is taboo. My censored article pointed out the bogusness of that history of science: Greeks were manifestly inferior to black Egyptians in mathematics and science as shown by the *non-textual evidence* of the grossly inaccurate Greek calendar. Though Romans laughed at the Greeks for their inaccurate calendar, the inaccuracy persisted with the succeeding Roman calendar, and its Julian AND Gregorian reforms (RAJU 2014; 2015), all because of ignorance of elementary fractions, well-known to the early Egyptians (CLAGETT 1999),⁶ so that the correct duration of the (tropical) year could not be readily *articulated*. No one responded intellectually to this argument, that early Greeks and Europeans, even in the 16th c., were so mathematically backward that the Gregorian reform of 1582 still used the primitive technique of leap years, instead of precise fractions,⁷ to state the correct duration of the tropical year.

Lacking an intellectual response to this compelling argument, and unable to accept the crash of their long-standing claims of superiority, the West applied authority: my article was censored in South Africa, and throughout the world, as the only way to contest it. Truth cannot be spoken: for what is publicly spoken must first be secretly approved by Whites/West, for that non-transparent church method (instead of open public debate, as was practised in ancient India) is the method of validating knowledge in the West (RAJU 2011).

“Pythagorean” “Theorem” and Myth Jumping

As a first step, let me point out the utter bogusness of the myth that the "Pythagorean" "theorem" was unknown to the Egyptians as Western historians like Gillings (1972) assert. Martin Bernal (personal communication, 9 Jan 2010) specifically asked me to examine this claim. The claim by Gillings, that Egyptians were ignorant of the “Pythagorean” “theorem”, completely ignores the non-textual

6 The original cover of the book had the famous “eye of Horus” fractions.

7 As a consequence of this mathematical clumsiness of 16th c. Europeans, even the reformed Gregorian calendar gets the tropical year right only on a 1000 year average, and not from year to year, as required for a good calendar. Equinox still does not come on a fixed day on that calendar. How could people who didn't even know fractions do any science?

evidence of engineering marvels like the pyramids. In fact, such non-textual evidence is far more reliable than the documentary “evidence” coming to us from the unreliable hands of Christian priests renowned for their manipulation of documents, through forgery and misinterpretation (e.g. the “Award of Constantine” on which the Vatican is founded).

However, in the case of “Pythagoras,” there is *no* documentary evidence for Pythagoras: there are no approximately contemporary primary sources establishing even the existence of Pythagoras, leave alone the claim that he proved some sort of “theorem” in some special way. Why, then, should we believe in the myth of the “Pythagorean theorem”? Because the lie is repeated innumerable times. The myth is found everywhere today due to the deliberately mischievous terminology of “the Pythagorean theorem” entrenched in present-day mathematics. School children are indoctrinated into the myth at an early age. (E.g. the class X Indian math school text⁸ repeats the term “Pythagorean theorem” 32 times.) Having spread such faith-based “history” through indoctrination, and to hide the lack of evidence for it, the apologist will pretend that the myth is evidence for itself, and try to shift the onus of proof on those who deny the myth. The apologist will make the ridiculous demand: prove that Pythagoras did NOT exist! Such ridiculous demands are easily made in the process of secretive refereeing, which helps to preserve the status quo.

However, there is ample *counter*-evidence that Pythagoreans had nil interest in *proving* theorems in some special way, and had only a *religious* interest in geometry. Pythagoreans linked geometry to the soul along the lines mentioned in Plato,⁹ who follows Egyptian mystery geometry (but breaks the mystery tradition in destroying its secrecy). But, obviously, racism is all about double standards, and the mere *myth* of Pythagoras, repeated thousands of times, is “evidence” for Greek “achievements” in math. One can understand why the West has produced so many myths, because, in Western history of math, myths routinely substitute for evidence!

This idea of myth as evidence (for itself) is clear also from the typical tactic of “myth jumping” used by apologists to “save” this false

8 Mathematics: Textbook for Class X, NCERT, <https://ncert.nic.in/textbook.php?jemh1=0-15>.

9 Plato, *Meno*, trans. Benjamin Jowett, <http://classics.mit.edu/Plato/meno.html>.

Western history. When the absence of evidence for Pythagoras is pointed out, the sole “evidence” produced is to jump to just another myth: the myth of Euclid, plus the myth that *he* proved some theorem in some special axiomatic way.

The Myth of Euclid

Once again, there is no evidence for Euclid (RAJU 2012), and certainly no evidence that he was a white male, as is invariably portrayed, to further colour 1930s prejudice, everywhere from Wikipedia to Indian school mathematics texts. Indeed, my censored article was a response to the similar racist claim that mathematics was the creation of dead white men, and to the resulting educational recommendations: that blacks and women, who are supposedly bad at math, should imitate the dead white men who supposedly created the subject of mathematics.

As regards “Euclid”, once again, it is not mere absence of evidence: there is again *counter*-evidence from Byzantine Greek texts. Those texts state that the author of the *Elements* (attributed to “Euclid”) was someone else,¹⁰ Theon of Alexandria or came after Theon, who comes some seven centuries after the purported date of “Euclid”. The social circumstances prevailing in Theon’s time were those of a religious war by the church against the Egyptian “pagan” notion of soul, used in Platonic and Neoplatonic geometry [Theon was the last librarian of the library of Alexandria which was burnt down by a Christian mob (GIBBON 1996).¹¹] We are expected to believe, like the faithful, that the then-prevailing social circumstances made no difference to the writing of the book around the time of Theon, or that Theon “misinterpreted” the “original” Euclid of whom there is no sign. We are also expected to believe that the eventual hilarious re-location of Euclid from Megara to Alexandria, as happened after five centuries (RAJU 2012, 36–37), makes no difference to the colour of his skin, even though Alexandria is located on the African continent.

10 Thomas Heath, *A History of Greek Mathematics* (Dover, New York, 1981).

11 E. Gibbon, *The History of the Decline and Fall of the Roman Empire*, ed. J.B. Bury with an Introduction by W.E.H. Lecky (New York: Fred de Fau and Co., 1906), in 12 vols. Vol. 5. https://oll.libertyfund.org/title/gibbon-the-history-of-the-decline-and-fall-of-the-roman-empire-vol-5#Gibbon_0214-05_262.

In fact, in all probability (and balance of probabilities is what applies to history), the author of the book *Elements* of Egyptian mystery geometry was the 5th c. Hypatia, Theon's daughter. She was a black woman since Alexandria is in Africa, and, in the absence of evidence, one must use the default skin colour which is black.¹² But, of course, the golden rule of racist/Western history is that prevailing Western myth is not only evidence, but the myth is also the sole acceptable evidence, and any facts or reasoning contrary to Western myths must be rejected, by censorship or other appeals to authority.

The Myth of Axiomatic Proofs in “Euclid’s” Elements

The myth of “Euclid” is NOT a simple myth (i) about one mythical individual called “Euclid”. It is a compound myth interwoven with the myth (ii) that the book *Elements* has axiomatic proofs, and the myth (iii) that such proofs are “superior”. The complexity of the Euclid myth enables myth jumping between these interwoven myths about “Euclid”. Thus, many people simplistically imagine that the Euclid myth is only about the person “Euclid”. “What does the existence of Euclid matter,” they say triumphantly, “there is the book”. That seems like a pretty solid piece of evidence to Western myth jumpers.

Yes, there is a book from around the 10th c., but it has NO axiomatic proof in it. It is a remarkable testimonial to Western gullibility (due to prolonged church hegemony over Europe), that the myth about axiomatic proofs in “Euclid” was uncritically accepted by all Western scholars for about 750 years from 1125, when the book first came to Europe, as an Arabic text, until the end of the 19th century when the Cambridge exam regulations for “Euclid” foolishly assumed¹³ the myth that the book actually had axiomatic proofs (so that the order of propositions mattered).

However, at the end of the 19th c., which saw a temporary decline in church hegemony, Dedekind (RAJU 2020c) pointed out that there is no axiomatic proof of even the first proposition in the

12 C. K. Raju, ‘Greedots and Pythagoras. 3: Was Euclid a Black Woman?’, 18 March 2020, <http://ckraju.net/blog/?p=189>.

13 <http://ckraju.net/geometry/cambridge-note.html>. If empirical proofs are given, as they are in the textbook (TAYLOR, 1893) commissioned by Cambridge along with these regulations, then the order of propositions is largely irrelevant: the “Pythagorean theorem” can be proved in one step instead of the 47 steps used in “Euclid”.

Elements. He tried to provide an axiomatic proof, but that required set theory. Cantor's set theory was riddled with paradoxes, so this project of a theory of "real" numbers was completed only after the axiomatic set theory of the 1930's. A little after Dedekind, Bertrand Russell (1902) explained that the proofs in "Euclid" were "a tissue of nonsense": he meant there are no axiomatic proofs in the "Euclid" book. Recognizing this, a little earlier, David Hilbert wrote a whole book on the *Foundations of Geometry* (HILBERT 1950), to supply the axiomatic proofs missing in the book *Elements* (though this rewrite involved great violence to the actual book *Elements*; for example distances cannot be measured in Hilbert's geometry).

So, there is the book from the 10th c., but, to reiterate, the fact is, there are NO axiomatic proofs in the book *Elements* attributed to Euclid, as was so long and so foolishly believed by almost, if not all, Western scholars. Though this fact ("no axiomatic proofs in the *Elements*") is publicly known for over a century, the West is unable to swallow it: hence the myth of "Euclid's" axiomatic proof is still asserted and taught as part of colonial education. So, saying "there is the book" is another classic case of myth jumping: these apologists are just jumping from the myth of the *person* Euclid to the myth about the *book Elements*, and deeming the latter myth to be strong "evidence". They simply deny the fact that the actual book, contrary to the compound Euclid myth, has no axiomatic proofs as was so publicly exposed over a century ago! Apologists who say, "the book is there" never actually read the book carefully, but uncritically imagine that no one can tell such a brazen lie about the book, as is told through the myth of "Euclid", even after its public exposure.

Further, there is a plan B, when the evidence is contrary to the myth: myth jumpers simply invent another myth to jump to, on the age-old tactic of telling a thousand lies to defend one lie. The new myth is that though Euclid failed to provide axiomatic proofs, in actuality, such was his intention. Now, judging intent is difficult under the best of circumstances, but how exactly does one judge the intention of a non-existent person (whose "existence does not matter")? Obviously, despite postmodernism, one must actually read the book.

The most perfunctory reading of the book shows that it is full of diagrams, which, as Russell (1902) noted are irrelevant (and misleading) for axiomatic proof. The *Elements* is, therefore, NOT a book on axiomatic proofs, but is a book on Egyptian mystery geometry

in the Platonic tradition. Plato explicitly explained¹⁴ the value of diagrams for mathesis, or learning by arousal of the soul, to make it recollect its past lives. The commentator Proclus explicitly cites Plato to explain why the book uses figures. But the primary rule of Western faith-based history of math, as one should well understand by now, is that myth is evidence, and all evidence contrary to the myth, even if this is evidence in front of one's eyes, should be thrown out to preserve the myth.

The correct understanding of the “Euclid” book, as a book concerning Egyptian/Platonic mystery geometry, fits in very well with the correct time of its real author: in the fourth-fifth century when the church was waging a violent war against that Egyptian/“pagan” (=“Neoplatonic”) notion of the soul, which therefore had to be defended. The best tool for that defence was mathematics (in the sense of mathesis), for it involved direct experience, not mere preaching. As is well known, Hypatia was a philosopher (=Neoplatonist) and hence aroused the ire of the church which brutally lynched her, long before it banned philosophy from Christendom in 532. The first commentator on the book, the philosopher (Neoplatonist) Proclus (PROCLUS 1970, 52) explicitly explains at great length that the book *Elements* (of geometry) is about mathesis and arousing the soul, to lead to “the blessed life”. But given the firm policy of Western faith-based history, to dismiss all evidence contrary to the myth, Proclus, too, is dismissed, for the myth, like racist prejudice, must prevail at all costs.

The Church’s Appropriation of Euclid

There is a strong political reason for Western “historians” to cling to the myth of “Euclid”, contrary to all evidence: the church, and particularly its crusading rational theology invented during the Crusades, is deeply invested in “Euclid”. (Obviously, reason has nothing to do with Jesus, and the word “reason” occurs in the Bible less than 100 times, depending on the translation.) So, why did the church turn to reason in the midst of a religious war?

Why was the Crusading church interested in reasoning? Because the real purpose of the Crusades was to convert Muslims by

14 Plato, *Phaedo*, trans. B. Jowett, <http://classics.mit.edu/Plato/phaedo.html>. Search for “diagram”.

force, in the manner the “pagans” of Europe were earlier converted to Christianity. But this earlier strategy of conversion by force failed with Muslims, who were militarily too strong. Muslims also rejected the Bible as corrupted, so the Bible could not be used to preach to them. But Muslims accepted reason as in the aql-i-kalam or Islamic rational theology. Therefore, the Crusading church adopted reasoning, as in Christian rational theology which started during the Crusades.

However, there are two kinds of reasoning, (1) reasoning with facts and (2) reasoning without facts. Reasoning with facts was fatal to church dogmas, for facts are fatal to church dogmas. For example, Aquinas reasoned about angels (AQUINAS [n. d.]),¹⁵ but, obviously, there are no facts about angels, so he began with axioms¹⁶ (=assumptions) about angels. Many other church dogmas such as God, heaven, hell, etc., would all collapse if reasoning with facts were used, for there are no facts related to those either. What the church realized was that the key conflict of its dogmas was not with reason (which conflict could be managed) but with facts (RAJU 2020b). (This was the time that the church actually adopted the Christian rational theology of Aquinas and his schoolmen to compete against the Islamic rational theology, or aql-i-kalam, propagated, among others, by Ibn Rushd/Averroes, whose books were first used by church universities to teach the reasoning of “Aristotle”.)

Since, axiomatic reasoning, or reasoning based on assumptions, and divorced from facts, was a key political requirement of the Crusading church, therefore, when the *Elements* first came to Europe, as a Crusading trophy, the church appropriated it, since reasoning without facts, or axiomatic reasoning, is not found in “Aristotle”.

That is, to fit the “Euclid” text to its political purpose, the church brazenly “reinterpreted” the book *Elements* as a book about metaphysical reasoning divorced from facts. (Through centuries of “adjusting” the Bible to meet similar immediate political requirements, church priests had gained mastery over such manipulation and

15 Thomas Aquinas, *Summa Theologica*, n.d., <http://www.newadvent.org/summa/1052.htm#article3>.

16 I am assuming that people understand the modern sense of “axiom” as an assumption, as used in formal mathematics, and as described in the class IX Indian school math text, p. 305 (“Axioms are statements which are *assumed* to be true without proof”, emphasis added). <https://ncert.nic.in/textbook.php?iemh1=a1-15>.

reinterpretation of texts.) The fact that for 750 years no Western scholar questioned the deviation of the actual “Euclid” book, from the myth of axiomatic proofs in it, is a tribute to the church hegemony over the Western mind. Far be it from any Western scholar to be sceptical enough to ask due to what social circumstances anybody in the minus 3rd century CE (the supposed date of “Euclid”) would write a book that suited the political requirements of the crusading church 1500 later; so well-suited, in fact, that the church would adopt the book as a text for the next 8 centuries.

The Fallibility Of Deduction

But perhaps there is something even more astonishing about Western gullibility. Though Dedekind, Russell, and Hilbert, all pointed out the falsehood of the (church) *myth* of axiomatic proofs in “Euclid's” *Elements*, they all accepted part (iii) of the “Euclid” myth: the church *superstition* that axiomatic proofs are infallible hence “superior” to empirical proofs, which are fallible.

Like all church dogmas, such as the infallibility of the pope, the belief in the infallibility of deduction, too, is contrary to the most elementary observation. As any mathematics teacher knows, students of mathematics frequently make mistakes in deductive proofs. These errors in deductive proofs are far more frequent (RAJU 2018b) than errors in empirical proofs. Especially, there are frequent errors in purported deductive proofs of complex problems such as the Riemann hypothesis, or the abc conjecture, or even in a game of chess. In fact, unlike the occasional error in observation or empirical proof, a complex task of deduction *almost invariably* involves errors, since the human mind is *more* fallible than the human senses.

It is no use saying that a *valid* deductive proof is infallible since that is a tautology that applies equally to valid empirical proofs. The question is: how does one *know* that a given deductive proof is actually valid? Correcting the manifest errors of deduction involves either induction (repeated re-checking of the purported proof) or reliance on authority (opinion of an authoritative mathematician). So, since the validity of a deductive proof is decided by induction or reliance on social authority, deduction is decidedly weaker than either induction or empirical proofs.

In short, axiomatic/deductive proofs are far MORE fallible than empirical proofs. The “Euclid” book itself is the perfect and most hilarious example of the fallibility of deductive proofs: for 750 years it was regarded in the West as the model of axiomatic proofs, when it actually has none!

Why Formal Mathematical Theorems are Invalid Knowledge

However, there is a further problem with deductive proofs. Mathematical theorems, *even if validly proved*, are invalid knowledge. Hence, the people's philosophers (Lokayata) from India rejected deduction as fallible thousands of years before the church declared it as infallible! The Lokayata objection was simple: deduction may begin from false premises. The classic Lokayata example (SURI 2000) was that observing a wolf's footprints, people wrongly inferred that a wolf was around, when in actual fact the wolf's footprints were made at night by a man to demonstrate the fallibility of deductive inference.

In formal math, it gets much worse than that: for the axioms (=assumptions) are *not* based on empirical observation but are metaphysics (= irrefutable in the Popperian sense). They have to be, for a chain is only as strong as its weakest link, and if the starting point of a chain of deductive inferences (mathematical proof) is empirical, hence fallible, so would be its conclusion (the mathematical theorem). That negates the whole basis of formal math that deductive proofs are used since they are (supposedly) infallible. Of course, the metaphysical nature of axioms greatly suited church rational theology: for the truth of metaphysics can only be decided on authority. Aquinas inferred the properties of angels (who do not exist in fact) from the axiom that angels occupy no space,¹⁷ and no one could challenge his authority because he was glorified as a saint. Nor can anyone today challenge the axioms of formal mathematics laid down exclusively by “superior” Westerners.

Modern-day logicians and philosophers accept the Lokayata argument but try to dodge its force by using a euphemism to describe the invalid knowledge (formal mathematical theorems) resulting from deductive inference as “relative truth”, relative to the axioms. It was to

17 Aquinas, *Summa Theologica*, First Part, Q. 52, article 3. <http://www.newadvent.org/summa/1052.htm#article3>.

expose this idea of mathematical theorems as *at best*, relative truths, relative to axioms, that I used the rabbit theorem in my censored article. The point is that absolutely any nonsense whatsoever may be a “relative truth”.¹⁸

People believe that such absolute nonsense cannot arise in actual mathematics. That is, they believe the axioms of mathematics must have some relation to reality, therefore the theorems must too. This is just the belief of the faithful who do not understand the metaphysics of infinity underlying the axioms of set theory, on which all current formal mathematics is based.¹⁹ For example, the Banach-Tarski theorem asserts that a ball of gold may be divided into a finite number of pieces which can then be reassembled, without stretching, to create two balls of gold identical in size to the first. This is a simple recipe for using set theory to get infinitely rich! This is obvious nonsense, but most people do not have the technical background to grasp why this nonsense is an inevitable aspect of present-day mathematics, just as Aquinas’ nonsense was an essential aspect of the Crusading theology of reason.

Since, however, this issue (axiomatic set theory) is too technical to take up here, we will limit ourselves, to the fact that the Pythagorean theorem is invalid knowledge. While Hilbert’s (or Birkhoff’s²⁰) axioms do result in an axiomatic proof of the “Pythagorean theorem”, this “rigorous proof” does NOT help to make it true in the real world.

Thus, the “Pythagorean theorem” is obviously false for (geodesic) triangles drawn on the curved surface of the earth. Thus, the theorem assumes that we are speaking of a triangle consisting of straight lines, but it is impossible to draw straight lines on the curved surface of the earth: the shortest distance between two points is a

18 There is also a further caveat to be attached the concept of deduced knowledge as relative truth: it is relative to the axioms *and* logic, but we will not go into it here. (RAJU 2001).

19 See for example my lectures at the Universiti Sains Malaysia (2010), on axiomatic set theory, with typos corrected, posted at <http://ckraju.net/sgt/technical-presentations-faculty/ckr-sgt-tech-presentation-2.pdf>.

20 (BIRKHOFF 1932) These were the axioms whose use was recommended by the Yale School Mathematics Study Group, after the “Sputnik crisis” (SCHOOL MATHEMATICS STUDY GROUP 1961)

curved line. This aspect of “non-Euclidean geometry”, for calculating longitudes, using (geodesic) triangles (today called plane navigation) was known to 7th c. Indian mathematicians,²¹ from centuries before the date of the earliest “Euclid” manuscript. It was, however, unknown to Europeans who accepted mathematical theorems as true and used it to determine longitude by “heaving the log”²² and consequently faced numerous navigational disasters from the 16th to the 18th century. Perhaps it is necessary also to point out that the “Pythagorean theorem” is not true anywhere in (curved) space either. It is not true anywhere in the real world. Naturally, there is no notion of “approximate *truth*” in formal mathematics, for a mathematical proposition is either true or false. There is, however, a notion of approximate *calculation* (even in regard to the “Pythagorean proposition”) from normal math from ancient times, as explained in the section below on the Pythagorean calculation.

In short, all three aspects of the Euclid myth, (i) that Euclid existed, (ii) that there are axiomatic proofs in the book attributed to “Euclid”, (iii) that axiomatic proofs are in any sense “superior” to normal proofs, lie shattered. Driving that home is necessary to bury forever the White/Western claim of “superiority”.

Greedlots

What is most curious, is the fact that Western scholars still hang on to the claim of “superiority”, at the core of racism, for that claim of superiority is what is the most essential part of the “Euclid” myth. That is, even after the humiliating public exposure of the total absence of axiomatic proofs in "Euclid", the most respected Western historians like Heath, Gillings, Needham (1981), and Clagett (CLAGETT, 1999), right up to the late 20th century, and Indian school texts in the 21st century, continue to assert that the “Pythagorean” “theorem” is a formal mathematical theorem of “Euclid”! To reiterate, the simple fact to the contrary is there was no formal (= axiomatic) mathematical proof of the Pythagorean theorem before the 20th century.

21 Bhaskara 1, *Mahabhaskariya*, 2.5.

22 For a quick account, see <http://ckraju.net/papers/presentations/Bengaluru-day1.html>, or the related video on “Euclidean geometry vs rajju ganita”, <https://www.youtube.com/watch?v=ERm25QgyW1w>.

Greediots is the only word for people who so persistently stick to myths about Greek superiority in math, without the slightest evidence, and by trying to marginalise all the counter-evidence. It is only poetic justice to apply this term “Greediots” to Gillings (GILLINGS 1972) a racist who first coined the term “pyramidiot”, while claiming that Egyptians lacked knowledge of the “Pythagorean” proposition. It also applies to Egyptologists such as Clagett, and it needs to be applied even to one of the most respected among Western historians, namely Needham. Western historians will forever stick to this false claim of axiomatic proofs in the “Euclid” book, because repeating a publicly exposed lie is their last desperate way to hang on to the claim of Western civilizational superiority, which substituted racism and its claim of White superiority, and is still so essential to the Western self-image. Euclid must fall to bring that racist self-image in line with reality.

One should expect resistance. Thus, the ignoble prize for Greedioty, and assertions of White/Western superiority, should go to the historian Lefkowitz who is indignant that some people have been trying to demolish the myths about Greek achievements in mathematics and science. Accordingly, she has written a book, *Not out of Africa* (LEFKOWITZ 1996) to contest some of the previous attempts such as those of James (2001), Diop (1974), and Bernal (1987), against the myths of Greek achievement in mathematics and science. Her version of the technique of using “Western myth as evidence” is simplicity itself: she simply cites an “authoritative” Western historian who has already done that! This plays on the psychology of the colonized, who are persistently taught that *only* Western sources are reliable, a cardinal principle of Wikipedia even today.

For example, as Diop correctly pointed out, the volumes of the sphere (approximately) and the cylinder were known to Egyptians and are found in the Ahmes (Rhind) papyrus (CLAGETT, 1999), which is over a thousand years before Archimedes, who is credited with a book on the Sphere and Cylinder (HEATH 1996), based solely on 16th c. accretive Byzantine sources! (FOWLER 2004). Note that between the date of Archimedes and the date of his supposed source, the current formula for the volume of a sphere had been derived in India (RAJU 2007). Though a professional historian, Lefkowitz deliberately never mentions any actual primary source. Her anxiety is to somehow re-

assert Greek “superiority”, by establishing that the 16th c. “Archimedes” did something “superior” to Egyptians. To this end, she cites the authority of Palter, and then goes on to assert (LEFKOWITZ 1996, 153) that “Archimedes determined that the volume of the cylinder was $\frac{3}{2}$ the area of the sphere”.

This is hilarious. Obviously, Lefkowitz is mathematically and scientifically illiterate, and never even properly did her school math, for she is comparing volumes and areas! Noticeably, also, Lefkowitz's book has been highly praised by numerous closet racists, who are presumably equally mathematically illiterate, but equally anxious to attack Afrocentrism any which way.

This also shows the extreme extent of nonsense to which Western “historians” will descend, to defend their absurd claim of the purported superiority of “Greeks”, to whom the Crusading church method of metaphysical reasoning in mathematics has been wrongly attributed. That false claim is an essential link in the propaganda of civilizational superiority, and the resulting globalisation of colonial education. Therefore, it is necessary to repeatedly trample on such claims, and expose them, for they are at the core of the beliefs which ensure the persistence of racism and colonialism.

“Pythagorean” Theorem Versus the “Pythagorean” Calculations

Finally, let us take note that the term “theorem” is critical to the church/racist/Western propaganda of civilizational superiority, hence it is today asserted that mathematics is solely about proving theorems, as is the case in formal mathematics (Western ethno-mathematics). As explained above, formal reasoning, or metaphysical reasoning, without facts, is an invention of the crusading church to enable it to adopt its theology of reason. Since the church concern was solely with conversion, or with persuading people, hence with proof, the church kind of proof (based on axiomatic reasoning divorced from facts) was declared as the key aim of “superior” mathematics! In actual fact, all practical value of mathematics comes from calculations [even if proofs are missing, as in the S-matrix expansion of quantum field theory, at the core of current physics, where there is no proof of convergence of even a single term in the expansion (RAJU 1983)].

Also, many times, formal (or church) mathematics, is confounded with Egyptian mystery mathematics explained by Plato, and Plato is cited to assert that the practical concerns of mathematics

are of little value. This is a matter on which Hardy (1940) dwelt at great length, arguing that mathematics is concerned, like poetry, with beauty. Though Plato was indeed concerned with the effect of mathematics, like music, on the soul, Hardy's assertion hides the fact that that Egyptian/Platonic notion of soul was cursed by the church (see: RAJU 2003, chp. 2, "The curse on 'cyclic' time"), and has no place in formal (church) mathematics.

Hence, formal mathematics also has no relation to soul arousal (or aesthetic value): it is manifestly ugly metaphysics. Hardy accepts that he has no definition of beauty, but says we all have an intuitive understanding of aesthetics. Why then should we reject the intuitive understanding of millions of schoolchildren who reject formal math as ugly, and abandon it, though the same schoolchildren have no difficulty in appreciating music, without learning anything about music? They understand better than Hardy the ugliness of formal mathematics, without knowing that its ugliness stems from its being a church metaphysics of infinity, unrelated to Plato's idea of mathematics as similar to music. Hardy, unfortunately, conflated the two distinct types of mathematics: Platonic mathematics and church mathematics. Formal (church) math has no beauty in it.

Also, none of these purported aesthetic claims about mathematics are publicly explained to the vast number of colonized students who study mathematics solely for its practical applications, to science and engineering. But the practical applications of mathematics are often deprecated, as something inferior (though this claim too is carefully kept away from the bodies which fund mathematics solely for its practical applications).

What, then, is "superior"? Certainly political or religious value to the church (of value to the coloniser) is the least important thing to the colonized, anything else would be undoubtedly superior. Therefore, the colonized need to thoroughly reject formal math.

Thus, it is important to discriminate between the inferior formal "Pythagorean" *theorem* and the superior normal "Pythagorean" *calculation*, required for practical applications. The Pythagorean theorem, as stated in the book "Euclid's" Elements, is no good for calculations needed for practical applications. In India, long before the Pythagoreans, the proposition was stated for a rectangle and its

diagonal,²³ rather than a right-angle triangle. We will use this form of the proposition since Gillings, quoting Heath, goes so far as to suggest that Egyptians did not know what a right-angled triangle was, and hence could not have known the “Pythagorean proposition”. But as the Ahmes papyrus shows the Egyptians certainly knew about the rectangle and its diagonal.

The “Pythagorean” *calculation* has two forms:

- (1) calculation of the diagonal from a knowledge of the sides of the rectangle
- (2) calculation of the sides from a knowledge of the diagonal and its angle with one of the sides.

The Pythagorean *calculation* is truly superior since one can deduce the “Euclidean” form of the Pythagorean *theorem* from (1), but not vice versa. But, to actually carry out the calculation, we first need knowledge of square roots. This knowledge of square roots is found in the Berlin papyrus, and in Iraq, and in India, but was unknown to early Greeks²⁴ who did not have even a systematic notation for fractions or any “algorithms” for division. Recall that “algorithm” is a term coming from al Khwarizmi's Latin name *Algorismus* or *Algorithmus* and that knowledge of algorithms came to Europe (RAJU 2020a) through his book *Hisab al Hind*. This has not prevented present-day mathematics from dishonestly speaking extensively about “Euclid’s division algorithm”—such is the standard of the Western history of mathematics.

European ignorance of square roots, and the fact that their knowledge of it came through Arabs, is clear from the current mathematical term “surd” for $\sqrt{\quad}$

23 Manava sulba sutra 10.10. This distinction between hypotenuse and diagonal is essential because racists like Heath did not understand the point about the Pythagorean proposition applied to the diagonal of a rectangle.

24 Square roots bring in a non-integer form of the proposition. Pythagoreans were concerned with integer triples because of the theory of music (“Pythagorean scale”), where using square roots, as in the modern equal tempered scale results in loss of musicality. That is, the church intervention in music (apart from mathematics) too resulted in loss of aesthetics! See, Raju (2007), and the excerpt at <http://ckraju.net/music/MathAndMusicEastAndWest.pdf>.

to do with square roots? Recall that $\sqrt{\square}$ is the diagonal of the unit square, and the Sanskrit word for diagonal is karna (and that this diagonal arises in the “Pythagorean” proposition, as stated in the Manava sulba sutra 10.10). However, the Sanskrit word karna also means ear. Hence, the wrong translation of bad diagonal = bad ear = deaf, in al Khwarizmi, was translated to the Latin surdus. That is, Europeans first learned about square roots from India via Arabs, after the 12th c, and had not the foggiest idea of the meaning of the terms they translated.

The second form of the "Pythagorean" calculation requires “trigonometry” which, too, Europeans learned from India, through Arabs, after the 12th c. This is clear from the fact that the word sine from the Latin sinus or fold is (as the OED informs us) from the Arabic jaib (=pocket) a misreading of jiba from the Sanskrit jiva for the sine, written as the consonantal skeleton jb in Arabic. The European lack of understanding is clear from the very word “trigonometry”, and the present-day miserable definition of sine as related to triangles,²⁵ though the concept actually relates to a circle. I have already dealt with the superiority of the Pythagorean calculation earlier (RAJU 2017b),²⁶ even in this article.

The Western apologist, anxious to defend the claim of superiority of formal math, will rush in with the apologia that the Pythagorean *theorem* is an approximation. But, first, there is no concept of approximate “truth” in formal math since propositions must be either true or false, not 0.9% true or 0.2% false. Secondly, approximate knowledge is worthless without an *estimate of the error*: it is like telling a shipwrecked sailor in the sea that he is “approximately near” land, where “approximately near” might mean anything from 30 m to 300 km which may be the difference between life and death! But the “theorem” provides no such error estimate. Indeed, the pretence that it is a theorem, or some special and “superior” kind of “exact” knowledge, is tied to grandiose myths of exactitude and eternal truth in mathematics, and that grandiosity precludes the possibility of spelling out the degree of approximation, for spelling that out would make it manifest that “Pythagorean

25 E.g., class X Indian school text, pp. 174-75.
<https://ncert.nic.in/textbook.php?jemh1=8-15>.

26 <http://ckraju.net/papers/Manuscript-Black-thoughts-matter-accepted-version.pdf>.

theorem” is at best only approximate knowledge, as others well knew, and as explicitly stated in the sulba sutra. The whole ground for the claim of the “superiority” of Western/formal math would then be lost.

In the practical use of the Pythagorean proposition, the distinction between theorem and approximate calculation becomes important. The Pythagorean proposition, which applied the (approximate) theory of plane navigation, was extensively used by Europeans, to determine longitude by “heaving the log”, until the 18th century. Thousands of sailors drowned due to the delusion that the Pythagorean theorem is an exact truth, as in the name “exact science” applied to mathematics, though it is neither exact nor a science. (It is not science since the axioms are metaphysics, and not exact since axioms can hence never be true in the real world.) Consequently, the theorems (relative truths) can never be exactly true in the real world.

In the case of the *calculation*, one can estimate the “error”. But to be able to estimate the error in the Pythagorean calculation, one needs to know the correct radius of the earth. In this department, too, Europeans lagged thousands of years behind others due to their inferiority in mathematics. Certainly, Greeks and Romans were unaware that the earth is even round (despite tall claims about Eratosthenes based on some 19th-century texts), and the documentary evidence for this ignorance comes from the fifth century Bible or even its later day versions.²⁷ In contrast, the fifth century Aryabhata, in India, stated (SHUKLA & SARMA 1981) that the earth is round (GOLA 6), and the very word Gola or the name for earth in Sanskrit, bhagola, means a sphere. Aryabhata's disciple Lalla (शिष्यधीवृद्धिद, 20-36/CHATTERJEE 1981) gave the simple reason for the sphericity of the earth: contrary to the “gospel truth” of the Bible, far off trees cannot be seen no matter how tall.

Distant ships disappear over the horizon, which is circular, and measuring the zam, or distance to the horizon, enables one to calculate the radius of the earth, from the second (or trigonometric) Pythagorean calculation. This can be done very accurately as Indian astronomers demonstrated long ago, and as al Biruni verified while checking out khalifa al Mamun's physical measurement of 1° of the arc.²⁸ The

27 <http://ckraju.net/hps-aiu/flat-earth-in-Bible.txt>.

28 For full details and original sources, see Raju (2007).

accuracy was better than 1%, as can be ascertained from the well-established relationship between the Arabic mile and the English mile. This was because of the accuracy of angle measurements obtained by using the two-scale principle, incorporated into traditional navigational instruments (RAJU 2007, chp. 5) (and attributed on the doctrine of Christian discovery to Vernier). It is natural to believe that this ancient knowledge of the radius of the earth goes back also to ancient Egypt, though Westerners do not like such a claim because it exposes their extreme inferiority and backwardness in mathematics, totally contrary to their long-time boasts of superiority.

But the fact is that it was because of their bad mathematics that Westerners were bad navigators even in the so-called “age of discovery”. In the 15th c., Columbus underestimated the size of the earth by 40% and recorded that he had reached China when he was in Cuba. This wrong idea of the earth’s size led to numerous navigational blunders ultimately resulting in Portugal passing a law in 1500 banning the carrying of globes aboard ships. Vasco da Gama was ignorant of navigation, and did not even know how to determine latitude, and was brought by an Indian navigator from Melinde in Africa to Calicut (RAJU 2007). But such is the extreme vanity and dishonesty of Westerners, that Vasco derogatorily refers to the Indian navigator as a pilot (one who guides the ship near a shore)! Recall that the Gregorian calendar reform of 1582 was needed just because an accurate calendar, and the precise date of the equinox, are needed to determine latitude in the daytime, by the age-old technique, from an observation of solar altitude at noon.

The famous longitude problem of European navigation was a problem for Europeans alone, just because of their persistently inferior knowledge of the mathematics of the Pythagorean calculation, up until the 17th c. In fact, as the seventh-century Indian mathematician Brahmagupta (the inventor of algebra) remarked, “ignorance of the Earth's radius makes longitude [calculations] futile”.²⁹ And Europeans, *therefore*, had the longitude problem, just because they lacked

29 Brahmagupta (7th c.) “भ्रूव्यासस्य अज्ञानाद् व्यर्थं देशान्तरं” (“ignorance of the radius of the earth makes longitude [calculations] futile”, ब्राह्मस्फुटसिद्धांत, chapter 11, तन्त्रपरीक्षाध्याय, verses 15-16. (SHARMA, 1966).

knowledge of the full Pythagorean calculation, and were consequently ignorant of the radius of the earth.

One should not be misled by any related false history. Note that, on the doctrine of Christian discovery, the Jesuit general Clavius (BAMBERGENSIS 1607) published in his name, in 1607, accurate trigonometric tables stolen by Jesuits from India, but the theft is given away by my epistemic test (RAJU 2020d): the fact that Clavius did not know enough trigonometry (second Pythagorean calculation) to calculate the radius of the earth. Though Europeans claim to have measured the radius of the earth, at long last, in the late 17th century, few believed it then. Combined with the mathematical illiteracy of European sailors, this ensured that the longitude problem persisted until at least the mid-18th-century when it was officially declared to have been half-solved, and the British Board of longitude constituted by the British Parliament in 1711, finally gave away *half* its prize money in 1763.

The next time someone talks of the “superiority” of Greek mathematics, one should repeat this counter-story of the persistent mathematical inferiority of Europeans until the 18th century, combined with their persistent failure to understand math from elementary fractions to the Pythagorean calculation. It was this persistent mathematical inferiority of Europeans that resulted in the European navigational problems, and the deaths of thousands of European sailors until the mid 18th century. Doubtless, the Cambridge mathematician Hardy would have lit his pipe, leaned back in his armchair and lectured one of those drowning British sailors how extremely boring practical mathematics was (unless he happened to be the one drowning).

More importantly, one needs to understand the danger of blindly imitating the “superior” West in mathematics: there is nothing superior about Western mathematics, except that blind imitation makes it superior. In fact, the West got most of its math (most present-day school/college) math from elsewhere, and only added some false history and church dogma to it, both of which need to be rejected.

Colonial Education

But, it is not enough to tell counter-narratives. The colonial education system, designed by the church, embeds propaganda in the

impressionable minds of children, by telling them propagandist stories from an early age. Children believe those stories without evidence at that age, and they have a hard time shaking them off at a later stage. In fact, they grow so protective of those first stories that they have been taught, that they still do not demand evidence (for the first story), when a new story is told, but will instead suspect the new story. The education system is a very effective means of propaganda, and it influences a very large number of people.

Therefore, it is necessary to decolonise the education system, especially in mathematics, and in the history and philosophy of science, to stop these wrong beliefs from being perpetuated. How that can actually be done has been demonstrated through a long series of pedagogical experiments, in various universities (and middle and high schools), in three different countries, over the last decade (RAJU 2018b; 2019).³⁰ These courses included both the teaching of an alternative history and philosophy of science, and an alternative mathematics. Specifically, one can reject “Euclidean” geometry, not the original mystery geometry but its brazen reinterpretation to suit the church political requirement of metaphysical reasoning, needed for Christian rational theology. But, for the purposes of the classroom, instead of that Egyptian mystery geometry, one can shift to Egyptian *practical* geometry.

The interesting thing is that this Egyptian practical geometry was done with the rope, as depicted on the eastern wall of the tomb of Djoserkaseneb at Luxor. Though there are no known records of how exactly this rope geometry (of harpedonaptae or “rope stretchers”) was done in Africa, Indians had a similar tradition of string geometry, which is better documented in the texts of the *śulba sūtra*. This documentation has already been used to create a school text in geometry.

The striking feature of the rope/string is that it is flexible, and can be used to measure the length of a curved line. This is in striking contrast to “Euclidean” geometry based entirely on straight lines. This dependence on straight lines is emphasized by the geometry box or compass box which is part of the paraphernalia of every school student. No instrument in the existing compass box can be used to

30 An English version is to appear in *Studies in Humanities and Social Sciences*, Vol 26. No2, <http://ckraju.net/papers/Beirut-paper%20for%20ias%20journal.pdf>.

measure the length of a curved line. This is what completely befuddled René Descartes who wrote in his *Geometry* (DESCARTES 1990, 544) that “the ratios of curved and straight lines are beyond the capacity of the human mind”. Descartes was talking obvious nonsense, for one can easily measure a curved line with a string and then straighten the string to compare its length with that of a straight line.

Measurement (whether with a string or straight-edged ruler) is an empirical process, therefore this string geometry admits measurement, and the related errors of measurement at a very fundamental level, without any foolish claims as to the exactitude and infallibility of mathematics.

Since, with a flexible string, one can directly measure a curved line, including the circle, defining angles in terms of radians makes perfectly good sense. The other great advantage of a string and the ability to measure the circle, is that apart from the value of π , well known to both Egyptian and Indian traditions, one can easily teach the second Pythagorean calculation.

The next question, obviously, is how this way of teaching elementary geometry in school interfaces with the calculus needed for science, at the university level. In fact, it interfaces extremely well as has been demonstrated by pedagogical experiments over the last decade in teaching calculus without limits, the way it developed in India, instead of teaching it the way it was misunderstood in Europe by Newton and Leibniz, a misunderstanding which persists to this day.

Thus the way forward is clear. Now it is more a matter of political will: whether we actually want to *do* something about racism and colonialism, or merely to keep talking about them and complaining. To actually do something, the colonised must at least be willing to experiment with something different from the church education brought by colonialism. If not, they can keep complaining forever, and it will not make the slightest difference to either the brutal racist or the equally brutal colonizer, who will only seek to derail the process of decolonization by exploiting the misplaced trust of the colonized in them.

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