Draft

Atman as a scientific notion, and its relation to physics and mathematics

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Extended Abstract

Part 1. Cosmic recurrence

The notions of आत्मन and मोक्ष are central to Hinduism, and at its philosophical core: the Upanishads. Hence, these notions ought to have been seriously discussed by Indian scholars. Such a discussion ought certainly to be initiated today. Are these notions scientifically valid? Thus, आत्मन and मोक्ष involve a notion of life after death or rebirth commonly rejected as a superstition today.

Rejection of superstitions is not something "Western": Aryabhata,[1] Lalla[2] and Vateshwar[3] rejected superstitions about Rahu, Ketu as demons, or शेष नाग as supporting the earth, etc. As regards आत्मन, Payasi (ca. -500 CE) performed some 30 *experiments*[4] with condemned felons to experimentally check whether the soul could be weighed, seen etc. He concluded that the soul does not exist. *We* conclude that the experimental method was used in India 2000 years before Francis Bacon: another nail in the coffin of the church/racist/colonial propaganda that science is "Western" in origin.[5]

However, there is no unique notion of life after death. What Payasi's experiments refuted was only a naïve notion of rebirth. The notion of life after death in Hinduism is a different one:[6] *rebirth takes place across cosmic cycles.* Not only are individuals reborn, but the whole cosmos recurs. Cosmic recurrence is scientifically possible if time is quasi-cyclic.[7] Quasi-cyclic time involves a notion of time very different from the one which prevails today, but it is not unscientific or invalid just for that reason.

This is *not* a retrospective reinterpretation. Thus, as stated in the Bhagvad Gita(8-16)[8] all things (not only living creatures) are subject to repetition. This rebirth or repetition is asserted to take place in

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1 आर्यभटीय, गोलपाद 6-7 compares the earth to a *kadamba* flower and asserts it stands supportless in space.

2 लल्ल, शिष्यधीव्रिद chp. 20 मिथ्याज्ञाननिराकरणम्

3 वटेश्वर, गोल, भूगोल:, 5.5.

4 Digha Nikaya, Payasi sutta. Hindi trans. Rahul Sankrityayan and Jagdish Kashyap, reprint Parammitra Prakashan, Delhi, 2002, pp. 199-201. Eng. trans. T. W. Rhys-Davids, *Dialogues of the Buddha*, vol. 2, London, 1910, pp. 346– 74. Reprinted by the Pali Text Society, *Sacred Books of the Buddhists*, vol. 2, ed. F. Max Muller, Routledge and Keagan Paul, London, 1977. Reproduced in *Cârvâka/Lokâyata*: *An Anthology of Source Materials and some Recent Studies*, ed. Debiprasad Chattopadhyaya and Mrinal Kanti Gangopadhyaya, ICPR, New Delhi,1990, pp. 8– 31.

5 C. K. Raju, *Is Science Western in Origin?* Reprint, Other India Book Store, 2014.

6 C. K. Raju, "Ancient and modern cosmology", *Proceedings of the Indian Association for General Relativity and Gravitation, Tenth Annual Meeting*, Bangalore, 1982, pp. 83-104. Also Indian Statistical Institute, Technical Report, No. P&E/E/12-79 (1979).

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

8 आब्रह्माभुवनाल्लोका: पुनरावर्तिनोऽर्जुन । मामुपेत्य तु कौन्तेय पुनर्जन्म न विद्यते ।।8-16।। "All things in this cosmos are subject to repetition, O Arjun. On finding me, O son of Kunti, they are no longer reborn."

successive days of Brahma (8-18-19).[9] Each day and night of Brahma is a rather long period of time spanning a 1000 (maha) yuga-s (8-17).[10] On the *Vishnu Purana* elaboration of the calculation,[11] a day and night of Brahma (kalpa + vikalpa) is 8.64 *billion* years. That is a *cosmic* time scale. The cosmic time-scale itself indicates that the reference is to cosmic recurrence: rebirth takes place a very long time after death, not immediately. (Let us not forget that, for centuries, all "reputed" Western scholars dismissed this cosmological time period as fabulous on their "superior" Biblical knowledge that the world was created only 6000 years ago, "knowledge" fine tuned to the minute by a Vice Chancellor of Cambridge University.)

Thus, two key features of life after death in Hinduism are (1) that not only are living creatures reborn, the entire cosmos repeats, and (2) that this happens in successive "days of Brahma" or cycles of the cosmos, separated by a cosmological time period. This is a clear picture of cosmic recurrence. The *kalachakra* and other such symbols equally indicate that time itself was traditionally regarded as quasi-cyclic.

With cosmic recurrence, the *atman* is readily understood as an abstraction which connects an individual in one cycle of the cosmos to another similar individual in another cosmic cycle.[12,13,14,15] As an abstraction, *atman* cannot be seen or weighed, as Payasi tried to do. Other common objections to the naïve notion of rebirth do not apply to this understanding of *atman* and rebirth in the context of cosmic recurrence.[16] (E.g. why don't we remember our past lives? Because memories commence afresh in each cosmic cycle. Why do the dead not return to tell us about life after death? Because they are not physically around until the cosmos, and whole sequence of events, repeats, etc. Nietzsche was eloquent about this.[17])

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9 अव्यक्ताद्व्यक्तय: सर्वा: प्रभवन्त्यहरागमे । रात्र्यागमे प्रलीयन्ते तत्रैवाव्यक्तसंज्ञके ।।8-18।। भूतग्राम: स एवायं भूत्वा भूत्वा प्रलीयते । रात्र्यागमेऽवश: पार्थ प्रभवत्यहरागमे ।।8-19।। "With the coming of the day (of Brahma) all things are manifest. In the night (or Brahma) they dissolve into what is called as the unmanifest. All past beings [and events] are created again and again and dissolve with the coming of the night (of Brahma), O Partha, and are again manifest with the coming of day (of Brahma)."

10 सहस्त्रयुगपर्यन्तमहर्यद्ब्रह्मणो विदु: । रात्रिं युगसहस्त्रान्तां तेऽहोरात्रविदो जना: ।।8-17।।

11 *The Vishnu Purana*, trans. H. H. Wilson, London, 1840, reprint, with an introduction by R. C. Hazra, Punthi Pustaka, Calcutta, 1961, chp. 3, pp. 19– 24.

12 The philosophical question of persistence of identity across cosmic cycles is no different from the question of the persistence of identity across the diastema between two instants of time. See C. K. Raju, "*Atman*, Quasi-Recurrence and *paticca samuppada*", in *Self, Science and Society*, *Theoretical and Historical Perspectives*, ed. D. P. Chattopadhyaya, and A. K. Sengupta, PHISPC, New Delhi, 2005, pp. 196-206. http://ckraju.net/papers/Atman-quasi-recurrence-and-paticca-samuppada.pdf.

13 C. K. Raju, "Time in Indian and Western traditions, and time in physics", Paper presented at the Seminar on *Scientific Traditions in India*, March, 1993. PHISPC Occasional Paper No. 23, New Delhi. In: *Mathematics, Astronomy and Biology in Indian Tradition*, PHISPC Monograph Series on History of Philosophy, Science, and Culture in India, ed. D. P. Chattopadhyaya and Ravinder Kumar, ICPR, New Delhi, 1995, pp. 56–93.

14 "Time in Medieval India." In: *Science, Philosophy, and Culture: Multidisciplinary Explorations*, Part 2, ed. D. P. Chattopadhyaya and Ravinder Kumar, PHISPC, New Delhi, 1997, pp. 253–78. Also in: *History of Indian Science, Technology, and Culture, AD 1000–1800,* ed. A. Rahman, Oxford Univ. Press, 1998, New Delhi. Further reprinted in *Indian Horizons*, **46**(4) (1999) and **47**(1) (2000), pp. 40–71.

15 C. K. Raju, "Kâla and Dik" chp. 5 in P. K. Sen & P. K. Sen et al. (ed), *Philosophical Concepts Relevant to Science in Early Indian Tradition*, PHISPC vol III.5, 2008, pp. 67–92.

16 *The Eleven Pictures of Time*, cited above, chp. 1: Life after death.

17 F. Nietzsche, *Eternal Recurrence*, 33. O. Levy, ed., *The Complete Works of Friedrich Nietzsche*, vol. 16, Foulis, Edinburgh, 1911, p. 253. Nietzsche used eternal recurrence on a stochastic (Markovian) model of physical time evolution, and thus used eternal recurrence rather than quasi-recurrence. In short, he fell a victim to Augustinian dichotomy between "linear" and "cyclic" time.

The key point, however, is this. Though an abstraction, the notion of *atman* remains a *physical* notion, in the sense of Popper, since it is embedded in the context of quasi-cyclic time which is refutable (or falsifiable). To reiterate, *atman* in this sense of cosmic recurrence is a physical notion, *not* a metaphysical one.

The other key point is this. Though refutable, this notion is *not* trivially refuted by present-day science. On Newtonian physics, the Poincare recurrence theorem[18] implies that a closed cosmos *must* be recurrent. Poincare recurrence means that any arbitrary (micro) state of the system *must* repeat *infinitely often*, to any given accuracy. Hence, on Newtonian physics, in a closed cosmos, all events must repeat. However, Newtonian physics is known to be incorrect (*conceptually* bad, precisely on the question of time).

The other drawback of Poincare recurrence is that it *forces* repeated rebirth, with no possibility of deliverance or *moksha* as is possible with quasi-cyclic time. Indeed, I have classified Poincare recurrence as supercyclic time to bring out the difference between the two notions of recurrence: eternal recurrence and quasi-recurrence. Mathematically, while Poincare recurrence applies to physics formulated using ordinary differential equations, it does *not* hold with my reformulation of physics using functional differential equations (whether with or without a "tilt in the arrow of time").[19] However, in my reformulation of physics, time may be *quasi*-cyclic if the tilt in the arrow of time *increases* with time. While a strong case can be made out for the existence of a tilt in the arrow of time, based on mundane observations,[20] we do not know today whether or how the tilt changes with time.

To summarise, (1) the core beliefs of Hinduism about आत्मन and मोक्ष are scientific, since refutable, and (2) they are *not* refuted by present-day science. (3) Nor, however, are they confirmed, though one could reasonably conjecture that they hold.

Part 2. The church curse on 'cyclic' time, and time in science

Thus, the question of the scientific validity of those core Hindu beliefs boils down to this. How should one decide the nature of time? How does one check whether or not time is in fact quasi-cyclic?

Unfortunately, as a result of colonial education we today believe that the validity of any novel scientific idea is best decided through certificates of Western approval, not through autonomous study or experiments. The superstition that Western social approval is the only "reliable" source of knowledge is endorsed, enforced, and propagated by Wikipedia to which a vast mass of people refer. Since science involves huge funding, and since the community controls the funds, social approval is all important for scientific practice: recall how the Higgs particle was repeatedly declared to be "the God particle".[21] True science, as distinct from such "social science", is, however, independent of community opinion.

In the present case, of आत्मन and मोक्ष, there is a further pitfall in deciding valid science on community beliefs. Community beliefs in the West may be hostile to it for non-scientific reasons. Thus,

18 A proof of this theorem can be found in any standard text on thermodynamics. For a proof of it in a very general form, see C. K. Raju, "Thermodynamic time", appendix to chp. 4, in *Time: Towards a Consistent Theory*, cited below.

19 C. K. Raju, *Time: Towards a Consistent Theory*, Kluwer Academic, Dordrecht, 1994. Fundamental Theories of Physics, vol. 65. For a more recent account, see the series of articles on "Functional differential equations", in *Physics Education.*

20 E.g., "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.

21 C. K. Raju, "The God particle", *Millennium Post*, 24 July 2012, archived at http://ckraju.net/press/2012/god-particle.gif.

community perceptions about time may be influenced by religious beliefs about time, just as happened earlier with a long series of Western scholars regarding the age of the cosmos. Indeed, long ago (5th Ecumenical Council, 552 CE), the church pronounced its great *curse* (anathema) on the belief in soul, and reincarnation in the context of quasi-cyclic time.

While this church curse on "cyclic" time applies to Hinduism, it was directed not against Hinduism, but against similar beliefs prevalent in early Christianity. Thus, similar notions of soul and quasi-cyclic time are also found among Egyptians (and Maya). The Greeks (and Romans) copied their gods from Egypt.[22] And Iesu is similar to Isis and Bacchus.[23] Hence, it is no surprise that in pre-Nicene Christianity, Origen championed a cycle of "ages", and the related notion of soul and quasi-cyclic time.[24] Indeed, he used notions similar to *karma* and *samskara* to argue that God believed in equity and justice![25]

However, the post-Nicene church rejected equity, for political reasons, since it had married the state, and equity offered no special benefits to Christians in after-life. Also, with many cosmic ages, each of immense duration, people were in no hurry to convert. That affected the church's coffers. The church *hence* cursed that related notion of soul, and repeated lives after death.[26] Briefly, the church replaced reincarnation by resurrection (life after death exactly once): everyone got only one chance. To emphasize the urgency to convert, the church emphasized that doomsday was just around the corner: one had to hurry up and convert or risk being damned for eternity.

This curse changed time perceptions in the West (from quasi-cyclic to apocalyptic time). It also turned the post-Nicene Christian notion of soul into a *metaphysical* and grossly unscientific notion. It is common to translate आत्मन as soul, but this confounds the two notions: the physical notion of आत्मन, and the metaphysical notion of soul in post-Nicene Christianity. Many people somehow believe that there is only one notion of soul which is is necessarily metaphysical.

This church curse on quasi-cyclic time was deeply influenced by the theology of Augustine who misrepresented Origen by confounding quasi-cyclic time with supercyclic time (or the Stoic notion of eternal recurrence). On the strength of this misrepresentation, Augustine claimed that Jesus' death would be in vain, for it would repeat in every cycle of the cosmos. (Origen had explicitly stated that Jesus did not suffer in earlier births.[27]) This confusion between the two pictures of time has so deeply penetrated the Western psyche that it is common to find this confusion even in present-day science. This is a clear example of how religious beliefs about time penetrate science.

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22 Herodotus, *History*, *Euterpé*, 50–58, trans. G. Rawlinson, Encyclopaedia Britannica, Chicago, 1996, p. 60.

23 For details, see, C. K. Raju, *Euclid and Jesus*, chp. 1

24 Origen, *De Principiis*. An easily accessible version is at http://www.newadvent.org/fathers/04122.htm. (The numbering may differ in other versions.) Particularly see II.1.1 for the definition of "world". II.3.1 for the question whether the world is unique. II.3.5 for the connection of "world" to "age", and the claim that the scriptures speak of a series of ages. II.3.4 for the description of exact recurrence and its denial, and for an acceptance of quasi-recurrence ("a diversity of worlds with changes of no unimportant kind"). A summary of relevant passages is posted at http://ckraju.net/papers/Appendix-on-Origen.pdf.

25 Origen, cited above, "every vessel, according to the measure of its purity or impurity, received a place, or region, or condition **by birth**, or an office to discharge, in this world...according to a most impartial retribution.... In which certainly every principle of equity is shown, while the inequality of circumstances preserves the justice of a retribution according to merit." [II.9.8] [Emphasis added]

26 *The Eleven Pictures of Time*, cited above, chp, 2: The curse on 'cyclic' time.

27 Origen asserts that Christ did not suffer in previous incarnations: "Christ did not suffer, nor even in the age which preceded that again; and I know not that I am able to enumerate the number of anterior ages in which He did not suffer. I will show, however, from what statements of Paul I have arrived at this understanding." *De Principis*, cited above, [II.3.5].

Thus, Stephen Hawking's chronology condition[28] (that there are no closed time-like curves), exactly mimics the church curse on "cyclic" time, in science. Like the church he excludes any kind of cyclicity in time by fiat. His arguments in support exactly mimic Augustine's wrong arguments by confounding quasi-cyclic time with supercyclic time.[29] Hawking used this postulate to reach the creationist conclusion[30] that the big bang involves singularities or a true "moment of creation", so that science has proved one time creation.

Further, his supporter Tipler wrote a book explicitly claiming that the Penrose-Hawking singularity theory proved the literal truth of Judeo-Christian theology as physics.[31] (Those who rush to dismiss Tipler as a crank, should note that his "no-return" theorem, prohibiting cosmic recurrence, using singularity theory, was published by the journal *Nature*, the ultimate Western certification, and his book too was published by the same publishers.) The point here is that a gullible belief in the West, as the sole source of valid knowledge, is a grave superstition, instilled by the church/colonial education just so that it can be exploited by the West on appropriate ("exceptional") occasions.

In my debate with Roger Penrose on this issue,[32] preceded by a series of seminars in Delhi University, it emerged that even the physics professors of Delhi University and JNU do not understand the mathematics and physics of singularity theory. Thus, they have no way to ascertain the truth on the strength of their own knowledge. Such ignorance of science combined with a superstitious belief in the West as "reliable" is a recipe for exploitation.

Hawking singularities are not an isolated example. Thus, the very first serious lesson in school science teaches children about Newton's "laws". Now, why should nature have any laws? Is that a scientific belief? Is it refutable? No. But it is a church dogma stated by Aquinas that God rules the world with eternal laws of nature.[33] This church dogma is taught as the first lesson in science, and no secularist to my knowledge ever had the courage to oppose such teaching. This dogma about "laws of nature" as part of science has been used in propaganda against Islam,[34] the current target, but it could equally well be used against Hinduism, and the central idea of *moksha*.

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28 S. W. Hawking and G. F. R. Ellis, *The Large Scale Structure of Space-Time*, Cambridge University Press, 1974.

29 For a comparison, see *The Eleven Pictures of Time*, cited above.

30 The creationist conclusion is the closing sentence of Hawking and Ellis, cited above, p. 364. It is further elaborated in Hawking's popular-level work, such as *A Brief History of Time*. Later on, Hawking modified his conclusions to include the theology of Aquinas. Hawking's prersonal beliefs about God were used for propaganda, but the church is about power, not belief in God. See, e.g., C. K. Raju, in: *DNA*, 16 Jan 2011, p. 9. "The Christian propaganda in Hawking's work". Original title: "Theology in a Scientific Bottle". Text: http://www.dnaindia.com/lifestyle/review_the-christian-propaganda-in-stephen-hawkings-work_1495047. Archived clipping: http://ckraju.net/press/2011/Hawking-review-dna-16-Jan-11-p9.gif.

31 F. J. Tipler, *The physics of immortality*, Macmillan, London, 1996, preface.

32 "Matter of the mind", 2-day debate with Roger Penrose, India International Centre, 22-23 Dec 1997.

33 Thomas Aquinas, *Summa Theologica*, *First part of the Second Part*, 91,1, "a law is nothing else but a dictate of practical reason emanating from the ruler...the whole community of the universe is governed by Divine Reason. Wherefore the very Idea of the government of things in God the Ruler of the universe, has the nature of a law. And since the Divine Reason's conception of things is not subject to time but is eternal, according to Proverbs 8:23, therefore it is that this kind of law must be called eternal." http://www.newadvent.org/summa/2091.htm.

34 C. K. Raju, "Islam and science", Keynote address at International Conference on "Islam and Multiculturalism: Islam, Modern Science and Technology", Asia-Europe Institute, University of Malaya, 5-6 Jan 2013, http://www.ckraju.net/hps-aiu/Islam-and-Science-kl-paper.pdf. In *Islam and Multiculturalism: Islam, Modern Science, and Technology,* ed. Asia-Europe Institute, University of Malaya, and Organization for Islamic Area Studies, Waseda University, Japan, 2013, pp. 1-14.

Likewise, Newton, contrary to his mentor Barrow (who ridiculed Augustine), made time metaphysical[35] and (super-)linear.[36] The conceptual confusion this generated was the exact reason why his physics failed.

These examples of how church beliefs about time have invaded science from Newton till Stephen Hawking are at odds with the naive belief that science is at war with the church. However, those who talk of "science and spirituality", especially religious figures, take science as a given. They do not ever consider the possibility that it may be necessary to modify present-day science to correct the religious biases which have crept into it, particularly into beliefs about time.

Part 3. The religious bias in mathematics and its effect on time beliefs

Both cases of Hawking and "laws of nature" are just examples of religious beliefs in science. At a more fundamental level, a religious bias *systematically* creeps into science through yet another route: present-day formalist mathematics.

People are incredulous at the thought of a religious bias in mathematics: they typically ask, where is the religious bias in 2+2=4? But it is the ignorance of the colonially educated which is pitiable. Ask *why* 2+2=4, and most people try to explain it by pointing out that 2 chairs and 2 chairs make 4 chairs. They are unaware of the fact that this is an empirical proof (प्रत्यक्ष प्रमाण, we can *see* those chairs). They are unaware that the church long ago declared empirical proofs as inferior, and that formal mathematics hence prohibits empirical proofs.

A formal mathematical proof of 2+2=4 is required to commence from some axioms, such as Peano's axioms, or those of axiomatic set theory. Few know what the axioms of formal set theory are (the head of an IIT math department could not even state the formal definition of a set when I challenged him to do so). Equally few know what a formal mathematical proof is. A formal proof is not a simple matter: a proof of 1+1=2 took Russell and Whitehead 368 pages, and nobody I know ever cross-checked it.

Where exactly is the religious bias? Prohibiting empirical proofs, by declaring them "inferior" to deductive proofs, also declares ALL systems of Indian philosophy (Hindu, Buddhist, Jain, Lokayata) as inferior, since all Indian systems, without exception, accept प्रत्यक्ष प्रमाण as the first means of valid knowledge. Such प्रत्यक्ष प्रमाण is accepted also in Indian गणित from the sulba sutra-s through Aryabhata down to the Yuktibhasha.[37] Thus, teaching formal mathematics at one stroke teaches that *all* Indian philosophy (Hindu, Buddhist, Jain, and even the Lokayata) is inferior.

Actually, the connection of mathematics to religious belief in the West goes even deeper. Thus, twenty years before the church cursed "cyclic" time and the related notion of soul, the same Roman king (Justinian) also banned all schools of philosophy and mathematics in the Roman empire. This was done for the little-known reason that mathematics was being used to promote that notion of soul—based on quasi-cyclic time, and very similar to the notion of *atman* central to Hinduism. Once again, the

35 C. K. Raju, "Time: what is it that it can be measured?", *Science & Education*, **15**(6) (2006) pp. 537–551. Draft available from http://ckraju.net/papers/ckr_pendu_1_paper.pdf.

36 For an elaboration, see *Eleven Pictures of Time*, cited above. Barrow had proposed two simple possibilities: that time is linear or cyclic.

37 C. K. Raju, *Cultural Foundations of Mathematics*, Pearson Longman, 2007. Chp. 2 "Proof vs pramana". For an earlier account, see, "Computers, mathematics education, and the alternative epistemology of the calculus in the Yuktibhasa", *Philosophy East and West* **51**(3) 2001 pp. 325-62.

colonised elite are incredulous at the thought that mathematics connects to the notion of soul. Once again, it is their ignorance which is to be pitied.

The very word "mathematics" derives from mathesis, which superficially means "learning". Plato clarified that "all learning is recollection" of eternal ideas in the soul. In Plato's *Meno*, Socrates demonstrates a slave boy's innate knowledge of mathematics. Socrates argues that if the slave boy didn't learn mathematics in this life, then he must have learnt it in a previous life. Socrates concludes that he has proved the existence of the soul. In his *Republic*, whose name our nation proudly carries, but which few read, Plato prescribes the teaching of mathematics quite explicitly *not* for its practical value, but for the good of the soul.[38]

This belief persisted in Neoplatonism, and went through that into the Islamic *falsafa* and *aql-i-kalam*. During the Crusades mathematics returned via Christian rational theology which borrowed from Neoplatonism via Islamic rational theology (since the goal was to persuade Muslims) but adapted it to make it compatible with its post-Nicene reformulation of the notion of soul. The church now glorified reason and declared it universal on the grounds that logic bound even God who could not create an illogical world. Note how, in the above quote from Aquinas, he speaks of Divine Reason, equating reason with the Christian God.

In fact, this notion of reason in mathematics, and the underlying notion of 2-valued logic in mathematical proof, is NOT god given or universal as priests like Aquinas and Kant wrongly said. The slightest familiarity with Indian culture shows that, from the earliest recorded history, Indians had a variety of logics, such as Buddhist catuskoti, Jain syadvada,[39] or Sanjay Belatthputta's seven-fold negation.

Given that reason is *not* culturally universal, the only scientific and secular way to decide the nature of reason and logic is to do so empirically. The moment we decide logic on empirical grounds, all of formalist mathematics crumbles, for empirical proof cannot any longer be held to be inferior to deductive proof. If we do decide logic empirically, it need not be two-valued. The nature of logic depends upon the nature of time. Empirically, time may have a local structure (instead of being a featureless line). The related temporal logic would be a quantum logic,[40] not a 2-valued one.

Abandoning formalism allows us to abandon the present-day Western misunderstanding of calculus, according to which metaphysical real numbers are needed even to write down the equations of physics. This presupposes that time must be like the real line, on pure metaphysical grounds, and without reference to empirical reality. An alternative way of doing calculus, as suggested by this author, thus needs to be promoted, for otherwise there is little possibility of exploring alternative structures of time in physics.

Part 4. Values: practical, not spiritual

If we accept the beliefs in आत्मन and quasi-cyclic time, then मोक्ष or deliverance (मुक्ति) from

38 For a detailed exposition of these and other issues, at an elementary level, see C. K. Raju, *Euclid and Jesus: How and why the church changed mathematics and Christianity across two religious wars*, Multiversity, Penang, 2012.

39 *Cultural Foundations of Mathematics*, cited above.

40 *Time: Towards a Consistent Theory,* cited above.

rebirth the natural *practical* course of action to follow.[41, 42] Repeated life after death is not something desirable. Thus, the belief in मोक्ष or deliverance is belief about the best way to conduct one's life based on a physical understanding of time and the cosmos. We can contest the underlying physical belief, but we should not keep calling it spirituality, in the orientalist tradition which wrongly assumed that the soul can only be metaphysics.

Part 5. What is to be done?

The message needs to be spread that early notions of life after death were all located in the context of cosmic recurrence, and that cosmic recurrence is scientifically possible. Further, people at large need to understand that religious biases about time have penetrated Western science, especially in the matter of time beliefs, and these biases must be eliminated. Further, religious biases have also penetrated mathematics, and an alternative philosophy of mathematics and an alternative way of dong calculus is necessary to be able to reformulate science appropriately to decide what is truly scientifically possible.

Can this be done? Unfortunately, in my experience of the last 40 years, contemporary Indian society has lost the capacity to autonomously handle novel knowledge claims. Colonisation denigrated all autonomously generated knowledge, so there is no longer any respect for it. The colonised elite are deeply mired in false church history and superstitious belief in Western certificates of appreciation. The Indian self-image, even about central issues, is completely determined by Western perceptions of spirituality. As for the masses, despite IT, they today value cricketers, film stars, neta-s and babu-s, wealthy people, and also swamis and other religious figures, and even some science managers. However, none of these socially respected figures (including science babus) have the requisite knowledge of science even to fully *understand* or publicly debate the novel answer that was proposed above that a different (but scientific) notion of time is central to the core beliefs of Hinduism.

Today devout Hindus spend billions on erecting temples. They believe they are helping to preserve tradition. What is needed to preserve tradition however is not more spaces for idols, but more social spaces for the knowledgeable—the truly knowledgeable who can work seriously on issues such as time at the real interface of science and religion, and not just produce apologias in imitation of church tradition.

41 C. K. Raju, "Reconstruction of values: the role of science", In: *Cultural Reorientation in Modern India* (ed. Indu Banga and Jaidev), IIAS, Shimla, 1996, pp. 369–392.

42 C. K. Raju, "Harmony principle", in *Philosophy East and West*, **63** (4) 2013, pp. 586-604. http://www.ckraju.net/papers/Harmony-principle-pew.pdf. Similar article in Shail Mayaram ed. *Samvad and Svaraj*, Sage, 2014, pp. 232-250.

About the author

C. K. Raju holds an MSc in math from Mumbai, and a PhD from the Indian Statistical Institute, Kolkata. He initially taught at Pune University, and researched in formal math (functional analysis), for several years. He was responsible for porting applications on India's first supercomputer Param, and has long been a Professor of mathematics and computer science, in various universities, in India and abroad. He has developed and maintains software for educational and industrial use. In 2010 he received the TGA gold medal in Hungary.

He has authored several critically acclaimed books, putting forward novel theses. In *Time: Towards a Consistent Theory* (Kluwer, 1994) he argued for a fundamentally new physics using functional differential equations, overlooked by Einstein. In *Cultural Foundations of Mathematics* (Pearson Longman, 2007) he proposed a new philosophy of math, called zeroism, and related it to the development of calculus in India while compiling evidence for its transmission to Europe in the 16th c. He later showed how correcting Newton's mistake about calculus also leads to a better theory of retarded gravitation, using functional differential equations. In the *Eleven Pictures of Time* (Sage, 2003) he related science and various religions through the shared interface of time perceptions. His shorter books include *Is Science Western in Origin?* and *Ending Academic Imperialism*. In *Euclid and Jesus* he explained for the layperson how religious beliefs enter into Western mathematics.

He has demonstrated through teaching experiments in 5 universities in 3 countries that teaching calculus with zeroism, as it developed in India, makes it easy enough to be taught in five days, and enables student to do harder problems not covered in usual calculus courses. He has also developed and taught other decolonised courses in math, physics, statistics, computers, and the history and philosophy of science.

In his research he has challenged a number of leading Western icons, including Isaac Newton, Albert Einstein, Richard Feynman, Stephen Hawking, Bertrand Russell, Karl Popper, Thomas Kuhn. He has also debunked many Western myths including those of Euclid, Archimedes, Aristotle, Claudius Ptolemy, Copernicus, Kepler, etc. His research has been coveted and repeatedly plagiarised by Westerners, including by a former President of the Royal Society.

As regards social sciences and humanities, he has been on the editorial board of *Journal of Indian Council of Philosophical Research*, etc., an Editorial Fellow of the Project of History of Indian Science, Philosophy and Culture, a Fellow of the Indian Institute of Advanced Study, and Associate Fellow of Nehru Memorial Museum and Library, etc. He is Vice-President of the People's Council of Education, and President-elect of the Indian Social Science Academy.