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OPINION

Star Wars in colonial Tamil region: contours of a discourse between European missionary and a ‘native’ pañcāngkam computer on ‘modern’ astronomy

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“*I can reject [Christianity, Hinduism]*[1] *Islam or Buddhism without making myself ridiculous, but I cannot deny the sphericity of the earth without ruling myself out of the community of rational beings, irrespective of race, nationality or religion.*” George Sarton, ‘Experiments with Truth by Faraday, Darwin, and Gandhi,’ Osiris, 1954, 11:87–107, on p. 107

ABSTRACT

A showdown between an overbearing American missionary wielding Copernican astronomy and a proud ‘native’ Tamil pañcāngkam computer clinging to absurd purāṇic myths may appear as an obvious fertile field to narrate the story of the spread of western science. Errors in native pañcāngkam were publicly demonstrated during the lunar eclipse on March 20, 1829, shocking the audacious natives to the core. This incident left the complacent native literati were dismayed to see the European missionaries could predict the eclipses without using to native ‘secret mnemonics’ Vākya. While the missionaries were perplexed at the predictions, even if inexact, made by the Tamil pañcāngkam paying obeisance to kantapurāṇam, which was steeped in flat earth theory, with legendary Mount Meru at the centre surrounded by concentric alternating seven continents and seven seas with luminaries like Sun, Moon and Grahas going around the axle passing through the centre of Meru. In ensuing interactions, conviviality, circulation and cosmopolitanism of ideas, the native literati encountering novel instruments like globe, telescope, clock, orrery, eclipse diagram, and the missionaries gleaning hitherto mysterious Vākya method and the heritage of native astronomy, cannot be fully captured the in the dichotomies of western/non-western (Hindu, Arabic and so on), metropole and periphery, traditional and modern, and secular and religious. The reconfiguration of ideas, both by natives and missionaries, were not by coercion, but by compulsion of

1 Added by the author for completeness sake.

ocular evidence and the protagonists behaved as if they were members of one community of rational beings, despite power hierarchies.

KEYWORDS: Rational Thinking, Western Science, Scientific Observation, Scientific Events

Introduction

The anticipation was in the air. That night, March 20, 1829, a partial lunar eclipse was computed to occur. A huge, boisterous crowd had assembled at the American Seminary at Batticotta near Jaffna, in the island of Ceylon. The raucous crowd had gathered to witness not just the awe inspiring cosmic spectacle, but also to witness to a grand brawl between their own 'native' almanack maker and the American missionary. Rev Daniel Poor of the American mission seminary at Batticotta had previously examined the native almanack computed by the reputed pañcāngkam[2] (almanack) maker Vicuvanāta sāsthriyār[3] and found it to be deviating from the computations presented in the European tables. Vicuvanāta sāsthriyār insisted that his computations derived from methods revealed in great antiquity would not fail. He was confident that the pañcāngkam was accurate and his timeless sāsthrā will not fail. Both had agreed for an intellectual duel of sorts; who's prediction would come out to be true. Which computation stands the test of observation? The 'native' crowd sure of themselves and reposing faith in the sāsthrā as well as the acumen of Vicuvanāta sāsthriyār, were waiting to see the missionaries being proved wrong. Only the time will tell; they have to wait patiently until the sun sets on the western horizon.

The emergence of the ideology of 'western science' is closely connected with the rise of colonial powers and colonial hegemony. This ideology by denying at the same breath the universality of modern science as well as the contributions made by non-European cultures and societies to the founding of the modern science placed the European civilisation on the pedestal. The privileging of science (and reason) among some natives created a counter ideology 'Eastern spiritualism'. Elsewhere I have argued (Venteswaran, 2007) that the educated 'native' intellectuals, during the late nineteenth and early twentieth

2 Tamil pronunciation of Pañcāṅga, traditional Hindu almanacs.

3 His name is spelt as Vesuvenathan in the contemporary missionary accounts.

century, rejected the notion of 'western science' and preferred to use 'modern' as the qualifier to the post-Galilean sciences, in their effort to blunt the cultural hegemony in the colonial context. 'Given the violence of the imperial experience', although 'it is tempting to imagine that different sciences and religions came into conflict' during the colonial period (Sivasundaram, 2010) 'notes that the argument is a 'misguided view'. There was 'repositioning of histories' by different communities, 'interrogation of beliefs about nature and life in the face of fresh ideas imported from other parts of the globe' which led to synthesis, collaboration, and renewal of both the sciences and religion.

Using the above episode of public wrangling between a European missionary and a 'native' almanack maker, encounter of modern science with 'local knowledge', this paper traces the response of the 'native' intelligentsia to the modern science introduced by the Europeans, during the early nineteenth-century Tamil region. What did people outside Europe, in particular, native intellectuals, make of the idea of 'Western' science? Novel instruments like a telescope, globe, clocks and so on, were introduced. How did the 'native' intellectuals react to these artefacts and legitimacy of using them to obtain and validate scientific knowledge? This paper argues that the dichotomies of western/non-western (Hindu, Arabic and so on), metropole and periphery, traditional and modern, and secular and religious to frame the encounter between the so-called modern European sciences and the traditional Indian science proves inadequate to appreciate the circulation and cosmopolitanism of ideas, in particular in sciences.

The Protagonists

Vicuvanāta sāsthriyār (1756–1845) (Pridhan, 1849) was an accomplished poet and a celebrated astronomer. Born at Araly in the Vaddukoddai region near Jaffna, his almanack or pañcāngkam was known for its accu racy[4] and was widely used by the Tamil

4 In the absence of handy devices like mechanical clock, it was not easy for the general population to actually verify the 'accuracy' of celestial events. Numerous cases of 'inaccurate' predictions were known, and Warren recalls an instance of huge crowd gathered at the Madras beach at the behest of a Madras almanac-maker merely expressed 'merriment on his ill-proficiency.'

people in Ceylon. It was said that nine generation preceding him were also celebrated pañcāngkam computers. Sir Alexander Johnston Chief Justice of Ceylon was 'pleased with his intelligence', that he 'procured for him from the George the IVth the honorary distinction of 'Almanack Maker to his Majesty' (Paridhan, 1849). In his pañcāngkam for the year 1828-29, Vicuvanāta sāsthriyār had predicted an eclipse of the moon on the 21st March, at twenty-four minutes past six pm, which was to obscure five-eighths of the lunar disc.

Daniel Poor (1789-1855) was an American Presbyterian missionary who arrived at Ceylon in 1816 to organise and run the American Seminary at Batticotta. A graduate of Dartmouth and M.A from Theological Seminary at Andover, Massachusetts, Rev. Daniel Poor volunteered to visit Jaffna, and founded the 'Common Free School', the first English school in Jaffna and converted it into 'Family Boarding School' in 1818. Dr Daniel Poor learnt Tamil and commenced preaching in Tamil just a year from the day he arrived in Tellippalai. Initially, twenty-six students, mainly Veḷḷāḷa, were enrolled in a four-year long curriculum that included a study of Bible and theology, astronomy and the natural sciences, but very soon became popular and much sought after educational institution in Jaffna region. He was also the first principal to admit girls and Dalit students to a school. He also established the now famous American College at Madurai, South India and was known for his efforts in at introduction of modern schools and colleges in Southern India and Ceylon. With the help of his native Tamil assistant, George Dashiel, Rev. Poor had learnt to read and interpret the native pañcāngkam. He had been noting the discrepancy between the computations of the pañcāngkam and the predictions of the European nautical almanack as well as Ferguson's and Enfield's astronomical tables[5].

5 'In the course of a few weeks he [Vicuvanāta sāsthriyār] sent me the result of his calculations showing the exact time of new and full moons for 1828. On comparing his account with the Nautical Almanac, I find the difference of time to be from three to fifty-two minutes, and in most instances later than the true time', 1830, Missionary Herald Vol XXVI, ABCFM, Crocker and Brewster, Boston pp 150

Missionaries and Eclipses

Within few weeks after his landing at Jaffna, a spectacular annular solar eclipse ensued on May 16, 1818. Rev Poor was enchanted with the 'beautiful appearance' (Missionary Herald, 1818) of the annular phase that lasted few minutes, and curious that although the sky was clear, and the sun was at vertical, the 'sun emitted but a faint light'. He also noticed that the 'the thermometer fell several degrees, and the air became much cooler.' While, he, an educated European was marvelling at the cosmic wonder, in contrast, the natives were anxious. He was amused to hear from some of the 'natives' that there are 'two planets, one called Ragoo, and the other Kadoo, in the shape of serpents, which intercept the light of the sun and the moon; the former causing an eclipse of the sun, and the latter that of the moon.' Moreover 'the common people, and most of the Brahmins' had even 'more gross ideas of the subject' and asserted that 'there is a large snake in the heavens, which bites the sun or the moon in an eclipse, and that when the eclipse is total, the snake swallows the sun or the moon.' In the midst of all these, there were local panchangins (Baden-Powell, 1896) who made visits to 'principal inhabitants to receive presents' and read the pañcāngkam.

Missionaries thought that the 'whole system of geography and astronomy, as taught in the Hindoo shasters is fabulous in the extreme' (4th Triennial Report, 1836) and 'verity of astrological predictions is one of the strong pillars of idolatry' and the 'prevailing notions astrology' which in-turn is 'closely interwoven with the mythology of the country'. Further, they thought that (Tucker, 1848) 'Bramins.. by their knowledge of astronomy foretold an eclipse, the people imagined them [possessing] supernatural power....'. As the 'phenomena of eclipses' (...) 'awaken universal attention', the missionaries posited that 'important advantages' can be 'gained by bringing into notice the errors of the Purana on this subject (4th Triennial Report, 1836).'

Until late nineteenth century, this remained an important theme in the school science and the educational efforts of missionaries and colonial government. The textbooks and instructional materials invariably discussed the phenomena of eclipse to demonstrate the absurdity of the Puranic myths[6]. Even casual traveller noted the penchant of colonial officials for using eclipses to demonstrate the superiority of the 'European sciences'. Julia Charlotte Maitland, a traveller to the South India during 1838 recalls how a British official used oranges and limes for the moon and earth to explain the phenomena of eclipses, to a terrified Bramin postmaster who was afraid that the serpent might eat up the Moon entirely (Maitland, 1861). Spencer, G.T. notes in journal (Spencer, 1845) 'Whilst I was writing, I remarked a strange shade come over the intensely bright sunshine, and found upon going out of my tent that there was an eclipse of the sun. I do not wonder at nations ignorant of its cause being startled and alarmed at such a sight. I asked one of my Hindoo servants what it was, and he told me, a snake was eating the sun. On putting the same question to a Mussulman, I was informed that the sun was in debt to somebody a large sum of money and that the creditor was then recovering it from him. To the Christian, this signs in the sun simply but emphatically declares the glory of Him that made it, and proclaims his handy-work'.

Rev Abraham Roger (Rogerius) who landed at Pulicat a coastal village off present day Chennai, way back in 1632, readily noticed the ubiquitousness of pañcāngkam and everyone (Donald and Edwin, 1994) 'made and alter their plans according to auspicious days and omens' and 'may miss sailing with the monsoons of the signs are not right'. The pañcāngkam computer was treated with great respect and deference. The missionaries observed that the'eclipses of the sun and moon, which they foretell from year to year, are regarded by the people as ocular demonstrations of the truth, not only of their system of eclipses but also of their mythology' (American Report of Commissioner

6 See for example Rev E Sargent, Thathuva Sasthram, Church Mission Press, Palayamcotta, 1874, p6; Christian Vernacular Education Society, Graganangal Yerpadum Karanangal, 1880; challenges the traditional Hindu popular mythological belief on Rahu and Kethu being the cause of Eclipse and provides 'scientific' explanation to the eclipse. Christian Vernacular Education Society, 'Pagola Sasthramum Jothista Sasthramum', 1891 aims to show 'belief in Jothista Sasthram leads to calamity'.see also, Selections from the Records of the Madras Government No LXIX: Report on Public Instruction in the Madras Presidency for 1859-60, Public Instruction Press, Madras, 1861, (p.66) for the 'official' prescribed curriculum for schools.

for Foreign Mission, 1834). Mr Schmid, another missionary in southern India was astonished by the smug dismissive attitude of the educated natives who said 'you may have necessity to read our books, but we do not want yours' and continued that the 'the science of predicting the eclipses of the sun and moon, contained in their sāsthrā, was a proof that their Vedams were of divine authority Missionary Register, 1824).' When presented with a globe, Vicuvanāta sāsthriyār, haughtily rebuffed, (Missionary Herald, 1831) 'Whatever proofs they produce, that the earth is round, this opinion cannot be admitted, as it contradicts the opinion of all antiquity'. These circumstances, as well as the 'interesting nature of the study, have made astronomy a subject of particular attention' amongst missionaries[7].

The Lunar Eclipse of 1829

On March 20, 1829, a partial lunar eclipse commenced at 12:57 UT and ended at 15:19 UT with the greatest magnitude at 14:08 UT. The 142 minutes long partial lunar eclipse had a magnitude of 0.372. Using the Nautical Almanac Rev Poor computed that the eclipse should commence nine minutes after sunset and that the three-eighths of the moon's disk will be eclipsed. The pañcāngkam by the Vicuvanāta sāsthriyār had predicted that the eclipse would commence 24 minutes after the sunset. Further, the almanack also claimed that five eighths of the moon's disc would obscure during the maximum eclipse and the total duration of the eclipse was computed to be 24 minutes more than that computed by the Nautical almanack.

Rev Poor was baffled by the glaring errors in the pañcāngkam, for instance, summer and winter solstices, were computed by pañcāngkam to be on 1st July and 10th January, but in fact were shown to be truly twenty days earlier (Winslow, 1840). He even erected a vertical pole and observed the shadow at noon to show

7 See also Elshakry, M., 2007. The gospel of science and American evangelism in late Ottoman Beirut. Past and present, 196(1), pp.173-214 and Dixon, T., Cantor, G. and Pumfrey, S. eds., 2010. Science and religion: New historical perspectives. Cambridge University Press for accounts of use of eclipses by the missionaries to demonstrate shortcoming among the 'native' cosmological systems.

the error in the pañcāngkam computation[8]. Even when Vicuvanāta sāsthriyār, keeping the social standing in mind, refused to meet in person, through a native convert, Dashiel, Rev Poor established a conversation. Intrigued at the native astronomy, as embodied in the pañcāngkam, Rev Poor requested Vicuvanāta sāsthriyār to provide the exact time of the new and full moons of the current year for comparing the native system of astronomy with the European. Once the table was made available, Rev Poor compared it with Nautical Almanac, found discrepancy ranging between three to fifty-two minutes.

It was in the course of this comparison; Poor found an error in the computation for the next eclipse. Rev. Poor sent a word to Vicuvanāta sāsthriyār pointing out the errors in the computations on the forthcoming eclipse. On hearing the discordance, Vicuvanāta sāsthriyār carefully reviewed his calculations and re-affirmed their correctness.

Disputes between various computations of astronomical events within the 'native' systems were not that uncommon in early nineteenth century. For instance, when the total solar eclipse occurred on 16 May 1817, 'considerable interest....was excited at Madras by the disagreement between the English and the Hindoo anticipation of this eclipse, as given in their respective local almanacks' (Blackwood's Edinburg Magazine, 1818). However, in this case, 'the Hindoo estimation proved by much the most accurate' as compared to the one computed by the Madras Observatory. Often computations mismatched from one almanack to another, (Nair, 2014) 'Serfoji's palace astronomers, the Madras Almanac and the Tranquebar Mission Almanac, disagreed with each other on the prediction of eclipses' during the early nineteenth century.

However, the dispute was with the nautical almanack. Amused Rev Poor had challenged the native almanack maker to put both the computations to the test of observation, to which the curious

8 This is a traditional method for determining time often used in pañcāngkam; time is often given as the length of the shadow of a śaṅku (gnomon). See S R Sarma, Astronomical Instruments in India, in Ruggles, C.L. ed., 2015. Handbook of Archaeoastronomy and Ethnoastronomy. Berlin: Springer., p 2007-2016

Vicuvanāta sāsthriyār readily agreed. If both Rev Poor and Vicuvanāta sāsthriyār are on two sides then who will play the 'umpire'? Rev Poor requested the paṇṭāram, temple priest, from the local kaṇṇakiyamman temple to adjudicate the contest. The paṇṭāram acquainted himself with the methods of time reckoning using both European clocks as well as traditional Indian shadow of the gnomon (śaṅku), ghatikā (clepsydra) and so on be an umpire.

The controversy became public and excited the Tamil population. Brahmins, confident of their computations instigated the local populace to assemble near the seminary to witness the approaching triumph of their religion over the errors of the *mleccha*. If the Europeans have been curious, the Brahmin and traditional educated Veḷḷāla scholars were initially dismissive of the Europeans.

On the day of eclipse a large crowd of the public, numbering more than hundred, gathered at the seminary grounds well before the appointed time. The sunset occurred at six pm, as 20th March, being very close to the vernal equinox. To the dismay of all those gathered, at the appointed time, instead of the moon, a small passing cloud was rising in the east, intercepting the view. 'At ten minutes after six, ...its northeastern limb was a little obscured, but it was not easy to determine whether this was occasioned by the cloud, or by the earth's shadow' (Missionary Herlad, 1830) 'It is the cloud,' cried the 'natives'. 'At twelve minutes after six all doubt was removed, and it was evident to all present that the eclipse had commenced several minutes previously'. Indeed the eclipse began correctly at the time predicted by Rev Poor, much to the discomfort of natives. However, the issue of the contest was not yet fully decided: two other tests remained to be tried, the extent of the obscuration, and the ultimate duration of the eclipse. These were watched with extreme anxiety by all those who gathered. In the end, to the dismay of all present, including the paṇṭāram, the native calculation was wrong in all the three particulars as predicted by Rev Poor.

While the eclipse was in progress, Rev Poor gave a lecture explaining the 'scientific' theory behind the eclipse using an orrery. The artificial moon in the orrery was seen partially eclipsed by the earth's shadow, causing 'eclipse'. Amazed paṇṭāram listened with great interest to the lecture by Rev Poor, made several judicious inquiries, convinced, at last, spoke openly in favour of the new theory. Nevertheless, paṇṭāram dismissed and scoffed at the connexion between the native systems of astronomy and religion, and that though the former should be overthrown, the latter would remain for ever unimpaired. The incident had a ripple effect all over Jaffna. One of the seminary students who visited his village were surrounded by a large crowd wanting to know the theory of eclipse professed by Europeans. He readily arranged a 'representation of the eclipse.....by means of a lamp and two small balls' and explained the theory (Missionary Herlad, 1830). While some observed that 'they ought not hastily to reject the opinions of their forefathers', others were pleased and 'heartily laughed at the idea that a serpent had seized the moon'.

This public spectacle was not the last. Once again when a total lunar eclipse ensued on September 3, 1830, Rev Poor made computations and published a comparative statement of the European and native calculation of the eclipse. The lunar eclipse 'commenced at the expected moment, to the freat joy of the members of the seminary' and the paṇṭāram 'pleasantly remarked, 'I see you are right again.'

The Cosmos in the Native Imagination

The cosmic description contained in the kantapurāṇam written in Tamil by Kacciyappacivācāriyar following the skaṇḍha mahāpurāṇam in Sanskrit informed and inspired the educated and lay 'native' public in the Jaffna region. Written in the style of purāṇ, celebrating the fêtes of Murugan (also called kanthan in Tamil), this work contains a chapter devoted to the description of earth and universe (Sivaraman, 2014). In the asura kāṇadam chapter anṭakōsa paṭalam sub section, the teacher of asuras, cukrācāriyār tells sūrapatmaṉ that earth is a flat, circular, with legendary Mount mēru at its centre. Unlike ordinary mountains, mēru is wider at the tip than the base, and the base of Mount mēru is encircled by seven concentric oceans and land mass. Hence the whole structure of Mount Meru and the landmass surrounding it looks like a bud of lotus. The tip of the mēru is the abode of gods, and the all the grahas including Sun and Moon revolve in a parallel plane around the imaginary axis around mēru. The central piece of the landmass is called Jambudweepan due to the abundant presence of 'naval'[9] fruit bearing tree. Above the Mount Meru are seven horizontal planes abode of various celestial luminaries such as Sun. Below the land are the subterranean netherworlds. Earth, grahas their maṉṭalams, stars and everything are enclosed in an egg-shaped space, anṭam, which extends to five crore Yojana in all the directions of Mount Meru.

The rhythm of day and night ensue as the sun revolves around mēru. Suryamaṉṭalam, the orbit of the sun, according to this purāṇ is at a distance of one lakh Yojana and cantramaṉṭalam, the abode of the moon is twice far as the sun from the earth. The 'maṉṭalams', abode/ orbits of other grahas are much above the cantramaṉṭalam. In addition to the four visible planets, Mercury, Venus, Mars, Jupiter and Saturn, the purāṇ also postulates the existence of two 'shadowy' planets Rahu and Ketu. Served head and tail of a serpent demon, these two 'shadow' planets harbour primal enmity and chase the sun and the moon. From time to time, they ravenously devour Sun and Moon resulting in solar/lunar eclipses[10].

Some simple trigonometry demonstrated to Rev Poor the untenability of the kantapurāṇam. 'In the Purana, the Polar Star is supposed to be situated directly above the summit of Mount Meru,

9 Tropical tree, Jamun i.e., Syzygium cumini

10 This is but one of the stories of 'local'. Spencer, G.T., notes another 'local' story; 'There was an eclipse of the moon last night. The Hindoo legend of the cause of a lunar eclipse is, that Gunputty climbed one night up a cocoanut-tree to refresh himself with a draught of milk from a nut, but in the midst of his enjoyment, the moon, which had been hidden by a cloud, suddenly burst forth in her glory, and detected the god in the somewhat ungodlike act of thus quenching his thirst. In his anger he squirted from his mouth some of the juice on the impertinently intruding planet, which left upon her countenance a deep stain; (it is not chronicled whether the deity was a chewer of betel;) and although time has almost worn it out, still this mark of her guilt and her punishment will break out again at certain seasons; and this we, in our ignorance, call an eclipse of the moon. The devout Hindoo never looks, therefore, at the moon when in that plight, lest the sight should bring to mind the indignity she presumed to inflict on Gunputty, by daring to gaze at him when it was his pleasure 'to preserve a strict incognito.' This legend is common in Canara and Malabar, but I am not aware that it extends to the other coast. I should think Neelcunde one of the prettiest spots in the world.' Spencer, G.T., 1845. Journal of a Visitation-tour, in 1843-4, Through Part of the Western Portion of His Diocese. Rivington. Pp 139

or the centre of the Earth, at the height of 1,500,000 yojanas, or more than 27,000,000 of miles' (Thierd Triennial Report, 1833). When observed from Batticotta the pole star was nearly 10 degrees. Thus if we take a right triangle with hypotenuse 27,000,000 miles and base angle 10 degree, then he computed and showed that from Batticotta 'Mount Meru so distant that we, instead of being in the first or Jambu Island, as is said in the Purana, must be as far off as the sixth Island'. Further for the pole star to rise by one degree, one had to just go to 'Negapatam' [Nagapattanam], but if the Earth were flat one would have had to travel about fourteen millions of miles. If the Earth were flat, England, where the pole star is 62 degrees high would be so far away that it would take 'journey some thousands of years' to reach Batticotta. Thus the description of the Earth was way off the mark in the purāṇam.

Puzzled Rev Poor

The missionaries may have 'won' the public contest and showed to the gathered 'natives' the accuracy of the European method in contrast to the Tamil method of computation of astronomical events. Having circumnavigated the Earth and sent expeditions to four corners of the world, Europe was much aware of the structure, shape, size and location of Earth in the cosmos. It was readily apparent, the myths of purāṇ like mount Meru and seven concentric oceans were but fantastic stories devoid of any truth.

He published a tract, following the dramatic events surrounding the 1829 lunar eclipse, when a lunar eclipse that was to take place on September 3, 1830. This provided a legitimate context to compare once again the computations and predictions made by Vicuvanāta sāsthriyār and extracted from the nautical almanack. Once again the predictions differed widely; (Missionary Herald, 1831) 'The eclipse will commence, according to the European account, at thirty-five minutes after eight o'clock, P. M., and according to the Tamulian account, at one minute after nine o'clock. The discrepance is greater at the beginning than at the ending of the eclipse.'

Presenting both the predictions, Rev Poor wrote a tract, titled 'astronomical errors (in Tamil)'. The objective of the publication was 1. To expose the fallacy of the argument urged by many in support of the Hindoo mythology, arising from the ability of the native astronomers to foretell eclipses. 2. To point out the errors which we have noticed in their calculations within a period of three years—having particular reference to the eclipse. 3. To awaken the attention of the people to the prevailing absurd theory of eclipses, which is taught in their most sacred books and interwoven with the whole system of Hindoo mythology (Missionary Herlad, 1831).' This publication presented the 'errors found in the calculations of eclipses, given in the native almanack, for two years preceding' and also about the 'those in reference to the eclipse that was about to happen' (American Board of Commissioner for Foreign Missions, 1834). Further, the publication gave some information on the 'eclipses of Jupiter's satellites, and the periodical return of comets', unknown to the native astronomy. The tract attempted to 'to expose the... fallacy of the argument... in favor of their whole system of idolatry, that Hindoo astronomers are able to foretel eclipses.. 'and so on.

He expanded and addressed many more doubts of the natives in his second tract published in 1833. A second tract that was published soon afterwards, with the aid of Jaffna Tract Society took the kantapurāṇam head-on. 'Mount Meru in its centre' and other 'absurdities in geography and astronomy' including the 'popular theory of eclipses' as found in the kantapurāṇam, are 'demonstrably false'.

Pointing out inaccuracies and trying to cast aspersions on native religion is one thing, trying to make sense native method for computation, albeit, not so accurate, is another matter. The Cosmos according to kantapurāṇam, endorsed by 'native' almanack makers was not just geocentric but was also a cocktail of ludicrous and preposterous. It was clear that geocentrism of the native cosmos was not itself a major hurdle for computing eclipses. After all, Europe, until Copernicus had managed with the Ptolemaic model and indeed predicted eclipses accurately enough. However, the earth was spherical in the Ptolemaic model, while kantapurāṇam considered Earth to be flat and Sun closer than Moon. If indeed the calculations were based on the planetary distances and other figures mentioned in kantapurāṇam, the almanack ought to be untenable[11]. Despite native pañcāngkam makers obeisance to kantapurāṇam, Rev Poor was sure that there must be another computational algorithm that predicted the astronomical events reasonably well.

Rediscovering Elements of Science in Indian Antiquity

Āryabhaṭa (476–550 CE), mathematician and astronomer asserted spherical nature of Earth, diurnal motion and revolution of through space around a stationary Sun and explained eclipses and lunation in 'scientific' terms of shadows, illumination and angle of sun's rays. 'In a lunar eclipse, the Moon enters the shadow of the Earth. In a solar eclipse, it enters the Sun's disc. Hence, a lunar eclipse does not begin on the western side, and solar eclipse does not begin in eastern side', said the astronomer Varāhamihira (505–587 CE). Much before the arrival of Europeans, many Indian astronomers have understood the geometry of the eclipses and have designed various computations to foretell the oncoming eclipses[12]. Kochhar opines that 'from 6th century CE till the time of Kepler's laws, Indian astronomers were probably the only ones in the world who could calculate eclipses with any degree of accuracy' (Kochchar, 2010) As Keller observes in ancient days, texts written on ola and copied from one repository to another, only relevant portions were taken (Keller, 2010). Rarely full text was possessed by many. Of course, Rev Poor was not aware of all these history, as most of the Indian work had been placed in oblivion with very few learning these books in those days.

When the eclipse commenced as predicted by Rev Poor, it was clear to all those assembled that had erred badly. Sullen and irate

11 Recall Rev Poor use of simple trigonometry to show that if one follows kantapurāṇam, then Batticotta should be placed really far away from the Meru, Pole.

12 See for a review of eclipses in Indian heritage. Vahia, M.N. and Subbarayappa, B.V., 2011. Eclipses in ancient India. In Proceedings of the Fourth Sympposium on History of Astronomy (eds Soma, M. and Tanikawa, K.), NAO, Japan (pp. 16-19).

paṇṭāram and the local crowd were[13] 'silent for a while' but then 'began to abuse' Vicuvanāta sāsthriyār. Sure Rev. Poor would have rejoiced at the turn of events and deck tilting towards him. It is not decimating but dialoguing that he desired. He even wrote in his journal (Missionary Herald, 1830), 'for several days after the eclipse; I was unwilling that Dashiel should visit the old, astronomer, lest he should think I wished to triumph over him'. Rather than joining the crowd in renouncing, Rev. Poor defended Vicuvanāta sāsthriyār on the ground that 'even the most learned men are liable to mistakes'. He had a high opinion of the capabilities of Vicuvanāta sāsthriyār, which at a later date he even offered a proposal for him to reach the Sanskrit language at the seminary (Missionary Herald, 1832).

Even while mocking the popular mythology of Rahu and Ketu, heavenly serpent monsters, devoured the sun and the moon, and thus occasioning eclipses[14], Rev Poor, perhaps aware of a different Indian tradition. He says[15] '... [t]hese serpents were doubtless originally intended as emblems of the ascending and descending nodes, called, even in some of our almanacks, the 'dragon's head' and 'dragon's tail,' near which alone eclipses can take place'. Echoing Lallācārya (Chatterjee, 1981) 'If your opinion is that a demon (Ragu/Ketu) invariably devours [the moon or sun] employing magic, how is it [that the event can be] found by calculation? Moreover, how [is it that there is] no eclipse except [at] new or full moon?', Rev. Poor tauntingly says 'strange as it may seem, their learned men can calculate the time when it will please Rahoo to seize the moon, how much of it will come within his grasp, and how long the struggle will continue.' Rev Poor was convinced of the 'high attainments in astronomy made by the Hindoos more than four thousand years ago', based upon his reading of J.Bently's on the antiquity of Surya Siddhanta in

13. Cited in Tracy, J., 1842. History of the American Board of Commissioners for Foreign Missions. MW Dodd., pp217
14 See Rajesh Kochhar, Historical Notes: Rahu and Ketu in Mythological and Astronomological Contexts, Indian Journal of History of Science, 45.2 (2010) 287-297 for a discussion of the evolution of the mythology and use of the terms, Rahu and Ketu, in Indian astronomical tradition.
15. Cited in Tracy, J., 1842. History of the American Board of Commissioners for Foreign Missions. MW Dodd., pp217

the Asiatic Researches, vol 6. He says ‘most ancient and approved system of astronomy, called Suria Siddanta, now extant in India’ is ‘well worthy the attention’.

The quest led him to re-discover episodes from the history of rational tradition in Indian astronomy and also ascertain the precise computational methods used by the ‘native’ Tamil pañcāngkam maker. After many months of interaction, Vicuvanāta sāsthriyār indeed pulled out a large volume written on Olas (cadjan leaf), which he identified Ernnel (ennul), a standard work for astronomical computation written in Tamil based on a Sanskrit text. However, he just permitted Dashiel to read just a few lines and refused to supply a copy to Rev. Poor saying that ‘If this book should fall into the hands of the missionaries, the people would cease to honor us and worship our gods.’ Undeterred, Rev Poor made many efforts to procure the copy of the text based on which the Tamil pañcāngkam makers were computing their almanacks. Even as early as 1825, Rev Poor was soliciting a copy of the ‘standard work on astronomy’ used by the native pañcāngkam computers. As the price quoted was exorbitant, and as he was not sure he was being given the correct copy, he did not venture to buy it. However, with the help of Dashiel, he was able to procure a copy of the (American Board of Commissioner for Foreign Mission, 1831) ‘standard work on astronomy, which is highly prized by the astronomers [in Jaffna]’ in 1829[16]. Tempered by this illumination, the rhetoric of Batticotta missionaries mellowed.

Observing the popularity and sequentiality of the almanack in everyday life of the Tamil society, Batticotta missionaries prepared their own ‘Tamil almanack’, which was prepared using the computations of the nautical almanack. The predictions for the phenomena like eclipse agreed with the observation, and hence the almanack asserted the superiority of itself over other native computations. From 1834 the Batticotta almanack was prepared and published with a print run of 30,000 copies distributed gratis,

16 This was a work by Ullamutaiyan, a Vākya mode of computational algorithms. It was later edited and published. Hoisington, H.R., 1848. [Coticattiram] The Oriental astronomer; being a complete system of Hindu astronomy, accompanied with a translation and numerous explanatory notes; with an appendix. Jaffna, American Mission Press, 1848.

including in mainland India. Computed and prepared by George Dashiell and Henry Hoisington, this almanack was initially cast in the idiom of the traditional pañcāngkam. Except for prognostication, all the five elements, Pañca (five) ñga (limbs/parts), being Vāra, that is, week day; Tithi, that is lunar day. It is indicative of the phase of the Moon; nakṣatra, that is, position of the Moon in the nakṣatra division; Yoga (means literally addition) that is the time period when the longitudinal motions of the Sun and the Moon when added amounts to 13° 12' or its integral multiple and Karaṇa that is half period of a tithi formed the part of the pañcāṅkam. This publication debunked kantapurāṇam, popular view of eclipse as well as the computations of Vicuvanāta sāsthriyār. It also contained copious extracts from Bhāskarāchārya's Siddhānta Shiromani, suggesting a spherical, revolving earth in contrast to kantapurāṇam.

The Response of 'Native.'

Unlike the missionary journals, we do not have any direct record of the 'native' response, which is a limitation of this study. The 'native' reaction recorded by the missionary journal are bound to be selective and limited. However gleaning these responses show us certain facets, even if not all, of the negotiation and reconfiguration 'natives' attempted.

Knowledge in the Indian society was held close and kept secret. At times, knowledge and skills like computing pañcāngkam, profitable and prestigious, was kept a secret within a family, father tutoring the son and no one. Even the texts, mostly recorded in olas, were rarely shared. In contrast, the missionary practice of publishing books and distributing them widely was strange to many of the native intellectuals. Vicuvanāta sāsthriyār once extracted a large volume written on Olas, called the Ernnel, consider 'standard work on astronomy' and even permitted Dashiel to read a few pages. However, he refused to make a copy saying that (Missionary Herald, 1830) 'If this book should fall into the hands of the missionaries, the people would cease to honor us and worship our gods'. Nevertheless, he would be willing to teach Dashiel but feared that he would 'immediately communicate it to the missionaries' and then turned to another Brahmin who was present, and said, 'These persons do not hesitate to tell to others whatever they know themselves.’ The native elites had to content with the democratisation of knowledge engendered by the nascent print culture introduced by the missionaries.

In the beginning, Vicuvanāta sāsthriyār and Rev Poor had mutual misgivings of each other's intelligence and expertise. Most of the almanack makers used the computations made by others and just copied them and produced pañcāngkam claiming their own, at times even without making corrections for the local time. Rev. Poor asked Vicuvanāta sāsthriyār to compute (Missionary Herald, 1830) ‘elements of the first eclipse that will happen next year’, to which haughtily Vicuvanāta sāsthriyār replied that ‘he could in a short time furnish me with the elements of eclipses for fifty years to come’ within an error of one naāẕai (twenty-four minutes)’. Having come across only the English almanack, the Ceylon calendar and finding it devoid of astronomical predictions, Vicuvanāta sāsthriyār was sure that the Europeans had very little knowledge of astronomy, and perhaps obtained astronomical knowledge by bribing native pañcāngkam computers like him. Only after taking a look at the Nautical Almanac, Vicuvanāta sāsthriyār understood the (Missionary Herald, 1830) ‘nature and extent of the calculations relating to the phenomena of the heavenly bodies during the space of a single month’, produced by European astronomers. Mutual respect and urge to understand each other developed over time, slowly but steadily.

Having shaken by the error in the pañcāngkam, and the ‘accuracy’ of the European computation, the paṇṭāram and the learned natives in the gathering on the grounds of the seminary on the day of the lunar eclipse were impressed. After listening to the explanation given by Rev Poor with the use of orrery the natives ‘expressed their surprise and admiration and acknowledged that it was a fair solution to the phenomenon’. Paṇṭāram even thought through and argued that ‘If this representation is correct, then the planets or fixed stars must occasionally be eclipsed by the earth's shadow, which is not the case.’ When he was reasoned that earth’s shadow is conical, occasioned by the diminutive size of the earth in comparison with the sun, he was able to put his objection to rest. All present were able to see that instead of ‘two great serpents, which have hitherto devoured the sun and the moon, and thus occasioned eclipses, have, by the light of science, been changed into two shadows, the one the shadow of the earth, the other the shadow of the moon'. However, another member of the audience, Aroomugam refused to change his view stating that all his ancestors cannot be that wrong.

The missionaries used the traditional shadow of the śaṅku (gnomon) to show the equinoxes and solstices computed by the pañcāngkam were in error (Winslow, 1840). This demonstration was readily evident, as it was based upon the traditional system and direct observation. The telescope, a novelty, enhanced the observational evidence and adduced European science, not in so much as 'directly' showing Earth is a sphere, or that Earth is rotating. It brought to fore aspects of nature hitherto unknown to 'native' educated elites, such as satellites of Jupiter and Saturn, clearly visible eclipses of the moon of Jupiter, Saturn's ring, crescent shape of Venus, the surface features on the Moon and so on. These novel and mesmerising sights of heaven 'made a deep and salutary impression upon all in the seminary' and those who care to look through the telescope. Earlier only the students and those in close contact with the seminary made telescopic observations, but the drama surrounding the Lunar eclipse of 1829 spurred interest in the native population and many educated 'native' literati thronged the seminary to look through the telescope.

The telescope indeed created suspicion at lease to some in the beginning. Aromoogum (Missionary Herlad, 1830), of 'considerable learning', 'employed at the station as an overseer of the workman', was suspicions initially that 'the instrument might perhaps be fitted in a manner intentionally to deceive those who look through it'. He was able to convince himself only after repeated observations through the telescope, with the aid of Rev. Poor. 'Though he is a man very unwilling to trust his senses in any point that contradicts his preconceived opinions, he has felt obliged to acknowledge that Jupiter has satellites which are constantly changing their situation, that the moon is a convex body, and that there are spots in the sun. He cannot, however, perceive any evidence that the earth is round, or that it is in motion, although his attention has often been directed to the evidence adduced in support of these phenomena'. One of the students remarked, 'you have often told us of these things, and we have learnt them in our books, but we always had some secret doubts whether they were so or not, but now we see with our eyes and know that they are true'.

With the repeated failure of his computation and the success of the one made by Rev Poor, at last, even Vicuvanāta sāsthriyār became curious and sought to look through the telescope, indicating (Missionary Herald, 1832) 'some change in the man's views and feelings'. He sent a word through the intermediator, Dashiel, and on this pretext, for the first time Rev Poor and Vicuvanāta sāsthriyār met face to face and had a civil dialogue on astronomy, sciences, and their respective religion. Obviously, keeping the caste rules intact, Rev Poor, being considered an 'outcaste', was not permitted to enter the premises of Vicuvanāta sāsthriyār, but was met at a 'convenient distance from his dwelling'. Although due to his infirmities he was not able to directly look through the telescope, Vicuvanāta sāsthriyār directed one of his young relatives. Rev Poor draw attention to the crescent shape of Venus, the convexity of the Moon's disc. When inquired 'if it were then true, that, the moon was twice as far from the earth as the sun, that eclipses were occasioned by serpents, &c', Vicuvanāta sāsthriyār conceded to the Copernican model, but asserted that ' such was the state of things formerly, but now it is quite otherwise.' He further added that 'though the statements there given on astronomy and some other sciences [in kantapurāṇam] do not apply to the present order of things, still a great part of the Puranurn holds true for all ages, and is useful to all people'. Theagnr, a noted mathematician of Wannarpony also accepted the truth of several important statements made in the tract on eclipse published by Rev Poor, which were 'wholly subversive of the Pouranic system', but confessed that he will not be able to accept it openly for the fear that (Missionary Herald, 1833) 'people would either reproach me for my past ignorance, or accuse me of having deceived them hitherto'.

The natives were curious. Following the eclipse and the publication of the tract, some 'respectable natives' from Jaffna and Nellore visited the seminary to view the astronomical apparatus, and to propose pertinent questions on geography and astronomy to Rev Poor. When the daily revolution of the Earth was mentioned, (Missionary Herald, 1833) "one of the learned Natives, with much seriousness contented 'that cannot be believed; for if the Earth should turn over, all the water in the seas, and elsewhere, would fun out.' This raised a laugh against him, and one of his people asked if he could not swing a vessel of water around his head without spilling it. The power of attraction in the load-stone was also shown; and the principle on which all heavy bodies near the Earth gravitate to its centre was explained."

However, natives were not passive but were not much pained at the errors in the native computations so much as the assault on the Puranic view, which threatened the established traditional social order. One anonymous letter retorted (Missionary Herald, 1831) 'How can you affirm that the earth is round, while you confess that no one has ever visited what you suppose to be the poles of the earth?' 'How can you teach that the sun stands still, whereas it is written in your bible, that Joshua stopped the sun in his course? Either your system of astronomy or your religion must be false.' 'What proof have you to offer that the earth is in motion?'. After diligent examination of the tract, Vicuvanāta sāsthriyār admitted the sphericity of Earth, eclipses are caused by shadows and so on, but insisted that (Missionary Herald, 1833) 'statements of the Pouranas relate to a previous creation.. [and]...that these subjects cannot be known but by a revelation from God, and that God has not yet revealed them, neither to the Hindoos nor the Europeans'. Sinneyer, another Brahmin remarked that even if 'God himself should declare there are incorrect statements in the Kunda Pournnn', 'he would not admit it'. As 'something all too material resists' our constructions, despite continued allegiance to kantapurāṇam, the new reality domain revealed by the modern science cannot be rejected and had to be somehow negotiated.

Retreat of Missionaries

Dazzled by the correct prediction the image of Rev Poor as a (Hoole, 1993) 'wandering sannyasin, preaching, the often repetitive, 'simple' gospel; only to be ignored and even laughed at' changed into an exalted 'new guru or Acarya', who needs to be revered and respected. Indeed the public contest over eclipse predictions resulted in the native learned to 'regard and treated the Seminary and the mission with more respect than formerly', the preachers had 'better access to the minds of men', what was the result of all these? A chronicler of the Batticotta mission was blunt (Tracy et al.,1840), ‘Not a single instance of conversion, for astronomical truth cannot change the heart’. After all, we know that the pursuit of how the heaven goes is not same as of quest how to go to heavens. Moreover, as one of the unintended consequence, traditional pañcāngkam makers just used the nautical almanack and publication of Batticotta seminary almanack in Tamil, to improve their computation of the pañcāngkam.

The missionaries became disillusioned after some years, M. D. Sanders, noted that although the Batticotta seminary taught (ABCFM, 1856) ‘more science than other English high schools of India’, he has ‘never seen the native teacher in Batticotta Seminary, who made science the handmaid of religion.’ While agreeing that[17] ‘public mind [is] elevated by diffusion of the light of science’, an internal report rebuked, ‘A distinguished astronomer, while contemplating God's wonderful works unfolded by the discoveries of science, exclaimed, ‘O Lord, what are we, that we should be permitted to walk in thy footsteps and think thy thoughts after thee!’ However, we, as Christians, are not only permitted to walk in the footsteps of the Almighty and think his thoughts after him but more—we are called to be co-workers, ‘laborers together with God,’ in his greatest, most glorious work’. Another mid nineteenth-century review report averred (ABCFM, 1856) ‘Teaching the English language, or teaching western science in that language,....is a delightful employment to all who are fond of teaching. However, it is not the best way to reach the minds of the Hindoos with the Gospel.’

A new paradigm was emerging by the middle of the nineteenth century, an ideology of colonialism, which saw European and in particular English as a superior race. It argued that[18] ‘probably the reason why the recent discoveries in science and art were kept hidden so long, was because the world was not good enough to render it safe to give such power to man’, and that

17 Report of the Deputation to the India missions made to the American Board of Commissioners for Foreign Missions at a special meeting, held in Albany, NY, March 4, 1856. Boston: Press of TR Marison p 67

18 Report of the Deputation to the India missions made to the American Board of Commissioners for Foreign Missions at a special meeting, held in Albany, NY, March 4,1856. Boston: Press of TR Marison p 69

this 'mighty power has come as a result of the progress of Christianity'. It warned that if 'this power [knowledge of modern science] is given to a heathen people in advance of the Christian principle necessary to control and regulate... we pervert the order of nature' and generate atheism rather than promote Christianity. The liberal educational ethos was abandoned, and the focus shifted in favour of direct proselytising.

Discussion

The emergence of the modernity in India, South Asia, in short non-West, was often seen as 'expansion of European science' '(Basalla, 1967), knowledge, especially natural knowledge, unidirectionally from centre to periphery. In this frame of perception, by tracing the origins of modern science to Colonial Europe, critics have claimed 'science' retains signs of supposed 'Western' values and birthmarks[19]. Thus science is not 'universal' as it often claimed, but 'parochial'.

The ideology of 'western science' stealthily divides the world into the West and the rest. Sure, the antiquated Eurocentrism, which sought to trace all science as a product of Western civilisation is passée. In its place, some scholars challenged the singularity of the term 'science' and argued 'identity' based knowledge seeking endeavours, 'local sciences'. A plurality of sciences, that too embedded in 'imagined communities' aka 'civilisations, results in the relativistic nightmares. If the ideology of 'western science', as a unique product of the European civilisation, having an unbroken heritage, largely emanating from within colonial milieu served the colonial interest, the ideology of 'Eastern' (or its many variants including Indian, Hindu, Arabic, Islamic) serves elites in sustaining hierarchy within their social sphere.

The ubiquitousness of 'texts, artefacts and instruments engaging the attention of human actors transgressing regional and

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19 See Nandy, A., 1988. Science, hegemony and violence: A requiem for modernity, Oxford University Press, Delhi; Goonatilake, Susantha 1984, Aborted discovery: Science and creativity in the third world. Zed books, London; Claude Alvares 1991, De-Colonizing History: Technology and Culture in India, China and the West: 1492 to the Present Day, - The Other India Press, Goa,

ethnic boundaries' Raina, 2015) in contemporary times is explained away by the claims that disproportionate power of colonialism is eclipsing the traditional ways of knowing and marginalising the periphery and erasing civilisations. This idea of a unilinear centre/periphery model of passive culture engagement has been challenged and is being more nuanced idea of continuous cultural 'exchange', 'contact' and 'domestication' of modern science in colonial societies (Raina, 2012).

Dhruv Raina departs from the notion that Indian modernity, is primarily a colonial modernity, Marked both by a sharp break and sudden transition from the traditional to the modern resulting from the assertion of colonial dominance (Rain, 2015). He contends that the early modernity was localised to the period 1450-1750 and was not the by-product of colonial modernity or globalisation. The early cosmopolitan[20] encounter in a way influenced the later day Indian response. Sujit Sivasundaram notes 'the ideas of modern science contributed to secular ideologies of nationalism, and was at times resisted by religious movements that sought to return to ancient scriptures, non-western elites also frequently sought to prove the scientific heritage of their own religions and utilized the new science to project a new religious vision of their societies' and the story of the encounter is not adequately captured by the ideas of 'colonial science' (Sivasundaram, 2005).

Recently history and philosophy of science scholars use 'cosmopolitanism' to transcends old centre/periphery dichotomies and view science as an essentially human endeavour, obviously rooted in local but transcending borders breaking 'incommensurability' meanings between two distinct cultures. In breaking away from deeply entrenched notions of the univocal universalism sans local histories of science, as well as the centre/periphery dissemination and hegemony model, Dhruv Raina and others offer a view that is 'cosmopolitan' (Raina, 2012).

20 While the main goals of globalization to 'manage the world', cosmopolitanism are projects that aim for 'understanding' and global conviviality. See Sumit Guha, 'Conviviality and Cosmopolitanism: Recognition and Representation of 'East' and 'West' in Peninsular India, c. 1600–1800,' in C. Lefèvre, I. Županov, and J. Flores (Eds), Cosmopolitismes en Asie du Sud: Sources, itinéraires, langues (XVIe–XVIIIe siècle), de l'EHESS Paris.

Characterised by the landscape of exchange and the openness to the unfamiliar, cosmopolitan view of the scientific encounter, view accumulation of science and technology knowledge as a product of exchange, translation and circulation, locally and globally rather than through supplanting and supplication[21].

In so far as we see the encounter between the European missionary Rev Poor and the native pañcāngkam maker Vicuvanāta sāsthriyār is framed as encounter between modern astronomy and traditional astronomy, resulting in the tradition and modernity debate, and seen essentially as a dramatic episode in cultural encounter before the formal inauguration of the processes of colonisation, we would miss out the crucial aspects of the cosmopolitan nature of a dialogue or conversation that ensued between them. In the approach of both Rev Poor and his adversaries, one can see a certain conviviality of cosmopolitanism, which respects ethical and religious differences while embracing knowledge and truth.

It is readily apparent that not only Rev Poor enlightened the 'natives', but he (and his colleges, like HR Hoshington) were able to learn something from the 'natives'. While indeed Rev Poor dismissed and scoffed at the myths and fabulous fantasies of the kantapurāṇam, he was curious and respectful of the computing ability using the Vākya algorithms[22], which he had obtained after much effort and subsequently edited and published by (HR Hoisington in 1848). Going beyond the staple caricature of 'superstitious heathen', this encounter left Rev Poor to admire the tradition of rational efforts of Bhāskarachārya and others in understanding the dynamics of Sun, Moon and the planets. The Puranic system of Geography and Astronomy contradicted not

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21 See Feza Günnergun and Dhruv Raina (eds.). 2011. Science between Europe and Asia: Historical Studies on the Transmission, Adoption and Adaptation of Knowledge, Boston Studies in the Philosophy of Science. Dordrecht:Springer; Plofker, K., 2002. Use and transmission of iterative approximations in Dold-Samplonius, Y. ed. India and the Islamic world. From China to Paris: 2000 Years Transmission of Mathematical Ideas, 46, Franz Steiner Verlag, pp.167- 186.

22 See Sriram, M. S. Vākya System of Astronomy. In Ruggles (Ed) Handbook of Archaeoastronomy and Ethnoastronomy, Springer Reference 2014, pp 1991-2000 and Hari Chandra (2001) vākyakaraṇa – A Study, Indian Journal of History of Science, 36.3-4, pp 127-149 for an exposition of how the vākya method work.

only the European Copernican ideas but also to that of twelfth-century Siddhānta Shiromani of Bhāskarāchārya. While this pedagogical method was structured to prove that the mythology of kantapurāṇam as wholly erroneous, it was also to lead step by step the 'native' students from the ideas of Bhāskarāchārya, which had geocentric spherical Earth to that of modern Copernican view of the solar system. While some of the topics (Winslow, 1840) 'mathematical demonstration was employed, and on others, the ocular and experimental proof was offered. That the Earth is not flat, as the sacred books of the Hindoos assert, was demonstrated by the rules of trigonometry', from the fact that the polar star rises more rapidly as we travel north than warranted by the kantapurāṇam's conception of a flat earth. The missionaries showed by use of the telescope, that 'Saturn is surrounded by a ring, and that Jupiter and other planets have satellites', although 'many were slow to credit their senses, and thought the missionaries were practising an optical delusion.' The missionaries argued that 'the doctrine of the 'nine planets,' including the sun and moon, also Roho and Kectoo (or the moon's nodes) is interwoven with the whole texture of the Puranas....,[and is the] foundation ...astrology' (ABCFM, 1838). By showing that actually there are 'five primary, and seventeen secondary planets, which were wholly unknown to those by whom the ancient systems were formed; and that consequently the results of the influence of the planets, as given by astrologers from year to year, must, necessarily, be incorrect; and all who rely upon them deceived', the missionaries attempted to contest the accuracy of astrology. The pedagogy also used experiments and showed that atmosphere has weight and elasticity using an air pump.

RF Young notes that this pedagogical innovation was appreciated and appropriated by Wilkinson in his Sihore school in reviving classical science and disseminating Copernicanism with the help of Pandits (Young, 1995). Local learned men, Wilkinson noted 'do not seem to have been aware of the existence of the Siddhintas ; or to have known that Bhāskar Āchārta had already spent the whole force of his science and ridicule in exposing the absurdities and impossibilities of the Puranic system' (Wilkinson, 1834). He was sure that change of heart is possible 'with no other coercive power than India's own time-tested traditions of rational enquiry for the testing of hypotheses in the exact sciences'. He rhetorically wondered 'is the heliocentric model, for instance, a better explanation for the retrograde motion of the planets (kaksakrama) than the geocentric model?'.

'By staging public experiments and scientific demonstrations, founding scientific societies and debating clubs, and writing and sponsoring new forms of print-press publications, from science journals to calendars and almanacs, missionaries had deliberately opened new avenues for public discussion and debate about science and its particular knowledge-claims (Elshakry, 2007). However, based on their lived experience, both Rev Poor and HR Hoshington forged a novel pedagogical model which surprisingly restored a degree of ethnic pride and a romantic return to the past. The missionaries did not reject or turn blind to the rich traditions of knowledge which were already flourishing in India before the arrival of the Europeans[23]. Nevertheless, it is pertinent to note that both the Copernican view as well as the classical treatises on Indian astronomy resurrected by Rev Poor to Jaffna peninsula's intellectuals contradicted the 'local sciences' entrenched in the cosmogony of kantapurāṇam.

While the three key elements of cosmopolitanism; cultural omnivorousness, ethnic tolerance, and cosmopolitics, are crucial, it is equally important to understand how the politics of knowledge plays itself out in the contact zones. The embrace of native to the Copernican solar system was not solely based upon the truth content of the claims but was also influenced by educational imperatives. Soon the 'the desire for English education has become intense among both Christians and ….solely upon the fact that being the language of the rulers of the land and of the missionaries, acquaintance with it is the stepping-stone to honor and wealth' (ABCFM, 1856). Nevertheless, the

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23 For example the works Hall F. E. and Bapu Deva Sastri (1859) Surya-Siddhānta, an ancient system of Hindu astronomy, with Ranganatha's exposition, Calcutta Sastri, Bapu Deva and Wilkinson, Lancelot 1861. The Surya Siddhānta or An Ancient System of Hindu Astronomy Followed by the Siddhånta Siromani, Translated into English with Extensive Explanatory Notes, by Pundit Bapu Deva Sastri & Lancelot Wilkinson. Bibliotheca Indica 32 Calcutta: Asiatic Society revitalised interest in ancient astronomy heritage in India.

acceptance of Copernican view solar system or new vistas revealed by the telescope was not coercion, but by compulsion of ocular evidence and all the participants were in as members of the community of rational beings, despite power hierarchies.

Early discussions of modern sciences in school education did not so much replace older disciplines or traditions of knowledge as redefine them. 'The very translation of the terms and concepts of these sciences, after all, involved a kind of conceptual syncretism' (Elshakry, 2010). However, impelled by the colonial imperative a new notion and narrative of 'western science' / 'English science' was emerging and framed the official vision of the colonial state. Although some missionaries who were keen to enlist 'modern science' in the service of their proselytising efforts, adopted the notion, not all subscribed to it.

Such dialogue resulted in a cosmopolitan encounter that resulted in 'subversive discourses among Indians with regards to the question of cosmology'. It also 'renewed stress on the Siddhantas and other ancient rational traditions', consequently 'reassertion of pride in India's scientific heritage' among the native intellectuals, however as Joydeep Sen points out very same process also led to centre staging of 'philosophical rationalisation' rather than 'experiential participation' in modern astronomy (Sen, 2015). The arrival of a new generation of educated Indian natives, ascending into the hierarchy of colonial scientific institutions, such as Chinthamani Ragoonatha Charry in the Madras Observatory during the 1850s resulted in re-emergence of 'philosophical and practical'.

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